ANALYSIS OF RESOURCE USE EFFICIENCY AND PROFITABILITY IN CHILLI PEPPER (*Capsicum frutescens*) PRODUCTION AND ITS CONTRIBUTION TO HOUSEHOLD FARM INCOME IN KADUNA STATE

BY

Bala MOHAMMED
M.Sc/AGRIC/2707/2011-2012

A THESIS SUBMITTED TO THE SCHOOL OF POSTGRADUATE STUDIES, AHMADU BELLO UNIVERSITY, ZARIA, IN PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR THE AWARD OF MASTER OF SCIENCE DEGREE IN AGRICULTURAL ECONOMICS.

DEPARTMENT OF AGRICULTURAL ECONOMICS AND RURAL SOCIOLOGY,
FACULTY OF AGRICULTURE,
AHMADU BELLO UNIVERSITY, ZARIA.

JUNE, 2015

DECLARATION

I hereby declare that this thesis titled "**Analysis of Resource Use Efficiency and Profitability in Chilli Pepper Production and its Contribution to Household Farm Income in Kaduna State"** 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 at any institution. All citation and sources of information are duly acknowledged by means of references.

....

Bala Mohammed **Date**
Student

CERTIFICATION

This thesis titled '**Analysis of Resource Use Efficiency and Profitability in Chilli Pepper Production and its Contribution to Household Farm Income in Kaduna State',** by Bala Mohammed meets the regulations governing the award of the Degree of Master of Science, Ahmadu Bello University, Zaria, and is approved for its contribution to scientific knowledge and literary presentation.

....

Prof. Ben Ahmed **Date**

Chairman, Supervisory Committee

....

Prof. Zakari Abdulsalam **Date**

Member, Supervisory Committee

....

Prof. Zakari Abdulsalam **Date**

Head of Department

....

Prof. A. Z. Hassan **Date**

Dean, School of postgraduate Studies,

Ahmadu Bello University, Zaria.

DEDICATION

This thesis is dedicated to my late parents may their soul rest in perfect peace and may Almighty Allah grant them JANNATUL-FIRDAUSE. God bless us all

ACKNOWLEDGEMENTS

In the name of Allah the beneficent the merciful, first and foremost, I give thanks to the Almighty God for His mercies and compassion upon me; He has been my strength all the way.

My special appreciation and gratitude goes to my supervisors Prof. Ben Ahmed and Prof. Z. Abdulsalam for being available, for their time, advice, encouragement, patience, invaluable assistance, close supervision, constructive criticisms, suggestion, correction and pieces of advice that aided the completion of this research work. May God bless you and your families.

I also like to express my appreciation to my lecturers, colleagues, friends and everyone who contributed in one way or the other in making this thesis successful.

Finally, my appreciation also goes to members of my family including my wife, children, brothers and sisters for their patience, encouragement, prayers and support all through. Thank you and God bless you all.

TABLE OF CONTENTS

Content **Page**

LIST OF TABLES

Table **Page**

LIST OF FIGURE

Figure **Page**

Abstract

Chilli pepper (Capsicum frutescens) is one of the major cash crops grown in Nigeria. This study seeks to determine the resource use efficiency and profitability in chilli pepper production and its contribution to household income in Kaduna state. Purposive and simple random sampling techniques were adopted in sampling the respondents. Descriptive statistics, net farm income, multiple regression analysis, stochastic frontier production function were used in estimating the result, using cross-sectional data of 200 farmers from the three major chilli pepper production area namely Ikara, Kubau and Soba. The findings of the analysis reveal that 56% of the respondents fall within the age range of 30-49years, Majority of the farmers (53%) had formal education. Household sizes ranged from 6-10 persons represent 33.5% of the respondents. Farmers with 6-10 years of farming experience constitute 24%. Majority of the farmers (72%) were not members of a cooperative society. Also 98.5% of the farmers financed their production through personal saving and 45.5% of the chilli pepper farmers have access to extension services of 1-2 times per season. The total revenue and costs in chilli pepper production were estimated as ₦111,857 and ₦45,881 respectively. The net farm income was therefore ₦65,976. The average rate of return on investment (return per naira invested) was ₦2.44, indicating that for every ₦1 invested in chilli pepper production a return of ₦2.44 was made. Thus, it could be concluded that chilli pepper production in the study area is profitable. The result of the multiple regression analysis revealed that the socio- economic variables i.e. education, farming experience and credit borrowed had significant influence to profitability either positively or inversely at different level of probability. The result of Cobb-Douglas stochastic frontier production function used to estimate technical efficiency of the farmers shows that the mean efficiency was 0.90 and It was observed from the study that 12% of the farmers had technical efficiency of less than 0.81 level efficiency while 88% of the farmers operate at 0.81 and above level efficiency. The farmer with the best and least practice had a technical efficiency of 0.98 and 0.74 respectively. Also 90% of the farmers were estimated to have technical efficiency exceeding 0.8, indicating there are some 10% technical inefficient farmers in the study area. The result of the contribution of crops to the average household farm income revealed that chilli pepper contributed 42% to the total household farm income compare to other crops produced by chilli pepper farmers in the study area. Price variation and high cost of inputs were the major constraints face by the chilli pepper. Findings further revealed that none of the sampled chilli pepper farms reached the frontier threshold however within the context of efficient agricultural production, output can still be increased by 10% using available inputs and technology and concluded that investment in chilli pepper production is a viable enterprises. Its recommended farmers should join cooperative association to enable them procured fertilizer and other agricultural inputs at the subsidised rate.

CHAPTER ONE

INTRODUCTION

1.1 Background to the Study

Chilli pepper (*Capsicum frutescens*) is a high value crop that is grown for cash by farmers all over the world (Aliyu *et al.*, 2012). Nigeria is known to be one of the major producers of pepper in the world accounting for about 50% of the African production (Idowu-agida *et al.,* 2010). Agriculture in Nigeria is dominated by the small scale farmers who are engaged in the production of the bulk of food requirements of the country (Asogwa *et al.,* 2006). In spite of the fact that these small scale farmers occupy a unique and pivotal position, they belong in the poorest group of the population and as such cannot invest much on their farms (Asogwa *et al.*, 2006). According to Ajibefun (2002), the vicious circle of poverty among these farmers has led to the unimpressive performance of the agricultural sector. Thus, resources must be used much more efficiently, which entails eliminating waste, thereby leading to increase in productivity and incomes (Ajibefun and Daramola, 2003).

Agriculture in developing countries is becoming more commercially oriented. Thus, there is the growing need to identify and improve production of commodities with international market potential. In Nigeria, such commodities include chilli pepper (Suleiman and Isah, 2010). Also, for a country to attain growth and development the economy has to be diversified. That is, there should be simultaneous development of the various sectors instead of practicing monoculturalism. In this respect, expansion of export base is of tremendous importance to the overall development of the economy (Awe and Ajayi, 2009).

Nigeria has good soils and weather that can readily support the growth and production of pepper. Pepper grown in Nigeria is in high demand because of its pungency and good flavour. It can readily be dried, ground and packaged for export. Investing in pepper production is one of the ways of sourcing for foreign exchange (Business Day, 2007). Exportation of pepper in Nigeria has once been reported to be a lucrative business (Idowu-agida *et al.*, 2010). The major area for its production is the Northern region is between latitudes 10^{o}N and $12^{o}30^{1}$N. Pepper is utilized mostly for culinary purposes and seasonings. It also has medicinal uses, internally as a stimulant and carminative and externally as a counter- irritant (Grubben and Tahir, 2004).

Idowu-agida *et al.* (2010) reported that pepper can be successfully grown in areas with annual rainfall between 600 – 2500mm. The moisture content of the soil and the prevailing temperature has important effects on the growth and yield of pepper. In general, the maximum growth and production of pepper occur between a temperature range of 18^{o}C and 30^{o}C. Chilli pepper on the other hand occurs in the wild, though domesticated in many parts of the tropics. In Nigeria in particular, *Capsicum frutescens* is third among the cultivated vegetables being utilized in the dry state as spice, Capsicum content, an alkaloid that is a digestive stimulant is used in ointment for relief of arthritic and neuropathic pains. *Capsicum frutescens* are rich in Vitamin A potency which is responsible for red colour in mature fruit. *Capsicum frutescens* are further used as pungent spices for domestic culinary purposes and by food manufacturing industries for seasoning of processed foods in the preparation of curry powder, hot sauce and in pickling (Ayorinde, 2011).

1.2 Problem Statement

Scarcity of resources has led to production economists to think about the reallocation of existing resources to have more output with given level of input combinations or to produce a prescribed level of output with the minimum cost without changing the production technology (Anwarul-huq and Fatimah, 2010).

Despite the economic importance of pepper in terms of income generation to farmers hence there should be a valid economic reason to boost its production and increase its level of contribution to the farmer's income. Farmers are interested in total profit made from the farm not putting in to cognisance which of the crops gives the highest level of profit or at what percentage each crop is contributing to overall profit, this will encourage them to improve in efficiency for productivity enhancement in order to maximised profit. Considering the above facts, the present study was under taken, to determine the level of technical efficiency of the chilli pepper producing farmers, to analyze the status of resource allocation and contribution to household farm income. Based on these the study seeks to provide answers to the following research questions.

(i) What are the socio-economic characteristics of chilli pepper farmers in the study area?

(ii) What are the costs, returns and profitability in chilli pepper production?

(iii) What are the socio-economic factors influencing profitability in chilli pepper production in the study area?

(iv) What are the technical and resource use efficiency in chilli pepper production?

(v) What is the contribution of chilli pepper to household farm income? and,

(vi) What are the constraints associated with the chilli pepper production?

1.3 Objective of the Study

The broad objective was to carry out an analysis of resource use efficiency and profitability in chilli pepper production and its contribution to household farm income in the study area. The specific objectives were to:

(i) describe the socio-economic characteristics of chilli pepper farmers in the study area,

(ii) determine the costs, returns and profitability in chilli pepper production,

(iii) determine the socio-economic factors influencing profitability in chilli pepper production in the study area,

(iv) estimate the technical and resource use efficiency in chilli pepper production,

(v) estimate the contribution of chilli pepper to household farm income; and,

(vi) identify the constraints associated with the chilli pepper production in the study area.

1.4 Justification of the Study

Chilli pepper has been used by the majority of Nigerian households and industries (confectionaries, beverages, medicinal etc) as part of their dietary and raw material respectively. The demand for pepper is rapidly increasing and there is a great need for increased production (Abayomi *et al.,* 2012). The efficiency with which farmers uses resources and technologies available to them are imperative in Nigeria agricultural production. Non consideration of this has resulted in low farm income which has weakened the financial position of smallholder farmers who produce most of the crops in Nigeria, a condition that has led to poor funding of their economic activities. The implication is that there is scope for further increase in output from existing hectares of crop if resources are accurately exploited (Rahji and Omotesho, 2006). Similarly, the measurement of the productive efficiency in agricultural production is an important issue because it gives pertinent information for making sound management decision in resource allocation. Except for a few descriptive studies, econometric analysis has yet to be conducted to examine the production function for chilli cultivation and its potential for future improvement. It is very important to carry out an investigation to ascertain ways by which increased chilli pepper production can be achieved and thereby increasing its contribution to the farmer's livelihood (income). The study's findings will provide useful information in that direction. The finding of the study will serve as a basis for researchers to do more work on chilli pepper production.

CHAPTER TWO

LITERATURE REVIEW

2.1 Origin and Spread of Chilli Pepper

Chilli peppers originated in the lowlands of Brazil in a location called the 'nuclear area' it has the greatest number of wild species of chilli peppers in the world today. Scientists believe that birds are mainly responsible for the spread of wild chilli peppers out of the area. They (birds) do not have the receptors in their mouths that feel the "heat" and a bird's digestive system does not harm the chilli pepper seed. So while birds could go around gathering up the small fruits and consuming them with no adverse effects, dispersed seeds would grow into new plants (Chile Pepper Institute, 2007).

According to Ayorinde (2011), the likely first location or area of origin is suggested as hearth of Bolivia. From here the various domesticated form, developed secondary centres, *capsicum frutescens* located in the northern half of South America to part of Central America and Caribbean area.

Chilli peppers are spread, when Christopher Columbus was looking for a new spice trade and bumped into the new world, he came across these new fruits when the Western Natives offered him some chilli pepper. When he ate the pods he felt the same "burn" or "heat" felt from black pepper and he mistakenly called it "pepper" this is why today chilli peppers are called peppers. Columbus took the fiery pods back to Spain and they quickly spread across the Eastern hemisphere and are used in almost every international cuisine around the world. Chile pepper plants are also grown in almost every country in the world (Chile Pepper Institute, 2007).

2.2 Chilli Pepper Production in Nigeria

Chilli pepper is a major vegetable crop in Nigeria and a high percentage of peppers grown in Nigeria come from the Northern Guinea and Sudan Savanna zones (Kaduna, Kano, Katsina, Kogi, Kwara, Yobe, Zamfara states, etc.) in northern Nigeria. The country obtains an average yield of 1021 kg/ha and is the third largest exporter of pepper (Alegbejo *et al.*, 2006).

Pepper consumption in Nigeria accounts for 40% of the total vegetable consumed per day, a total of 100-200ha is being assigned to pepper production annually in Nigeria (Adetula and Olakojo, 2006). Table represent the country's domestic production of chilli pepper for 10 years (2002-2011).

Table 1: Nigeria's Domestics' Production of Chilli Peppers, 2000-2011

Year	Area Cultivated (ha)	Production (tonnes)	Yield (kg/ha)
2002	31075 Im	58676 Im	18882 Fc
2003	32034 Im	61470 Im	19187 Fc
2004	32609 Im	65382 Im	20050 Fc
2005	30750 F	48000 F	15610 Fc
2006	31000 F	49000 F	15806 Fc
2007	31200 F	49000 F	15865 Fc
2008	33000 F	50000 F	15152 Fc
2009	33000 F	45000 F	13636 Fc
2010	33600 F	50000 F	14881 Fc
2011	33500 F	65221 F	19469 Fc

Im=FAO data based on imputation methodology, F=FAO estimate, Fc= FAO calculated data. (FAOSTAT, 2013)

2.3 Global Demand and Supply of Chilli Pepper

Total world production of peppers was estimated to be 14-15 million metric tonnes a year (Weiss, 2002). Pepper is one of the most varied and widely used foods in the world. Pepper production has increased in recent years worldwide. That could be at least in part because of the high nutritional value of pepper (Business Day, 2007).

The global demand and supply of chilli pepper have been steadily increasing. Between 2000 and 2007, fresh chilli and pepper increased on average by about 6.6% per year in the world and 6.3% per year in Europe. World production of chilli has grown on average by about 3.9% per year during the last 10 years and this led to a steady increase of global demand. The main chilli pepper producers in the world are China, Mexico, and Turkey, which in total account for more than 70% of the world chilli pepper production. The leading world exporters include Mexico, the Netherlands and Spain. Nigeria ranks 7th place among the world chilli producers, producing approximately 3% of total global production (FAOSTAT, 2008). CAPPI (2007) reveals that, most of the chillies produced are being consumed domestically in the country of production. The figure below represents the world chilli pepper production.

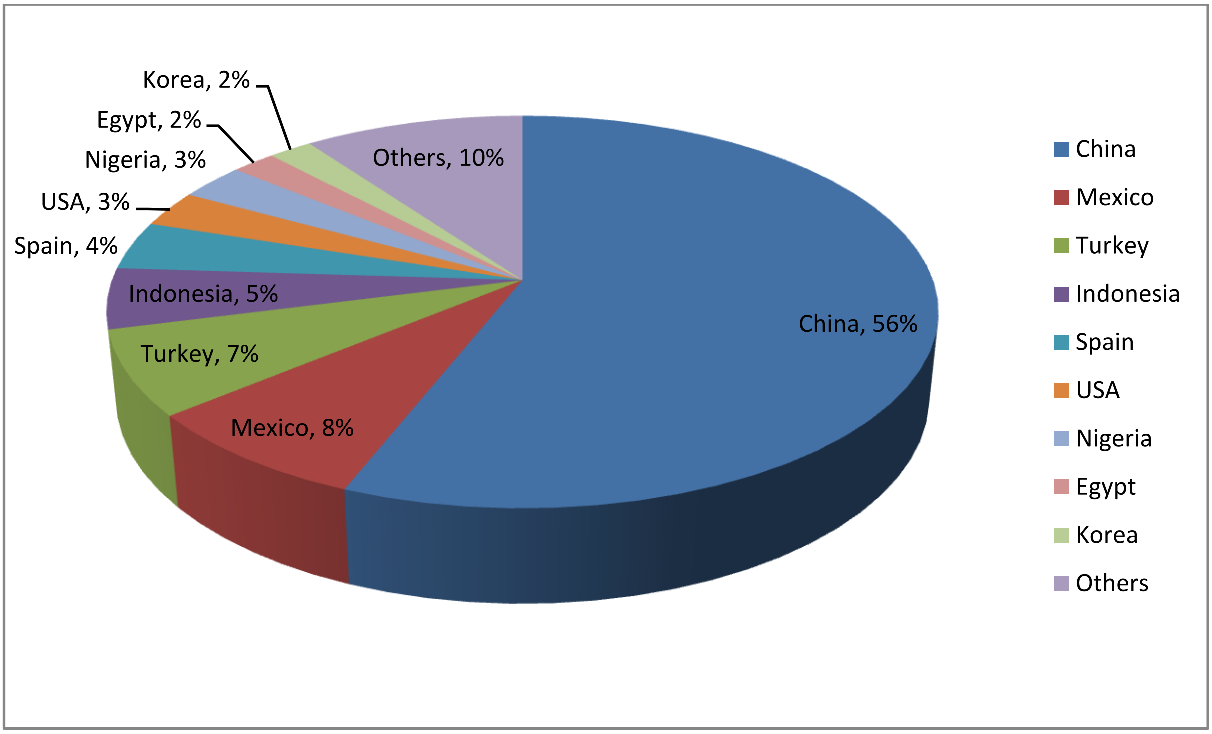

Figure 1: World chilli pepper production (FAOSTAT, 2010).

2.4 Economic Importance of Chilli Pepper

In recent years, interest and demand for peppers has increased dramatically worldwide and peppers have achieved major economic significance in the global market (International Pepper, 2012). The economic importance of chilli-pepper to Nigerian economy has been identified and documented by many research efforts. Examples of such research efforts are found in the works of Erinle (1987), IAR (1985), Njoku and Ene (1982) and FAO (1996). Apart of potentials of this commodity to generate foreign exchange for Nigeria, their common use in confectionary, medicinal and culinary purpose is on the increase. Specifically, chillies are used both as pungent or condiment for culinary purposes for domestic catering and food processing industry. The moderate pungency of the Nigerian chilli allows its use for the production of spice blends and red pepper. Industrial users also require the moderately pungent chillies (Nigerian type) for use in the pharmaceutical industries (Suleiman and Isa, 2010).

In Nigeria, *Capsicum frutescens* is third among the cultivated vegetables being utilized in the dry state as spice, capsicum content and an alkaloid that is a digestive stimulant is used in ointment for leaf of arthritic and neuropathic pains (Ayorinde, 2011). Capsicum species are rich in Vitamin A which is responsible for red colour in mature fruit. *Capsicum frutescens* are further used as pungent spices for domestic culinary purposes and by food manufacturing industries for seasoning of processed foods in the preparation of curry powder, hot sauce and in pickling (Ayorinde, 2011).

According to CBN, (1995), the economics of pepper is characterised by wide and frequent changes in price. The prices are generally low at both domestic and export market. Others economic uses include.

(i) Both green and red Chillies are used to impart pungency to the food (ii) Red chilli powder is used as condiment in every household. (iii) Green chillies of some varieties are used as vegetable. (iv) It is also used for preparation of chutnees, masala, sauces and pickles. (v) It is rich source of vitamin C. (vi) Extract of green chillies can be used as bio-insecticide.

2.4.1 Health benefits of chilli peppers

According to Power Your Diet (2009), chilli pepper contains an impressive list of plant derived chemical compounds that are known to have disease preventing and health promoting properties. Other health benefits of chilli pepper include:

(i) Chillies contain health benefiting alkaloid compound in them, capsaicin, which gives strong spicy pungent character. Early laboratory studies on experimental mammals suggest that capsaicin has anti-bacterial, anti-carcinogenic, analgesic and anti-diabetic properties. It also found to reduce LDL cholesterol levels in obese individuals.

(ii) Fresh chilli peppers, red and green, are rich source of vitamin-C. 100g fresh chillies provide about 143.7µg or about 240 percent of RDA. Vitamin C is a potent water-soluble antioxidant. It is required for the collagen synthesis in the body. Collagen is the main structural protein in the body required for maintaining the integrity of blood vessels, skin, organs, and bones. Regular consumption of foods rich in vitamin C helps the body protect from scurvy; develop resistance against infectious agents (boosts immunity) and scavenge harmful, pro-inflammatory free radicals from the body.

(iii) They are also good in other antioxidants like vitamin A, and flavonoids like *ß-carotene, α-carotene, lutein, zea-xanthin, and cryptoxanthin*. These antioxidant substances in capsicum help to protect the body from injurious effects of free radicals generated during stress, diseases conditions.

(iv) Chillies contain a good amount of minerals like potassium, manganese, iron, and magnesium. Potassium is an important component of cell and body fluids that helps controlling heart rate and blood pressure. Manganese is used by the body as a co-factor for the antioxidant enzyme, superoxide dismutase.

(v) Chillies are also good in B-complex group of vitamins such as niacin, pyridoxine (vitamin B-6), riboflavin and thiamine (vitamin B-1). These vitamins are essential in the sense that body requires them from external sources to replenish.

(vi) Chilli peppers have amazingly high levels of vitamins and minerals. Just 100g provides (in percent of recommended daily allowance):

240% of vitamin C (Ascorbic acid), 39% of vitamin B-6 (Pyridoxine), 32% of vitamin A, 13% of iron,14% of copper and 7% of potassium, but no cholesterol.

2.4.2 Medicinal uses

Chilli peppers contain chemical compound capsaicin. Capsaicin and its co-compounds used in the preparation of ointments, rubs and tinctures for their astringent, counterirritant and analgesic properties. These formulations have been in use in the treatment of arthritic pain, post-herpetic neuropathic pain, sore muscles, etc. Scientific studies on experimental mammals suggest that capsaicin has anti-bacterial, anti-carcinogenic, analgesic and anti-diabetic properties. It also found to reduce LDL cholesterol levels in obese persons. (Power Your Diet, 2009).

2.4.3 Culinary uses

Raw, fresh chillies should be washed in clean water before use in cooking in order to remove any residual fungicides, sand and soil. Chillies either fresh or powder form, can cause severe burning sensation to hands and may cause severe irritation to nasal passages, eyes and throat. Therefore, it may be advised in some sensitive individuals to use thin hand gloves and face masks while handling chillies.

Here are some serving tips; chopped peppers are being used in the preparation of chilli sauce, pizzas, rolls, and in variety of dishes using fish, meat and chicken in many Central American and European regions.

Dried chilli powder is an important ingredient in the spice mix known as curry powder in many Asian countries. Hot chillies are used as a condiment in the preparation of soup, chilli sauce, spicy water; vinegar-spice mix, etc (Power Your Diet, 2009).

2.4.4 Selection and storage

According to Power Your Diet (2009), selection and storage of chilli pepper involves chillies soaked in yogurt and then dried under sunlight, are used as side-dish during dinner, chilli peppers are available year around in the markets either in the fresh, dried or powdered form. In the store, buy fresh chilli peppers instead of powder since, oftentimes it may contain adulterated spicy mixtures.

Look for raw, fresh chillies featuring brilliant color (green, yellow, orange, red depending on the variety), with healthy stalk, wholesome and compact. Avoid those with spots or those spoiled tips and inflicted by molds. At home, it should be stored in the refrigerator in a plastic bag where they will stay fresh for about a week. Completely dried red chillies are also available in the markets. Dry chillies can be stored at room temperature in a cool, dark place, inside airtight containers for many months; and can be milled to powder using mixer/grinder as and when required. If you want to buy dry chilli powder instead, go for the authentic and branded products. Powdered chilli pepper should be stored in cool place in airtight containers.

2.4.5 Safety profile

(i) Chilli peppers contain capsaicin, which gives strong spicy pungent character which when eaten causes severe irritation and hot sensation to mouth, tongue and throat.

(ii) Capsaicin in chillies initially elicit inflammation when it comes in contact with the delicate mucus membranes of oral cavity, throat and stomach, and soon produces severe burning sensation that is perceived as 'hot' through free nerve endings in the mucosa. Eating cold yogurt helps reduce the burning pain by diluting capsaicin concentration and preventing its contact with stomach walls.

(iii) Avoid touching eyes with chilli-contaminated fingers. Rinse eyes thoroughly in cold water to reduce irritation.

(iv) Chillies may aggravate existing gastro-esophageal reflux (GER) condition.

(v) Certain chemical compounds like aflatoxin (fungal mold), found in spoiled chillies have been known to cause stomach, liver and colon cancers (Power Your Diet, 2009).

2.5 The Concept of Efficiency

The question of how to measure efficiency has received considerable attention in economic literature. A profit function is an extension and formalization of the production decisions taken by a farmer. According to production theory, a farmer is assumed to choose a combination of variable inputs and output that maximize profit subject to technology constraint (Sadoulet and De Janvry, 1995). Following the work of Farrell (1957), efficiency can be defined as the ability to produce a given level of output at lowest cost. The concept of efficiency has three components: technical, allocative and economic efficiency.

Technical efficiency is defined as the ability to achieve a higher level of output, given similar levels of inputs. Allocative efficiency deals with the extent to which farmers make efficiency decisions by using inputs up to the level at which their marginal contribution to production value is equal to the factor cost. Technical and allocative efficiencies are components of economic efficiency (Abdulai and Huffman, 1998).

Efficiency is the ability of a firm to achieve potential maximum profit, given the level of fixed factors and prices faced by the firm (Adesina and Djato, 1996). Aigner *et al*. (1977), however, showed that profit function models do not provided a numerical measurable of firm-specific efficiency and popularised the use of the translog production frontier approach. The stochastic frontier approach has gained popularity in firm- specific efficiency studies. Example of recent application includes (Ali and Flinn, 1989; Kumbhakar and Bhattacharyya, 1992; Ali *et al*., 1994).

The stochastic profit frontier function is an extension of incorporating farm level prices and input use in the frontier production function. The incorporation of the farm specific level prices leads to the profit function approach formulation (Ali and Flinn, 1989;

Wang *et al.,* 1996). A production approach to measure efficiency may not be appropriate when farmers face different prices and have different factor endowment (Ali and Flinn, 1989). Hence the use of stochastic profit functions to estimate farm specific efficiency directly (Ali and Flinn, 1989; Ali *et al.,* 1994; Wang *et al*., 1996). The profit function approach combines the concepts of technical, allocative and scale inefficiency in the profit relationships and any errors in the production decision translate into lower profits or revenue for the producer (Rahman, 2003). Profit efficiency is defined as the ability of a farm to achieve highest possible profit given the prices and levels of fixed factors of that farm and profit inefficiency in this context is defined as the loss of profit from not operating on the frontier (Ali and Flinn, 1989).

In agriculture, a farmer has to pay attention to relative prices of the inputs such that the production is undertaken at the point where the isoquant is tangent to isocost line. If that is not done, economic efficiency is not achieved. The farmer may be able to achieve technical efficiency but not allocative efficiency. This inefficiency could arise from a number of sources, which include access to appropriate information in a timely manner or lack of skills to take advantage of modern agricultural inputs.

Basically, what is being referred to here is the managerial ability of the farmer. The farmer should be able to make decisions that lead to optimal utilization of resources and this requires accurate information on availability of the new varieties, the inputs, and access to markets.

According to Bamidele *et al*. (2010), efficiency include technical and allocative efficiency, he isolated allocative efficiency into absolute and relative efficiency and affirmed that these can be analysed in the production function framework. Efficiency has the capacity to produce desired results with a minimum expenditure of time, money, energy or material (National Academy of Science USA, 1975). In context of the stochastic frontier production function, the technical efficiency of an individual firm is defined as the ratio of the observed output to the corresponding frontier output, conditional on the levels of inputs used by the firm. Thus, the technical efficiency of firm i is:

TE = exp (-μ), that is --- (1)

TE = (X_{it}. P) / (X_i. P) -- (2)

EE = (X_{ie}. P) / (X_i. P) -- (3)

Where,

TE_i = Technical efficiency of farmer i

EE = Economic efficiency of farmer i

X_{it}. P = Technically efficient costs of production

X_{ie}. P = Economically efficient costs of production

X_i. P = Actual operating input combination of the farm

The technical efficiency of a firm ranges from 0 to 1. Maximum efficiency in production has a value of 1. Lower values represent less than maximum efficiency in production.

Technical inefficiency= 1- TE_i

The cost frontier dual to the production frontier:

$Ln(C_i) = \alpha_0 + \sum \alpha i ln P_{ij} + y ln(Y_i{}^*)$ --- (4)

Where,

C_i is the cost to production of output Y, P_{ij} is a vector of input price, and α is a vector of parameters. From this function, we also get allocative and economic efficiencies.

The combinations of equations (2) and (3) is used to obtain the allocative efficiency (AE) index following Farell (1957)

AE = EE / TE = (X_{ie}. P) / (X_i. P) -- (5)

The efficient production is represented by an index value of 1.0 while the lower values indicate a greater degree of inefficiency. Using the method by Bravo-Ureta and Pinheiro (1997) which was based on the work of Jondrow *et al* (1982), efficiency can then be measured using the adjusted output as shown in equation (6)

$$Y^* = f(X_i; \beta) - U \quad \text{------} \quad (6)$$

Where U can be estimated as

$$E(ui / \varepsilon i) = \frac{\sigma \lambda}{1 + \lambda^2} \quad \frac{f^*(\varepsilon i \lambda / \sigma) - \Sigma i \lambda}{1 - f^*(\varepsilon i \lambda)} \quad \text{------} \quad (7)$$

Where,

$f^*(\varepsilon i\ \lambda / \sigma)$ and $f^*(\varepsilon i\ \lambda)$ are normal density and cumulative distribution functions respectively,

$\lambda = \sigma u / \sigma v$

$\varepsilon = V_i - U_i$ and

Y^* is the observed output adjusted for statistical noise

When εi, σ and λ estimates, are replaced in equations (6) and (7), it will provide estimates for U and V. The term V is a symmetric error, which accounts for random variations in output due to factors beyond the control of the farmer e.g. weather, disease outbreaks, measurements errors, etc. The term U are non negative random variables representing inefficiency in production relative to the stochastic frontier. The random error Vi is assumed to be independently and identically distributed as $N(o, \delta v^2)$ random variables independent of the U is which are assumed to be non negative truncation of the $N(o, \delta u^2)$ distribution (i.e. half-normal distribution) or have exponential distribution.

The ratio of total output to total input is called technical efficiency and this ratio is 1 for the efficient firm and > 1or < 1 for inefficient firms. Price efficiency is define by the tangency of the price line to the isoquant, this indicate that a minimum possible amount of each input is being used to produce a unit of output at given level of price. The overall efficiency is a product of technical efficiency and price efficiencies (Farrell, 1957).

To determine resource use efficiency (r) requires the determination of optima level of input which is that amount of input that will maximize profit through the process explain earlier. Therefore, the decision rule will be as follows.

r=1, It indicates optimal utilization of resources which is economic optimum point.

r<1, It indicates over utilization of resources

r>1, It indicates under utilization of resources

r<0 It indicates inefficiency and over utilization of resources

2.6 Analytical frame work

2.6.1 Farm profitability analysis

This involves estimation of costs and returns of production. Gomez (1975) and Adeleke, *et al*., (2008) developed a farm level model to evaluate alternative cropping mixtures and patterns. These involves as follows: (i) profitability: this is measured as the differences between value of yield and cost of production, and (ii) Net return: this involves the difference between value of yield and cost of inputs, including hired labour. In choosing economic indicators on the basis of production factors affected by potentials innovation, Abedullah and Mushtaq (2007) suggested the use of the following: (i) the gross margin and returns to variable cost, where only capital is affected. (ii) Yield/labour ratio, where only labour is affected, and (iii) Gross margin, return to variable costs and monetary return to labour, where capital and labour are affected.

The 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 for estimates. Gomez (1975) said that in spite of the limitations, Cost and return analysis is a useful tool for enterprises comparison and indicating a profitability pattern of aggregate input use.

As with any economic analysis, the profitability of an investment is based on a comparison of the returns and cost of the investment. Another way to add value on the production side would be to reduce processing costs by increasing the efficiency (and thus the profitability) of production (Masters *et al*., 2005). Hence, the profitability of crop production depends on reducing the farming cost as much as possible, and at the same time maximizing the income from the sale of crop.

Profitability in some farm business exists because they are managed more efficiently than others. The reward for doing the job better is usually profit. The prospect of earning and maintaining profitability serves as the incentives for creativity and efficiently among farmers. Profitability stimulates risky ventures and drives farmers to develop ways of cutting cost and improving technology always in an effort to satisfy consumer interest (Troke, 2008). Profitable agriculture is dependent on productive soil and guava production is not an exception.

Net farm income is the difference between gross income (revenue) and total cost of production. (Olukosi and Erhabor, 2008). It is used to show the levels of costs, returns and net profit that accrue to farmers involved in production. The technique emphasizes the costs (fixed and variable cost) and returns of any production enterprise. Olukosi and

Ogungbile (2006) have examined two major categories of costs involved in crop production. These are fixed and variable cost. Fixed costs (FC) refer to those costs that do not vary with the level of production or output while variable cost (VC) refers to those costs that vary with output. The total cost (TC) is the sum of total fixed cost (TFC) and total variable cost (TVC).

NFI= TR-TC -- (8)

Where:

NFI= Net Farm Income (Naira)

TR= Total Revenue (Naira)

TC= Total Cost of Production (Naira)

TC= TVC+TFC

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

2.6.2 Stochastic frontier analysis

The stochastic frontier production function is a method of economic modelling. It has its starting point in the stochastic production frontier models simultaneously introduced by Ogundari (2006), Rahman and Umar (2009), Thomas (2007), Emokaro and Ekunwe (2009) and others which derived from the error model of Aigner *et al*. (1977) and Meeusen and Van den Broeek (1977). The stochastic frontier production function in its implicit form is written as:

$Y_i = f(x_i.\beta) + e_i$ -- (9)

$e_i = v_i – u_i$ --- (10)

Where:

Y_i = quantity of output of the i^{th} farm

x_i = vector of the inputs used by the i^{th} farm

β = a vector of the parameters to be estimated

e_i = composed error term

v_i = random error outside farmer's control

u_i =technical inefficiency effects

f(x_i, β) = a suitable function of the vector

This according to Ogundari (2006), it has been used by many empirical studies, particularly those relating to agriculture in developing countries and also that the functional form meets the requirement of being self-dual (allowing an examination of economic efficiency). The empirical stochastic frontier Cobb-Douglas production function is specified as follows:

$\ln Y = \beta o + \beta_1 \ln X_1 i + \beta_2 \ln X_2 i + \beta_3 \ln X_3 i + \beta_4 \ln X_4 i + \beta_5 \ln X_5 i + (Vi-Ui)$ ------------------ (11)

Where,

ln = the natural logarithm

Y = output of chilli pepper (kg)

βo = constant term

β_1- β_5 = regression coefficients

X_1 = farm size (ha)

X_2 = quantity of seed (kg)

X_3 =quantity of fertilizer (kg)

X_4 = total labour used (man days)

X_5 = agrochemical (litre)

Vi = random variability in the production that cannot be influenced by the farmer.

U_i = deviation from maximum potential output attributable to technically inefficiency.

The inefficiency of production, U_i was modelled in terms of the factors that are assumed to affect the efficiency of production of farmers. Such factors are related to the socio-economic and management variables of the farmers. The determinant of technical inefficiency is defined by:

$U_i = \delta_0 + \delta_1 1nZ_1 + \delta_2 lnZ_2 + \delta_3 lnZ_3 + \delta_4 lnZ_4 + \delta_5 lnZ_5 + \delta_6 lnZ_6 + \delta_7 lnZ_7$ --------------------- (12)

Where:

U_i = inefficiency effects (profitability)

δ_0 = constant

δ_1-δ_7 = Parameters to be estimated.

Z_1 = age of farmer (years)

Z_2 = formal education (years of formal schooling)

Z_3 = household size (number of people)

Z_4 = farmers experience (number of years in chilli pepper production)

Z_5 = pepper related cooperative membership (years of participation)

Z_6 = amount of credit (amount of credit obtained)

Z_7 = access to extension services (number of visit)

These variables are assumed to influence technical efficiency of the chilli pepper farmers. The gamma ($\gamma = \sigma^2 \mu / (\sigma 2 \mu + \sigma \nu)$ which is the ratio of the variance of U $\sigma^2 \mu$ to the sigma squared ($\sigma^{2)}$ which is a summation of variances u and v of U and V ($\sigma^2 = \sigma^2 \mu + \sigma^2 \nu$) were also determined.

On the other hand, U_i is a non negative truncated half normal random variable associated with farm- specific factors which lead to the ith farm not attaining maximum efficiency of production. U_i is associated with technical inefficiency of the farm and ranges between zero and one. U_i follows an independent and identical half-normal distributed N ($0.\delta^2 u$). N represents the number of the farms involved in the cross-sectional survey. According to Bakhsh (2007), stochastic frontier production function model is estimated using the maximum likelihood estimation procedure (MLE).

2.6.3 Problems of efficiency measurement

Farrell's definitions as elegant as they are cannot be measured easily as precise measurement rests on the assumption of an efficient isoquant. Efficiency measures as the average productivity of the say land, labour, capital, water and so forth can only be a meaningful index of technical efficiency if any one of the resources is limiting in the production process (Olayinde and Heady, 1982).

The index of efficiency measured as the weighted average of all inputs compared with the output has index number problems and is consequently not a reliable measure of technical efficiency. In addition the use of cost comparisons in the production process as an index of technical efficiency has restricted application where all farm or plants do not face same factor price (Olayinde and Heady, 1982).

Olayinde and Heady (1982) asserted that the theory of the concept of technical efficiency based on the assumption that all farm firms have an identical production function, that is identical technology, identical fixed factor endowment and therefore, a short run concept of efficiency seem to have a less significant impact in the area of production measures than improvement in technical efficiency.

Maximum efficiency is guaranteed if single products are produced under conditions of decreasing returns (or increasing costs) and if commodities produced in combination are never produced within the range of complementary relationships (Han, 2004).

Measurement of efficiency started with Farrell (1957) who, following Debreu (1951), proposed a division of efficiency, which represents a firm's ability to produce a maximum level of output from a given level of inputs, and allocative efficiency, which is the ability of a firm to use inputs in optimal proportions given their respective prices and available technology. Technical efficiency is the extent to which the maximum possible output is achieved from a given combination of inputs or the ability of a firm to obtain maximal output from a given set of inputs. Allocative efficiency is the ability of a firm to use inputs in optimal proportions, given their respective prices and production technology. The combination of these two measures yields the level of economic efficiency.

There are several approaches to analysing the determinants of technical efficiency from stochastic production frontier function. One is a two-step procedure in which the frontier production function is first estimated to determine technical efficiency indicators while the indicators thus obtained are regressed against a set of explanatory variables that are usually firm specific characteristics. While this approach is very simple to handle, the major drawback is that it violates the assumption of the error term. In the stochastic frontier model, the error term is assumed to be identically independently distributed (Jondrow *et al.*, 1982). In the second step the technical efficiency indicators obtained are assumed to depend on a certain number of factors specific to the firms which implies that the inefficiency effects are not identically distributed. This major drawback led to the development of a more consistent approach that modelled efficiency effects as an explicit function of certain factors specific to the firm, and all the parameters are estimated in one step using maximum likelihood procedure.

2.7 Review of Empirical studies

2.7.1 Stochastic frontier function

In order to estimate the level of technical efficiency in a manner consistent with the theory of production function, Cobb-Douglas type stochastic frontier production function was used in the present study. The Cobb-Douglas form of production function has some well-known properties that justify its wide application in economic literature

(Henderson and Quandt, 1980). It is a homogeneous function that provides a scale factor enabling one to measure the return to scale and to interpret the elasticity coefficients with relative ease. It is also easy to estimate and mathematically manipulate. At the same time, the Cobb-Douglas production function makes several restrictive assumptions. It is assumed that the elasticity coefficients are constant, implying constant share for the inputs. The elasticity of substitution among factors is unity in the Cobb-Douglas form. Moreover, this being linear in logarithm, output is zero if any of the inputs is zero and output expansion path is assumed to pass through the origin. However, it is also argued that if interest rests on efficiency measurements and not on an analysis of the general structure of the underlying production technology, the Cobb-Douglas specification provides an adequate representation of the production technology. In addition, its simplicity and widespread use in agricultural economics outweigh its drawbacks.

Translog stochastic production function is also used to estimate the significant relation of different variables which in turn affects the level of efficiency. Translog function is a flexible functional form. But it is more difficult to mathematically manipulate and can suffer from degree of freedom and multicollinearity problems (Rahman, 2002). However, large sample size is needed for Translog functional form. Total sample size of the present study was 100, which may be considered not large enough for Translog functional form.

Cobb-Douglas functional form is used in this study because the coefficient estimated directly represents elasticity of production (Abedullah and Ahmad, 2006). Cobb-Douglas production function is adequate in the representation of the production process since we are only interested in the efficiency measurement, and not production structure (Taylor and Shonkwiler, 1986). Furthermore, Cobb-Douglas production function has been widely applied in estimating farm efficiencies (Ahmad *et al.,* 1999; Kebede, 2001; Hassan and Ahmad, 2005; Abedullah and Ahmad, 2006; Ogundari and Ojo, 2007; Abedullah and Mushtaq, 2007; Oladeebo and Fajuyigbe, 2007; Narala and Zala, 2012; Hussain *et al.,* 2012). The empirical result showed that the estimated farm level of technical efficiency ranged from 47.0% to 97.1% while majority of the farmers (90%) had technical efficiency exceeding 0.71. the study also found fingerling, labour and pond size being efficiently allocated while gender, household size and education were found to be negatively related to technical efficiency; and experience and age were found to be positively related to technical efficiency.

2.7.2 Technical efficiency

The term efficiency of a firm can be defined as its ability to produce the largest possible amount of output from a given set of inputs. It is very important factor for productivity growth especially in an economy where resources are scarce and opportunities to use new technologies are limited, inefficiency studies indicate the potential possibility to raise productivity by improving efficiency without necessarily developing new technology or increasing the resource base (Baifarin *et al* 2010) An underling premise behind much of research in efficiency is that farmers are not making efficient use of existing technology, then efforts designed to improve efficiency would be more cost-effective than introducing new technologies as a means of increasing agricultural output (Huynh, 2008: Adeleke. 2008). Production efficiency has two components: technical and allocative efficiency. Technical efficiency is the extent to which the maximum possible output is achieved from a given combination of inputs or the ability of a firm to obtain maximum output from a given set of input. Allocative efficiency is the ability of a firm to use inputs in optimal proportions given their respective prices and production technology (Coelli*et al*., 1998). Technical inefficiency occurs when the level of production for the firm is less than the frontier output and it increases when timing and methods of application of production inputs are mismanaged. Allocative inefficiency increases when the ratio of marginal products of input is not the same to the ratio of market prices (Bashkh, 2007). Another definition exits which looks at relative technical efficiency. A producer is fully efficient on the basis of available evidence if and only if the performance of other producers does not show that some inputs or outputs can be improved without worsening some of its other inputs or outputs. With this definition, there is no need for recourse to prices and other assumptions of weights which are supposed to reflect the relative importance of the different inputs and outputs (Adeleke. 2008). The measurement of technical efficiency is important. According to Alvarez and Arias (2004), technical efficiency reduces production costs and makes a firm more competitive.

The allocative efficiency index measures a production unit's ability to choose the input combination that minimizes cost given the best available technology. It is the ratio between the minimum costs if it were technically efficient. Because allocative efficiency implies substituting or intensifying the use of certain inputs based on their prices, inefficiencies may stem from unobserved prices, from incorrectly perceived price or from lack of accurate and timely information (Bashkh, 2007).

Most of the empirical studies conducted on efficiency by researchers give a different result as regard to farmer's degree of their efficiency or inefficiency level, in some cases farmers are said to be almost efficient while in other areas they are said to be both technically and economically inefficient. Ohajianya *et al* (2013) on their studies on Technical and Economic Efficiencies in Poultry Production in Imo State, Nigeria using the stochastic frontier production function found out that the mean technical efficiency of poultry farmers was 75%, while their mean economic efficiency was 21%. The generalized likelihood test indicated that, the poultry farmers are not fully technically and economically efficient in resource use. There is 79% allowance to increase economic efficiency of poultry farmers by improving in technical efficiency. Similarly, Biafarin *et al* (2010) on their study on determinant of Technical, allocative and Economic Efficiencies in the plantain production industry in Ondo state, Nigeria found out that using stochastic parametric techniques technical efficiency varied from 14 to 83% with mean of 61%; allocative efficiency varied from 14 to 83% with a mean of 83%; and economic efficiency varied from 3 to 67% with a mean of 35%. The researchers concluded these widely varying indices of efficiency among plantain farmers indicate great potential to achieve productivity growth through improved efficiency using existing technologies and the available resources in the study area. However, to Oladeebo, (2012) on his study of Technical Efficiency and Rural Poverty Among Farmers in Nigeria, showed that poor male- headed households were more technically efficient tan their poor female-headed households counterparts(with mean technically efficiency estimates of about 91% and 82% respectively) and for Ogundari and Ojo (2006), on their research on an Examination of Technical, Economic and Allocative efficiency of Small Farms: The case study of cassava Farmers in Osun State concluded by saying that cassava farmers in the study area exhibit decreasing positive return to scale giving the value of return to scale (RTS) of 0.840. This equally shows that cassava farmers in the study area were efficient in allocating their resources. Additionally, the analysis revealed the predicted efficiency measure disaggregated into technical (TE), economic (EC) and allocative efficiency (AE) with a view of examining not only TE but EE and AE when measuring productivity shows that mean TE, EE and AE of 0.903, 0.89 and 0.807 where obtained from the analysis respectively meaning that TE appears to be more significant than AE as a source of gain in EE.

Cobb-Douglas functional form is used in this study because the coefficient estimated directly represents elasticity of production (Abedullah and Ahmad, 2006). Cobb-Douglas production function is adequate in the representation of the production process since we are only interested in the efficiency measurement, and not production structure (Taylor and Shonkwiler, 1986). Furthermore, Cobb-Douglas production function has been widely applied in estimating farm efficiencies (Ahmad *et al.,* 1999; Kebede, 2001; Hassan and Ahmad, 2005; Abedullah and Ahmad, 2006; Ogundari and Ojo, 2007; Abedullah and Mushtaq, 2007; Oladeebo and Fajuyigbe, 2007; Narala and Zala, 2012; Hussain *et al.,* 2012). The empirical result showed that the estimated farm level of technical efficiency ranged from 47.0% to 97.1% while majority of the farmers (90%) had technical efficiency exceeding 0.71. the study also found fingerling, labour and pond size being efficiently allocated while gender, household size and education were found to be negatively related to technical efficiency; and experience and age were found to be positively related to technical efficiency.

2.7.3 Farm profitability analysis

Cost- return analysis is usually form the basis for farm profitability analysis, it involves itemizing the cost and returns of production and use them to arrive at such estimates as the return to one unit of the resources used, the gross margin, as well as the gross and net returns. The farm income is the total output multiply by the price per unit cost. Therefore, farm income is the total revenue generated from the production while net farm income is the difference between the total revenue and total cost. The total cost of production includes both total variable cost and total fixed cost. Total variable cost includes; cost of seed, cost of fertilizer, cost of labour, and cost of agrochemical while total fixed cost include cost of land. Result from empirical studies conducted by researchers in agriculture gives conflicting result as regard to the profitability of the farm enterprise. While in some cases farmers are said to be making economic profit, some are making normal profit and to others, they are making loss. Alam*et al* (2013) on their study of Economic Analysis of Cotton Production in Selected Local Government Areas of Taraba State discovered that the average costs and returns of cotton farmers in the study area were ₦37,629 per hectare and ₦58,801.12 per hectare respectively. Labour cost has the highest percentage (21%) of the total cost of production. The total variable cost constituted 95% while fixed cost constituted just 5% of the total cost. The enterprise had an average net farm income of ₦21,172.12. The result of the study further revealed that returns on Naira invested by farmers in the study area were ₦0.56, meaning that a farmer gain 56 Kobo in every one naira invested in cotton production. The result of the study clearly indicated that cotton production is a profitable venture and so farmers in the study area should be advised to venture into because it is profitable enterprise. This finding is in conformity with the result of Ibrahim (2008) who conducted a research on the economics of sole cotton production in Lau Local Government Area of Taraba State and came out with a similar result that is, returns on investment of ₦0.76. Similarly Baiyegunhi and Fraser (2009) in their studies of profitability of Sorghum production in three villages of Kaduna state discovered that the gross-margin obtained from the farm enterprises without family labour costed was ₦7,414.72 but when family labour and home consumption was accounted for, it drops to give a gross-margin of ₦5,414.92. The study further concluded that the small scale farmers are mostly subsistence farmers and are not making profit enough to expand their production beyond subsistence needs. Furthermore, Adeyemo *et al*, (2009) on their study of the economic efficiency of small scale farmers in Ogun state find out that the Gross-margin and profit on cassava production in the study area was found to be ₦105,775 and ₦95,738.10 respectively.

CHAPTER THREE

METHODOLOGY

3.1 Description of the Study Area

The study was conducted in three local government areas of Kaduna state namely Ikara, Kubau and Soba. These local government areas are located in the Northern guinea savannah ecological zone of Nigeria and the choice of these local government areas were made because of the reasonable numbers of chilli pepper farmers in the areas (KADP, 2012).

Kaduna state lies between latitudes 09^{o} 02’ and 12^{o} 32’ North of the equator and between longitudes 06^{o} 15’ and 08^{o} 50’ East of the prime meridian. The state shares boundaries with Katsina and Kano state to the north, Plateau to the north east, Nasarawa and Abuja to the south and Niger and Zamfara state to the west (KADP, 2012). The state has a total land area of about 4.5 million hectares, with an estimated total arable land of about 2.02 million ha comprising 1.94 million ha upland and 0.08 million ha lowland. There are two distinct seasons in the state namely wet and dry seasons. Wet season generally spans from April to October, while dry season falls between October to March. The average rainfall is about 1,482 mm, while temperature ranges from 35°C-36°C during the humid period to as low as 10°C-23°C during the hamattan periods of November – February (KADP, 2012).

Kaduna state vegetation is divided into Northern Guinea Savanna and Southern Guinea Savanna. The soil is developed from undifferentiated complex igneous and metamorphic rocks. The fine top soil couple with reasonable organic matter in it enhances the fertility status, especially the southern part of the state. The physical properties of the soil are moderately good and allow continuous cropping for variety of crops. The total number of households in the state that grow pepper in 2011 stood at 84,471 (KADP, 2012).

3.2 Sampling Procedure and Sample Size

A multi stage sampling technique was employed to select the respondents for the study. In the first stage, Ikara, Kubau and Soba local government areas were purposively selected out of 23 local government areas in the state on the basis of being the most prominent producing areas of chilli pepper in the state (KADP, 2012). In the second stage two villages were purposively selected from each of the three local government areas based on the large number of chilli pepper farmers in the areas. In the third stage simple random sampling non replacement method was employed to select 10% out of the population of chilli pepper farmers in each of the villages, its represent a sample of 200 respondents used for the study.

Table 2: Distribution of respondents in the study area

Local govt	Villages	Sampling frame	Sample size (10%)
Ikara	Auchan	376	37
	Wambai	408	40
Kubau	Kuli	302	30
	Zuntu	255	25
Soba	Bagadi	237	23
	Gimba	457	45
Total		2035	200

Source: Kaduna State Agricultural Projects (KADP), 2013

3.3 Method of Data Collection

Primary data were use for this study. The interview method of data collection with the aid of structured questionnaire was used to obtain information from the selected farmers in the study area. Data collection was centred on socio-economic characteristic of the farmers such as age, gender, household size, educational status, farming experience, amount of credit, access to extension service, cooperative membership, farm size, quantities and prices of various production inputs used by the farmers, constraint faced by the farmers in chilli pepper production, as well as information on the quantity of chilli pepper output and its price.

Similarly, information on the quantity and price of other crops produced by chilli pepper farmers, as well as quantities and prices of various production inputs used in producing such crops during the period under review were obtained and used in the study to estimate the percentage contribution of chilli pepper and other crops to the household farm income of chilli pepper farmers in the study area.

3.4 Analytical Techniques

The analytical tools employed for this study were descriptive statistics, net farm income, multiple regression analysis and stochastic frontier production function.

3.4.1 Descriptive statistics

Descriptive statistics such as frequency, percentage, minimum, maximum, mean and standard error were used to achieve objective (i), (v) and (vi) of the study.

3.4.2 Net farm income

Net farm income was used to achieve objective (ii), the differences between the two parameters are a measure of the net farm income. The farm income is the total output multiply by the price per unit cost. Therefore, farm income is the total revenue generated from the production while net farm income is the difference between the total revenue and total cost. The total cost of production includes both total variable cost and total fixed cost. Total variable cost includes; cost of seed, cost of fertilizer, cost of labour, and cost of agrochemical while total fixed cost include cost of land. The formula for net farm income is stated as follows.

NFI= TR-TC -- (13)

Where:

NFI= Net Farm Income (Naira/ha)

TR= Total Revenue (Naira/ha)

TC= Total Cost of Production (Naira/ha)

TC= TVC+TFC

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

TVC = (seed, fertilizer, labour and agrochemicals)

TFC = (cost of renting land and depreciation of tools)

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

$$D = \frac{(P - S)}{N} \quad \dots\dots\dots\dots\dots\dots\dots\dots\dots\dots \quad (14)$$

Where:

D = Depreciation (Naira)

P = Purchase value (Naira)

S = Salvage value (Naira)

N = Life span of asset (years)

Return per Naira Invested (RNI) is obtained by dividing the Gross Income (GI) over the Total Cost (TC).

Therefore,

$$RNI = \frac{(GI)}{TC} \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots .. (15)$$

Where:

RNI = Return per Naira Invested

GI = Gross Income

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 operating at loss

3.4.3 Multiple regression analysis

Multiple regression analysis was used to estimate the socio-economic factors influencing profitability of chilli pepper production (objective-iii). The probability of a farmer being profitable is determined by an underlying response variable that captures the true economic status of a farmer.

π= f(X_1 X_2 X_3 X_4 X_5 X_6 X_7 + u) -- (16)

π= $\beta_0 + \beta_1 X_{1+} \beta_2 X_{2\,+} \beta_3 X_{3\,+} \beta_4 X_{4\,+} \beta_5 X_{5\,+} \beta_6 X_{6\,+} \beta_7 X_{7\,+}$ ei ----------------------------------- (17)

Where:

π= Profit (naira/kg)

$\beta_{1\,-}\,\beta_7$ = the coefficients for the respective variables in the model

μi = error term

X_1 = age of farmer (years)

X_2 = formal education (years of formal schooling)

X_3 = household size (number of people)

X_4 = farmers experience (number of years in chilli pepper production)

X_5 = pepper related cooperative membership (years of participation)

X_6 = amount of credit (amount of credit obtained)

X_7 = extension visit (number of visit)

The specification of the model for the socio-economic characteristic in equation (16) implies that, if the independent variables in the model have a positive sign on an estimated parameter, then the associated variable has a direct relationship with profit while a negative sign indicates an inverse relationship to profit.

Thus, the *a priori* expectation was that the coefficients of the whole independent variables of the socio-economic characteristic in the model (i.e X_1, X_2, X_3, X_4, X_5, X_6 and X_7) should be positive, respectively. Therefore, each variable was expected to have positive effect on profit.

3.4.4 Stochastic frontier production function

Stochastic frontier production function was employed to achieve objective (iv) of the study. The stochastic frontier production function in its implicit form is written as:

$Y_i = f(x_i.\beta) + e_i$ -- (18)

$e_i = v_i - u_i$ --- (19)

Where:

Y_i = quantity of output of the i^{th} farm

x_i = vector of the inputs used by the i^{th} farm

β = a vector of the parameters to be estimated

e_i = composed error term

v_i = random error outside farmer's control

u_i =technical inefficiency effects

$f(x_i, \beta)$ = a suitable function of the vector

The empirical stochastic frontier Cobb-Douglas production function is specified as follows:

$\ln Y = \beta o + \beta_1 \ln X_1 i + \beta_2 \ln X_2 i + \beta_3 \ln X_3 i + \beta_4 \ln X_4 i + \beta_5 \ln X_5 i + (Vi\text{-}Ui)$ ------------------ (20)

Where:

ln = the natural logarithm

Y = output of chilli pepper (kg)

βo = constant term

β_1- β_5 = regression coefficients

X_1 = farm size (ha)

X_2 = quantity of seed (kg)

X_3 =quantity of fertilizer (kg)

X_4 = total labour used (man days)

X_5 = agrochemical (litre)

Vi = random errors outside the farmers control.

U_i = technical inefficiency effects.

The determinant of technical inefficiency is defined by:

$U_i = \delta_0 + \delta_1 1nZ_1 + \delta_2 \ln Z_2 + \delta_3 \ln Z_3 + \delta_4 \ln Z_4 + \delta_5 \ln Z_5 + \delta_6 \ln Z_{6} + \delta_7 \ln Z_7$ --------------------- (21)

Where:

U_i = inefficiency effects

δ_0 = constant

δ_1-δ_7 = Parameters to be estimated.

Z_1 = age of farmer (years)

Z_2 = formal education (years of formal schooling)

Z_3 = household size (number of people)

Z_4 = farmers experience (number of years in chilli pepper production)

Z_5 = pepper related cooperative membership (years of participation)

Z_6 = amount of credit (amount of credit obtained)

Z_7 = extension visit (number of visit)

$Ln(C_i) = \alpha_0 + \sum \alpha i ln Pij + yln(Yi^*)$ -- (22)

Where:

C_i is the cost to production of output

Y, Pij is a vector of input price, and α is a vector of parameters.

Ln is the natural logarithm.

α_0 is the constant

Pij is the unit price of the ith farm

∑ is the summation.

The explicit form of stochastic frontier cost function is specified as:

$lnC = \beta_0 + \beta_1 lnX_1 i + \beta_2 lnX_2 i + \beta_3 lnX_3 i + \beta_4 lnX_4 i + \beta_5 lnX_5 i + (Vi + Ui)$ -------------- (23)

Where:

ln = the natural logarithm

C = Total cost of output (Naira)

X_1 = cost of renting farm (Naira)

X_2 = cost of seed (Naira)

X_3 = cost of fertilizer (Naira)

X_4 = cost of labour (Naira)

X_5 = cost of agrochemical (Naira)

β_0 = constant term

β_1- β_3 = regression coefficients

V_i = random variability in the production that cannot be influenced by the farmer.

U_i = deviation from maximum potential output attributable to technically inefficiency.

The specification of the model for the inefficiency effects in equation (21) implies that, if the independent variables of the inefficiency model have a negative sign on an estimated parameter, then the associated variable has a positive influence on efficiency while a positive sign indicates that the reverse is true.

Thus, the *a priori* expectation was that the coefficients of the whole independent variables of the inefficiency model (i.e Z_1, Z_2, Z_3, Z_4, Z_5, Z_6 and Z_7) should be negative, respectively (i.e. less than zero).Therefore, each variable was expected to have positive effect on technical efficiency.

3.4.5 Definition and measurement of variables

(i) Output (Y): This is the product harvested from the sample fields (dried chilli pepper). It measured in kilogram.

(ii) Farm size (X_1): The inclusion of this variable in the model is to determine the extent to which variability in output is affected by farm size and was measured in hectares. The estimated coefficient of farm size was expected to have positive effect on chilli pepper output.

(iii) Quantity of seeds (X_2): Seed was measured in kilogram. It is included in the model to examine how variability in quantity of seed used affect output. The estimated coefficient of seed was expected to have positive effect on chilli pepper output.

(iv) Quantity of fertilizer (X_3): It was measured in kilogram. It is included in the model to examine how variability in quantity of chemical fertilizer used affect output. The estimated coefficient of fertilizer was expected to have positive effect on chilli pepper output.

(v) Labour (X_4): This consist of family and hired labour, it is included in the model to examine how variability in labour used affect output. Following Norman (1972), children age 7-14years are accorded 0.5 of adult male equivalent, female adult of 15-46 years are accorded 0.75 and male adults of 15-64years are accorded 1.00. Labour was measured in man-day. The estimated coefficient of labour was expected to have positive effect on chilli pepper output.

(vi) Quantity of agrochemical (X_5): It is included in the model to examine how variability of the quantity of pesticide used affect output. It was measured in litres. The estimated coefficient of agrochemical was expected to have positive effect on chilli pepper output.

(vii) Age (Z_1): This refers to the number of years of an individual attained from birth. It is a continuous variable and was measured in years. Hofferth (2003) argues that the higher the age of the household head, the more stable the economy of the farm household, because older people have also relatively richer experiences of the social and physical environments as well as greater experience of farming activities. More also, older household heads are expected to have better access to land than younger heads, because younger men either wait for a land distribution, or have to share land with their families. The estimated coefficient of age was expected to have negative sign on the technical inefficiency.

(viii) Educational status (Z_2): This refers to the acquisition of knowledge through formal education and it is measured in years of studying. The estimated coefficient of education was expected to have negative sign on the technical inefficiency

(ix) Household size (Z_3): This means the total number of people in the house which includes the wives, children and dependents that reside within the same house. Since food requirements increases with the number of person in the household and also because land and finance to purchase agricultural inputs are limited. Increasing family size, according to Brown (2004), tends to exert more pressure on consumption than the labour it contributes to production. This was measured in numbers. The estimated coefficient of household size was expected to have negative sign on the technical inefficiency.

(x) Farming experience (Z_4): This refers to the years the farmer has actively engaged in chilli pepper production and was measured in years. The estimated coefficient of farming experience was expected to have negative sign on the technical inefficiency.

(xi) Cooperative membership (Z_5): This refers to the years the farmer has actively engaged in chilli pepper related cooperative association and was measured in years. The estimated coefficient of cooperative membership was expected to have negative sign on the technical inefficiency.

(xii) Amount of credit obtained (Z_6): This refers to amount of credit obtained during the production period from both formal and informal sources. The estimated coefficient of credit obtained was expected to have negative sign on the technical inefficiency.

(xiii) Extension visit (Z_7): This refers to the number of times a farmer has extension visit per production season formal or informal. The estimated coefficient of extension services was expected to have negative sign on the technical inefficiency.

CHAPTER FOUR

RESULT AND DISCUSSION

4.1 Socio-Economic Characteristics of Chilli pepper Farmers

4.1.1 Age distribution of farmers

The study revealed that 37.5% of the chilli pepper farmers were within the age range of 30-39 years with mean of 46 years. This implies that, more than one-third of the farmers are still strong and active and they can participate actively in farming activities. The age distribution is expected to have positive influence on the respondent's participation in chilli pepper production, which invariably means better efficiency in production. This result is also in line with the findings of Obeta and Nwabo (1999) which observed that youth constitute the majority of the farmers, and younger farmers are more flexible to new ideas and risk; hence they are expected to adopt innovations more readily than older farmers.

Table 3: Distribution of chilli pepper farmers according to age

Age (years)	Frequency	Percentage
20-29	5	2.5
30-39	75	37.5
40-49	37	18.5
50-59	58	29
>60	25	12.5
Min	22	
Max	80	
Mean	46	
SE	0.71	

4.1.2 Educational level

Education is an important socio-economic factor that influences farmers' decision making because of its influence on farmers' awareness, perception and adoption of innovations that can bring about increase in productivity. The result in Table 4 shows that 47% of chilli pepper farmers had no formal education, while 30% of the respondents are within 1-6 years of education which means they had only primary education, and 15.5% had secondary education while 7.5% had tertiary education. This indicates that the farmers' educational level is low. This finding is at variance with Amaza (2000), education has a positive and significant impact on farmers' efficiency in production. Thus, literacy level will greatly influence the decision making and adoption of innovation by farmers, which may bring about increase in productivity.

Table 4: Distribution of chilli pepper farmers according to educational level

Education (years)	Frequency	Percentage
No formal education	94	47
1-6	60	30
7-12	31	15.5
12-above	15	7.5

4.1.3 Household size

Table 5 shows the distribution of chilli pepper farmers by household size. The majority of the farmers (33.5%) had household size that ranged from 6-10 persons. The average household size was 11 persons. According to the report of (Oluwatayo *et al.*, 2008), there is a positive and significant relationship between household size and farmers' efficiency in production. However, the absolute number of people in a certain family cannot be used to justify the potential for productive farm work. This is because it can be affected by some important factors namely; age, sex and health status.

Table 5: Distribution of chilli pepper farmers according to household size

Household size (number)	Frequency	Percentage
1-5	42	21
6-10	67	33.5
11-15	50	25
16-20	21	10.5
21-25	12	6
26-30	4	2
>31	4	2
Min	1	
Max	40	
Mean	11	
SE	0.53	

4.1.4 Farming experience

The process of gaining knowledge and skills is term experience. It is a measure of the period an individual farmer was involved in chilli pepper production. The more numbers of years of production by chilli pepper farmers, the more knowledge and skills gained. Experience influences individuals' perception and understanding of the management requirements and consequently improved farm produce.

Farming experience is another important socio-economic factor that can bring about increase in productivity. The result in Table 6 shows that 24% of chilli pepper farmers had an experience of 6-10 years, 18.5% of the respondents are within 11-15 years of farming experience while 17.5% of the respondents are within 1-5 years of farming experience which means that chilli pepper farmers in the study area had vast experience in their production.

Table 6: Distribution of chilli pepper farmers according to farming experience

Farming experience (years)	Frequency	Percentage
1-5	34	17
6-10	48	24
11-15	37	18.5
16-20	19	9.5
21-25	22	11
26-30	14	7
>31	26	13
Min	1	
Max	50	
Mean	17	
SE	0.81	

4.1.5 Membership of cooperative society

The result in Table 7 shows the numbers of years spent in cooperative. About 72% of chilli pepper farmers do not participate in any chilli pepper related cooperative association and the reasons for this include: being small scale and unawareness of any association while 28% participated with average of 1.7years. The effect of this result is that most of the chilli pepper farmers in the study area do not enjoy the assumed benefits accrued to co-operative societies through pooling of resources together for a better expansion, efficiency and effective management of resources and for profit maximization. Ekong (2003) and Ajayi (2002) Stated that membership of cooperative societies has advantages of accessibility to micro-credit, input subsidy and also as avenue in cross breeding ideas and information.

Table 7: Distribution of chilli pepper farmers according to membership of association

Cooperative (years)	Frequency	Percentage
Non member	144	72
1-5	24	12
6-10	30	15
>11	2	1
Min	0	
Max	15	
Mean	1.7	
SE	0.23	

4.1.6 Source of capital for chilli pepper farming

The result in Table 8 shows that 98.5% of chilli pepper farmers financed their production from personal savings while 1.5% sourced credit, through Bank of agriculture. The low access to credit could be attributed to the fact that government seldom grants financial credit to farmer. Ekong (2003) asserts that credit is a very strong factor that is needed to acquire or develop any enterprise; its availability could determine the extent of production capacity. It also 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.

Table 8: Distribution of chilli pepper farmers according to source of capital

Source of capital	Frequency	Percentage
Informal	197	98.5
Formal	3	1.5
Min amount of credit (₦)	0	
Max amount of credit (₦)	150000	
Mean amount of credit (₦)	1750	
SE amount of credit (₦)	1025.89	

4.1.7 Number of extension visit

The data in Table 9 revealed that 41.5% of chilli pepper farmers in the study area have no extension visit while (58.5%) have extension visit with average of 1 visit, this could be attributed to increased of extension agent-farmers' ratio by the KADP in the study area. The implication is that it would increase farmer's efficiency and enhance productivity.

Table 9: Distribution of chilli pepper farmers according to number of extension visit

Extension visit (no of visit)	Frequency	Percentage
No extension contact	83	41.5
1-2	91	45.5
3-4	25	12.5
>5	1	0.5
Min	0	
Max	5	
Mean	1	
SE	0.08	

4.2 Analysis of Costs, Returns and Profitability in Chilli Pepper Production

4.2.1 Summary of inputs and output

The summary statistics of level of inputs and output production in the study area are reported in Table 10. It shows that agricultural production in the study area is labour intensive. The average yield per hectare was 1118.57kg/ha. This was obtained from 1.05 hectare of farm size, average seed was 1.71kg/ha, average fertilizer was 292.17kg/ha, 26 man-day for maximum labour applied while the minimum labour used was 5 man-days and average agrochemical was 4.31 litres. This however, contradicts the recommended rates per hectare for seed (1.08kg), fertilizer NPK 15:15:15 (200kg) (NAERLS, 2013), and the average pepper potential yield of (3956kg/ha) (Idowu-agida *et. al.*, 2010). This implies that chilli pepper farmers in the study area are over-utilizing their resources to produce less than the potential yield per hectare.

Table 10: Summary of the inputs and yield of chilli pepper

Variables	Unit	Mean	Standard deviation	Min	Max
Seed	Kg/ha	1.71	1.67	0.22	12.25
Fertilizer	Kg/ha	292.17	240.79	25	1250
Labour	Man-day/ha	12.65	3.56	5	26
Agrochemical	Litre/ha	4.31	2.95	1	20
Yield	Kg/ha	1118.57	919.25	210	6180

The average farm size of 1.05ha was used

4.2.2 Analysis of cost of chilli pepper production

The average quantity of seed was 1.71kg/ha with an average market price of ₦1000 per kg was used and this constitutes 3.7% of the total cost of production. The quantity of fertilizer was 292.17kg/ha with an average market price of ₦100 per kg used and quantity of agrochemical was 4.31 litres/ha with an average market price of ₦650 per litre was used, they constitute 63.7% and 6.1% of the total cost of production respectively.

Labour costs consist of cost of land preparation, planting, fertilizer application, weeding, replacement, harvesting and drying. The family labour was computed on the basis of opportunity cost in man-day. The wage rate varied according to farm operation to be performed. An average wage rate of ₦450 per man-day was used giving the average labour cost to be ₦5692.5 which constitutes 12.4% of the total cost of production.

The total cost of fixed inputs (cost of renting land and depreciation of tools) incurred on chilli pepper production was ₦6460 and this constitute 14.1% of the total cost.

4.2.3 Return to investment in chilli pepper production

The analysis of average cost, return and profitability per unit of chilli pepper production in Table 11 shows that cost of fertilizer constitutes a large proportion with 63.7% of the total cost. According to Akande *et al*. (2008) pepper has also been shown to respond very well to the application of fertilizer.

The total revenue (TR) was ₦111,857 while the total cost (TVC + TFC) was ₦45,881 The net farm income was therefore ₦65,976 the rate of return on investment (return per naira invested) was ₦2.44, indicating that for every ₦1 invested in chilli pepper production in Kaduna state, a return of ₦2.44 kobo was made. Thus, it could be concluded that chilli pepper production is profitable in the study area. Based on the findings of Idowu-agida (2010) the maximum gross return of ₦1, 037,500, net returns (₦768, 801) and benefit to cost ratio of (3.9:1) were obtained. The highest profit (₦3.90) per naira invested was recorded and the result on the average indicated that pepper production was profitable.

Table 11: Average cost, return and profitability per unit hectare of chilli pepper production

Variable	Value/ha (naira)	% Contribution
Total revenue (TR)	111,857	
Total cost (TVC+TFC)		
1. seed (kg)	1710	3.7
2. fertilizer (kg)	29,217	63.7
3. labour (man-day)	5692.5	12.4
4. agrochemical	2,801.5	6.1
Total variable cost (1 + 2 + 3 + 4)	39,421	
5. cost of renting land	5,020	10.9
6. depreciation of tools	1,440	3.2
Total fixed cost (5 + 6)	6,460	
Total cost (39,421 + 6,460)	45,881	
Net farm income (TR – TC)	65,976	
Return per naira invested (TR/TC)	2.44	100

4.3 Socio-Economic Factors Influencing Profitability of Chilli Pepper Production

The result of the multiple regressions presented in Table 12 shows that some of the coefficients of the variables (education, household size and farming experience) included in the model had positive signs while others (age, cooperative membership, credit obtained and extension contact) had negative signs. The implication is that any increased in respect of variables with positive signs or decrease with respect to variables with negative signs could lead to increase in farmer's profit.

The result also shows that the R^2 value of 0.52 implies that 52% of variation in profitability in chilli pepper has been explained by the socio-economic factors of the farmer and that 48% was as a result of the random error term. This implied that the model gave relative fit of the data and that the socio-economic characteristics of chilli pepper farmers had a relative influence in profitability in chilli pepper production.

The result revealed that the coefficient of education (1254.82) was found to be positively related to profitability and significantly had a direct influence to profitability in chilli pepper production at 10% level of probability. This implied that the higher the level of education of the respondents the higher the level of profitability in chilli pepper production. This finding is in line with Amaza (2000); education has a positive and significant impact on farmers' efficiency in production. Thus, literacy level will greatly influence the decision making and adoption of innovation by farmers, which may bring about increase in productivity and profit.

Table 12: Relationship between famer's socio-economic variables and profitability in chilli pepper production

Variables	Parameters	Coefficients	Std. Error	T-Value
Constant	β_0	34451.86**	16970.63	2.030
Age	X_1	-430.04	412.511	-1.042
Education	X_2	1254.82*	668.49	1.877
Household size	X_3	38.37	492.56	0.078
Farming experience	X_4	1522.22***	328.41	4.635
Cooperative	X_5	-560.03	1020.69	-0.549
Credit borrowed	X_6	-1.15*	0.61	-1.885
Extension visit	X_7	-3934.88	2876.56	-1.368

*Note: *** significant at 1% level of probability, ** significant at 5% level of probability and * significant at 10% level of probability.*

Fit R-squared = 0.52
Adjusted R-squared = 0.45

Farming experience had a positive coefficient (1522.22) and significant at 1% level of probability. This implies that farmers with high experience realise more profit more than inexperience farmers.

Amount of credit obtained had a negative coefficient (-1.15) and significant at 10% level of probability and negatively related with profitability in chilli pepper production. This implied that as the farmer continues to obtain more credit the profitability of chilli pepper production would tend to decline. This is contrary to apriori expectation of the amount of credit obtained. This could be attributed to the fact that government seldom grants financial credit to large numbers of farmer and when done with high interest rate.

4.4 Technical and Resource Use Efficiency of Chilli Pepper Production

4.4.1 Technical efficiency of chilli pepper production

The variances of the technical efficiency presented in Table 13 indicate that, the sigma-square and the gamma were both positive and significantly different from zero at 1% and 5% level of probability respectively. This indicates a good fit and the correctness of the specified distribution assumption of the composite error term. Hence the use of the stochastic frontier function estimated by the Maximum Likelihood Estimates procedure is suitable for the data.

However, the estimated coefficients of all the parameters of production function (farm size, seed and fertilizer) were positive and significant at 10%, 1% and 1% level of probability respectively, except labour and agrochemical which were negative and not statistically significant. The average technical efficiency for the farmers is 0.90 implying that, on the average the respondents are able to obtain 90% of potential output from a given mixture of production inputs. Thus, in a short run, there is minimal scope

(10%) of increasing the efficiency, by adopting the technology and techniques used by the best chilli pepper farmer.

The result shows that the coefficient of farm size (β_1) was positive and significant at 10% level of probability. This implies that an increase in farm size would result to an increase in the quantity of chilli pepper produced in the study area by coefficient of variation (0.213).

The estimated coefficient for seed (β_2) was 0.636 which is positive and statistically significant at 1% level probability. This conforms to the *a priori* expectation that increase in seed would bring about increase in output. The estimated 0.636 elasticity of seed implies that increasing the use of seed by 1% will increase chilli pepper 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 in line with the findings of Shehu *et al.,* (2010) who observed that the estimated coefficient of seed inputs was positive as expected and significant at 1% level which implies that the more seed is applied the better the output.

The production elasticity of output with respect to quantity of fertilizer (β_3) was 0.053 which is positive and statistically significant at 1% level. This implies that a 1% increase in fertilizer will increase chilli pepper output by 0.05%. Fertilizer is a major soil augmenting input because it improves the quality of soil by raising yields per hectare. This study is in agreement with the findings of Maurice (2004) and Oladiebo and Fajuyigbe (2007). A timely and efficient management and utilization of fertilizer input will improves the quality and quantity of yields per hectare.

The estimated coefficients of Labour (β_4) and agrochemical (β_5) were negatively related with the output and not statistically significant from zero. This implies additional use of labour and agrochemical would reduce the output by the coefficient -0.085 and -0.069 respectively. This is against the *a priori* expectation and the negative effect of these inputs (labour and agrochemical) could be attributed to overutilization of the resource in chilli pepper production.

Table 13: Result of maximum likelihood estimates of frontier production function of chilli pepper production

Variables	Parameters	Coefficients	Std. Error	T-Value
Production				
Constant	β_0	4.24***	0.586	7.24
Farm size	β_1	0.213*	0.120	1.78
Seed	β_2	0.636***	0.106	6.61
Fertilizer	β_3	0.053***	0.0101	5.13
Labour	β_4	-0.085	0.014	-0.61
Agrochemical	β_5	-0.069	0.054	-1.29
Diagnostic statistics				
Sigma-square	(σ^2)	0.2162***	0.0229	9.455
Gamma	(γ)	0.040**	0.018	2.17
Log likelihood function=	*L/f*	-128.037		
LR test of the one-side error	10.086			
Total number of observation	200			
Mean efficiency	0.901			

*Note: *** significant at 1% level of probability, ** significant at 5% level of probability and * significant at 10% level of probability.*

5.4.2 Estimated stochastic frontier cost functions

The Maximum Likelihood (ML) estimates of the stochastic frontier translog cost parameters for chilli pepper are presented in Table 14. For the cost function, the sigma (σ^2 = 0.27) highly significant at 1% level of probability and the gamma (γ=0.8167) is quite high and highly significant at 1% 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 (γ = 0.8167) shows that 82 percent of the variability in the output of chilli pepper farmers that are unexplained by the function is due to allocative inefficiency.

The results of translog stochastic frontier cost function for chilli pepper in Kaduna State are shown in Table 14. The estimated coefficients of the parameters of the cost function are positive except that of farm size and agrochemical which are negative and not significant different from zero.

The coefficients of the cost of seed, fertilizer and labour were positive and statistically significant at 1%. This implies that they are important inputs in production of chilli pepper. The estimated coefficient of the variable output was positively signed and statistically significant at 1% level indicating that if there is an increase in chilli pepper output the total cost of production will increase. This shows that the cost of production is influenced by the quantity of output realized. The result of this research agrees with the findings of Ogundari *et al.,* (2006) where they reported direct effect of output on cost of production in their study on economies of scale and cost efficiency in small scale maize production in Nigeria.

Table 14: Result of maximum likelihood estimates of frontier cost function of chilli pepper production

Variables	Parameters	Coefficients	Std. Error	T-Value
Constant	β_0	5.6017***	0.3110	18.010
Cost of farm size	β_1	-0.0795	0.0679	-1.171
Cost of seed	β_2	0.1596***	0.0518	3.0810
Cost of fertilizer	β_3	0.4838***	0.0579	8.363
Cost of labour	β_4	0.3517***	0.0840	4.185
Cost of agrochemical	β_5	-0.0426	0.0281	-1.517
Cost of output	β_6	0.2672***	0.0407	6.561
Sigma-square	(σ^2)	0.2698**	0.5667	0.476
Gamma	(γ)	0.8167**	0.3777	2.162
Log likelihood function=	*L/f*	-24.1297		
LR test of the one-side error	1.7403			
Total number of observation	200			
Mean efficiency	0.633			

*Note: *** significant at 1% level of probability, ** significant at 5% level of probability and * significant at 10% level of probability.*

5.4.3 Frequency distribution of technical efficiency estimates of chilli pepper farmers

The frequency distribution of the technical efficiency estimates for chilli pepper farmers in the study area as obtained from the stochastic frontier model presented in Table 15. It was observed from the study that 12% of the farmers had technical efficiency (TE) of less than 0.81 level efficiency while 88% of the farmers operate at 0.81 and above level efficiency. The farmer with the best and least practice had a technical efficiency of 0.98 and 0.74 respectively. This implies that on the average, output fall by 2% from the maximum possible level due to inefficiency. Also 90% of the farmers were estimated to have technical efficiency exceeding 0.8, indicating there are some 10% technical inefficient farmers in the study area.

The study also found that for the average farmer in the study area to achieve technical efficiency of his most efficient counterpart, he could realize about 10.2% (1-0.90/0.98*100) cost savings while on the other hand, the least technically efficient farmers will have about 26.5% (1-0.74/0.98*100) cost savings to become the most efficient farmer.

Table 15: Frequency distribution of technical efficiency from the stochastic frontier model

Technical efficiency level	Frequency	Percentage
0.61-0.80	24	12
0.81-1.00	176	88
Total	200	100
Mean	0.90	
Min	0.74	
Max	0.98	

4.4.4 Estimated technical inefficiency in chilli pepper production

The estimated result of the inefficiency model is contained in Table 16. A negative sign on a parameter means that the variable reduces technical inefficiency, while a positive sign increases technical inefficiency. The results shows that age of the farmers, level of education, farming experience, credit obtained and extension contact have a negative sign, and therefore reduce technical inefficiency (or increase technical efficiency) while household size and cooperative association have positive signs, implying that they increase technical inefficiency (or reducing technical efficiency).

The coefficient of farmer's age was inversely related to technical inefficiency and not statistically significant. This had a positive influence on technical efficiency in chilli pepper farming in the study area. This study is in conformity with the *a priori* expectations that age of the respondent's increases as the technical inefficiency decreases. This finding is in difference with Kolawole and Ojo (2007) who in their study of small scale farmers in Nigeria found age to be positively related to inefficiency.

The estimated coefficient of education has a negative sign and not statistically significant. This indicates that level of education attained increase technical efficiency. This could probably be explained by the fact farmers probably employ their educational advantages as opportunity to develop their production capability and inferably would be ready to adopt innovations and technologies for improved productivity and is in line with the public assertion that education advancement bring about better technical efficiency in farming as a result of easy understanding of farming technologies and adoption of new innovations.

The coefficient of household size in the inefficiency model is positive but not significantly different from zero. This may be due to the fact that farmers with large household size has more people to feed with less income left to acquire inputs for production. These findings agree with the findings of Zalkuwi (2010) there is a positive and significant relationship between household size and farmers' efficiency in production. However, the absolute number of people in a certain family cannot be used to justify the potential for productive farm work. This is because it can be affected by some important factors namely; age, sex and health status. This shows that a reasonable number of the respondents have a large household size. Higher household size provides enough persons for family labour and less money will be needed to pay for hired labour. The coefficient of farming experience in the inefficiency model is negative and significant at 10% level of probability. This implies that farming experience reduces technical inefficiency and contributes positively to technical efficiency in chilli pepper farming in the study area.

The estimated coefficient of cooperative association has a negative sign related to technical inefficiency and significantly different from zero at 5% level of significance. This implies that it reduce technical inefficiency (or increasing technical efficiency), despite the low participation of the farmers in cooperative membership in the study area.

Extension contact also has a negative sign related to inefficiency and significantly not different from zero. This implies that it increase technical efficiency (or reducing technical inefficiency). This is in line with several studies that found extension to be positively related with technical efficiency (Bifarin *et al*., 2010).

The estimated coefficient of credit accessibility has negative estimate related to inefficiency and not statistically significant. Ekong (2003) asserts that credit is a variable that is needed to acquire or develop any enterprise; its availability could determine the extent of production capacity. It also 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.

Table 16: Result of maximum likelihood estimates frontier technical inefficiency of chilli pepper production

Variables	Parameters	Coefficients	Std. Error	T-Value
Inefficiency model				
Constant	Z_0	0.32	0.46	0.708
Age	Z_1	-0.0007	0.012	-0.060
Education	Z_2	-0.001	0.012	-0.11
Household size	Z_3	0.0022	0.016	0.13
Farming experience	Z_4	-0.020*	0.010	-1.87
Cooperative membership	Z_5	-0.164**	0.074	-2.216
Credit borrowed	Z_6	-0.004	0.0036	-1.41
Extension visit	Z_7	-0.014	0.054	-0.24
Diagnostic Statistic				
Sigma-squared	(σ^2)	0.2162***	0.0229	9.455
Gamma	(γ)	0.040***	0.018	2.17
Log likelihood function	*L/f*	-128.037		
LR test	10.086			
Total no of observation	200			
Mean efficiency	0.90			

*Note: *** significant at 1% level of probability, ** significant at 5% level of probability and * significant at 10% level of probability.*

5.5 Contribution of Chilli Pepper to Household Farm Income

The main economic activities in the study areas were crops production. The summary of the contribution of chilli pepper to household farm income is presented in Table 17. The net average household farm income is derived from the total net revenues from chilli pepper and other crops produced by chilli pepper farmers for the year under review. The relative contributions of the various farm income sources are shown in Table 17.

The information obtained indicates that the contribution from chilli pepper amounted to 42% of total household farm income in the study area. Christopher and Yusoff (2011) asserted that the importance of pepper production to food security especially in Nigeria is of significant importance for continued sustenance of improved agricultural productivity. Then followed by maize with about 11%, rice about 10%, soya beans about 8% and other crops (sorghum, groundnut, onion, sugarcane, cowpea and tomatoes), about 30%. This finding provides enough evidence for the chilli pepper farmers to reallocate some resources from other crops production to chilli pepper production if only they view profitability and efficient utilisation of resources as their main goals.

Table 17: Contribution of chilli pepper to total household farm income

Income	Amount	% Contribution
Chilli pepper	65,976.00	42.2
Maize	16,728.50	10.7
Rice	15,321.43	9.8
Soya beans	11,881.92	7.6
Other crops	46,433.31	29.7
Total income	156,341.16	100

Field survey, 2014

5.6 Constraints Associated with the Chilli Pepper Production in the Study Area

The problems faced by chilli pepper farmers in the study area were ranked according to their severity as stated by the farmers in Table 18. The problem of price fluctuation was the most severe constraint of chilli pepper producers with about 42% of the respondents attesting to this fact. Speculative activities of marketing middlemen were responsible for price fluctuation by chilli pepper producers, this is line with the findings of Suleiman and Isah (2010) that frequent price variations of chilli-pepper is major concern to producers, marketers and consumers. Chilli pepper related group were formed as a coping strategy in order to maintain price stability. The problem of High cost of inputs (fertilizer, labour and seed) were also perceived to be most severe constraint of chilli pepper producers with about 42% of the respondents attesting to this fact. According to the respondents fertilizer is made available when farmers are far into the production period, sometimes at the middle of the raining season and family labour was predominant in the study area and that is why there was acute shortage of labour. According to the farmers, during active period of production-every household would have been engaged in his family farm work. The demand for labour is normally very high and expensive during the peak period of land clearing, ridging, harvesting, processing and weeding. The problem of pest and disease was more severe constraint of chilli pepper producers with about 29% of the respondents attesting to this fact, leaf coloration, premature falling of seed and seed dormancy were responsible for pre-harvest and post-harvest losses by chilli pepper producers and use of insecticides and wood ash were coping strategy to ameliorate this problem while about 16% of the respondent were moderately severe with lack of capital to expand their production and this constraints was ameliorated through micro finance banks and personal savings.

Table 18: Constraints associated with the chilli pepper production in the study area

Constraint	*Frequency	Percentage	Rank	Coping strategy
Price fluctuations	84	42	1	Join cooperative association and storage
High cost of inputs (fertilizer, labour and seed)	84	42	1	Use of poultry droppings, cow dung's, family labour and re-circle of improved seed
Pest and diseases	58	29	3	Use of insecticide and wood ash
Inadequate capital	33	16.5	4	Micro finance banks and personal savings
Total	272			

*Multiple responses allowed

CHAPTER FIVE

SUMMARY, CONCLUSION AND RECOMMENDATIONS

5.1 Summary

The study carried out an analysis of resource use efficiency and profitability in chilli pepper production and its contribution to household farm income in Kaduna state.

The study came up with six specific objectives. These were to: describe the socio-economic characteristics of chilli pepper farmers in the study area, determine the costs, returns and profitability in chilli pepper production, determine the socio-economic factors influencing profitability of chilli pepper production in the study area, estimate the technical efficiency in chilli pepper production, estimate the contribution of chilli pepper to household farm income, and identify the constraints associated with the chilli pepper production in the study area.

Three local government areas and two villages were purposely selected in each local government area on the basis of prominent area of chilli pepper production in Kaduna state and primary data were collected from 200 randomly selected respondents of chilli pepper farmers using structured questionnaire and the statistical tools used to analyze the data were descriptive statistics, net farm income, multiple regression and stochastic frontier production function model.

The result of the analysis shows that 56% of the respondents fall within the age range of 30-49 years, 53% of the farmers had formal education, 33.5% farmers with the household size ranged from 6-10 persons. Farmers with 6-10 years of farming experience constitute 24%. Majority of the farmers (72%) were not members of a cooperative society. 98.5% of the farmers financed their production through personal saving and 45.5% of the chilli pepper farmers have access to extension services of 1-2 times.

The average revenue and costs in chilli pepper production were estimated as total revenue (TR) was ₦111,857 while the total cost was ₦45,881. The net farm income was therefore ₦65,976. The average rate of return on investment (return per naira invested) is ₦2.44, indicating that for every ₦1 invested in chilli pepper production in study area; a return of ₦2.44 was made. Thus, it could be concluded that chilli pepper production in the study area is profitable.

The result of the multiple regression analysis revealed that the socio- economic variables of farmers i.e. education and farming experience were positively significant to the profit of chilli pepper farmers at different level of probability.

The result of Cobb-Douglas stochastic frontier production function that used to estimate technical efficiency of the farmers shows that the mean efficiency was 0.90 and It was observed from the study that 12% of the farmers had technical efficiency (TE) of less than 0.81 level efficiency and while 88% of the farmers operate at 0.81 and above level efficiency. The farmer with the best and least practice had a technical efficiency of 0.98 and 0.74 respectively. This implies that on the average, output fall by 2% from the maximum possible level due to inefficiency. Also 90% of the farmers were estimated to have technical efficiency exceeding 0.8, indicating there are some 10% technical inefficient farmers in the study area.

The result of the contribution of each crop to the average household farm income of chilli pepper farmers in the study area shows that chilli pepper had contributed 42% to the total average household farm income compare to other crops been produce by chilli pepper farmers in the study area in a farming season.

The variation in price of chilli pepper and high cost of inputs were the major constraints face by the chilli pepper farmer followed by pest and diseases and lack of capital as third and fifth respectively.

5.2 Conclusion

Based on the findings from the study it can be concluded that investment in chilli pepper production is a viable enterprises for income generation, poverty alleviation, job creation and improvement of food security to every household since it is a profitable venture.

The farm specific technical efficiency distribution reveals that none of the farmers achieved the maximum efficiency level. Thus, within the context of efficient agricultural production, output can still be increased by 10% using available inputs and technology.

5.3 Contribution to Knowledge

1. The study revealed that chilli pepper production in the study area is profitable despite the problems identified.
2. The study revealed that chilli pepper farmers in the study were technically efficient.
3. The study revealed that chilli-pepper had contributed significantly to the total household farm income in study area against other crops cultivated by the chilli pepper farmers.
4. The study revealed that price fluctuations and high cost of inputs (fertilizer, labour and seeds) were the major constraints faced by the chilli pepper farmers.

5.4 Recommendations

In light of the findings of the study, the following recommendations are proffered:

(i) Cooperative association is one of the variables that were negatively significant to technical inefficiency (increasing technical efficiency), it is therefore, recommended that chilli pepper farmers should join cooperative societies to enable them procured fertilizer and other agricultural inputs at the subsidised rate.

(i) It was found that education was an important factor in increasing the profitability in chilli pepper production. It is therefore recommended that adult education should be organized to farmers by KADP to enhance efficiency, productivity and income.

(iii) Since chilli pepper production in the study area has been shown to be very profitable and has huge potential for income generation, it is recommended that farmers should go into chilli pepper production to make more income.

(iv) Fertilizer is one of the inputs that were positively significant to technical efficiency in chilli pepper production. Therefore, farmers, government and private organisations should collaborate and made available, timely, adequate and affordable supply of fertilizer to farmers.

(v) To prevent the frequent price fluctuation, it is recommended that interested farmers should dry their chilli pepper and store when the price is lowest and sell when price is highest.

REFERENCE

Abayomi Y.A., Aduloju M.O., Egbewunmi M.A. and Suleiman B.O. (2012). Effects of Soil Moisture Contents and Rates of NPK Fertilizer Application on Growth and Fruit Yields of Pepper (*Capsicum* Spp.) Genotypes. *International Journal of Agricultural Science*, 2(7):651-663.

Abdulai, A. and Huffman, W.E. (1998). An Examination of Profit Inefficiency of Rice Farmers in Northern Ghana. Department of Economics, Iowa State University, Ames. *International Journal of Agricultural Economics and Rural Development,* 1(1).

Adesina, A. and Djato, K.K. (1996). Farm size, relative efficiency and agrarian policy in Cote d'Ivoire: Profit function analysis of rice farms. *Journal of Agricultural Economics,* 14:93- 102.

Adetula A.O. and S.A. Olakojo (2006). Genetic Characterization and Evaluation of Some Pepper Accessions *Capsicum frutescens* (L.): The Nigerian 'Shombo' Collections. *American-Eurasian Journal of Agriculture and Environmental Science*, 1(3):273-281.

Adeyemi, S.A.O. and Edema, A.A.O. (1987). *Outlook for production and Marketing of Chillies under the Present dispensation in Nigeria.* Paper presented at the National Conference on Trade in Ginger, Sheanuts and Chillies, Organized by the Nigerian Export Promotion councils, Kaduna Nigeria.

Adigun, J.A. (2001). Influence of intra-row spacing and chemical weed control on the growth and yield of chilli pepper (*Capsicum frutescens L*.) in the Nigerian Northern Guinea Savannah. *Nigerian Journal of Horticultural Science,* 5:67-73.

Adubi, O.T (2003). *An economic analysis of rice processing and marketing in Oshun and Ogun State, Nigeria.* Unpublished Ph.D thesis, Department of Agricultural Economics and Extension, Obafemi Awolowo University, Ile-Ife, Nigeria.

Aigner D, KCA Lovell and P. Schmidt, (1977). Formulation and estimation of stochastic frontier production function models. *Journals of Econometrics*, 6:21-37

Ajibefun IA, Daramola AG (2003). Determinants of Technical and Allocative Efficiency of Micro–Enterprises: Firm–Level Evidence from Nigeria. African Development Bank, 4:353-395.

Ajibefun, IA (2002). *Analysis of policy issues in technical efficiency of small scale farmers using the stochastic frontier production function with application to Nigerian farmers.* Paper prepared for presentation at the International Farm Management Association Congress, Wageningen, Netherland, July 2002, p. 8.

Ali F, Parikh A, Shah MK (1994). Measurement of profit efficiency using behavioral and stochastic frontier approaches. *Journal of Applied Econometrics*, 26:181-188.

Ali, M., and Flinn, J. (1989), Profit efficiency among Basmati rice producers in Pakistan Punjab. *American Journal of Agricultural Economics*, 71(2):303-310.

Aliyu, L, Yahaya, R. A, Arunah, U.L and Haruna, I.M (2012). Response of two Chilli Pepper Varieties (*Capsicum frutescens* L.) to Harvesting Frequency. Available online at www.elixirpublishers.com. *Elixir International Journal*, 42(2012):6493-6495

Amaza, P. S and Olayemi J. K (2000) The Influence of Education and Extension Contact on Food Crop Production in Gombe State; *Nigeria Journal of Agribusiness and Rural Development* l(1):80-90

Amaza, P.S. (2000). Resource-use Efficiency in Food Production in Gombe State, Nigeria. An Unpublished PhD; dissertation submitted to the Department of Agricultural Economics, University of Ibadan

Asogwa B.C, Umeh J.C, and Ater P.I (2006). *Technical efficiency analysis of Nigerian cassava farmers. A guide for food security policy.* Poster paper prepared for presentation at the International Association of Agricultural Economists Conference, Gold Coast, Australi, p.14.

Awe, A. A. and S. O. Ajayi (2009). Diversification of Nigerian Revenue Base for Economic Development: The Contribution of the Non-Oil Sector. *Pakistan Journal of Social Sciences*, **6**(3):138-143.

Ayorinde, I.O. (2011). Growth and Yield of Hot Pepper (*Capsicum Frutescencs)* as Influenced by Bed Width and Within Row Spacing. Submitted to the Department of Horticulture, Collegeof Plant Science and Crop Protection, University of Agriculture Abeokuta, Ogun State.

Bakhsh, K. (2007). An analysis of technical efficiency and profitability of growing potato, carrot, radish and bitter gourd: A case study of Pakistani Punjab. An Unpublished PhD dissertation submitted to the Department of Environmental and Resource Economics. University of Agriculture, Faisalabad, Pakistan.

Bamidele F.S., Abayomi, O.O. and Esther O.A. (2010). Economic Analysis of Rice Consumption Patterns in Nigeria. *Journal of Agricultural Science & Technology.*

Battese, G.E and Coelli, G.S. (1977). Estimation of a Production Frontier Model with Application to the Pastoral Zone of Eastern Australia, *Australia Journal of Agricultural Economics*, 21(3): 169-179

Brown, W.H. (2004). Useful Plants of the Philippines, Vol. 1 (Tech. Bui. 10). Phil. Department of Agriculture & Natural Resources., Manila. 1951.

Business Day (2007). Producing pepper for export market 2007: www.businessdayonline.com.

CAPPI, (2007). Centre for Agricultural Policy with Prosperity Initiative; Short analysis of the chilli sector as regards demand, competitiveness, impact and opportunities with the aim of helping to eradicate poverty in Vietnam through market forces. *Supported by Prosperity Initiative.*

CBN, (1995). Central bank of Nigeria; *Annual report and statement of account 1993,* CBN publication.

Chile Pepper Institute (2007). The Story of chilli pepper, Chile Pepper Institute News Letter, Las Cruces, New Mexico State University.

Ekong E. E. (2003) Rural Sociology: *An Introduction and Analysis of Rural Nigeria,* Uyo: Dove Educational Publication.

Erinle, I.D. (1987). *Problems of Production and Marketing of Ginger*. A Paper presented at the Ginger Trade Conference Organized by the Nigerian Export Production Council. Kaduna, April, 1987.

FAO, (1996). Food and Agricultural Organisation, FAOSTAT ONLINE. *http://faosts.fao.org*

FAO, (2008). Food and Agricultural Organisation, FAOSTAT ONLINE. *http://faosts.fao.org*

FAO, (2012). Food and Agricultural Organisation, FAOSTAT ONLINE. *http://faosts.fao.org*

Farrell, M.J. (1957). The measurement of production efficiency. *Journal of the Royal Statistical society service A (general)*: Part 3, 120:253-290.

Gomez, O. (1975). Economic of Agricultural Production and Resource Use. Prentice Engle Wood, New York, 428p.

Grubben, G.J.H and Tahir, I.M., (2004). *Capsicum species*, In Plant Resources of Tropical Africa 2. Vegetables PROTA Foundation, Backhugs Publishers, Leiden, Netherlands/ICTA, Wageningen, Netherland, 154–163.

Han, S.K. (2004). A New 2-Arrylbenzofuran with Anti-Oxidant Activity from Black Coloured Rice Bran. *Chem. Pharm. Bull*, 52(11):1365-1366.

Idowu-agida O. O, E.I Nwaguma and Adeoye I.B. (2010). Cost Implication of Wet and Dry Season Pepper Production in Ibadan, Southwestern Nigeria. National Horticultural Research Institute, Ibadan, Nigeria. *Agriculture and Biology Journal of North America*, 2010.

Institute for Agricultural Research (1985). *Report of a Survey in Problems of Production and Marketing of Chilli peppe*r, A. B. U. Zaria.

International Pepper (2012). *Proceeding of 21st International Pepper Conference.* Florida, USA 2012.

Jondrow, J.,Lovell, C.A., Materov, I. And Schmidt, P. (1982). Estimation of Technical Inefficiency in the Stochastic Frontier Production Model. *Journal of Econometrics*, 19: 23-38.

KADP, (2012). Kaduna State Agricultural Development Project: *Agricultural Production Survey* (APS, 2009-2011).

KADP, (2012*).* Kaduna State Agricultural Development Project*: Tip to Successful Production in Kaduna State in the Year 2012.*

Kolawale, O. and Ojo, S.O. (2007). Economic Efficiency of small scale food crop production in Nigeria: A Stochastic Frontier Approach. *Journal of social science,* 14(2):123-130.

Kumbhakar, S.C. and Bhattacharyya, A. (1992). Price Distortions and Resources- use inefficiency in India Agriculture: A Restricted profit function Approach. *Review of Economics and Statistics.* 74:231-39.

Meeusen, W. And J. Van den Broeck. (1977). "Efficiency Estimation from Cobb-Douglas Production Functions with Composed Error" *International Economics Review*, 18:435-444.

NAERLS, (2013). Pepper production under irrigation, NAERLS Press, 206:31p

Nasiru M. O. (2010). Microcredit and Agricultural Productivity in Ogun state, Nigeria. *World journal of Agricultural sciences. 6(3): 290-296*

Njoku B.O. and L.S.O. Ene, (1982). *Problems of Production and Marketing of Ginger, Sheanut and Chillis.* Paper presented at the National Conference on Traded in Ginger, Sheanut and Chillises, Kaduna.

Norman, D.W. (1972). *An Economic Survey of three villages in Zaria Province. 2 Input Output Study*. Vol.1 text. Samaru Miscellaneous paper 37.

Ogundari, K. (2006). Determinants of profit efficiency among small scale rice farmers in Nigeria: A profit function approach. *Research Journal of Applied Science,* 1(1-4): 116-122.

Ogundari, K., Ojo, S.O. and Ajibefun, I.A. (2006). Economies of scale and cost efficiency in small scale maize production: empirical evidence from Nigeria. *Journal of social science.* 13(2): 131-136

Oladiebo, J.O and Fajuyigbe, A.A. (2007). Technical efficiency of women upland rice farmers in Osun state, Nigeria. *Journal of human ecology* 22(2):93-100.

Olagoke, M.A. (1991). Efficiency of resource use in rice production systems in Anambra State, Nigeria. Published in issues. *African Journal Development*, Win rock International, Arlington USA. 146p.

Olayinde S.O. and Heady E.O. (1982). Introduction to Farm Management Principles and Application. Agitab Publishers Limited, Zaria. Pp. 112

Olukosi, S.O and P.O. Erhabor (1988). Introduction to Farm Management Economics Principles and Application. Agitab Publishers Ltd, Zaria – Nigeria. 92p.

Power Your Diet, (2009). Power Your Diet; Your guide to healthier nutrition, *www.nutrition-and-you.com*

Rahji MAY and Omotesho OA (2006). Technical inefficiency and comparativeness in production: The case of rice farmer in Niger State. *Journal of Agriculture and Food Development*, 8(1&2): 67-76.

Rahman, S (2003). *Profit efficiency among Bangladeshi rice farmers*. Contributed paper for the 5th conference of the International Association of Agricultural Economists, Durban, South Africa, August 2003, p. 21.

Sadoulet E. and De Janvry, A. (1995). Quantitative Development Policy Analysis. Stochastic Frontier Production Function Model." *Journal of Econometrics,* 1(1). 21-37.

Shehu, J.F., Iyortyer, J.I., Mshelia, S.I. and Jongur, A.A.U. (2010). Determinants of yam production and Technical efficiency among yam farmers in Benue State, Nigeria. *Journal of social science*, 24(2):143-148.

Suleiman A. and S. I. Isah (2010). Spatial Integration of Selected Markets of Dried Chilli Pepper and Ginger in Northern Nigeria. *Savannah Journal of Agriculture,* 5: 29-37.

Suleiman, A. (2008). Economic Analysis of Price Variation of Dried Chilli Pepper and Ginger in Three Agro-Ecological Zones of Northern Nigeria. *Savannah Journal of Agriculture.*3:77-85

Wang J, Cramer G.L, Wailes E.J. (1996). Production efficiency of Chinese agriculture: Evidence from rural household survey data. *Agricultural Economics,* 15: 17-28.

Wiess, E.A. (2002). World Production and Trade: CABI Publishing, CAB International, Wallingford, UK

Zalkuwi, J. W. Dia, Y.Z. and Dia, R.Z.(2010). Analysis of Economic Efficiency of Maize Production in Ganye Local Government Area Adamawa state, Nigeria, *Report and Opinion,* 2 (7) http//www.sciencepub.net/report, retrieved 18th June, 2013

Appendix I: Questionnaire

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

A. SOCIO-ECONOMIC CHARACTERISTICS

1. Name of Farmer..

2. Sex: Male ( ) Female ( )

3. Age (Years).............................

4. Marital Status: Married ( ) Single ( )

5. Years of Education

(a). No formal education ( )

(b). Primary education. .... (years)

(c). Secondary education...................... (years)

(d). Tertiary education. .... (years)

6. Family Size (Number of people depending on you for living)...

7. Years of experience (How long have you been in chilli pepper farming)? ....

8. What other crops do you cultivated other than chilli pepper in the production season?

(i)....................................... (ii)...................................... (iii).......................................

9. What is the relative importance of pepper among the other crops cultivated? ....

....

10. Do you belong to any pepper related co-operative/association? Yes ( ) No ( )

11. If yes, (Years of participation)..................................

12. What benefits did you derive as a member?

(i)...

(ii)..

(iii)...

13. What is your major source of capital for chilli pepper farming?

a. personal savings ( ) b. credit borrowed ( )

14. If you borrowed, what were the sources of the credit?

a. Commercial banks ( )

b. Nigerian Agricultural Cooperative and Rural Development Bank (   )

c. Cooperative Society (   )

d. Others (specify)...

15. How much did you borrowed to finance chilli pepper farming in the last production season?

SOURCE OF LOAN	AMOUNT	INTEREST (%) CHARGED
Commercial banks		
Nigerian Agricultural Cooperative and Rural Development Bank		
Cooperative Society		
Others (specify)		

16. Have you ever been visited by an extension agent? Yes (   )   No (   )

17. If yes, how many times in last one year? ....

18. What extension information did the agent give you? ....

19. Of what benefits were the information given to you to the success of your farm? ....

....

B. INFORMATION ON INPUTS

1. Total farm size (Ha)

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

Plot No/Name	Plot Size (Ha)/acre
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 Hectere of land per season in your village? ....Naira

2. Variable inputs (last production season).

(i) Seed (Kg)

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

(ii) Fertilizer

Plot No/Name	Fertilizer Type	Quantity (Kg)/bag	Cost per bag (₦)
1.			
2.			
3.			

(iii) Labour input

(a) Land preparation

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

(d) First Weeding

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

(e) Second Weeding

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

(f) Replacement

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

(h) Drying

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

(i) Information on the sales of chilli pepper

Plot No/Name	No of qty produced	Total sales
1		
2		
3		

C. INFORMATION ON INPUTS OF OTHER CROPS

2. Variable inputs of other crops (last production season).

(i) Seed (Kg)

Type of Crop	Quantity of Seed(Kg)	Cost (₦)
1.		
2.		
3.		

(ii) Fertilizer

Type of Crop	Fertilizer Type	Quantity (Kg)/bag	Cost per bag (₦)
1.			
2.			
3.			

(iii) Labour input

(a) Land preparation

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

(b)Planting

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

(c) Fertilizer Application

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

(d) First Weeding

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

(e) Second Weeding

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

(f) Replacement

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

(g) Harvesting

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

(h) Information on the sales of other crops

Type of Crop	No of qty produced	Total sales
1		
2		
3		

CONSTRAINTS OF CHILLI PEPPER PRODUCTION

S/n	CONSTRAINTS
1	
2	
3	
4	
5	
6	
7	
8	
9	
10	

Suggest possible solution to the constraints in chilli pepper production.

1…………………………………………………………………………………………………

…………………………………………………………………………………………………

2…………………………………………………………………………………………………

…………………………………………………………………………………………………

3…………………………………………………………………………………………………

…………………………………………………………………………………………………

4…………………………………………………………………………………………………

…………………………………………………………………………………………………

5…………………………………………………………………………………………………

…………………………………………………………………………………………………

6…………………………………………………………………………………………………

…………………………………………………………………………………………………

7…………………………………………………………………………………………………

…………………………………………………………………………………………………

Thanks for your Attention