ECONOMIC ANALYSIS OF CABBAGE PRODUCTION IN PLATEAU STATE, NIGERIA

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

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

JUNE, 2016

DECLARATION

I hereby declare that this thesis titled **'Economic Analysis of Cabbage Production in Plateau State, Nigeria'** has been written by me and it is a record of my research work. No part of this work has been presented in any previous application for another degree or diploma at any institution. All borrowed ideas have been duly acknowledged in the text and a list of references provided.

_____ _____

Charles Omoruyi EBOJEI Date
Student

CERTIFICATION

This thesis titled **"Economic Analysis of Cabbage Production in Plateau State, Nigeria"** by Charles Omoruyi**EBOJEI** meets the regulations governing the award ofthe Degree of Doctor of Philosophy of theAhmadu Bello University, Zaria, and is approved for its contribution to knowledge and literary presentation.

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DEDICATION

This thesis is dedicated to the memory of my loving parents, Mr P.J. Ebojei and Mrs G.A. Ebojei.

ACKNOWLEDGMENT

I appreciate the Almighty God for His protection and provision during the period of my study. I also appreciate Him for the knowledge bestowed upon me to enable me finish the thesis successfully.

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ABSTRACT

This study was carried out with the main aim of evaluating economic efficiency and profitability of cabbage production among farmers in Plateau State. A total of 230 cabbage farmers were randomly selected from three Local Government Areas (Jos North, Jos South and Riyom) in the State for the survey using a well-structured questionnaire.The three Local Government Areas were purposively chosen for the survey because the weather in the area was conducive for the production of cabbage in the State.A random selection of two villages from each of the selected Local Government Areas was done.The villages selected were: Naraguta and Yelwa from Jos North, Zawan and Kuru from Jos South; and Riyom and Ta hoss from Riyom. A sample size of 10% was chosen from a sample frame of 2330 cabbage farmers. Descriptive statistics, gross margin analysis model and the stochastic production frontier model were used to analyse the data collected from the farmers.Results show that technical efficiency of the farmers was concentrated at the efficiency class of 81 – 100 where 56% of the farmers fall into this category. The mean technical efficiency was 70%, and the most technically inefficient farmer shows cost saving of 30.07%. The predicted allocative efficiencies differ substantially among the farmers ranging from 0.17 – 0.91 with the mean allocative efficiency of 56%. The most allocative inefficient farmer had cost saving of 81.32%. The average economic efficiency of the farmers was 42%.The variable cost for cabbage production in the study area was ₦56,100 per hectare. Among the variable costs, fertilizer recorded the highest cost of ₦13,500 representing 24% of the total cost of production, followed by planting materials with a cost of N12,500 representing 22% of the cost of production. From the results, the gross farm income realized by a farmer was₦175,000 per hectare. The gross margin per hectare was ₦118,900. This shows that cabbage production in the study area is profitable to the tune of ₦118,900 per hectare. The return to naira invested was 2.12, signifying a profit of ₦2.12K to every ₦1 invested. The three most important constraints farmers faced in cabbage production were: inadequate fertilizers, inadequate credit facilities and insecurity. The study recommended the training of farmers by donor agencies in the country on the use of organic fertilizers as a substitute to inorganic fertilizers; to be facilitatedby the State's Agricultural Development Authorities.

CHAPTER ONE

INTRODUCTION

1.1 Background to the Study

Cabbage(*Brassica oleracea*var. *capitata*) is a member of the exotic vegetable group widely consumed in Nigeria and commonly grown on the Plateau because of the near temperate climate. Cabbage is commercially cultivated for its large, leafy head that is rich in vitamin C. It is generally believed to have originated from the wild, leafy, non-heading types of vegetable which are found growing in Europe (Grubben and Denton, 2004). It is regarded as the most important member of the *Cruciferae*or mustard family, and has remained one of the world's leading vegetable crops.

Vegetables are nutritionally important to man as they provide the much needed vitamins, minerals and fibre. They are important protective food and highly beneficial for the maintenance of health and prevention of diseases. They contain valuable food ingredients which can be successfully utilized to build up and repair the body. Vegetables are valuable in maintaining alkaline reserve in the body. They are valued mainly for their high vitamin and mineral contents. There are different kinds of vegetables. They may be edible roots, stems, leaves, fruits and seeds. Each group contributes to diet in its own way. Fleshy roots are high in energy value and good sources of vitamin B. Seeds are relatively high in carbohydrates and proteins. Leaves, steam and fruits are excellent sources of minerals, vitamins, water and roughage. The level of vegetable consumption in Nigeria is rising annually owing to greater appreciation of their food value (Haruna, 2003). A distinct class of vegetables in Nigeria are the exotic vegetables. They are known for their unique taste, nutritional value and various health benefits. They help keep a balance between the fluids of the body.

Cabbage is one of the most popular vegetables in the world because of its adaptability to a wide range of climatic conditions and soil types, ease of production and storage, and its food value (AsiaFarming, 2015). In Nigeria, production of this important vegetable is mostly carried out in the north especially Plateau State (Ogedegbe and Law-Ogbomo, 2013). Plateau state is the home of exotic vegetables including cabbage because of its cool weather condition. Other exotic vegetables cultivated on the Plateau include: lettuce, cucumber, carrot etc. They are termed exotic because these are species of vegetables that are not indigenous to Nigeria. They are primarily cultivated in the temperate regions of the world. Cabbage does well in some local government areas of Plateau State. The local government areas are Jos North, Jos South and Riyom. Cabbage is predominantly cultivated in these areas because of their high altitude which result in the areas having cool climate. Since it is not a common vegetable that can be cultivated in any part of the country, the demand then outweighs the supply. This ordinarily will enrich the producers of this commodity thereby financially empowering the farmers in this part of the country. Production of these vegetables as a small scale enterprise can financially empower the poor people especially women with little capital, limited access to land and working under labour constraints (Lewis, 1997). The cash they provide contributes significantly to food security at the household level and enables women to attain a degree of financial independence within the family budget.This study examined the profitability of cabbage in Plateau State and how efficient are the farmers in the production of the crop.

1.2 Problem Statement

Nigeria is blessed by nature with vast resources; both human and land to boost optimum output in agriculture to be able to adequately cater for the food/diet requirement of her populace. The weather/climate condition supports the production of most crops. Majority of Nigerians have annexed these endowments of nature by going into agriculture as more than 70% of the population is involved in farming (Usman, 2015). Yet poverty in the land, especially in the northern part of the country is paradoxically equal to the percentage of the populace involved in farming.Majority of these farmers reside in the rural areas and poverty is more predominant in these areas. As Aigbokan (2000) found that an increasing number of Nigerians are living in absolute poverty in the rural areas. This logically connotes that since majority of the populace in the rural areas are farmers, then the fangs of poverty are on these farmers despite the natural endowment. Some of the contributory factors leading to farmers' poverty in Nigeria are that agricultural holdings are small and scattered, and farming is carried out with simple tools. Large-scale agriculture is not common. Smallholder farmers, who use simple production techniques and bush-fallow cultivation, cultivate areas of one-half to two hectares each and contribute two-thirds of farm production (Metz, 1991).

Plateau State has the highest altitude among the States in Nigeria, resulting in some parts of the State having cold climate which supports the cultivation of unique crops. Such crops include cabbage, lettuce, cucumber, carrot and Irish potato. These crops are being produced in large quantity on the Plateau as Jim and Tony (2006) submitted that, Good Performance of cabbage production has been reported in places like Jos Plateau, Nigeria to have the highest cabbage production in Africa. The production of these crops, ceteris paribus, is supposed to fetch the farmers in this region extra finance which will

make them to at least live an average life above the poverty threshold because these crops are predominantly cultivated in this part of the country as a result of the near temperate weather condition. The income of the farmers is also supposed to be on the high side because the demand for these crops is nationwide as Ogbodo et al. 2009 Puts it, The bulk of Cabbage consumed in the Southern part of Nigeria is produced in the Northern section of the Country. This situation has led to prohibitive prices of Cabbage owing to the imputed cost of transportation from North to South of Nigeria. The demand of Cabbage also outstrips the supply; causing scarcity of the commodity.Omeh (2012) buttressed this fact when he opined that cabbage is used in a variety of dishes, and it is widely consumed raw as well. It is in high demand in Nigeria and sells for reasonably good prices. If farmers have high yield in their crops and the demand for such crops is high, this consequently gives rise to high prices which eventually accrue more income to the farmers. Under the analysed condition, cabbage farmers in Plateau State should have no relationship with poverty, but the poverty rate recorded in the State is as high as 74.1% (NBS, 2012). Putting into consideration the fact that more than 70% of the Nigerian population is involved in farming as reported by Usman (2015), it is an obvious fact that poverty on the Plateau is still an issue. Also, the farmers still live in traditional houses made of mud and thatched roofs and some of them are unable to send their children to school because of fund constraint.

This unique form of vegetable, because of its strategic region of production, if produced with the required agricultural techniques have the propensity of uplifting the financial condition of the farmers and hence better their standard of living. The cash earned from this enterprise cancontribute significantly to food security at the household level and enable farmers to attain a degree of financial independence, yet poverty still looms.

Thus probing the question, are these farmers producing optimally and efficiently?This study therefore examines the economic analysis of the production of cabbage in Plateau State by verifying the degree of profit accruable to cabbage farmers in Plateau State. This study will therefore answer the following research questions:

i. What are the socio-economic characteristics of cabbage farmers in the study area?
ii. How profitable is cabbage production in the study area?
iii. What is the economic efficiency of cabbage farmers?
iv. What are the constraints militating against cabbage production in the study area?

1.3 Objectives of the Study

The broad objective is toanalyse the economic efficiency of cabbage farmers in Plateau State. The specific objectives are to:

i. describe the socio-economic characteristics of cabbage farmers in the study area,
ii. determine the profitability of cabbage production,
iii. analyse the economic efficiency of the cabbage farmers and
iv. describe the constraints faced by cabbage farmers in the study area.

1.4 Justification for the Study

The importance of vegetables in our diets in maintaining good health cannot be overemphasized. Vegetables are widely under esteemed because few horticultural research institutes publish figures demonstrating that they can give unusually large annual yields of edible dry matter, including protein and βcarotene (provitamin A). It is also not realized that they supply many communities with as much protein as is supplied by fish, and that more communities used to eat them on that scale (Pirie, 1984). Cabbage is an example of this group of vegetable, which contains anthocyanins, which have anti-carcinogenic properties, i.e. it helps the human body fights off cancer. Study into this important class of food will provide information on the level of production and expose the degree of efficiency or inefficiency associated with its production. The findings of this research will provide policy makers the necessary information on how to introduce policies on increasing the efficiency and reducing poverty among cabbage and other vegetable farmers. This will also provide researchers the basic information and data necessary for further research into vegetable production. The findings of this research will provide vegetable farmers the necessary information on how to improve the efficiency of vegetable production. It will also disclose to them the socio-economic variables that limit efficiency in production.

CHAPTER TWO

LITERATURE REVIEW

2.1 Agriculture and the Nigerian Economy

Globally, agricultural production is crucial to the overall wellbeing of the populace, especially in developing countries. This necessitates different countries to give high priority to agriculture and struggle to develop and sustain the sector, thereby ensuring sustainable food security, employment opportunities, and foreign exchange earnings amongst others. However, in Nigeria, where over 70% of the population, mostly rural dwellers, is involved in agricultural activities, yet accounting for less than 7% of the foreign exchange earnings, the sector remains largely traditional, subsistent and undeveloped. The Nigerian agricultural sector is dominated mostly by smallholder producers, who operate farm lands of no more than two (2)hectares accounting for over 90%of agricultural outputs (Azih, 2008). The food crops dominate production and the major food crops are rice, sorghum, millet, maize, cassava and yam. These are produced in less than 50% of the 79 million hectares of available arable land area (Manyong*et al.*, 2005).

The sudden increase in agricultural growth rates experienced has been attributed mainly by expansion in areas planted to staple crops. Productivity has remained flat and yields of most crops are actually declining (Oni *et al.*,2009). Public intervention and investments under the National Food Security Programme and Agricultural Transformation Agenda were aimed at sparking off a sustainable Green Revolution in the country.As it has been observed, Nigeria may not be able to meet its food production and poverty reduction goals without a significant and sustainable production

increase in the agricultural sector.Furthermore, the global food crisis of early 2008 has not removed Nigeria from the unpredictable shortages of global food and price spirals of the period thus worsening Nigeria's ability of making food available and accessible at affordable prices to the teeming consumers. Reliance on food imports to supplement local production and demand remains the only option unless the sector is given more attention and enabling policy environment to improve farmers' productivity and efficiency. As common to traditional agriculture, the returns to farmers are not attractivedue to high cost of production and low productivity. According to Ojehomon*et al.* (2009), the only way out to achieving self-sufficiency in Nigeria is to have a policy mix that will embraces institutional restructuring, strategic investments and coordinated efforts at all levels to empower farmers and provide improved conditions in rural areas. Such efforts would focus on rehabilitating degraded rural infrastructure, adopting productivity and efficiency enhancing measures and taking steps to stimulate competitiveness.

2.2 Vegetable Production

The importance of vegetables as major and efficient sources of micronutrients in African diet cannot be over stressed. Vegetables are nourishing foods because they contain a little of all the substances man needs: protein, mineral salts, sugars, vitamins, aromatics, colouring agencies, iron and essential oils that increase man's resistance to disease. In this class of food, man finds the wide range of nutritive elements he needs. Vegetables are therefore complementary foods of the first order, and are much more important for man's health than products of animal origin (Hugues and Philippe, 1995). Badmus and Yekini (2011) opined that vegetables are an important feature of Nigerian's diet that a traditional meal without it is assumed to beincomplete. They went

further to say that in developing countries; the consumption of vegetables is generally lower than the FAO recommendationof 75kg per year in habitant (206g per day per capita). Still on the importance of vegetable, Food and Agricultural Organisation (FAO, 1992) estimated that about 790 million people are chronicallyundernourished in the developing regions of the world. Specifically, daily food consumption consists of mainly cereals, roots and tubers. This poor feeding habit predisposes the people to infections and such disease as typhoid fever, heart, liver and kidney disease due to poor body defence mechanisms (Ibeawuchi, et al., 2015)

Vegetable growers could make an important contribution to the national food supply where a healthy and expanding market gardening industry is a safeguard against the lowering of health standards necessary for productive output in an expanding economy (Tyndal,1998): Shortage of animal protein causes illness, but this may be prevented by proper mixture of different vegetable protein that is equal in quality with animal protein. Growing vegetable is particularly suited for small scale farmers and their families, and because of their limited resources they can meet the cultivation requirement of irrigation by the use of watering can (Robert, 2003). Baffour et al. (2005) defined vegetable as the edible portion of an herbaceous annual or perennial crop which could either be served raw (green/fresh) orafter a little cooking. Dry season vegetable production also called vegetable forcing in the production of vegetable outside the normal growing season using certain infrastructures such as green houses, irrigation, watering can, etc. In Nigeria, there are two distinct seasons, the rainy season and the dry season. The rainy season is the normal cropping season and this starts from April and stops in October, while the dry season starts from November and ends in March. During the rainy season, the production of vegetable is high resulting in the saturation of the market, but during

the dry season there is usually the scarcity of this important farm product thereby leading to a high price due to short supply. This seasonality has resulted in food insecurity which is a challenge to sustainable food production. It has also been found that most farmers do not want to go into large scale production because they are apprehensive of high risk. This has made the farmer to grow vegetables as intercrop of low significance as a way of avoiding risk. It is surprising that after two decades of horticultural research and extension activities in Nigeria, farmers are not yet sure and confident that the extra cost concomitant with the adoption of new technologies would bring extra benefits. This has implication for accurate assessment of the potentials of dry season vegetable production as a source of income for the farmer (Ibekwe and Adesope 2010)

In Nigeria, vegetable production has been on -going for decades, providing employment and income for theincreasing population especially during the long dry season. However production is constrained by inadequateinfrastructure, agronomic and socio-economic variables (Sabo and Zira, 2008). Production of vegetable is a major occupation of people of northern Nigeria, especially in the dry season when rainy season cultivation is over (Tsoho and Salau, 2012). This activity is both an income earner as well as a source of employment to a large proportion or otherwise underemployed labour force (Ibrahim, 2005). Tsoho and Salau (2012) submitted further that For the individual farmer there is a problem of what combination of crops to grow on limited land area with given quantities of labour, capital, management and other resources in order to maximize returns to vegetable production. Vegetables also contribute to the income of both the rural and urban dwellers. Horticultural crop production creates jobs. On average it provides twice the amount of employment per

hectare of production compared to cereal crop production (Ali et al., 2002). The move from cereal production towards high-value horticulture crops is an important contributor to employment opportunities in developing countries (Joshi et al.,2003).

2.3 Classification of Vegetable Crops

According to Agriinfo (2015), there are many numbers of Vegetables. Different parts are used for consumption. They are botanically different and their climatic and cultural requirements are different. There are four Main Methods of Classification Based on:

a. Education Botanical relation

b. Based on Hardiness (Tolerance to low temp)

c. Parts Used for consumption

d. Methods of Culture

a. Botanical classification

This method of classification is based on botanical relationships of crops in responding to cytology, morphology, taxonomy and cross ability. This is useful for crop improvement and seed producers for deciding isolation distance. The control requirements may vary .inSolanaceous family which includes potato, chili and brampal.Cucurbitaceous have similar cultural requirements and common pests and diseases. Common names are different but scientific names are common all over the world. It gives information on class, family, genus, species, variety etc. Thus botanical classification is useful to breeder, seed producer and to avoid confusion in common name.

b. Classification based on hardiness

Vegetables are grouped as hardy or tender on the basis of tolerance to frost, tolerance to lower temperature. This gives information of season of growing i.e. summer or winter. Examples are given below:

Hardy	Semi Hardy	Tender
Asparagus	Beet Root	Okra
Cabbage	Carrot	Brinjal
Garlic	Cauliflower	Tomato / Chili
Onion	Palak	Beans
Peas	Potato	Cucurbit
Radish		Sweet Potato
Spinach		Sweet Potato
Spinach		Amaranthus
Turmp		

Adapted from Agriinfo (2015)

c) Based on parts used for consumption

From roots to fruits different parts of vegetables are consumed. On that basis vegetables are classified as:

Leafy Vegetable	Palak, AmaranthusMethi (leaves)
Root	Carrot, Radish, Turnip', beet root
Fruit	Tomato, Biinjal; Cucurbit
Bulb	Onion, Garlic
Tuber	Potato, Sweet Potato

Adapted from Agriinfo (2015)

d) Based on method of culture

In this method all those crops having similar cultural requirements are grouped together. In this method one can generalise cultivation practices for one group and thus avoid repeating individuals for all crops. There are 11 classes. In some cases they are botanically also similar. For convenience, they are grouped as follows:

I.	Perennial Vegetable	Asparagus, cocinia (Tondali), Parwal, Drumstick
2	Greens	Spinach
3	Salad Crops	Lettuce, celery
4	Cole Crops	Cabbage, Cauliflower
5	Bulb Crops	Onion, Garlic
6	Root Crops	Carrot / radish, turnip
7	Tuber	a) Potato, b) Sweet Potato
8.	Peas & Beans	Cluster bean, cowpea, Dolichas
9	Solanaceous	Tomato, Brinjal, Chili,
10	Cucurbits	Watermelon, pumpkin, gourds, Cucumber etc.
11	Okra	Okra

Adapted from Agriinfo (2015)

Bareja (2015) grouped vegetables based on their edible botanical parts. He opined that vegetables can be grouped into the following:

i. Root Vegetables – plants which are sources of edible roots, mainly modified underground roots, e.g., beets. These modified roots are either tuberous roots or fleshy roots.

ii. Stem Vegetables – plants which are sources of edible botanical stems which are usually immature and succulent. They can be divided further into those plants in which

the edible plant structure consists mainly of aerial stems, e.g., bamboo shoot and those with underground modified stems such as corms, tubers, bulbs, rhizomes, and stolons.

iii. Leafy Vegetables – plants which are sources of edible leaves in various stages of development. The leaves may be separate and fully expanded or, as in cabbage, form a head. It includes, in some species, succulent stems, e.g., sweet potato (camote tops).

iv. Flower Vegetables – plants which are sources of edible flowers or inflorescences including, in some species, accessory parts like the stalk (pedicel or peduncle). In cauliflower, it consists of the stalk and an immature inflorescence. But in squash, it is the mature flower.

v. Fruit Vegetables – plants which are sources of edible botanical fruits, either simple or compound, e.g., tomato and corn (maize)

vi. Seed Vegetables – plants which are sources of edible botanical seeds, mostly under the family Leguminosae or Fabaceae (legumes), e.g., mung bean.

2.4 Importance of Vegetable

Leafy vegetables are importantfeatures of Nigerian diet that a traditional mealwithout it is assumed to be incomplete. Indeveloping countries, the consumption ofvegetables is generally lower than the FAOrecommendation of 75kg per year in habitant(206g per day per capita). In urban areas, wherethe village pattern is being replaced by a moresophisticated way of life, many people in thecommunity cannot produce their own vegetables and a few part-time growers devote their sparetime to the production of their own supplies ofexotic vegetables as a backyard, urban and marginal farms (Badmus and Yekinni, 2011).

Vegetables supply most of the nutrients that are deficient in other food materials; this includes supply of minerals, especially calcium and iron. Vegetables are acid neutralizers e.g. okra, *Corchorus*spp neutralizes the acid produced from some fruits and they prevent constipation and promote digestion as a result of fibres/roughages obtained from okra, cucumber, amaranthus, lettuce and cabbage. Vegetables are rich sources of vitamins A, B, and C which helps to lower susceptibility to infection. e.g.: Carrots, sweet corn, amaranthus and celosia provide Vitamin A; Bitter leaf, water leaf, *solanum* and celosia provide Vitamin B; Tomatoes, carrots, lettuce, cabbage and amaranthus provide Vitamin C. Also, some vegetables are rich sources of carbohydrate e.g. potatoes, sweet corn, carrot etc. Green beans and peas are cheap sources of protein. Vernonia (Bitter leaf), Amaranthus and *Telfeira*provide some amount of protein in human diet. Vegetables are generally needed to have balanced diets and overcome nutritional deficiencies and make our staple food more palatable and enhance their intake (Olasanta, F.O. *et al.*, 2009).

2.5 Gains of Vegetable Production in Nigeria

In eradicating extreme hunger and poverty, vegetables generate more jobs per hectare in on-farm and off-farm than staple based agricultural enterprises (Ali et al., 2002). This benefits farmers and landless labourers in both rural and urban areas. Value addition to fruits and vegetables generates further employment in the associated agri-businesses and further down the commodity chain from the producer to the consumer. Fruits and vegetables can generate higher profits than staple crops, especially when land is relatively scarce and labour is abundant (Minot and Ngigi, 2004). The value of fruits and vegetables per unit area is significantly higher than the value of the cereal crops.

Although the costs of inputs such as labour can be higher, the profits are higher and the income thus generated can be used for many different purposes in terms of eradication of hunger and affording access to education and health care. Over two billion people suffer from micronutrient deficiencies through poor diets. Vegetables are the most appealing and affordable sources of these micronutrients. Diet improvement increases a person's productivity, reduces health care related costs and therefore raises the productivity and incomes of the poor.

2.5.1 Achieve universal primary education

Micronutrient deficiencies impair cognitive and psychomotor skills, particularly in young children. These deficiencies can be alleviated through eating a balanced diet, rich in vegetables and fruits. With these improved, micronutrient-rich diets, children's cognitive and psychomotor skills are enhanced. Children who learn more and do well in school are more likely to want to stay in school and their parents are more likely to see the financial benefits of supporting their children's education (Haddad et al., 2002). Increased education also enhances the ability of the new generation of farmers to adopt more advanced technologies and crop management techniques.

2.5.2 Promote gender equality and empower women

Fruits and vegetables production, in particular, provides women with economic opportunities. Women are the principal producers of most horticultural crops in developing countries and are predominantly involved in the value-addition activities from production to marketing. Targeting women in agricultural technology dissemination can have a greater impact on poverty than targeting men. The enhanced

social and economic status of women, for example achieved through horticultural activities, leads to greater household food and nutrition security (IFPRI, 2005). In addition to the financial benefits of horticultural production, increasing women's access to vegetables and fruits for themselves and their families, will improve their health and work performance, thereby contributing to higher incomes. The sale of garden surplus is often a major source of income for rural women, and largely used for crucial family needs.

2.5.3 Ensure environmental sustainability

Legume vegetable crops increase soil fertility through atmospheric nitrogen fixation. Leguminous vegetables integrated into cereal-based cropping systems in rotation or as part of a mixed-cropping system enrich the soil.

2.5.4 Health benefits

2.5.4.1 Reduce child mortality

Malnutrition is one of the major causes of, or is a significant contributing factor to, child mortality in developing countries. The link between horticulture and child mortality is indirect, but important. The absence of essential micronutrients exacerbates poor children's vulnerability to disease. Improving access to vegetables and fruits in their diets reduces mortality and morbidity of infants and children under five years old, particularly in rural areas (von Braun et al., 2004). Improving diets of women of child-bearing age and specifically pregnant women, reduces infant mortality and may reduce maternal transmission of HIV/AIDS to infants.

2.5.4.2 Improve maternal health

Maternal health depends on having achieved food security during girlhood as well as a diet rich in micronutrients during conception, pregnancy and the first few months after childbirth (von Braun et al., 2004). The health of women before conception directly impacts their health during pregnancy and child birth. The majority of pregnant women in developing countries suffer from anemia and other micronutrient deficiencies. This affects both their productivity during pregnancy and can lead to complications for the fetus during and after childbirth. Horticulture can benefit maternal health directly by improving the quality of women's diets. Vegetables and fruits are the most appropriate sources of micronutrients in the diets of these women, and are critical in regions where vegetarian diets predominate.

2.5.4.3 Combat HIV/AIDS, malaria and other chronic diseases

Healthy, well-nourished people are able to resist many infectious diseases and have better resources to be able to fight infections. The human body's immune system relies on a balanced diet, rich in micronutrients, to be effective. Diets rich in vegetables and fruits bolster the body's immune system, helping it to resist HIV/AIDS, malaria, diarrhea, tuberculosis and many other infectious diseases (FAO/ILSI, 1997). A balanced diet, rich in micronutrients, is likely to reduce the number of chronic infections, prevent some infections and help the body to combat the severe infectious diseases which are common in developing countries and which are the leading causes of adult and childhood mortality. Fruits and vegetables are also considered by FAO and WHO as the primary nutritional tools to prevent non-communicable and micronutrient deficiency related diseases (WHO- FAO, 2005). Diabetes type 2, obesity and certain

cardiovascular diseases and cancers can be significantly reduced via increased consumption of fruits and vegetables (WHO, 2003). Iron deficiency affects at least 2 billion, and perhaps up to 3.5 billion people. Shortage of iron in the diet causes reduced productivity, which results in economic losses of billions of dollars globally (Weinberger, 2004; UN, 2004). These losses are so substantial that economists at the Copenhagen Consensus in 2004 agreed that relieving iron and other micronutrient deficiencies should be the second highest priority in world development initiatives, second only to relieving the HIV/AIDS crisis (Economist, 2004). Although essential in diets, not enough vegetables and fruits are available, especially to poor families in developing countries. Rates of production of vegetables and fruits cannot satisfy consumer demand and these micronutrient- rich food sources are often too expensive for the poor.

2.5.4.4 Pharmaceutical properties of vegetables

The potential of the Nigerian flora as a veritable source for pharmaceuticals and other therapeutic materials have been emphasized (Gbile and Adesina, 1986). Medicine constitutes one of the many resources of the forest on which the health of the average African population depended since the time of creation. Fruits and vegetables have usually served as the repository of healing materials and have been acknowledged to be generally safe without or with minimum side effects (Gbile and Adesina, 1986). Fruits and vegetables have usually constituted the main repository of drugs and many have been known not to pose any threat to human life. Twenty eight (28) medicinally important leafy vegetables and their therapeutic uses have been documented (Ayodele, 1996) as well as list of fruits with medicinally properties have also been documented (). Emphasis has been mainly on the leaves of the plants since these are usually consumed.

Other parts of the plants such as stem, seeds, fruits and flowers in some cases are also useful medicinally. The family Compositae/Asteraceae has the highest recorded number of plants (21%) followed by the Cucurbitaceae (14%) and Malvaceae and Solanaceae (11%). Sixty eight (68%) percent of the documented vegetables are cultivated, 11% are usually obtained in the wild while 21% are either cultivated or obtained from the wild.

2.6 Challenges of Fruits and Vegetable Production in Nigeria

2.6.1 Pest and diseases

Pest and diseases affect fruits and vegetables in the field and subsequently reduce their shelf lives and affect their appearance which is one important aspect of horticultural crops. Fruits and vegetables are vulnerable to bacterial, viral, fugal and nutritional diseases.

2.6.2 Poor agricultural pricing and low fertilizer use

Fertilizer use is promoted mainly by the fertilizer subsidy policy in Nigeria. Input subsidies have been a part of Nigeria's agricultural price policy since independence, and in spite of economic reforms in Nigeria, fertilizer subsidies have remained. In addition, under these sustained and high input subsidy programs, investments in core public goods such as research and extension, which also aim to boost productivity, are limited. Although improved crop varieties exist, low fertilizer use is a serious constraint to agricultural productivity growth, averaging 10 to15 kilograms per hectare. An important factor is low and unstable domestic production. There has been no domestic production of fertilizer since the early 2000s, because NAFCON, the dominant fertilizer producer in Nigeria, has been shut down (IFPRI, 2008). Other issues which affect domestic

supply of fertilizers include high transport costs from port to inland destinations, poor distribution infrastructure, the absence of capital for private sector participation in distribution, significant business risks facing fertilizer importers, and inconsistencies in government policies.

2.6.3 Low access to agricultural credit

Access to agricultural credit has been positively linked to agricultural productivity in several studies. Yet this vital input has eluded smallholder farmers in Nigeria. Banks with large loan funds are generally difficult for smallholder farmers to access. Problems with collateral and high interest rates appear to frequently screen out most potential rural smallholder beneficiaries. In addition, agricultural loans are often short-term with fixed repayment periods, a loan structure that is not suitable for annual cropping or livestock production.

2.6.4 Land tenure insecurity

An important institutional constraint is the absence of a clear title to land. Group ownership of land in Nigeria has been associated with such problems as limited tenure security, restrictions on farmers' mobility, and the inevitable fragmentation of holdings among future heirs. It may also limit access to formal credit, since the farmer cannot use land as collateral. This reduces incentives to invest in land quality maintenance or improvement (IFPRI, 2008). Because poor farmers cannot afford alternative farmlands, and do not have customary access to lands not inherited, they remain on depleted lands and further degrade these resources. Thus, poverty and custom may constrain farmers' ability and willingness to mitigate land degradation, leading to declining productivity.

2.6.5 Low and unstable investment in agricultural research

When research is poorly funded, agricultural technologies cannot be improved, and there will be no downstream farm income increase, rural employment generation, reduction in food prices, establishment of agro-based industries, and economic growth. In short, the absence of new technologies in agriculture will slow the growth of agricultural productivity and the reduction of rural poverty. Public research and development (R&D) spending in Nigeria has been low and unstable since independence, and the government budget process for funding agricultural research is complex (IFPR1, 2008). The time between the submission of planned budgets by research agencies and the approval and release of funds is lengthy and often out of tune with research work plans. The approved amounts and the disbursement processes very often fall far short of the planned budgets of the research agencies. Private sector involvement in agricultural research has remained negligible to date.

2.6.6 Poor market access and marketing efficiency

Vegetable marketing efficiency in Nigeria is dismally low. Transport costs are high due to poor road conditions, limiting access to inputs, credit, and output markets, and reducing the transmission of key market information.

2.6.7 Poor infrastructure

The necessary infrastructure such as adequate water supplies and transport and marketing systems is generally lacking in Nigeria, giving producers, processors and marketers little incentive to expand operations. An inefficient, expensive transport

system adversely affects input/output cost and supply, reducing farmers' potential income from marketing their products

2.6.8 Post-harvest losses of fruits and vegetables

Losses of horticultural produce are a major problem in the post-harvest chain. They can be caused by a wide variety of factors, ranging from growing conditions to handling at retail level. Not only are losses clearly a waste of food, but they also represent a similar waste of human effort, farm inputs, livelihoods, investments and scarce resources such as water (World Resource Institute, 1998). Post-harvest losses for horticultural produce are, however, difficult to measure. In some cases everything harvested by a farmer may end up being sold to consumers. In others, losses or waste may be considerable. Occasionally, losses may be 100%, for example when there is a price collapse and it would cost the farmer more to harvest and market the produce than to plough it back into the ground. Use of average loss figures is thus often misleading. There can be losses in quality, as measured both by the price obtained and the nutritional value, as well as in quantity.

In Nigeria, enormous quantities of vegetables are produced and staggering figures are sometimes given as estimated annual production. For example, figures like 3.8 million tonnes of onions, 6 million tonnes of tomatoes, 15 million tonnes of plantain and 35 million tonnes of citrus have been quoted as annual production levels for some fruits and vegetables, which are really large quantities of food crops (Oyeniran, 1988; Erinle 1989). However, it is the amount of the produce available to the consumer rather than the level of production that is more important.

Vegetables in their fresh forms contain high percentage of water. They are living and hence carry out their physiological function of respiration thereby absorbing and releasing gases and other materials from and to their environment. These activities lead to their deterioration in transit and storage, which is more rapid under conditions of high temperature and humidity. As a result, heavy losses are encountered in these crops. No one knows exactly how much food is lost between harvest and consumption. The supplied figure for post-harvest loss estimates for fruits and vegetables are difficult to substantiate except on limited, controlled experimental basis. Nonetheless, it is noted that losses as high as 50% are common in fruits and vegetables between rural production and town consumption in the tropics (Oyeniran, 1988), these losses occurred during transportation, storage and marketing (Daramola, 1998; Okhuoya, 1995).

Several factors are responsible for these damages and losses in the fresh produce. One of these factors is vibration resulting from the transport vehicles as they traverse undulation and irregularities on the roads (Jones et al., 1991). Another factor is attributed to the use of unsuitable packaging containers. To curtail or minimize these damages require detail studies to identify the specific parameters involved. Until the locations of handling losses in the system are identified, opportunities to reduce them would be limited.

2.7 Cabbage Production

Cabbage, *BarccicaOleraceal L*, is from a group of plants known as the Cole crop, derived from the Middle Age English Word “Col”. The Romans called the crop “caulis” while the Greeks called them “Kaulion”. All these words mean stem. Other plants in this group include cauliflower, kale, collards, broccoli, kohlrabi and Brussels's sprout.

Wild Cole corps is found growing around the Mediterranean and Atlantic coastal Europe. Cabbage and kale are thought to have their origin from Western Europe, while broccoli and cauliflower from the Mediterranean region. Cabbage and kale are the Coles to be first domesticated, about 2,000 years ago before then they were collected from the wild and used for medicine (Bewick, 1994).

Cabbage is a soft plant which may be eaten with fish, meat, salad, other preparation or eaten raw (Lawal, 1998). Cabbage production has been playing a vital role in both human and animal nutrition, poverty reduction and in changing farmers' socio-economic status (Lawal, 1998). Cabbage is fairly low in calorie, a good source for many minerals particularly potassium, relatively high in vitamin C and A, relatively low in protein content, it makes food palatable and supplies good enrichment to the body (Bewick, 1994). Uncooked cabbage is high in glutamine, an amino acid essential for intestinal health. Cabbage contains vitamin K (essential for blood clothing protein), potassium (which help regulates blood pressure) and quartering antioxidant that is a natural antihistamine that can benefit allergy sufferers (Earth clinic, 2008).

Cabbage is a cool season crop planted early or late in the growing season. Best quality cabbage is produced in the day time temperature of 70-80, and sunny conditions and moist, fertile, well-drained soil. Cabbage can be propagated by direct seeding, mechanical methods or by seedling transplant. Commercial propagation favours transplanting while fresh market growers chose to direct seeding. Cabbage needs irrigation water each week, requiring 120-150 kg of nitrogen, 50-100 kg of phosphorous and 120-180 kg of potassium per acre with addition of potassium and phosphorous based on test of soil. Hand hoeing can be done to control weeds or use of herbicides for

commercial producers. Fields are scouted for insects, weeds and disease throughout growing season. Cabbage can either be harvested by hand or mechanically (Rourke *et al*,2001).

The insect pest of cabbage in Northern Nigeria includes: · Cabbage Looper (*Trichoplusiani*) Diamond back moth (DBM) (*Plutellaxylostella*) · Imported Cabbage Worm (*Pierisrapea*). · Cabbage Maggot *(Delia radicum*) ·Flea Beetles (*Phyllotretaspp*). Even though quality may vary, cabbage that is produced for the fresh market consumers have a very low tolerance to insect pest damage (Foster and Flood, 1995). Pest management should begin with treatment of soil in the nursery. As the medium of growth, the soil is important target for pest attack in the nursery. Important pathogens of economic importance like bacterial wilt, root knot nematodes, sclerotium wilt and fusarium wilt live in the soil. When seedlings are raised in the nursery, soil infested with these pathogens should be avoided or treated. When seedlings are raised in boxes they should be sterilized by heating the seed bed soil. The seed bed should be fumigated against nematodes, fungi and soil insects.

There are resistant cabbage varieties against some of the pathogens that the cabbage crop is exposed to in the field. When varieties from such cultivars are used in nursery, usually seedlings have the required vigor to withstand pest attack at the beginning of their life circle. Protective chemicals should be used to treat seed for planting (Alao, 1989).

In Nigeria, cabbage is commonly cultivated in Plateau State and widely consumed raw and cooked by humans for vitamin and mineral nutrition (FAO, 2000). Ogbodo*et al*.

(2009) buttresses the fact when they opined that the bulk of Cabbage consumed in the Southern part of Nigeria is produced in the Northern section of the Country. This situation has led to prohibitive prices of Cabbage owing to the imputed cost of transportation from North to South of Nigeria

2.8 Economic Importance of Cabbage

Cabbage is a prominent member of this class of food - vegetables and it is grown mostly as an annual crop. It is the most easily grown of the cole crops (which include broccoli, brussels sprouts, and cauliflower) because it can be planted under a wide variety of conditions. As a native of the temperate zone, however, it thrives best in cool, moist climates (USDA, 1995). Cabbage is easily grown under wide range of conditions and is adaptable to most areas of Africa (Smith, 1995). According to Grubben and Denton (2004), it can be grown throughout the year in most parts of Africa. Good performance has been reported in places like Jos Plateau, Nigeria to have the highest cabbage production in Africa (Jim and Tony, 2006).The food and Agricultural Organisation (FAO,1988) identified cabbage as one of the top twenty vegetables and an important source of food globally. It has been domesticated and used for human consumption since the earliest antiquity (Smith, 1995). It is a rich source of vitamin A and C. The green outer leaves of cabbage are richer in vitamin A,calcium and iron than the white inner leaves. Headed cabbage are usually consumed as a cooked vegetable, or eaten fresh as aningredient of coleslaws and mixed salads (Grubben and Denton,2004). Cabbage production has been playing a vital role in both human and animal nutrition, poverty reduction and in changing farmers' socioeconomic status (Lawal, 1998). Cabbage is fairly low in calorie, a good source for manyminerals particularly potassium, relatively low in protein content, it makes food palatable and supplies good enrichment

to the body (Bewick, 1994). Uncooked cabbage is high in glutamine, an amino acid essential for intestinal health. Cabbage contains vitamin K (essential for blood clothing protein), potassium (which help regulates blood pressure) and quartering antioxidant that is a natural antihistamine that can benefit allergy sufferers (Earth clinic, 2008).

2.9 Origin, Distribution and Production Trend of Exotic Vegetable

The exotic vegetable originated from areas with cool season climate/temperate region. In Nigeria, they are grown in high altitude areas such as Sahel and tropical uplands of Jos and Adamawa State. They are very popular especially in the urban areas such vegetables groups are: Beet, lettuce, cabbage, radish, carrot, irish potato etc.The cultivation of exotic vegetables demands special methods which are difficult and expensive and they have poor seed formation and require special storage condition i.e under warm-season tropical conditions (Olasanta, *et al*., 2009).

Exotic vegetable describes the tender edible shoot, leaves, fruits and root of plants and spices that are consumed whole or in part, raw or cooked as a supplement to starchy foods and meat. Vegetables are classified according to the part consumed (disposition) these includes: Leafy vegetables; the leaves and succulent young shoots are picked for consumption. Examples are amaranthus, celosia, pumpkin, lettuce, cabbage, bitter leaf, water leaf, jews mallow and fluted pumpkin. Fruit vegetables; this comprises of young, immature unripe fruits or mature ripe fruits of plants grown as vegetables. Examples are cucumber, tomato, okra, pumpkin, eggplant, garden egg, water melon, sweet pepper and chilli pepper. Seed vegetables;this group is important for the seed produced. Examples are Egusi melon and Ito melon. Root vegetables; such as sweet potato, irish potato,

carrot and radish. Spices: important for their flavor and colour in foods such as chilli pepper, onion, garlic and basil. (Olasanta, *et al.,* 2009).

Exotic vegetable (leafy and fruits) are widely cultivated in most parts of Sub-Saharan Africa, as a cheap and reliable sourceof protein, vitamins, zinc and iron. They constitute between 30% and 50% of iron and vitamins A in resource poordiet. Vegetable production in Nigeria is characterized by use of crude implements, non-availability of inputs, illiteracy,expensive and complextechnologies. (Mofeke*et al.,* 2003).

In Nigeria, vegetable production has been on -going for decades, providing employment and income for theincreasing population especially during the long dry season. However production is constrained by inadequateinfrastructure, agronomic and socio-economic variables (Sabo and Zira, 2009).

FAO (2013) estimated that the world production of vegetables over a three-year period (1993-1995) was 489 million tons. This trend increased as expected, reaching a global production of 508 million tons in 1996. This trend in production is expected to increase at a rate of 3.2 percent per year. However, this trend is not uniform worldwide, especially in developing countries where the lack of adequate infrastructure and technology constitutes the major drawback to compete with industrialized countries. Nevertheless, developing countries will continue to be the leaders in providing fresh exotic vegetables to developed countries. Most developing countries have experienced a high increase in vegetable production, as in the case of Asia (China) and South America (Brazil, Chile). Asia is the leading producer of vegetables with a 61 percent total

volume output and a yearly growth of 51 percent. However, the U.S. continues to lead in the export of vegetables worldwide with orange, grapes, and tomatoes.

2.10 Socio-economic Characteristics of Farmers

The role of socio-cultural and economic characteristics of farmers in agricultural production has been widely acknowledged, these affect the farmers' productivity. The level of farmers' education is believed to influence the use of improved technology in agricultural production and hence farm productivity (Awolola, 1995). According to Adubi (1992), farmers' age in correlation with farming experience had significant influence on the decision-making process of farmers with respect to risk aversion, adoption of improved agricultural technologies and other production related decisions.

According to Adeniyi (1988), farm size, location and tenancy have effect on land productivity since it affects the farmers' incentive to increase or decrease their production. Similarly, from his study of farmers socio-economic factors and efficiency in food crop production in Gombe State, Nigeria.Amaza (1999) found that where land, family labour, hired labour and fertilizer are the major factor that influences the output of food crops, farmers' specific factors which comprise of education and contact with extension agents are the significant factors that accounted for observed variation in efficiency among the farmers.

The pattern of land ownership by inheritance and purchase tends to promote security, management and motivation to farmers for efficient utilization of resources than land acquired through lease or hire (Rahman, 2003).

2.11Measurement of Farmers' Efficiency and Productivity in Agricultural Production

Efficiency of a farm refers to the performance of the farm in the utilization of resources at its disposal (Kalirajan and Shand 1994) as cited by Maurice (2012). This performance is either compared with the normative desired level or with that of any other farm. The analysis of efficiency is generally associated with the possibility of farms producing a certain optimal level of output from a given bundle of resources or certain level of output at least cost.

Measurement of efficiency according to Ogunjobi (1999) as cited by Maurice (2012) is important for the following reasons: Firstly, it is a success indicator, performance measure by which productive units are evaluated. Secondly, only by measuring efficiency and separating its effects from the effects of the production environment can one explore hypotheses concerning the sources of efficiency differentials. Identification of source of inefficiency is important to institution of public and private agencies designed to improve performance. Thirdly, the ability to quantify efficiency provides decision makers with mechanism with which to monitor the performance of production system or units under their control. In some cases, theory provides no guidance or provides conflicting signals concerning the impact of some phenomena on performance. In such situation empirical measurement provides qualitative as well as quantitative evidence (Coelli, 1994).

The Centre for Efficiency and Productivity Analysis (CEPA, 2003), recommended the use of either Data Envelopment Analysis or Stochastic Frontier Production (DEA or

SFPF) in measuring the efficiency of production due to the inadequacies associated with the use of the Least Squares Econometric Production Models and Total Factor productivity Indices (LSEPM and TFPI). The Data Envelopment Analysis (DEA) is non-parametric requiring the use of linear programming while SFPF is parametric and involves the use of econometric methods. The assumption that the production function of a fully efficiency firm is known is not true in practice. So Farrell (1957) suggested that it can be estimated from simple data using either parametric or non-parametric function such as Cobb-Douglas form. The parametric form resulted in the development of the stochastic frontier approach (CEPA, 2003), the advantage of Stochastic Frontier Production Function (SFPF) is that it account for the "noise" or disturbance problem often encountered in data collection. The stochastic frontier production function model used for this study because of its parametric nature is reviewed below.

2.12Mathematical Models used in Efficiency Studies

2.12.1 Stochastic frontier production function model

The stochastic frontier production model represents an improvement over the traditional average production function and over the deterministic functions, which use mathematical programming to construct production frontiers. The notion of a deterministic frontier shared by all firms ignores the possibility that a firm's performance may be affected by factors entirely outside its control such as bad weather and input supply breakdowns as well as by factors under its control (i.e., technical inefficiency). To lump up the effects of exogenous shocks, both favourable and unfavourable, together with the effects of measurement errors and inefficiency into a

single one-sided error term, and to label the mixture inefficiency is a problem with the deterministic frontiers.

To solve this problem associated with the deterministic frontiers, stochastic production frontier was developed. Aigner *et al.* (1977) and Meeusen and Broeck (1977) simultaneously introduced stochastic production frontier models. The econometric approach to estimate frontier models uses a parametricrepresentation of technology along with a two-part composed error term.Under the assumption that f(xi;β) is of Cobb-Douglas type, the stochastic frontier model can be written in logs as:

$$lnY_i = \beta_0 + \sum_{n}^{1} \beta_i lnx_{ni} + \varepsilon_i \dots\dots\dots\dots\dots\dots\dots (2.1)$$

where$\varepsilon_i$is an error term with

$$\varepsilon_i = v_i - u_i \dots\dots\dots\dots\dots\dots\dots\dots\dots (2.2)$$

i = 1, 2, 3, ……..n

The economic logic behind this specification equation (2.9) is that the production process issubject to two economically distinguishable random disturbances: statisticalnoise represented by $v_i$and technical inefficiency represented byu_i. There aresome assumptions necessary on the characteristics of these components. Theerrors $v_i$are assumed to have a symmetric distribution; in particular, theyare independently and identically distribute as $N(0, \sigma_u^2)$. The component$u_i$is assumed to be distributed independently of $v_i$and to satisfy$u_i \geq 0$ e.g., it followsaone-sidednormaldistribution $N^+(0, \sigma_u^2)$. The non-negativity ofthe technical inefficiency term

reflects the fact that if $u_i > 0$ the countrywill not produce at the maximum attainable level. Any deviation below thefrontier is the result of factors partly under the production unit's control,but the frontier itself can randomly vary across firms or over time for thesame production unit. This last consideration allows the assertion that thefrontier is stochastic, with a random disturbance $v_i$being positive or negativedepending on favourable or unfavourable external events.Conventionally, the efficiency term can take the form of a truncated normaldistribution, of a half-normal distribution, of an exponential distribution,or of a gamma distribution.

The modelling, estimation and application of stochastic frontier production function to economic analysis assumed prominence in econometrics and applied economic analysis following Farrell (1957) seminal paper where he introduce a methodology to measure technical, allocative and economic efficiency of a firm. Farrell's measure of efficiency depends on existence of an efficient production function with which observed performance of firm can be compared. A production function based on the 'best' practical results would have to be used as a reference for measuring individual performance. However, due to problem of complication, Farrell considered it better to compare performance with the 'best' obtain than to set up some unrealizable ideal. He then obtain from scattered diagrams of several firms an isoquant showing the least exact standard of efficiency assumption of convexity to the origin and non-positive slope at any point.

Farrell (1957) constructed a free disposal convex hull of observed input-output ratios by using linear programming technique, and this is non-parametric in nature. Farrell's model which is known as a deterministic non-parametric frontier attributes any

deviation from the frontier and imposes no functional form on the data. All computation is restricted to a technology exhibiting constant returns to scale.

Aigner and Chu (1968) as cited by Maurice (2011) estimated a deterministic parametric frontier by specifying a homogeneous Cobb-Douglas production function. This approach provided a common frontier for all firms under study and the firm's efficiency is derived by comparing the firm's performance with that of the common production frontier. The approach ignored the fact that a firm's performance is affected by some exogenous factors, such as weather, which are beyond the control of the firm. Also, a deficiency characterizing all deterministic frontier models is their sensitivity to extreme observations. It is in this context, the stochastic frontier model proposed independently by Aigner*et al.* (1977) and Meeusen and Van den Broeck (1977) which is extended by Jondrow*et al.*(1982) takes in to consideration the influence of uncontrollable exogenous factors in the estimation process.

The stochastic frontier has been modeled with a composite error term, comprising of two components. A symmetric components which permits random variation of the frontier across firms and captures the effects of measurement errors, other statistical noise and random shocks outside the firm's control; and a one-sided component which captures firm-specific effects such as slackness in production, which are under the control of the firms and influence their level of achievement of technical efficiency. The stochastic frontier model is specified as:

$$Y_i = f(X_i; \beta) \exp (V_i - U_i) \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \quad (2.3)$$

i = 1,2,- - - - - - - N

Where Y_i is quantity of output; X_i is a vector of inputs; β is a vector of parameters; $V_i$is a random error which is associated with random factors not under the control of the farmer (example weather, measurement error etc), having zero mean. It is assumed to be independently and identically distributed as $\sim N(0, \delta_V^2)$, and having half normal (exponential) distribution. The $U_i$is a non-negative random variable, which is the inefficiency associated with a number of technical factors in production. The distribution of inefficiency component can take many forms but it is not symmetrical. Thus, $U_i = 0$ for a farm whose output lies on the frontier, and U_i 0 for a farm whose output lies below the frontier. Typically, U_i follows an identical and independent half-normal distribution as U /$N(0,\delta_V^2)$/ and arises from the truncation at zero of the normal distribution.

Technical efficiency (TE) therefore, is the ratio of the frontier output to the observed output, that is;

$$TE = Y_i^*/Y_i \quad \text{.....(2.4)}$$

$$= f(X_i; \beta) \exp(V_i - U_i) / f(X_i; \beta) \exp(V_i)$$

$$TE = \exp(-U_i)$$

Where TE 1 and U>0. Y_i achieves its maximum feasible value of $f(X_i \beta) \exp(V_i)$ if and only if TE = 1, otherwise TE 1 provides a measure of the shortfall of the observed output from the maximum feasible output (Kumbhakar and Lovell, 2003).

2.12.2 Stochastic frontier cost function model

The corresponding Cobb-Douglas cost frontier as used by Ogundari and Ojo (2007) specified a stochastic cost function with behavior inefficiency component to estimate all parameters together in one step maximum likelihood estimation. This is used in estimating the allocative efficiency of the farmers. The model is implicitly expressed as:

$$C_i = g\ (P_i;\ \beta) + (V_i + U_i) \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (2.5)$$

Where C_i is the total input cost of the ith farm, P_i is a vector of variable input prices employed by the ith farm in food crop production; g is a suitable functional form such as the Cobb-Douglas function, β is the parameter to be estimated, V_i is the symmetric component which represents random disturbance cost due to factors outside the control of the farmers, while $U_i$is the one sided disturbance term used to represent allocative inefficiency and is independent of V_i.

The cost efficiency of an individual farm is defined in terms of the ratio of observed cost (C^b) to the corresponding minimum cost (C^{min}) given the available technology. That is,

$$\text{Cost efficiency } (C_E) = \frac{C^b}{C^{min}} = \frac{g\ (P_i,\ Y_i;\ \beta) + (V_i + U_i)}{g\ (P_i,\ Y_i;\ \beta)} = \exp\ (U_i)$$

Allocative efficiency ranges between zero and one. Economic efficiency (E_E) is obtained as the product of technical and allocative efficiency. That is,

$$E_E = (T_E)\ X\ (C_E)$$

Inferences about the parameters of the stochastic production and cost frontiers were obtained by the Maximum Likelihood Estimation (MLE) developed by Coelli (1994). This was done using computer program FRONTIER version 4.1.

The modelling and estimation of production efficiency of a farm relative to other farms or to the 'best' practice in an industry has become an important area of economic study. The advantage of the stochastic frontier model is that it allows for the estimation of individual firm efficiency level with both time variations and cross-sectional data. Also it is possible to find out whether the deviation of a firm's actual output from its potential output is mainly because it did not use the best practice technique or is due to external random factors. Thus, one can say whether the difference between the actual output obtained and the potential frontier output, if any, occurred accidentally or not. If both error terms are not carried out and it will give some sort of an average production function.

Battese and Coelli (1988) suggested that the quantity exp (- U_i) can be predicted by using its conditional expectation, given the composed random errors $V_i - U_i$, evaluated at the maximum likelihood estimate of the parameters of the model. Aigner*et al.* (1977) suggested that the maximum likelihood estimates of the parameters of the model be obtained in terms of the parameterization $\delta^2 = \delta_u^2 + \delta_v^2$. Battese and Corra (1977) as cited by Maurice (2011) defined Υ as the total variation in output from the frontier and which is attributed to technical efficiency and is bounded between zero and one ($0 \leq \Upsilon \leq 1$) i.e.

$$\Upsilon = \delta_u^2/\delta^2$$

2.13 Production Efficiency and its Components

In every country, enhancing productivity and efficiency in agricultural sector remains a vital key to improving the standard and quality of life, especially in developing countries where a preponderant majority of the poor are employed. One strategy to improving farm productivity is the adoption of new technologies. The adoption of new technologies, as a means of accelerating economic development, has been the focus of a number of researchers and policymakers. Awotide*et al*. (2010), Kudi*et al*. (2011) and Dontsop*et al.* (2011)focused particularly on the role of new technologies in fostering productivity and development. But technological progress is not the only parameter that determines output growth, enhancement in efficiency can also affect growth in output.

Perhaps the most important work in the production efficiency literature is that of Farrell (1957) who drew upon the work of Debreu (1951) and Koopmans (1951). This research laid the foundation for the development of a number of related efficiency models, collectively known as *frontier* models.

There are two main benefits that result from estimating frontier functions, as compared to estimating average functions using *ordinary least squares* (OLS) technique. First, when a frontier function is estimated, the result is strongly influenced by the best performing firm, and therefore the frontier reflects the technology set that the most efficient firm uses. Compare this to the estimation of an average function, which only shows the technology set employed by an average firm. Second, frontier functions provide a useful performance benchmark. These functions normally represent best practice technology, against which the efficiency of other firms within the industry can be measured. It is for this reason that frontier estimation continues to attract attention in the empirical production economics literature.

In microeconomic theory of the firm, production (or economic) efficiency is decomposed into technical and allocative efficiency. A producer is said to be technically efficient if production occurs on the boundary of the producer's possibilities set, and technically inefficient if production occurs on the interior of the production possibilities set. That is, technical efficiency is the extent to which maximum possible output is achieved from a given combination of inputs (Haghiri, 2003). On the other hand, a producer is said to be allocatively efficient if production occurs in a region of the production possibilities set that satisfies the producer's behavioural objective.

Farell (1957) distinguished between technical and allocative efficiency in production through the use of a frontier production function. Technical efficiency is the ability to produce a given level of output with a minimum quantity of inputs under certain technology. Allocative efficiency refers to the ability of using inputs in optimal proportions for given factor prices (i.e. where the ratio of marginal products for each pair of inputs is equal to the ratio of market prices). The product of technical and allocative efficiency is the Economic efficiency. An economically efficient input-output combination would be on both the frontier function and expansion path. Alternatively, economic efficiency can be defined as the ability of a production organization or any other entity to produce a given output at minimum cost. If a firm has achieved both technically and allocatively efficient levels of production, it is economically efficient and new investment streams may be critical for any new development.

2.13.1 Technical efficiency

One of the important measures of overall resource use efficiency is technical efficiency. Farrell (1957) defined technical efficiency, as the ability of the firm to produce on the isoquant frontier. Also, technical efficiency of an individual farm is defined in terms of the ratio of the farm's actual output to its maximum frontier output for a given level of inputs and chosen technology (Kalirajan and Shand, 1994). They advanced that technical efficiency is attained when the best available technology is used. It therefore implies that the frontier output varies with the level of technology employed by the farm. On the other hand, technical inefficiency arises when less than maximum output is obtained from a given bundle of factors (Russell and Young, 1983). Technical efficient farms are those that operate on the production frontier, and the level by which a farm lies below its production frontier is regarded as the measure of technical inefficiency. However, when farms fail to operate on their frontiers but somewhere below them, they are said to be technically inefficient.

Amaza and Olayemi (2002) also used the stochastic frontier production function in their study of Gombe State farmers. They concluded that 98% of the variation in output among farmers was due to differences in technical efficiencies. Thus, the result of the diagnostic statistics confirmed the relevance of stochastic frontier production function using maximum likelihood estimator (MLE).

Tiamiyu *et al.* (2008) showed that the mean technical efficiency of rain-fed upland rice farmers in the Guinea Savanna Zone of Nigeria to be 65%. He concluded that, farmers' technical efficiency is significantly influenced by educational level, rice farming experience, extension contact and credit use among the sample farmers. Omotesho*et*

al.(2008), in their study of technical efficiency of youth participation in agriculture in Ondo State showed that, efficiency differential exist among the youths in the programme furthermore, land, labour, herbicides and number of cassava cuttings were found to be the major factors that influence output of the youths. The mean technical efficiency was found to be 85%.

The stochastic frontier production function was also used by Shehu, *et al.* (2007) in their investigation of productivity and technical efficiency of small-scale rice farmers in Adamawa State. The technical efficiencies of the farmers range from 74%- 98% with a mean technical efficiency of 95.7%. The farmers were found to be operating in an irrational stage of production as shown by return to scale of 1.06. in another study (Shehu*et al.*, 2007) of technical efficiency of small-scale rain-fed upland rice farmers in North-West Agricultural Zone of Adamawa State, the empirical result indicate that more than 88% of the farmers were more than 80% technically efficient. Farming experience, household size and level of education were found to reduce technical inefficiency while farmers' age increases technical efficiency. Giroh (2007), analysed the technical efficiency of rubber tapping in Rubber Research Institute of Nigeria (RRIN), Benin City and concluded that opportunity exist for non-permanent and permanent rubber farmers to increase their efficiency by 5% and 50% respectively.

Maurice *et al.* (2005) evaluated the technical inefficiency in rice based cropping patterns among dry season fadama farmers in Adamawa State using the stochastic frontier production approach. The empirical evidence from the inefficiency model shows that level of education and farming experience increase the technical efficiency of the farmers. Ojo and Imoudu (2000) in their study of productivity and technical

efficiency, they found out that training of farm settlers increase their technical efficiency than those not trained and concluded that productivity is positively correlated with training.

Asogwa*et al.*(2007) studied the relationship of technical efficiency and socio-economic variables of cassava farmers in Nigeria. The findings indicate that a significant relationship exist between technical efficiency and output of cassava (0.542), farm income (0.612), processing cost (-0.414), gari yield (0.608), gross margin (0.483), education (0.699), farming experience (0.278), and extension contact (0.585), of the sampled cassava farmers in Nigeria.

2.13.2 Allocative efficiency

Allocative efficiency relates to the degree to which a farmer utilizes inputs in optimal proportions, given the observed input prices (Coelli*et al.*,2002; Ogundari*et al.*, 2006). According to Farrell (1957), allocative efficiency refers to the ability of a firm to produce at a given level of output using cost-minimizing inputs prices. That is, resources are used so that the value of an additional unit of output (the value of the marginal product) is equal to the cost of an additional unit of output. Thus, a profit-maximizing entrepreneur will not use a resource beyond the point where the resource adds just as much to his revenue as it adds to his cost.

Russell and Young (1983) looked at Allocative Efficiency (AE) as a condition that exists when resources are allocated within the firm according to market prices. In a materialistic society according to them, this will represent a desirable characteristic

when market prices are a true measure of relative scarcity. This will be the case when prices are determined in perfectly competitive markets, but when prices are distorted by monopolistic influences or where some goods remain outside the market system the role of prices in resources allocation is greatly impaired.

By comparing the value of marginal product with the price of the resource tests the efficiency of resource allocation (Gittinger, 1982). The test gives an indication of the direction and magnitude of resource adjustment needed to achieve optimum resource allocation. Ogundari and Ojo (2006) described allocative efficiency as the ability to choose optimum input levels for a given factor price i.e. when production occurs at a point where the marginal value product equals marginal factor cost.

2.13.3 Economic efficiency

Economic efficiency as defined by Bravo-Uretaet *al.*(1997) is the capacity of a firm to produce a predetermined quantity of output at a minimum cost for a given level of technology. It is an overall performance measure and is equal to the product of Technical Efficiency (TE) and Allocative Efficiency (AE) i.e EE = TE x AE. The simultaneous achievement of both efficient conditions according to Heady (1952) occurs when price relationship are employed to denote maximum profits for the firm or when the choice indicators are employed to denote the maximization of other economic objectives.

Abdourahamaneet *al.*(2001) defined economic efficiency as the ability to produce a given level of output using a cost minimizing input ratios. Farrell (1957) defined

economic or total efficiency as the product of technical and allocative efficiencies. An economically efficient input-output combination would be on both the frontier function and expansion path.

Economic efficiency also defined as the ratio of minimum observed total production cost (C^*) to actual total production cost (C). Economic efficiency is the inverse of cost efficiency, thus EE = 1/CE. Ogundari and Ojo, (2006) studied the production efficiency of cassava farmers in Osun State using farm level data. The stochastic frontier production and cost functions were used to predict the technical and economic efficiency respectively. They predicted that, TE and AE are basis for calculating economic efficiency. The TE, EE and AE were found to be 0.903, 0.890 and 0.807 respectively.

2.14 Empirical Applications of Production Frontiers in Agriculture

Empirical estimates from the result of studies carried out by Erhabor and Emokaro (2008), on cassava farmer in Edo State showed that the farmers in three ecological zones of the state were not efficient in their use of production resources. The land and planting material were under-utilized in the three zones; labour (both family and hired) was over utilized in Edo South and Central and under-utilized in Edo North. This suggests the existence of reasonable gap in the production technologies of cassava farmer in three ecological zones. Relevant intervention is therefore, needed in the transfer of production technology that would enhance the current level of efficiency of the cassava farmers.

In a similar view, Omoteshoet *al.* (2008) reported that the efficiency of youth participation in agriculture in Ondo State is below frontier production. The estimated minimum efficiency of the youth was 32.62% while maximum efficiency was 96.25% and the mean technical efficiency was 85.23%. This mean value indicates that if input usage is increased by 14.77% the youth will be operating on the production frontier thus, opportunity still exists for increasing productivity and income though increased efficiency in resource utilization. The major factors influencing the technical inefficiency of the youth in the study area are household size, usage of extension services and educational level of the participants.

In another study by Girohet *al.* (2008) on the profitability analysis and technical efficiency of rubber latex production that farmers made a net farm income of ₦14,214.11/ha. Analysis of the technical efficiency of farmer from the Stochastic Frontier Production Function revealed that, the farmers were operating below production frontier the average area of 0.72 or 72%. Fifty six percent of the farmers have their technical efficiency below the mean while 44% attained technical efficiency above the mean; there was a wide variation in technical efficiency among the farmers which the authors recommended for further investigation.

2.15Costs and Return in Agricultural Production

Cost refers to the value of inputs used in production while profit is obtained by subtracting the costs from the revenue. Farm costs are often divided into fixed and variable costs. Fixed costs are incurred in fixed assets such as building, land, fences and other permanent assets, on the other hand; variable costs are those costs incurred on assets that can be liquidated, examples are the costs of fertilizer, animal feed, labour,

drugs, etc. (Adegeye and Dittoh 1985; Olukosi and Erhabor, 1988). In which ever form the costs is incurred is with the hope of deriving some benefit from the action taken. A rational decision maker is assumed to choose an enterprise combination with lower cost and greater profit all things being equal.

Sankhayan (1988) asserted that agricultural production function is the principles for allocation of scarce resources (Inputs) such as land, labour, capital and management which have alternative uses so as to achieve predefined objectives such as profit maximization, satisfaction or combination of both at micro and macro levels. Similarly, Olayide and Heady (1982) observed that agricultural production involves the process of combining input resources into organized productive unit under management with ultimate objective to maximize profit, maximize satisfaction, minimize cost or a combination of some or all of the motives of a farm enterprise.

Alimi (2000) opined that production is the conversion of inputs into output. It is the use of resources to obtain output and these resources could be aggregated into land, labour, capital and management.

2.16 Resource use Efficiency in Agricultural Production

In a study of resource use efficiency of maize production in Ondo State, Imoudu (1992) showed that price of maize, price of cassava, farm size and quantity of inputs had significant impact on farmers output of maize and that farm size had the lowest elasticity coefficient. Abang*et al.*(2001) showed that small holder cassava farmers in Cross River State were not efficient in the use of production input. Similarly, it was also

shown by Omonona (2003) that small holder cassava farmers were not efficient in the use of production inputs in Kogi State.

Erhabor and Emokaro (2008), applied the Stochastic Frontier Production Function (SFPF) in estimating the efficiency of resource use in cassava production in Edo State, and concluded that the farmers were not efficient in their use of production inputs. Using SFPF to estimate the efficiency of cassava farmers in Edo State, but this time on a disaggregated basis, Erhabor and Emokaro (2008), reported that cassava farmers in the three agro-ecological zones of Edo State were not efficient in their use of production resources. Umoh (2006) conducted a study on resource use efficiency in urban farmers in UyoAkwa-Ibom State using Stochastic Frontier Production Function (SFPF). It was reported that urban farmers were 70% technologically efficient with maximum and minimum technical efficiency of 0.91 and 0.43 respectively.

Oaikhena (2005) used stochastic frontier production function approach to analyse the resource use efficiency and land productivity of food crop farmers in Niger Delta Area of Nigeria. The study shown that, the estimated coefficient for age, sex, family size and year of schooling were positive, which implies that these socio-economic factors affect the production efficiency negatively.

2.17Calculating Profit Margin in Agricultural Production

There are two components for computing profits in agricultural production; revenue and cost. Revenue is the total income accruable to a farmer from the sale of his output and other valuable by-products. Revenue may refer to income in general, or it may refer to

the amount, in a monetary unit, received at the end of a production year. For a farmer to obtain revenue at the end of the production year, he has to incur cost used in obtaining production inputs which if well utilized, will generate output to the farmer and subsequently revenue through the sale of the output. Cost in agricultural production is of two types; variable cost and fixed cost. Variable costs are costs incurred during the use of variable inputs such as fertilizer, seed, agrochemicals and feed. Fixed costs are cost incurred on fixed items. Fixed items are items that can be used for more than one production cycle. Depreciation is the indirect cost for using a fixed asset. Examples of fixed assets are: land, implements/machines, farm houses, pens, etc. The summation of the two types of costs is known as the total cost of production. The difference between the total revenue and the total cost is known as the profit margin. There are basically two types of tools used in computing profit margin in agricultural production. They are Net Farm Income (NFI) and Gross Margin Analysis (GMA)

2.17.1 Net farm income

Net farm income is income generated by farm business after paying all expenses (operation & investment activities). This includes net gain from sale of capital assets and paying owner/operator's time & management

The net farm income is computed thus:

NFI = TR – TC ……. (2.6)

Where:

NFI = Net Farm Income (N)

TR = Total Revenue (N)

TC = Total Cost (N)

The net farm income can also be computed using the formula:

NFI = GM – TFC …….. (2.7)

Where:

NFI = Net Farm Income

GM = Gross Margin

TFC = Total Fixed Cost

The net farm income is used to calculate the profit accruable to large scale farming. It puts into consideration costs from the fixed asset of the farm. It is not commonly used in the computation of profit for small scale farmers because peasant farmers engage very little capital assets in production.

2.17.2 Gross margin analysis

Gross margin analysis by definition is the difference between the gross farm income and total variable cost (Olukosi and Erhabor, 1988). Normally, gross margin analysis is used to test the effects of changes that do not alter the fixed cost of production, especially the cost of land and other durable factors. It is used to determine the potential profitability and effect on farmers' farm income. It has the advantage of being simple as well as useful in the analysis of the profitability of small scale farms that have small fixed costs (Samm, 2009).

Adebayo (2005), defined gross margin per hectare as the difference between total revenue per hectare and total variable cost per hectare and is expressed as:

GM = TR – TVC ……. (2.8)

Where:

GM = Gross margin from the production (₦/ha)

TR = Total revenue from the production (₦)

TVC = Total variable cost from the production (₦/ha)

The gross margin analysis is mostly used in the computation of accruable profit to an average Nigerian farmer because it does not take into account the fixed asset of the farmers which is minimal on the farm.

CHAPTER THREE

METHODOLOGY

3.1 The Study Area

This study was conducted in Plateau State, Nigeria located between latitude 8^0 22' and 10^0 24' North and longitude 8^0 32' and 10^0 38' East. Plateau State is primarily an agrarian community.The State comprises a landmass of 30, 913 square kilometres or 6,678,162 acres (NBS, 2006a). About two thirds of the land area is arable. The major food crops include Irish potatoes, sweet potatoes, chilli pepper and tomatoes. The leafy vegetables include cabbage, onions, garlic while cereals include maize, rice, sorghum and millet. The State also produces Acha, legumes, cowpea, soyabeans, groundnuts, sesame. Roots and tuber crops are cassava, yam, and cocoyam. Vegetables include carrots, lettuce, radishes, cucumber, sweet pepper, hot pepper, green beans, parsley and fruits include strawberries. There are also tree crops like coffee, gum Arabic, citrus, mangoes and guava. Cereal production on the Plateau represents about 34% of all agricultural produce; root and tubers production represents about 32% while horticultural crops stand out at about 21%. The least is forest products which represent 13% (EoPSD, 2010)

Plateau State falls largely within the northern guinea savannah zone which consists mainly of cropland, short trees and grasses. The upper Plateau however has unique mountain vegetation which is influenced by the near temperate climate. The major soil types of the State belong to the broad category of tropical ferruginous soils which are much thinner on the Plateau but attain greater depths in the southern parts of the State. The State is characterized by a near temperate climate on the Jos Plateau with a hot and

humid climate in its lower parts. Generally, weather conditions are warmer during the rainy season (April – October) and much colder during the Harmattan period (December – February). The mean annual temperature in the State ranges from 20 to 25 degree Centigrade, while the mean annual rainfall figures ranges from 131.75cm in the southern part to 146cm on the Jos Plateau (EoPSD, 2010)

The State is bordered in the Northwest by Kaduna State, in the Northeast by Bauchi and in the Southwest by Nasarawa State, while in the Southeast is Taraba State. Population density varies among the Local Government Areas of the State. Jos North, Jos South and Jos East have a combined population density of 391 persons per square kilometres to become the most densely populated parts of Plateau State. The rest of the State has a fairly low population ranging between 40 and 125 persons per square kilometres (EoPSD, 2010)

Plateau state consists of seventeen Local Government Areas (LGAs) with a combined population of 3,178,712 people (NBS, 2006b). The exotic vegetables are predominantly cultivated in four Local Government Areas because of the near temperate climate of these Local Government Areas. They are Jos North, Jos South, Jos East and Riyom Local Government Areas.

3.2 Sampling Size and Sampling Technique

A multi-stage sampling technique was used to select respondents for this study. Three Local Government Areas namely: Jos North, Jos South and Riyom were purposively selected for field survey. These three Local Government Areas were chosen for the survey because the weather in the area is conducive for the production of cabbage in Plateau State.The second stage involved a random selection of two villages from each of the selected LGA. Also, these villages were selected because these are among the very few villages that have the required climate for cabbage production and for uniformity of sampling. The villages selected are: Naraguta and Yelwa from Jos North, Zawan and Kuru from Jos South; and Riyom and Ta hoss from Riyom.The sample frame and sample sizes of the farmers in the selected villages are presented in table 3.1. The sample frame was obtained from the list of cabbage farmers at the Plateau State Agricultural Development Programme (ADP) office in Jos. The sample size was 10% of the sample frame giving a total of 230 cabbage farmers.

Table 3.1: Sample frame and sample size for respondents of cabbage farmers in Plateau State

Local Government Area	**Village**	**Sample frame**	**Sample size (10% sample frame)**
Jos North	Naraguta	622	62
	Yelwa	501	50
Jos South	Zawan	354	35
	Kuru	302	30
Riyom	Riyom	269	27
	Ta hoss	260	26
Total		**2330**	**230**

3.3 Method of Data Collection

Primary data were collected from the cabbage farmers from six villages in the selected Local Government Areas.The primary data were generated through interviews using structured questionnaires which were administered to the cabbage farmers by trained enumerators. Information relating to 2013 cropping season were obtained from the respondents to achieve the stated objectives.

3.4 Analytical Technique

The analytical tools that were used to achieve the objectives of this study include: Descriptive statistics,

3.4.1 Descriptive statistics

Descriptive statistics such as mean, percentages, and frequency distribution was used to achieve objectives 1 and 4.

3.4.2 Gross margin analysis

This evaluates the costs and returns of an individual enterprise. The gross margin per hectare will be estimated using the following relationship:

$$GM = TR - TVC \quad \text{.....(3.1)}$$

$$TR = Y_m * P_m$$

Where:

GM = Gross margin (₦/ha)

TR = Total revenue (₦/ha)

TVC =Total Variable Cost (₦/ha)

Y_m = Output of vegetable (kg/ha)

P_m = Unit price of vegetable (₦)

$$\text{and } TVC = \sum_{i-j}^{n} P_i X_i \quad \text{..... (3.2)}$$

Where:

P_i = unit price of the ith input (₦)

X_i = quantity of the ith input per hectare.

$\sum$ = summation sign

Output was measured in kilogrammes. The Gross Margin Analysis was used to achieve objective 2.

3.4.3 Stochastic frontier production-function

The stochastic frontier production function can be expressed in a general form as:

$Y = f(\beta, Xi)e^{\epsilon;}$ ……..1

Where;

Y = quantity of output

Xj = a vector of input quantities

β= a vector of parameters

e = error term

Є = stochastic disturbance term consisting of 2 independent elements V and U

$Є = v-u$ ……..2

Combining equations 1 and 2 gives

$Y = f(\beta, Xi)e^{v-u}$ ----------3

The empirical stochastic frontier production function model was applied in this study. The study adopted Cobb-Douglas Frontier Production Function as described by Tadesse and Krishnamoorthy (1997) as;

In $Y = \ln\beta_0 + \beta_1 \ln x_1 + \beta_2 \ln x_2\ \beta_3 \ln x_3 + \beta_4 \ln x_4 + \beta_5 \ln x_5 + \beta_6 \ln x_6 + V\text{-}U$ …… 4

Where;

Y = output (kg).

X_1 = farm size (hectares)

X_2= quantity of planting material (kg)

X_3 = quantity of agrochemical used (liters).

X_4 = quantity of fertilizer used (kg).

X_5 = family labour used (man –day).

X_6 = hired labour used (man-day).

V= measurement error and other factors not under the control of farmer.

U = Technical inefficiency, that is, what is left for farmer to do to reach the outer bound production frontier.ln = logarithm to base e.

The Stochastic frontier production function also incorporates a model of inefficiency effect. In the inefficiency analysis, certain factors that contribute to the inability of the farmer to operate on the frontier will be examined. These factors include age, farming experience, education, access to credit and number of extension visits to farmers (socio-economic factors).

For this analysis, technical inefficiency of the farmer is defined by the equation

$$U = \partial_0 + \partial_1 \ln Zi + \partial_2 \ln Z_2 + \partial_3 \ln Z_3 + \partial_4 \ln Z_4 + \partial_5 \ln D_1 + \partial_6 \ln D_2$$

The β's and ∂'s are scaler parameters to be estimated. The variances of the random errors $\sigma^2 v$ and that of the technical inefficiency effect $\sigma^2 u$and overall variance of the model $\sigma^2$are related thus

$\sigma^2 = \sigma^2 v + \sigma^2 u$ and the ratio $\lambda = \sigma^2 u / \sigma^{2,} v$ measures the total variation of output from the frontier that can be attributed to technical inefficiency (Battese and Corra, 1977). The estimates for all the parameters of the stochastic frontier production function and theinefficiency model was obtained using FRONTIER VERSION 4.1 computer programme (Coelli, 1994).Thus the stochastic production frontier was used to measure the technical efficiency, allocative efficiency and economic efficiency. This tool was used to achieve objectives 3

CHAPTER FOUR

RESULTS AND DISCUSSION

4.1 Socio-economic Characteristics of Cabbage Farmers

The socio-economic characteristics of cabbage producers in the study area were analysed and interpreted. The section describes the socio-economic variables and how they influence the level of efficiency or otherwise of the farmers in the study area. The socio-economic variables investigated included: age, experience, number of years in a cooperative society, Gender, Household size, Amount of credit, number of extension visits.

4.1.1 Gender distribution of cabbage farmers

The result from the field on gender distribution of cabbage farmers indicated that 62% were male while 38% were female. The analysis revealed that males are more involved in cabbage production in the study area than female. This may be attributed to lack of access to productive resources such as land and finance by women. A similar result was reported by Ofuoku et al. (2014) in their study on socio-economic variables among arable farming households in Nigeria. Results of the study show that 61% of the farm household heads were male while 39% were female. Also Osei et al. (2013), in their study on Practices and constraints to cabbage production in urban and peri-urban Ghana: Focus on BrongAhafo and Ashanti Regions, reported that 67% of the cabbage farmers were male while 33% were female. The result is reflected in table 4.1

Table 4.1: Distribution of respondents according to gender

Gender	Frequency	Percentage
Male	143	62
Female	87	38

TOTAL	**230**	**100**

4.1.2 Age distribution of cabbage farmers

Table 4.2shows the age distribution of cabbage producers in the study area. The study revealed that 86% of the farmers were within the active age range of 21 – 50 years. However, 12% of the farmers were more than 50 years old while 2% were less than 21 years old. The average age of the cabbage farmers was 39 years. This implies that the mean age is still very much active and can positively influence the level of cabbage production in the study area. These findings are in order with that of Usman (2009), who in is study on Economics of seseme production in Jigawa state discovered that the active age bracket of seseme producers was with the age bracket of 26 – 50 years and the mean age of producers was 42 years.

Table 4.2: Distribution of respondents according to age

Age (years)	Frequency	Percentage
< 21	3	1.30
21 – 30	44	19.13
31 – 40	93	40.43
41 – 50	62	26.96
> 50	28	12.17
TOTAL	**230**	**100**
MEAN	**39**	

4.1.3 Educational status

Most farmers in the study area had one form of education or the other. Result presented in Table 4.3 shows that 27% of the cabbage farmers had primary education, while 64%

had secondary education. Four percent (4%) had tertiary education while only 5% had no formal education. This result indicated that education in the study area is of high importance. The high level of literacy in the study area implies that the respondents have the propensity to accept and adopt innovations brought to them by extension agents which will positively affect their productivity and subsequently, income.

Table 4.3: Distribution of respondents according to educational status

Educational level	Frequency	Percentage
Primary	62	27
Secondary	147	64
Tertiary	9	4
No formal education	12	5
TOTAL	**230**	**100**

4.1.4 Household size

The household size determines the available labour force to be employed in carrying out production activities in an average Nigerian farm family. The major source of labour-supply in peasant farming system, which is labour intensive, is family labour. Table 4.4 shows that 58% of respondents had a family size of 6 – 10 persons, followed by a household range of 11 – 15 representing 22% of the total farmers, while 12% of the respondents had a household size of between 1 – 5 persons. Only 8% of the farmers had a family size greater than 15 persons. The mean household size was 9 persons inferring that family labour could be a ready source of labour on the respondents' farm. This is in line with the findings of Jyanya et al. (2014) who worked on Economic analysis of irrigated irish potato production in plateau state. In their results it was observed that 90% of the farmers had high family size ranging from six to above ten household

members. According to them large family size implies availability of free family labour, thereby reducing the cost of labour in production.

Table 4.4: Distribution of respondents according to household size

Household size (Number)	**Frequency**	**Percentage**
1 -5	28	12
6 – 10	133	58
11 - 15	51	22
>15	18	8
TOTAL	**230**	**100**
MEAN	**9**	

4.1.5 Farming experience

Farming experience is a vital criterion for efficiency, as improvement in farming methodology is being carried out from one farming season to another. Results from Table 4.5 indicate that 58% of the farmers have been engaged in cabbage production for between 6 – 15 years. Moreso, 18% of the farmers had farming experience of between 16 – 30 years. This result implies that more farmers are engaging in cabbage production in the study area mainly because of the profit and more awareness of the crop. The average years of cabbage farming among the respondents was 10 years. This implies that cabbage production could be efficient in the study area as the years of experience could positively affect it. This result is congruent to the findings of Anselm and Ubokudom. (2014) who worked on Economics of water leaf production in Akwa Ibom State, Nigeria. The results show that about 70% of the farmers had 1-10 years of experience in waterleaf production. The mean farming experience was 8.5 years, indicating that the majority of the farmers have been in the business for long, and are therefore conversant with the problems of the area.

Table 4.5: Distribution of the respondents based on their farming Experience

Years of farming experience	Frequency	Percentage
1 - 5	54	23.48
6 – 10	88	38.26
11 – 15	46	20.00
16 – 20	34	14.78
21 – 25	6	2.61
26 - 30	2	0.87
TOTAL	**230**	**100**
MEAN	**10**	

4.1.6 Farm size

The size of a farm is a measure of the yield of the crop being cultivated. Result from the field indicated that respondents farm sizes ranged from 0.4 – 6.0 ha with the average put at 2 ha. Table 4.6 shows the size of the farm holdings among the farmers. About 19% of the cabbage farmers in the study area had farm sizes ranging from 0.1 – 1ha, while 78% of farmers had farm sizes ranging from 1.1 – 4ha. About 2.6% had farm sizes more than four hectares. With the average farm size put at 2 hectares, this implies that production could be improved upon as 2 hectare per average household of 9 persons is on the low side. The result is similar to that of Apata et al. (2011) in a paper presentation at the 85th Annual Conference of the Agricultural Economics Society Warwick University, titled The Economic Role of Nigeria's Subsistence Agriculture in the Transition Process: Implications for Rural Development. In the presentation, the authors posited that subsistence farmers play an important role for food security with an average farm size ranges between 0.7-2.2 hectares.

Table 4.6: Distribution of respondents according to farm size

Farm size (Hectares)	Frequency	Percentage
0.10 – 0.50	18	7.83
0.51 – 1.00	25	10.87
1.10 – 1.50	30	13.04
1.51 – 2.00	44	19.13
2.10 – 2.50	34	14.78
2.51 – 3.00	30	13.04
3.00 – 3.50	26	11.30
3.51– 4.00	17	7.39
4.10– 4.50	3	1.30
4.51– 5.00	1	0.43
5.10– 5.50	1	0.43
5.50– 6.00	1	0.43
TOTAL	**230**	**100**
MEAN	**2ha**	

4.1.7 Land tenure system

The system of land ownership among the respondents in the study area is captured in Table 4.7. About 76% of respondents acquired their land by inheritance while 14% purchased their land for farming. About 10% rented, leased or hire their land. It was observed that farmers, who either purchased, rent, lease or hire their lands were settlers in the study area.

Table 4.7: Distribution of respondents based on land tenure system

Nature Of Land Acquisition	Frequency	Percentage
Inheritance	175	75

Purchase	32	15
Rent/Lease/Hired	23	10
Total	**230**	**100**

4.1.8 Access to credit/amount of credit

About 5% of farmers had access to formal credit, while 42% had access to credit through friends and relatives. About 53% had no access to credit as reflected in table 4.8. This implies that credit from formal institutions to farmers in assisting to boost productivity is still discouraging. The amount of credit given to farmers ranged from N5,000 to N200,000.

Table 4.8: Access to credit by cabbage farmers

Credit	**Frequency**	**Percentage**
Access to credit	108	47
Non-access to credit	122	53
Total	230	100

4.1.9 Extension contact

The results in Table 4.9 revealed that 45% of the respondents were not visited by extension agents during the production season while 38% indicated that they received visits from the extension agents once in 4 months; 9%, 6% and 2% were visited once in three months, once in two months and once a month respectively. This implies that the extension programmes in the study area are either understaffed or ill-equipped as revealed by a large percentage of the farmers who were not reached by the extension programmes.

Table 4.9 Distribution of respondents according to number of extension visit

Period	Frequency	Percentage
Once a month	5	2.10
Once in two months	14	6.12
Once in three months	20	8.60
Once in 4 months	88	38.08
Not at all	103	45.10
Total	**230**	**100**

4.2 Profitability analysis for cabbage production

Results of the profitability analysis carried out are presented in Table 4.10. The results show that the Total Variable Cost (TVC) per hectare for cabbage production in the study area was ₦56,100. Variable cost comprise of most of the expenditure used in the production of cabbage in the study area. Among the variable costs recorded by the cabbage producers, fertilizer recorded the highest cost of ₦13,500 representing 24% of the total cost of production per hectare. This was followed by planting material and hired labour put at 22% and 21% respectively.

Table 4.10: Gross Margin analysis for cabbage production in Naira/hectare

Variables	Unit price	Value (N)	Percentage

Variable cost			
planting material (number)	5	12,500	22.28
agrochemical (litre)	425	5100	9.09
fertilizer (kg)	180	13500	24.07
family labour (manhr)		8,000	14.26
hired labour (manhr)		12,000	21.39
Others		5,000	8.91
I. Total Variable Cost		**56,100**	**100.00**
Farm Income			
Yield (2189.5 balls)			
Price/ball = ₦80			
II. Gross farm income		**175,000**	
III. Gross margin (II-I)		**118,900**	
IV. Return to Naira invested (III/I)		**2.12**	

From the results, the gross farm income realized by a farmer is ₦175,000 per hectare. The gross margin computation shows a value of ₦118,900 per hectare. This shows that cabbage production in the study area is profitable to the tune of ₦118,900 per hectare. The profit obtained in cabbage production in the study area is not in much variance with that obtained from the production of another exotic vegetable (watermelon) in Ekiti and Borno States respectively. Ajewole (2015) found out that the gross margin for watermelon production in Ekiti State was ₦138,044.22 per hectare while Ibrahim (2011) recorded a gross margin of ₦105,002.95 per hectare from watermelon production in Borno State. The return to naira invested was found to be 2.12. This implies that for every ₦1 invested in cabbage production in the study area, a farmer gets ₦2.12K as profit.

4.3 Determinants of Economic Efficiency

4.3.1 Technical efficiency

The results of the maximum likelihood estimation of the production function arepresented in Table 4.11. The analysis revealed that the log likelihood ratio value which represents the value that maximises the joint densities in the estimated model shows a value of 34, exceeding the critical chi-square values of 21.66 at 1% level of significance. The gamma statistics of 72.2 implies that about 72 % variation in the output of cabbage farmers was due to differences in their technical efficiencies. Thus it shows that technical inefficiency effects were present in cabbage farming in the study area.

Table 4.11: Estimates of stochastic frontier production function

Variables	Coefficient	Standard Error	T – ratio
Production model			
Constant	6.3068	1.7882	3.5270**
Farm size (ha)	2.1091	0.9145	2.3065**
Planting material (kg)	- 0.5418	0.9556	- 0.5669
Agrochemical (litres)	- 0.9134	0.2565	3.5606***
Fertilizer	0.1522	0.1971	0.7720
Family labour (man-days)	0.0840	0.1944	0.4321
Hired Labour (man-days)	0.0408	0.1947	0.2097
Technical efficiency model			
Constant	- 0.0937	3.2922	- 0.0285
Age (years)	0.0436	0.3333	1.3058
Yrs of Experience in cabbage production (yrs)	- 0.0327	0.03277	-1.1777
Education (yrs)	-0.0004	0.0013	-2.234**
Years of cooperative membership (yrs)	- 0.0132	0.1982	-0.0667
Gender (male =1; female = 0)	- 0.0759	0.0814	0.9322
Household size	-0.0340	0.2929	-0.1161
Amount of credit received (Naira)	0.1049	0.1808	0.5801
Number of extension visits	0.0384	0.2240	0.1713
Sigma squared	1.5275	0.5874	2.6005***
Gamma	0.7223	0.0074	3.6567***
Log likelihood function		- 34.19	

*** = significant at 1%

** = Significant at 5%

* = Significant at 10%

Farm size

The size of a farm is found to be a critical factor of production and the output depends on it. In the production of cabbage in the study area, it is considered to be a positive factor for high output. The *apriori* expectation is that, the larger the farm size, the higher the output of cabbage, ceteris paribus. From the results of the technical efficiency, it shows that farm size is an important factor of production based on its significant level at 5%. The coefficient of this variable shows a positive value, indicating that the larger the farmsizes of the farmers, the higher the output of cabbage in the study area and vice versa. This implies that, farmers with larger farm sizes tend to produce higher quantity of cabbage than their colleagues with smaller farm sizes, all other factors remaining constant. This is in line with the *apriori* expectation that output increases with farm size. The coefficient value of 2.1091 implies that if the size of the farm is increased by one hectare, this will result in an increase of 211% of the total output, *ceteris paribus*.

Planting material

The planting material (seeds) shows a negative relationship with output. This relationship connotes the fact that the higher the quantity of seed used for the cultivation of cabbage, the lower the output. The negative relationship of the seed input might be due to late planting of the seeds as well as incorrect spacing, which probably resulted in overcrowding thereby leading to competition for nutrients and consequently low yield. A similar negative result was obtained by Ogundare and Ojo (2007) in their work on an examination of technical, economic and allocative efficiency of small farms: the case study of cassava farmers in Osun State of Nigeria.

Agrochemical

The coefficient of the variable used in the production of cabbage in the study area shows a negative relationship with output. This negative relationship can be attributed to the quantity used, time and method of application which deviated from the traditional method. The negative sign implies that as agrochemicals used by the farmers increases, the quantity of cabbage produced decreases.

Fertilizer

Estimated coefficient for fertilizer used in the production of cabbage in the study area shows a positive relationship with output. The result implies that higher usage of fertilizer by the farmers brings about increased output of the crop. The input was not significant in the production of cabbage in the study area. This means that cabbage production may not require much fertilizer application for increased yield of the crop.

Family labour

Family labour had a positive relationship with output. The result shows that the use of family labour resulted in higher output of cabbage in the study area, although it was not significant in the production system. This is in line with the general opinion that labour adds significantly to output. This is obvious that labour is a vital factor of the production system, when it is not adequate and inappropriately used, it could result in low yield.

Hired labour

The hired labour coefficient is also positive and not significant as the family labour. The result also indicates that the use of hired labour amounts to higher output. Both family and hired labour were used optimally in the production process. The result shows that the use of hired labour contributed positively to the production process thereby resulting in higher yield of cabbage in the study area.

4.3.2 Determinant of technical inefficiency

This section reports of sources of inefficiency estimates (table 4.10). The results of the technical inefficiency of cabbage production in the study area show that various impacts were recorded. A negative value for the production inefficiency variable implies a positive effect on the technical efficiency and vice versa. Therefore, the positive estimated coefficient for age implies that older respondents tend to be more technically inefficient, because technical inefficiency tend to increase with age. This finding is consistent with studies by Awudu and Huffman (2000), Ojo (2003) and Kudi (2005). The implication of the result is that farmers who are about 50 years and above tend to put less strength on the farm thereby affecting yield and subsequently income negatively, while farmers that are younger work more on the farm thus affecting yield positively.

Years of experience in cabbage production shows an inverse relationship with technical inefficiency vis-à-vis positive relationship with technical efficiency. This inverse relationship indicates that more years dedicated to cabbage farming results in increased technical efficiency leading to higher output. Hence, cabbage farmers with less years of experience tend to be less efficient than those with higher years of cultivating cabbage.

The negative estimated coefficient for education implies that respondents with greater years of schooling tend to be more technically efficient, because technical inefficiency tend to reduce as schooling years increases. The coefficient of education is in line with the hypothesized expected sign. This is in consonance with the findings of Amaza and Tashikalma (2003) and Shehu and Mshelia (2007). The implication is that, with more years of formal education, new technologies could be better understood and adopted, which subsequently make it possible to move close to the production frontier. Education was found to be statistically significant at 5% level of probability for cabbage farmers in the study area. The significance of educational attainment implies that education is an important variable for cabbage production. This is because education facilitates adoption of innovation.

Coefficient for years of cooperative membership has a negative value. The negative effect of membership of cooperative society on technical inefficiency by the cabbage producers is an indication that those who belong to association tend to be more technically efficient than those who do not belong to cooperative association. Although, membership of cooperative was not significant, it is not in agreement with the expectation because belonging to association enhances efficiency among farmers as cooperative serve as a medium for information on input and output exchange to improve yield.

The coefficient for household size was negative in the model. An increase in the number of people in a household will lead to a decline in technical inefficiency of the farmers. Therefore, farmers with larger household sizes tend to be more technically efficient than

households with lesser people. This could be that farmers tend to substitute hired labour with family labour thereby, reducing the cost of production. In addition, household members may take instructions from their household head easily and followed to the advantage of the family. Moreover, these household members may have been working together for some time which could bring about specialization and effective use of productive resources.

The amount of credit received had a positive sign. This implies that amount of credit received by farmers tend to technical inefficiency. This could be attributed to the fact that most cabbage farmers in the study area did not have access to credit to enable them embark on real production and those who had credit got very small amount. This could be seen in the socio-economic analysis where more than 50% of farmers did not have access to credit. This variable limited their capacity to be efficient.

Number of extension visits had a positive coefficient. The positive sign of number of extension visits on the model of technical inefficiency for cabbage farmers in the study area signifies a reduction in technical efficiency with less contact of the farmers with extension agents. This also implies that more cabbage farmers extension contact will bring about increased technical inefficiency; resulting into lower output. This is against the general opinion concerning extension services which serves as the medium for educating farmers on new innovations before adoption of the technology. Where the extension services programme is not adequately designed to include a particular innovation, such contact with agents who are not duly knowledgeable about such technology could bring about reduced technical efficiency. Also, untimely delivering of

the extension services may give rise to lower efficiency as some information on specific innovation may not reach the target audience on time.

4.3.3 Allocative efficiency

In the cost frontier function (Table 4.12), the variance of the allocative model indicates positive and significant values for sigma squared designating the presence of a one-sided error component in the model. This is in conformity with the assumption of the stochastic frontier on error components. Similarly, the gamma coefficients were positive and statistically significant at 1% level of probability, thereby fulfilling the assumption of the model on presence of inefficiency factors. The gamma parameter estimate revealed that 77% of the variation in the total cost of producing cabbage in the study area by the farmers was due to changes in their cost efficiencies. This shows that cost inefficiency contribute significantly to the total cost of cabbage production in the study area. So the assumption that the parameter estimate of gamma = 0 is rejected. In the same manner, the log likelihood ratios of 47 for the respondents; exceeding the chi-square critical value at 1% level of probability with number of restriction (degree of freedom) of 9, shows the presence of allocative inefficiency. Thus, the assumption that the inefficiency effects are absent from the model, is hereby rejected.

Table 4.12: Estimates of stochastic frontier costs function

Variables	Coefficient	Standard Error	T – ratio

Cost function			
Constant	5.4624	0.4018	13.5958***
Cost of Planting material (₦)	-0.0034	0.0669	- 0.0505
Cost of Agrochemical (litres) (₦)	0.3318	0.0656	5.0588***
Cost of Fertilizer ₦)	0.0284	0.0079	3.5982***
Cost of Family labour (man-days) (₦)	0.0345	0.0102	3.3729***
Cost Hired Labour (man-days)(₦)	0.0656	0.0528	1.2423
Output (kg)	0.0356	0.0299	1.1893
Allocative efficiency model			
Constant	0.4286	0.2802	1.5299*
Age (years)	0.0024	0.0027	0.8757
Yrs of Experience in cabbage production (yrs)	0.0004	0.0027	0.1316
Years of cooperative membership (yrs)	0.0049	0.0116	0.4187
Gender (male =1; female = 0	- 0.0207	0.0076	- 2.7227***
Household size	- 0.0022	0.0150	- 0.1471
Amount of credit received (₦)	0.0554	0.0143	3.8793***
umber of extension visits	0.0255	0.0059	4.2972***
Sigma squared	0.0994	0.0147	6.7562***
Gamma	0.7654	0.3080	2.4853***
Log likelihood function		- 47.40	

*** = significant at 1%

** = Significant at 5%

* = Significant at 10%

Cost of planting material

The coefficient estimate for the cost of planting material shows an inverse relationship with allocative efficiency. This negative relationship implies that an increase in the cost of planting material will result in reduction of allocative efficiency. The variable is not significant to allocative efficiency. This insignificance is against the expectation; but it may be connected to the quality of the material.

Cost of agrochemicals

The cost of agrochemicals has a positive relationship with allocative efficiency. Increasing the cost of agrochemicals would result in increase in the total cost of production for cabbage farming in the study area. This emanated from the positive sign of the variable, indicating that a rise in the cost of agrochemicals can increase the total cost of cabbage production in the area. Hence, price of agrochemicals could affect production cost positively vis-à-vis income being negatively affected as a result of high production cost. Agrochemical cost was significant at 1% level of probability. This implies that allocative efficiency is significantly affected by the cost of agrochemicals incurred by the respondents.

Cost of fertilizer

The cost of fertilizer in cabbage production in the study area recorded positive estimated coefficient. The variable therefore contributes positively to the general allocative efficiency in cabbage production. This shows that cost of fertilizer have a direct effect on cost allocation. The positive relationship of this variable and allocative efficiency indicates that an increase in the cost of fertilizer will result in an increase in total cost of

producing cabbage by the farmers. Cost of fertilizer was found to be significant at 1% level of probability.

Cost of family labour

Cost of family labour recorded a positive sign against allocative efficiency. The result shows that cabbage production has a positive relationship with total cost of production. This means that an increase in the cost of family labour will bring about an increase in the total cost of production of cabbage in the study area. This could be so as labourer from the family may not be very knowledgeable to the farming practices and how to use the inputs effectively thereby leading to wastage of resources which can increase cost of production. The ability of a farmer to effectively manage resources depends on his knowledge on management practices.

Cost of hired labour

This variable shows a positive sign, indicating a positive impact on the total cost of production. Therefore, allocative efficiency tends to increase with increased total cost of production. The impact of cost of hired labour on cabbage production in the study area was not significant. This is possible because, hired labour could be substituted by family labour which is viewed as a cheaper source of labour, thereby affecting efficiency positively.

Output

The main aim of production is increased output to maximise profit through the sale of the crop. From the analysis, output recorded a positive value among the respondents.

The positive correlation indicates that cabbage contributed positively to the total cost of production; meaning that, increased output results to increased total cost of production. The effect of output on total cost of production is not significant. This may not be unconnected to the aim of cultivation by the cabbage farmers. It could be that they cultivate without minding the outcome of the output. The result of this research agrees with the findings of Ogundari et al. (2006) where they observed a positive effect of output on total cost of production in their study on economies of scale and cost efficiency in small scale maize production in Nigeria.

4.3.4 Allocative inefficiency

The age of the respondents was observed to be positively signed; signifying an inverse relationship with cost efficiency due to positive correlation with allocative inefficiency. The implication of this result is that as the age of the respondents increases, allocative efficiency will reduce by the value of the coefficient of the variable. This means that older cabbage farmers tend to allocate their inputs more inefficiently than their younger colleagues.

The coefficient of years of experience in cabbage production was positively related to cost inefficiency, indicating a positive effect on allocative inefficiency. This means that if cabbage farmers' farming experience increases, there would be a rise in the farmers' allocative efficiency. The positive relationship with allocative inefficiency is against the expectation, signifying that as farming experience increases, allocative inefficiency also increases. This effect could be that, as respondents' farming experience increases, strict adherence to methods of financial and resource allocation are consistently adhered to.

The probability level was not significant; this implies that the years of experience may not be very pertinent in the production of cabbage in the study area.

Years of belonging to a cooperative membership has a positive value for cabbage producers sampled, implying that it has positive effect on allocative inefficiency. This suggests that cost efficiency would be high for cabbage farmers who do not belong to a cooperative society. Belonging to a cooperative society enables the farmer to interact and share information with each other on farming and input sourcing. The sign of the coefficient estimate signifies that the members of the cooperative society tend to have higher cost inefficiency.

The variable, gender, possesses a negative sign for the production of cabbage in the study area. The variable was considered as a dummy where females where allotted 0, and the male assigned 1. The result from the respondents show that females are more cost efficient than their male counterpart. This could be plausible as females prefer using manual or family labour for operations like weeding, harvesting, which is considered as a cheaper source of labour than other means such as agrochemicals and hired labour. This could be attributed to the prudent nature of women in terms of income spending. The variable shows a 1% level of significance; implying that for the production of cabbage, sex is a factor determining allocative efficiency.

The value of the household size of sampled cabbage farmers' estimated coefficient was negatively signed; implying a negative effect on allocative inefficiency of the respondents. Cabbage farmers with larger household sizes tend to be more cost efficient

than their counterparts with smaller household sizes. This may be attributed to the cheap family labour and services sorted from the family members.

Number of extension visits estimated coefficient was positively related with allocative inefficiency of the respondents. Respondents with access to extension contact tend to be less cost efficient that their counterparts without extension contact. The result contradicts the assertion that extension agents serve as educators and information bearers on new innovations to clientele. It may be suggested that because cabbage farmers in the study area sort for information from various media, other than extension agents; hence, the extension agents' information is not seen as new. The variable was statistically significant at 1% level of probability, indicating the relevant extension contact in the study area.

4.3.5 Economic efficiency

The mean economic efficiency among the cabbage farmers in the study area was 0.42. This implies that the farmers are 58% inefficient in the production process as the efficiency level was put at 42% as shown in Table 4.15.

4.3.6 Return to scale analysis

The elasticities of production (farm size, fertilizer, family labour and hired labour) were positive decreasing function. The return to scale analysis is presented in Table 4.13. The return to scale of 0.93 implies that the production process is less efficient as production is expanded signifying a decreasing return to scale. That is at this stage, output is increasing by less than the proportional change in inputs.

Table 4.13: Elasticities and return to scale of the parameters of the stochastic frontier production function

Variable	Elasticities
Farm size	2.1091
Planting material	-0.5418
Agrochemical	-0.9134
Fertilizer	0.1522
Family labour	0.0840
Hired labour	0.0408
Return to scale	**0.9309**

4.4 Frequency Distribution of Technical, Allocative and Economic Efficiency of the Farmers

The frequency distribution of the technical, allocative and economic efficiency of cabbage producers in the study area were analysed and the results presented below.

Results of the technical efficiency distribution of the respondents show that technical efficiency of the farmers was concentrated at the efficiency class of 81 – 100 where 56% of the farmers fall into this category as shown in Table 4.14. This implies that the cabbage farmers' technical efficiency was high with a mean of 70%. This result is in conformity with the findings of Bifarin et al. (2010) where they indicated that about 72% of the plantain farmers in Ondo State were operating above 50% technical efficiency. The mean technical efficiency was 70%, this implies that if the average sampled farmer was to achieve the technical efficiency level of its most efficient counterpart, then the average farmer could realise a 30% cost saving i.e [1 – (70/100) x 100]. A similar calculation for the most technically inefficient farmer shows cost saving of 30.07% i.e [1 – (68.6/98.1) x 100]

Table 4.14: Distribution of technical efficiency of cabbage farmers

Class	Frequency	%
0 – 20	22	9.56
21 – 40	42	18.26
41 – 60	29	12.61
61 – 80	8	3.48
81 – 100	129	56.09
Total	230	100
Minimum	0.08	
Ximum	1.00	
Mean	0.70	
Std dev	0.32	

The predicted allocative efficiencies differ substantially among the farmers ranging from 0.17 – 0.91 with the mean allocative efficiency of 0.56 as reflected in Table 4.15. This implies that if the mean farmer in the sample was to achieve allocative efficiency level of its most efficient counterpart, then the average farmer could realize a38.46 percent cost saving i.e {1- (56/91) x 100}. A similar calculation for the most allocative inefficient farmer reveals cost saving of 81.32% i.e [1 – (17/91) x 100]

Table 4.15: Distribution of allocative efficiency of cabbage farmers

Class	**Frequency**	**Percentage**
0 – 20	2	0.87
21 – 40	40	17
41 – 60	96	41.74
61 – 80	76	33.04
81 – 100	16	6.96
Total	230	100
Minimum	0.17	
Maximum	0.91	
Mean	0.56	
Std dev	0.16	

The predicted economic efficiencies estimated as inverse of cost of efficiencies differs among the farmers, ranging between 0.03 – 0.91 with a mean economic efficiency of

0.42 as shown in table 4.16. This implies that if the average farmer in the sample area were to reach the economic efficiency level of its most efficient counterpart, then the average farmers could experience a cost saving of 54% i.e. [1 – (42/90) x 100]. The same computation for the most economically inefficient farmer suggests a gain in economic efficiency of 97% i.e. [1 – (3/91) x 100]

Table 4.16: Distribution of economic efficiency of cabbage farmers

Class	Frequency	%
0 – 20	60	26.07
21 – 40	41	17.83
41 – 60	67	29.13
61 – 80	56	24.35
81 – 100	6	2.61
Total	230	100
Minimum	0.03	
Ximum	0.91	
Mean	0.42	
Std dev	0.24	

4.5 Constraints to Cabbage Production

The constraints to beekeeping in the study area highlighted by the bee farmers were: inadequate fertilizer, inadequate credit facilities, insecurity, poor transportation network, and high cost of labour. Others were; diseases and pest, high cost of agrochemicals, marketing and storage problems (Table 4.17). Inadequate fertilizer was the major problem highlighted by farmers as about 40% of farmers complained of the inadequate supply of the input. Fertilizer is an important input that boosts yield of crops. If fertilizer is scarce, it will lead to high cost of the input and this will discourage peasant farmers from acquiring the commodity which will adversely affect productivity.

It could also lead to underutilization by the farmers, which might result to farmers reducing their farm holdings as a result of insufficient fertilizer caused by high cost of the input. Inadequate credit facilities was ranked 2nd as the problem confronting cabbage farmers in the study area. Farmers complained of the bureaucratic encumbrances in acquiring soft loans from the formal sector. Credit is important for the farmers to acquire needed inputs to boost production. Gross inadequate of this facility will limit farmers in acquiring the needed inputs and infrastructure in the production of cabbage. If this constraint is adequately tackled, cabbage production could be higher in the study area.

Insecurity was ranked 3rd among the constraints faced by farmers in cabbage production. Some years back (precisely in 2008), there has been renewed hostilities on the plateau between the 'indigenes' and the 'settlers' and this has adversely affected agricultural production in the area as farmers have been attacked on their farms. This has limited farmers to farming areas not too prone to attacks. Farmers find it difficult to go to their farms for fear of been attacked. This act has prevented some women and children from going to their farms and this has greatly hampered agricultural activities in recent times in the study area. If this problem is not tackled politically, it might lead to the short supply of cabbage and other exotic vegetables as the plateau is the main area for producing these commodities in the country. Poor transportation network was ranked 4th, farmers find it difficult transporting their produce from production site to the market as they complained of bad road network in the study area. This implies that some of the cabbage produce might get spoilt in the store or on their way to the market. Some of the respondents also complained of the mode of transporting the commodity to the market. Vehicles with open roof are sometimes used in transporting the cabbage

thereby opening up the produce to direct sunlight which reduces the shelve life. The roads are also in bad shape and sometimes the vehicle conveying the produce to the market get stuck or fall off the road leading to loss of the commodity.

Table 4.17: Constraint of cabbage production

Constraint	**Frequency**	**Percentage**	**Ranking**
Inadequate fertilizer	91	39.56	1st
Inadequate credit facilities	51	22.17	2nd
Insecurity	23	10	3rd
Poor transportation network	21	9.13	4th
High cost of labour	18	7.83	5th
Diseases and pest	9	3.91	6th
High cost of agrochemicals	8	3.48	7th
Marketing problem	5	2.17	8th
Storage problem	4	1.74	9th
Total	**230**	**100**	

High cost of labour was ranked as the 5th problem farmers' face in producing cabbage in the study area. This could suggest that available labour is insufficient or farmers do not have finance to hire labour to work on their farms. This could be that most energetic youths have migrated out of the area in search of white-collar jobs. It could also be that the insecurity being witnessed in the area is not encouraging labourers to go to the farm to work for fear of being attacked by the perceived enemies. Diseases and pests was ranked 6th among the respondents. The ranking shows the adverse effect of diseases and pest on the crop in the study area. The effect can reduce the amount of profit realized by the farmers as much of the finance is used in the tackling of the menace. The effect of diseases and pest could result to crop losses leading to food insecurity and poor health among the farming households. In addressing this problem, the farmers may be investing on agrochemicals with their low financial position, thereby further degrading their living standard. High cost of agrochemicals was ranked 7th by the respondents. This collaborate the diseases and pests constraint. With high cost of agrochemicals,

farmers will be unable to purchase enough chemicals to off-set the diseases and pests infestation in the study area. This will subsequently have an adverse effect on output. The constraint ranked 8th by the farmers was marketing problem. Market pricing is a factor that encourages production. The main aim of production is for consumption and sale. If the market price is poor, it brings about low profit margin leading to low standard of living among farmers. The production of cabbage depends on the market price which serves as a motivating factor to farmers. If the price is low, it dampens the morale of the farmer and could lead to low production. The least of the farmers problems was storage which was ranked 9th. Farmers lack storage facilities in storing the cabbage after harvest. The produce is been stored in a small room which hardly contains all the harvest at a time. For this reason, cabbage are placed on one another, an act which facilitate spoilage.

CHAPTER FIVE

SUMMARY, CONCLUSION AND RECOMMENDATIONS

5.1 Summary

Cabbage is a vegetable that belong to the exotic vegetable group. It is termed exotic because its origin is foreign to Nigeria and it thrives best in temperate regions of the world. In Nigeria, it is predominantly cultivated on the plateau because the plateau has a weather condition similar to what holds in the temperate regions like Europe and America. Other exotic vegetable grown on the plateau include cucumber, carrot and lettuce. This study titled "Analysis of Economic Efficiency of Cabbage farmers in Plateau State" was conducted with the major aim of determining the profitability of the crop on the plateau. Other objectives of the study are; to describe the socio-economic characteristics of cabbage farmers in the study area, assess determinants of productive and economic efficiency, and to describe the constraints militating against cabbage production in the study area.

This study was conducted in Plateau State because of the intensiveness of cabbage production in the area. A multi-stage sampling technique was used to select respondents for this study. Three Local Government Areas namely: Jos North, Jos South and Riyom Local Government Areas of Plateau State were purposively selected for field survey. These three Local Government Areas were chosen for the survey because these are the areas where the exotic vegetables are predominantly produced in Plateau State because of its peculiar temperate weather condition. The second stage involved a random selection of two villages from each selected LGA. The villages are: Naraguta and Yelwa from Jos North, Zawan and Kuru from Jos South; and Riyom and Ta hoss from

Riyom. A total of 230 cabbage farmers were randomly selected from a sample frame of 2330. The sample frame was got from a preliminary survey to the Agricultural Development Programme (ADP) in Plateau State. Primary data were collected from the exotic vegetable farmers. The primary data were generated through interviews using structured questionnaires which were administered to the exotic vegetable farmers to source for information that best address the objectives of the study based on the 2013 farming season. The analytical tools used in capturing the objectives of the study were: descriptive statistic, stochastic frontier production function and gross margin.

Results of the socio-economic characteristics show that 62% of the cabbage farmers were male while 38% were female. The analysis revealed that males were more involved in cabbage production than females which may not have access to land which can hinder their involvement in cabbage production. Result revealed that the average age of the cabbage farmers was 39 year with 86% of the farmers in the active age range of 21 – 50 years. This shows that the mean age is still very much active and can positively influence the level of cabbage production in the study area. The educational status of the respondents shows that 27% of the cabbage farmers had primary education, while 64% had secondary education. Four percent (4%) had tertiary education while only 5% had no formal education. The high level of literacy in the study area implies that the respondents are willing to accept and adopt innovations brought to them by extension agents which will positively affect their productivity and subsequently, income. The household size analysis show that 58% of respondents had a family size of 6 – 10 persons, followed by a household range of 10 – 15 representing 22% of the total farmers, while 12% of the respondents had a household size of between 1 – 5 persons. Only 8% of the farmers had a family size greater than 15 persons. The mean household

size was 9 persons inferring that family labour could be a ready source of labour on the respondents' farm. About 58% of the farmers had been engaged in cabbage production for between 5 – 15 years, while the average years of experience was 10 years. The average farm size of farmers was 2 hectares, while 77% of farmers had farm sizes ranging from 1 – 5 ha. About 76% of respondents acquired their land by inheritance while 14% purchased their land for farming. About 10% rented, leased or hire their land. This implies that majority of the farmers were indigenes of the area. About 53% of the farmers had no access to credit, while only 5% had access to formal credit. This implies that credit from formal institutions to farmers in assisting to boost productivity is still discouraging. About 45% of the farmers were not visited by extension workers, a trend most likely to hamper the use of modern technology in food production.

The technical efficiency analysis revealed that farm size was significant and positive, implying that the higher the sizes of the farms, the higher the output of cabbage in the study area. Estimated coefficient for fertilizer used in the production of cabbage in the study area shows a positive relationship with output. The result implies that higher usage of fertilizer by the farmers brings about increased output of the crop. The quantity of planting material showed a negative relationship with output. This implies that the higher the quantity of planting material used for the cultivation of cabbage, the lower the output. This though is against the apriori expectation.

Age, amount of credit received and number of extension visits were positively related to output. The result indicates that higher usage of any of these variables by the cabbage producers would bring about increased output of the crop; whereas years of experience in cabbage production, education, years of cooperative membership, gender and

household size showed negative relationship with output. Education was found to be significant, meaning it is relevant in the production of the crop.

The technical inefficiency of cabbage production in the study area shows that coefficients of years of experience in cabbage production, education, years of cooperative membership, gender and household size where negative. Increase in any of these variables will result to increase in technical efficiency. This implies that a male respondent with greater experience in cabbage production, with more education, and greater household size tend to be more technically efficient than those with less experience in cabbage production and less education and lower household size.

The allocative efficiency result revealed that cost of agrochemical, cost of fertilizer and cost of labour (both family and hired) showed positive estimated coefficients for cabbage production in the study area. The variables therefore contributed positively to the general allocative efficiency of cabbage production. The positive relationship of these variables and allocative efficiency indicates that an increase in the cost of these variables, will result to an increase in total cost of producing cabbage by the farmers. This means that if farmers increase the use of any off these variables, the total cost of producing cabbage would increase as well. Conversely, the addition of the cost of planting material will reduce total cost of producing cabbage in the study area. In allocative efficiency, cost of agrochemical, cost of fertilizer and cost of family labour were significant at 1% level of significance for the cabbage farmers.

The allocative inefficiency of the cabbage producers depends on gender, amount of credit received and number of extension visits as they were significant in the model.

This means that farmers with these variables will allocate resources inefficiently in the production of cabbage. Whereas, household size negatively affects allocative inefficiency; therefore, farmers with large family size are likely to be more efficient in the cost allocation of resources.

The cost-return analysis (profitability analysis) revealed that the average gross farm income realized by the farmers in the study area was ₦175,000 per hectare Thus, the gross margin computed was ₦118,900. Fertilizers recorded the highest variable cost of ₦13,500 representing 24% of the total cost of production. This implies that fertilizer is the most sought after of the inputs in cabbage production in the study area. The results show that cabbage production in the study area is profitable to the tune of ₦118,900 per hectare.

Cabbage production was not without constraints in the study area. Respondents were mostly affected by inadequate fertilizer as a major constraint. Other constraints according to the farmers in other of descending ranking were: inadequate credit facilities, insecurity, poor transportation network and high cost of labour. Others are diseases and pest, high cost of agrochemicals, marketing and storage problems. Insecurity was ranked 3rd among the constraints faced by farmers in cabbage production. This has limited farmers to farming areas not too prone to attacks. Farmers find it difficult to go to their farms for fear of been attacked. This act has prevented some women and children from going to their farms and this has greatly hampered agricultural activities in recent times in the study area. Diseases and pests was ranked 6th among the respondents. The ranking shows the adverse effect of diseases and pest on the crop in the study area. The effect can reduce the amount of profit realized by the

farmers as much of the finance is used in the tackling of the menace. Marketing and storage problems were ranked 8th and 9th respectively. If the market price is poor, it brings about low profit margin leading to low standard of living among farmers.

5.2 Conclusion

Based on the findings of this study, it is concluded that cabbage production is profitable in the study area. The size of the farm was found to be significantly related to the technical efficiency of the farmers. Deliberate policy to enable willing farmers acquire more land should be put in place to boost the production of cabbage. Results from the study also revealed that cabbage production in the study area is averagely economically efficient. The major socio economic characteristics that positively influenced technical efficiency of cabbage production in the study area were: age, years of experience in cabbage production and household size. Fertilizer was the major farm input sought after by farmers.

5.3 Recommendations

Cabbage production in the study area, though profitable, was not without some technical and social challenges. If these constraints are effectively tackled by necessary agencies, cabbage farmers will be more economically efficient in their production and this will enhance their income level which will subsequently uplift their living standard. It is in line with this that the following recommendations are hereby proffered:

i. Fertilizers should be made available at affordable prices by policy makers in the state as this was the major problem adduced by farmers. The use of organic fertilizers should also be encouraged by the State's Ministry of

Agriculture. Training on the use of compost manure can be taken to the farmers through extension agents.

ii. Sustainable credit facility can be provided to farmers through partnership with formal financial organizations. The credit warrantee system can be introduced in the study area where loans are being granted to farmers at the beginning of the planting season to carry out farming activities. After harvest, farmers store their commodity in a warehouse and the credit organization and the farmers both have access to the store. Both parties organize for the sale of the produce and the income is shared according to agreement. This method is being practiced in other West African Countries such as Cote d'ivoire and Niger and it has been successful.

iii. Security should be beefed up on the plateau as this will restore confidence to the farmers in accessing and carrying out farming activities on their farms. Political means of resolving the insecurity issue should also be exploited.

iv. Good road networks should be provided by the government (State or Federal, where applicable) to aid easy movement of farm produce to the designated location.

v. The extension agents can involve the non-governmental organizations through partnership with them in facilitating trainings on the use of improved technologies in crop production and also bringing farm inputs such as fertilizers to the farmers at a subsidized rate.

vi. Training on the use of organic manure can be sponsored by donor agencies in the country. This can be facilitated by the state's Agricultural Development Authorities (ADPs). This will go a long way in ameliorating

the crave for inorganic fertilizers which are scarce and expensive and add significantly to the cost of production.

5.4 Contribution to Knowledge

i. The study contributed to the body of knowledge by revealing that cabbage farmers in the study area are 70% technically efficient. However, there is still room to increase the level of technical efficiency by 30% through adopting technologies used by the frontier farmers.

ii. The study shows that the mean allocative efficiency of an average cabbage farmer in the study area was 56%. This implies that about 44% of the excess cost of production can be saved by efficient allocation of resources

iii. Results from the study further reveal that an average cabbage farmer in the study area had an economic efficiency level of 42%

iv. The gross margin analysis shows that cabbage production in the study area is profitable to the tune of N118,900 per hectare

v. The return to naira invested was 2.12, which implies that for every ₦1 invested in cabbage production in the study area, a farmer makes a profit of ₦2.12K

vi. The average farm size for cabbage production in the study area was 2.0ha. Implying that cabbage production in the study area is predominantly carried out by small scale farmers.

5.5 Limitations of the Study

The survey experienced several problems which are common to many fieldwork experiences. The most serious problems were:-

i) Poor records keeping by the farmers – The habit of farm records keeping was poorly practiced by the farmers, even though only 5% had no formal education (Table 4.3). All the farmers interviewed provided the needed information from memory.

ii) Very few studies were carried out on economics of cabbage production in Nigeria, so there were very little results to compare with in terms of the findings of this study.

REFERENCES

Abang, S.O, E. Ekpeni and W.W. Usani (2001). Technical and Allocative Efficiency of Small Scale Cassava Growers in Five Selected Local Government Areas of Cross River State. *Global Journal of Applied Science*. 7(1):11-13

Abdourahamane, T; E.B. Bravo-Ureta, and T.E. Rivas (2001). Technical Efficiency in Developing Country Agriculture: A Meta-Analysis. *Journal of Agricultural Economics*. 25:235-243.

Adebayo, E.F. (2005). Application of Goal Programming to Resources Allocation Behavior ofDairy Producers in Adamawa State, Nigeria.*Journal of Sustainable Development in Agriculture and Environment* 1 (1):60–69.

Adegeye, A.J. and Dittoh, J.S. (1985).*Essentials of Agricultura*l *Economics.* Impact Publishers, Ibadan, Nigeria, pp.71.

Adeniyi, J.A. (1988). Farm Size and Resource-use Efficiency in Peasant Production of Rice. *The Nigerian Geographical Journal*, 30: 98-101.

Adeoti, A.I. (2002) Economic analysis of irrigation and rainfed production systems in Kwara state, Nigeria. Unpublished PhD thesis, Department of Agricultural Economics, University of Ibadan.

Adubi, A. A. (1992). An Empirical Analysis of Production Risks and Attitudes of Small Farmers in Oyo State, Nigeria.Unpublished Ph.D Thesis, University of Ibadan, Nigeria.

Agricultural Research Council of Nigeria (2010). Strategic Plan 2011 – 2020. Agricultural Research Council of Nigeria, Federal Ministry of Agriculture and Rural Development.

Agriinfo (2015). Agriculture Information Bank. Agriinfo.in/default.aspx

Aigbokhan, B.E. (2000); Poverty, Growth and Inequality in Nigeria: A Case Study. African Economic Research Consortium (AERC) pp 1-4

Aigner, D.I.C., Lovell, A.K. and Schmidt, P., (1977). "Formulation and estimation of stochastic frontier production function models." *Journal of Econometrics* 6:21-37.

Ajewole O.C. (2015). Income and Factor Analysis of Watermelon Production in Ekiti State, Nigeria.*Journal of Economics and Sustainable Development.* 6 (2) 67-73.

Ali, M., U. Farooq, and Y.Y. Shih (2002): Vegetable research and development in the ASEAN region:a guideline for setting priorities. ln: C.G. Kuo (ed). Perspectives of ASEAN cooperation in vegetable research and development. Shanhua, Taiwan: Asian Vegetable Research andevelopmentCenter. p. 20-64.

Alimi, T. (2000).Resource-use Efficiency in Food Production in Oyo State of Nigeria. *Journal of Agriculture and Environment.* 1:1-7.

Amaza, P.S. (1999).Farmers Socio-economic Factors and Efficiency in Food Crop Production in Gombe State, Nigeria. *Nigerian Journal of Rural Economy & Society,*1: (5) 18-19.

Amaza, P.S. and A.K. Tashikalma, 2003.Technical efficiency of groundnuts production in Adamawa State, Nigeria.*Journal of Arid Agriculture*. 13: 127 - 131

Amaza, P.S. and Olayemi, J.K. (2002).Analysis of Technical Inefficiency in Food Crop Production in Gombe State, Nigeria.*Applied Economic Letters,* 9: 51-54.

Anselm A.E. and Ubokudom E.O. (2010).Economics of Waterleaf (Talinum triangulare) production in Akwa Ibom State, Nigeria.*The Journal of Field Actions.Field Actions Science Reports*. 4:1-2

Apata T.G., Folayan A., Apata O.M. and Akinlua J. (2011). The Economic Role of Nigeria's Subsistence Agriculture in the Transition Process: Implications for Rural Development. 85th Annual Conference of the Agricultural Economics Society Warwick University.

AsiaFarming (2015). Cabbage cultivation: Cabbage farming information guide. www.asiafarming.come

Asogwa, B.C, J.C. Umeh and P.I. Ater (2007).Technical Efficiency Analysis of Nigeria Cassava Farmers.A Guide for Food Security Policy.Proceedings 9th Annual National Conference for National Association of Agricultural Economics (NAAE). 5th-8th November, 2007.

Awolola, M.D. (1995). Education and Farmers Motivation: Case of Five Villages in Zaria Area of Kaduna State. *Journal of Rural Development and Administration,* 27, (2) 1-12.

Awudu, A. and Huffman, W. (2000). "Structure adjustment and Economic Efficiency of Rice Farmers in Northern Ghana" *Economic Development and Cultural change.* 503 – 519.

Azih, I. (2008). A Background Analysis of the Nigerian Agricultural Sector (1998 to 2007). OXFAM NOVIB Economic Justice Campaign in Agriculture Report.Pp 49

Badmus, M.A. and Yekinni, T.O. (2011).Economic Analysis of Exotic Vegetable Production among Urban Fadama Women Farmers in Akinyele Local Government Area of Oyo State, Nigeria.*International Journal of Agricultural Economics and Rural Development,* 4(1): 21. Retrieved April 30, 2013 from: www.lautechaeeedu.com/journal/ijaerd5/ijaerd5-3.pdf.

Bareje, B.G. (2015). The different types of vegetables.www.cropsreview.com

Battese G.E and Coelli T. J. (1988). Prediction of firm-level technical efficiencies with a generalized frontier production function and panel data. Journal of

Econometrics 38: 387 – 399

Battese, G. E. and Corra, G. S. (1977). "Estimation of a Production Frontier Model with Application to the Pastoral Zone of Eastern Australia."*AustralianJournal of Agricultural Economics*.21 : 169 – 179.

Bewick, A.T (1994), Cabbage diseases and Production, University of Florida Cooperative Extension Service, Fact sheet HS-712

Bifarin, J.O., Alimi, T., Baruwa, O.I. and Ajewole, O.C. (2010).Determinant of Technical, Allocative and Economic Efficiencies in the Plantain (Musa spp.) Production Industry, Ondo State, Nigeria. Proceeding of International Conference on Banana and Plantain in Africa, Edited by T. Dubois et al. Acta Hort. 879, 199-210

Bravo-Ureta, B.E; Boris, E. and Pinheiro, E.A. (1997). "Technical, Economic and Allocative Efficiency in Peasant Farming: Evidence from the Dominican Republic". The Development Economics, 35(1): 48-67. In Maurice, D.C. (2011). Mathematical Models Used in Agricultural Production, Efficiency Studies-A Review.Unpublished Ph.D Non-Thesis Seminar Sumitted to the Department of Agricultural Economics and Extension, School of Agricultural and Agricultural Technology, Moddibo Adama University of Technology, Yola, Nigeria.Pp. 4.

Centre for Efficiency and Productivity Analysis (CEPA, 2003). Short Course on Production Economics, Productivity and Efficiency Measurement, Centre for Efficiency and Productivity Analysis (CEPA) New England. Pp 634: In Erhabor, P. O. and Emokaro, C. O. (eds) *Comparative Analysis of Marginal Productivity and Efficiency of Resource-use among Cassava Farmers in Edo State: A Mitigation Measure against Food Crisis*: Proceedings of the 10th Annual National Association of Agricultural Economics (NAAE), Held at 750 Seater Lecture Theatre Main Campus, University of Abuja- Nigeria pp. 58-64.

Coelli, T.J. (1994). A Guide to Frontier Version 4.1: A Computer Programme for Stochastic Frontier Production and Cost Function Estimation. Department of Econometrics, University of New England, Armidale, NSW 2351. Australia.

Coelli, T.J; Rahaman, S. and Thirtle, C. (2002). Technical Allocative, Cost and Scale Efficiency in Bangladesh Rice Cultivation: A non-parametric approach. *Journal of Agricultural Economics,* vol.53 pp.607-626.In Maurice, D.C. (2011). Mathematical Models Used in Agricultural Production, Efficiency Studies-A Review. Unpublished Ph.D Non-Thesis Seminar Sumitted to the Department of Agricultural Economics and Extension, School of Agricultural and Agricultural Technology, ModdiboAdama University of Technology, Yola, Nigeria.Pp. 3.

EarthClinic(2008). Folk Remedies and HolisticCures.Http//www.earthcliniccabbagecures.com. Retrieved 10th March 2008

Employment-oriented Private Sector Development Programme (2010). A Profile of the Plateau State Economy.Baseline Survey Report.Business Development Services/Value chain development.Conducted by GOPA Consultants GmbH. Hindenburgring 18, D-61348 Bad Homburg.

Erhabor, P.O. and Emokaro, C.O. (2008).Comparative Analysis of Marginal Productivity and Efficiency of Resources-use among Cassava Farmers in Edo State. A Mitigating Measure Against Food Crisis; Proceedings of the 10th Annual National Conference of the National Association of Agricultural Economics, Held at 750 Seater Lecture Theatre Main Campus, University of Abuja-Nigeria pp. 58-64.

Erhabor, P.O. and Emokaro, C.O. (2008).Comparative Analysis of Marginal Productivity and Efficiency of Resources-use among Cassava Farmers in Edo State. A Mitigating Measure Against Food Crisis; Proceedings of the 10th Annual National Conference of the National Association of Agricultural Economics (NAAE), Held at 750 Seater Lecture Theatre Main Campus, University of Abuja-Nigeria pp. 58-64.

FAO. 1988. Traditional Food Plant. Food and Agricultural Organization of the United Nations, Rome, Italy.

FAO (2013) (Corporate Document Repository). Fruits and Vegetables: An Overview on Socio-Economic and Technical Issues. Retrieved on April 30, 2013 from: www.fao.org/docrep/005/Y438e04.htm

Farrell, M.J. (1957). The Measurement of Productivity Efficiency, *Journal of Royal Statistics Society,* Series A. (General) 120:253-281.

Giroh, Y. (2007). Analysis of Technical Efficiency of Rubber Tapping in Rubber Research Institute Benin City, Edo State, Nigeria. An Unpublished M.Sc. Thesis Submitted to the Department of Agricultural Economics and Extension, School of Agriculture and Agricultural Techology, Federal University of Technology Yola. Pp.17-19.

Giroh, D.Y., Umar, H.Y., Nudamatiya, A.B and Moses, J. (2008). Analysis of Profitability and Technical Efficiency of Rubber Latex Production in Southern Nigeria: An Implication for Tree Crop Research: 10th Proceedings of the Annual National Conference of the National Association of Agricultural Economics (NAAE), Held at 750 Seater Lecture Theatre Main Campus, University of Abuja, Nigeria. pp.127-135.

Gittinger, J.P. (1982). Economic Analysis of Agricultural Projects, Second Edition, A World Bank Publication, the John Hopkins University Press, Baltimore and London

Grubben GJH. and Denton OA. 2004. Plant resource of Tropical Africa and vegetables.PROTA foundation, Wageningen, Netherlands / Backlmys Publishers, Leiden,Netherlands / CTA Wageningen, Netherlands.668 pp.

Haruna, U. (2003). Strategic Options for Profitable Marketing of Fadama Crops. A paper presented at the MTRM, SAPD Headquarters, Bauchi. February 17 – 18. Pp 8

Heady, E.O. (1952).*Economics of Agricultural Production and Resource-use*.Prentice Hall New Jersey.In Maurice, D.C. (2011). Mathematical Models Used in Agricultural Production, Efficiency Studies-A Review. Unpublished Ph.D Non-Thesis Seminar Sumitted to the Department of Agricultural Economics and Extension, School of Agricultural and Agricultural Technology, ModdiboAdama University of Technology, Yola, Nigeria.Pp.4.

Hugues, D. and Phillippe D.L. (1995).*African gardens and orchards growing vegetables and fruits*. Alphabet publishers, Owerri.

Ibeawuchi, I.I., Okoli, N.A., Alagba,R.A., Ofor,M.O., Emma-Okafor, L.C., Peter-Onoh, C.A andObiefuna, J.C. (2015).Fruit and Vegetable Crop Production in Nigeria: The Gains,Challenges and The Way Forward. *Journal of Biology, Agriculture and Healthcare,* 5 (4): 194-208

Ibekwe, U,C. and Adesope, O.M. (2010). Analysis of dry season vegetable production inOwerriWest Local Government Area of Imo State, Nigeria. *Journal of Development and Agricultural Economics,* 2(6): 245-249

Ibrahim, U W (2011): Analysis of Production Efficiency and Profitability of Watermelon in Kaga and Kukawa Local Government Areas of Borno State, Nigeria. An unpublished M.Sc Dissertation submitted to the Department of Agricultural Economics and Rural Sociology, Ahmadu Bello University, Zaria, Nigeria.

Ibrahim, N.D. (2005). Insect infestation and control of thrips in onion in Sokoto State, Nigeria. An unpublished Ph.D. thesis submitted to the Department of crop protection, faculty of Agriculture, University of Ilorin, Ilorin, Nigeria.

Imoudu, P.B. (1992). Maize Production and Marketing in Ondo State: An Unpublished M.Sc. Thesis, Federal University of Technology Akure, Ondo State.

Jim M. and Tony N. (2006).*Cabbage growing Primefact 90 (replaces AGFACT. H8*). 1.27. NSW Department of primary Industries (publ) Pp 1 - 7.

Jondrow, J., C.A.K. Lovell, I.S. Materov and P. Schmidt (1982). The Estimation of Technical Inneficiency in the Stochastic Frontier Production Function Model, *Journal of Econometrics* 19, 233-238.

Joshi, P.K., A Gulati, P.S. Birthal and P.P. Rao (2003): Agricultural diversification in India.

Jyanya B.A., Dawang N.C., Zarmai D.U. and Mashat I.M. (2014).Economic Analysis of Irrigated Irish Potato Production in Plateau State.*Developing Country studies* 4(12) 80-86

Kalirajan, R.J. and Shand, R.T. (1994).Economics in Disequilibrium.An Approach from the Frontier.Macmillan Ltd. India.In Maurice, D.C. (2011). Mathematical Models Used in Agricultural Production, Efficiency Studies-A Review. Unpublished Ph.D Non-Thesis Seminar Sumitted to the Department of Agricultural Economics and Extension, School of Agricultural and Agricultural Technology, ModdiboAdamu University of Technology, Yola, Nigeria. Pp. 2-3

Kudi, T. M. (2005). "Economic Analysis of Sesame Production and Marketing in JigawaState".Unpublished Ph.D. Thesis, Department of Agric. Economics and RuralSociology, A. B. U., Zaria, Nigeria.

Kumbhakar, S.C. and Lovell, C.A.K. (2003). "*Cross-Sectional Production Function Models*", *Stochastic Frontier Analysis*, Cambridge University press p.65

Lawal, R.(1998). Adoption of Recommended Pest and Diseases control techonologies in vegetable crops among farmers in SabonGari L.G.A, Unpublished B.Agric Research project. Ahmadu Bello University, Zaria.

Lewis, I. (1997). Network vegetable production Africa: its contribution to conservation and use of traditional vegetables, in Traditional African Vegetables. Proceedings of the IPGRI International Workshop on Genetic Resources of Traditional Vegetables in Africa. Pp. 159 – 160

Manyong, V.M., Ikpi, A., Olayemi, J.K., Yusuf, S.A., Omonona, B.T., Okoruwa, V. andIdachaba, F.S. (2005). Agriculture in Nigeria: identifying opportunities for increased commercialization and investment. IITA, Ibadan, Nigeria.Pp 159.

Maurice, D.C. (2012). Optimal Farm Plan and Resource Allocation in Food Crop Production in Adamawa State, Nigeria. Unpublished Ph.D Thesis submitted to the Department of Agricultural Economics and Extension, School of Agriculture and Agricultural Technology. ModibboAdamaUnversity of Technology, Yola. Pp. 11-19.

Maurice, D.C. (2011). Mathematical Models Used in Agricultural Production, Efficiency Studies-A Review. Unpublished Ph.D Non-Thesis Seminar Sumitted to the Department of Agricultural Economics and Extension, School of Agricultural and Agricultural Technology, ModdiboAdamu University of Technology, Yola, Nigeria. Pp.6-7.

Maurice, D.C., Amaza, P.S. and Tella, M.O. (2005).Analysis of Technical Inefficiency in Rice-Based Cropping Patterns among Dry Season Fadama Farmers in Adamawa State, Nigeria.*Nigeria Journal of Tropical Agriculture*, Vol. 7, Published by School of Agriculture and Agricultural Technology, Federal University of Technology, Yola.

Meesusen, W., Broeck, V.D., (1977). Efficiency estimation for Cobb-Douglass production function with composed error. International Economic Review 18:435-444.

Metz, H.C. (1991). Nigeria: A Country Study. Washington: GPO for the Library of Congress. www.countrystudies.us/nigeria

Minot, N. and M. Ngigi (2004): Building on successes in African agriculture: are Kenya's horticultural experts a replicable success story?" IFPRI Focus 12, Brief 7 (April). Washington D.C.: International Food Policy Research Institute.

Mofeke A.L.E., Ahmada A. and Mudiane O.J. (2003).“Relationship between yield and seasonal water use for tomatoes, onions, and potatoes grown under fadama irrigation”. Asset Series A. 3:35-46.In Busari, A.O., Idris-Adeniyi, K.M and Oyekale, J.O (2012).Economic Analysis of Vegetable Production by Rural Women in Iwo Zone of Osun State, Nigeria.*Journal of Agricultural Sciences*Vol. 3(1):6-8

Motherland Nigeria (2010).Agriculture and Animals. www.motherlandnigeria.com/index.html

National Bureau of Statistics (2012).Nigeria Poverty Profile 2010. www.nigerianstat.gov.ng

National Bureau of Statistics (2006a).National Abstract of Statistics. www.nigerianstat.gov.ng

National Bureau of Statistics (2006b).Federal Republic of Nigeria.2006 Population Census.www.nigerianstat.gov.ng

Oaikhena, I.F. (2005). Land Productivity Differential and Resource use Efficiency by Food Crop Farmers in the Niger Delta Area of Nigeria. Second Seminar Paper Presented at the Department of Agricultural Economics University of Ibadan.

Ofuoku A.U., Idoge D.E. and Ovuigho B.O. (2014). Child Labour in Agricultural Production and Socioeconomic Variables among arable farming households in Nigeria. *Journal of Rural Social Science.* 29 (2) 67 – 81.

Ogbodo, E.N., Okorie, P.O. and Utobo, E.B. (2009).Evaluation of the Adaptability of Cabbage (*Brassica oleracae*L. Var. Capitata) to the Agro-Ecology of Ebonyi State, Southeastern Nigeria.*International Journal of Sustainable Agriculture* 1 (2):41-48

Ogedegbe, S. A. and Law-Ogbomo, K. E. (2013).Growth and yield of cabbage (*brassica oleracea*l.) as influenced by poultry manure and NPK application.*Nigerian Journal of Agriculture, Food and Environment.* 9(4):19-24

Ogundari, K. 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):125-130

Ogundari, K. and Ojo, S.O. (2006). “An Examination of Technical Efficiency and Allocative Efficiency of Small-Scale Farmers: The Case Study of Cassava Farmers in Osun State of Nigeria”. J. Cent Eur. Agric 7 (3): 423-432: In: Omotosho, O. A; Mohammed Lawal, A. and Falola A. (eds.) *Technical Efficiency of Youth Participation inAgriculture; A Case Study of the Youth in Agriculture Programme in Ondo State, Nigeria.* 10th Annual National

Conference of Nigerian Association of Agricultural Economics (NAAE) held at 750 Seater Lecture Theatre, University of Abuja-Nigeria.

Ogundari, K., Ojo, S.O. and Ajibefun, I.A. (2006). Economics of Scale and Cost Efficiency in Small Scale Maize Production: Empirical Evidence from Nigeria, Journal of Social Science, vol. 13, No.2, pp.131-136. In Maurice, D.C. (2011). Mathematical Models Used in Agricultural Production, Efficiency Studies-A Review. Unpublished Ph.D Non-Thesis Seminar Submitted to the Department of Agricultural Economics and Extension, School of Agricultural and Agricultural Technology, ModdiboAdama University of Technology, Yola, Nigeria. Pp. 3.

Ogunjobi O.P. (1999). Efficiency of Smallholder Cocoa Farmers in Ondo State:A Stochastic Frontier Analysis. M.Sc Thesis, Unpublished, Federal University of Technology, Akure.

Ojehomon, V. E. T., Adebayo, S. B., Ogundele, O. O., Okoruwa, V. O. Ajayi, O., Diagne, A. and Ogunlana, O. (2009). Rice Data Systems in Nigeria, Building Rice Data System for Sub-Saharan Africa.A National Rice Survey Report.Pp 78.

Ojo, S.O. and Imoudu, P.B. (2000). Productivity and Technical Efficiency: A Comparative Analysis of Oil-Palm Farms in Ondo State, Nigeria.

Ojo, S. O. (2003). "Productivity and Technical Efficiency of Poultry Egg Production in Nigeria". *International Journal of Poultry Science.* 2(6):459 – 464

Olasanta, F.O., E.A. Makinde and A.W. Salau (2009).Lectuer Note, HRT 501: Vegetable Crops Production, Department of Horticulture, College of Plant Science and Crop Production, University of Abeokuta, Ogun State, Nigeria. Pp.1-5. Retrieved on May 4, 2013 from: www.unaab.edu.ng/attachments/482_HRT501.pdf

Olayide, S. O. and Heady E.O. (1982).*Introduction to Agricultural Production Economics*. University Press, Ibadan.

Olukosi, J.O. and Erhabor, P.O. (1988).*Introduction to Farm Management, Economic Principles and Applications*.Agitab Publishers Ltd, Samaru, Zaria. pp. 48-53.

Omeh, D. (2012). Commercial vegetable farming in Nigeria.www.wealthresult.com

Omonona, B.T. (2003). Efficiency of Resource use in Cassava Production in Kogi State, Nigeria: Implication for Food Security and Environmental Degradation. Journal of Environmental Extension. Vol. 4, pp. 13-17.

Omotesho, O.A. Muhammed-Lawal, A. and Falola, A. (2008).Technical Efficiency of Youth Participation in Agriculture. A Case Study of the Youth in Agricultural Programme in Ondo State: 10th Annual National Conference of the National Association of Agricultural Economics (NAAE), Held at 750 Seater Lecture Theatre Main Campus University of Abuja, Nigeria. pp. 98-105.

Oni O., Ekonya E., Pender J., Phillips D., Kato E. (2009). Trends and Drivers of

Agricultural Productivity in Nigeria. International Food Policy Research Institute.Nigeria Strategic Support Programme (NSSP) Report 1

Osei M.K., Osei K., Braimah H., Mochiah M.B., Berchie J.N., Bolfrey-Arku G., Lamptey J.N.L. (2013). Practices and Constraints to Cabbage production in Urban and Peri-urban Ghana: Focus on BrongAhafo and Ashanti Regions. *Basic Research Journal of Agricultural Science and Review* 2 (1) 5-14.

Pirie, N.W. (1984). Comments on the importance of green vegetables.*Plant Foods for Human Nutrition.*35:1 (73 – 80)

Rahman, S. (2003). Profit Efficiency among Bangladesh Rice Farmers. Proceedings of the 25thInternational Conference of National Association of Agricultural Economics (NAAE) Held in University of Ibadan, Nigeria. pp. 591.

Russell, N.P. and Young, T. (1983).Frontier Production Function and the Measurement of Technical Efficiency.*Journal of Agricultural Economics.*Vol.34, pp.139-150.In Maurice, D.C. (2011). Mathematical Models Used in Agricultural Production, Efficiency Studies-A Review. Unpublished Ph.D Non-Thesis Seminar Submitted to the Department of Agricultural Economics and Extension, School of Agricultural and Agricultural Technology, ModdiboAdama University of Technology, Yola, Nigeria, Pp. 3.

Sabo E. and Zira Y.D. (2009).“Awareness and Effectiveness of Vegetable Technology Information Packages byVegetable Farmers in Adamawa State, Nigeria”. *AfricanJournal of Agricultural Research* Vol. 4 (2), pp. 065-070. In Busari, A.O., Idris-Adeniyi, K.M and Oyekale, J.O (2012). Economic Analysis of Vegetable Production by Rural Women in Iwo Zone of Osun State, Nigeria. *Journal of Agricultural Sciences*Vol. 3(1) pp.6. Retrieved on May 4, 2013 from: www.unaab.edu.ng/attachments/482_HRT501.pdf

Samm, B.M. (2009). Gross Margin Analysis and Linear Programming: Tools in understanding how Farmers in the Guinea Savannah Region of Nigeria rejected the most Profitable type of Sorghum recommended by Scientists. Proceedings; Pre-conference of the Western Agricultural Economics Association, 2009 meeting. June 24, pp. 1-20.

Sankhayan, P.L. (1988). *Introduction to Economics of Agricultural* Production.Prentice Hall of India Private Limited New Delhi P.1.

Shehu J.F. and Mshelia S.I. (2007). Productivity and technical efficiency of small scale rice farmers in Adamawa State, Nigeria. *Journal of agricultural and social sciences*. 4: 117 - 120

Shehu, J.F., Tashikalma, A.K. and Gabdo, B.H. (2007). Efficiency of Resource-Use in Small–Scale Rain fed Upland Rice Production in Northwest Agricultural Zone of Adamawa State, Nigeria: 9th Annual National Proceedings of National Association of Agricultural Economics held at ATBU 1000 Seater Lecture Theater Bauchi. pp.15-18.

Smith M. 1995. Report on the expert consultation on procedures for revision of FAO guidelines for predictions of crop water requirement. Rome FAO, 45p. Soil types effects on Growth and dry matter production of spring onion. Journal of Horticultural Sciences and Technology 77: 340 -5.

Talabi S.O. and Onasanya O. (2010).Agriculture.Online Nigeria Portal. www.onlinenigeria.com

Tadesse, B. and Krishnamoorthy, S. (1997). Technical efficiency in paddy farms of Tamil Nadu: An Analysis based on farm size and Econological Zone. *Journal of Agricultural Economics*, 16:185-192.

Tiamiyu, S.A, J.O. Akintola and M.A.Y. Rahji (2008).Potentials for Rain-fed Upland Rice Productivity Growth in the Guinea Savannah Zone of Nigeria. Proceedings 10th Annual National Conference of the National Association of Agricultural Economics.Held at 750Seater Lecture Theatre Main Campus University of Abuja, Nigeria.

Tsoho, B.A. and Salau, S.A. (2012).Profitability and constraints to dry season vegetable production under fadama in Sudan savannah ecological zone of Sokoto State, Nigeria.*Journal of Development and Agricultural Economics*, 4(7): 214-222.

Umoh, G.S. (2006). Resource use efficiency in Urban Farming: An Application of Stochastic Frontier Production Function (SFPF): *International Journal of Economics and Social Studies*. 43(1):93

Usman S. (2009). Economics of Sesame production in Jigawa State, Nigeria. An unpublished M.Sc Thesis, Department of Agricultural Economics and Rural Sociology, Faculty of Agriculture, Ahmadu Bello University, Zaria, Kaduna State.

Usman S. (2015). Efficiency and competitiveness of rice production system in three selected States of Northern Nigeria. An unpublished PhD Thesis in the Department of Agricultural Economics and Rural Sociology, Faculty of Agriculture, Ahmadu Bello University, Zaria, Nigeria.

APPENDIX I: QUESTIONNAIRE FOR THE STUDY

TOPIC:ANALYSIS OF ECONOMIC EFFICIENCY AMONG CABBAGE FARMERS IN PLATEAU STATE.

Instruction: This questionnaire is for research purpose only, kindly tick (√) or fill in the blank spaces as appropriate

Questionnaire No. ……... Village ……. L.G.A. ……

Date of administration…….

Name of respondent (optional) ……...

Name of crop …….

DEMOGRAPHIC DATA

1. Sex: Male ( ) Female ( )
2. How old are you?.....
3. Marital status

   Single ( ) Married ( )
4. Number of wives …….
5. Number of children

Age range (years)	No. of Male children	No. of Female children
0 – 14 15 – 21 >21		
Total		

6. Number of other dependants

(a) 1( ) (b) 2 ( ) (c) 3 ( ) (d) 4 ( ) (e) >4 (specify)…

7. Level of education

i. No formal education ( )

ii. Primary education ( )

iii. Secondary education ( )

iv. Post secondary education ( )

INFORMATION ON WEALTH/POVERTY STATUS

8. Which of the following do you have?

i. Vehicle ( ) ii. Motorbike ( ) iii. Television set ( ) iv. Radio ( )

v. Refrigerator ( ) vi. Landed property ( ) …..Ha. vii. Zinc-roofed house with cement ( ) viii. Zinc-roofed house with mud ( ) ix. Thatched-roof house with cement ( ) x. Thatched-roof house with mud ( ) xi. Bicycle ( ) xii. Stove ( ) xiii. Telephone (handset) ( )

9. How many of the following do you have?

i. Herds of cattle ( ) ……..

ii. Goats ( ) …….

iii. Sheep ( ) ……

iv. Donkeys ( ) ……

v. Chicken ( ) ……

vi. Others (specify) ……..

SECTION B FARMING ACTIVITIES

10) How long have you been in cabbage production? _____

11) Do you grow cabbage as a sole crop? Yes ( ) No ( )

12) If yes, why do you grow cabbage as a sole crop?_____

_____

_____

_____

_____

13) Do you grow cabbage in mixture with other crop(s)? Yes ( ) No ( )

14) If yes, fill the table below

Field no	Size of field (acre/ha)	Crop mixtures
1		Cabbage
2		Cabbage
3		Cabbage
4		Cabbage

15) What agronomic benefits do you derive from mixing cabbage with the above named crops? _____

_____

_____

16) How did you acquire the farmland(s)?

i) Through inheritance ( ) ii) Purchase ( ) iii) Borrowed ( ) iv) Rent/ lease/ hire ( )

v) Gift ( )

17) If land was hired, leased or rented, how much did you pay per annum?

₦_____size_____

18) If land was purchased, what was the amount paid? ₦_____-

_____

19) What was the mode of cultivation on cabbage field?

i) Animal traction ( ) ii) Tractor hiring ( ) iii) Hand implements ( )

iv) Others (specify) _____

20) If you employed the services of a tractor, how much did you pay

per hectare? ₦_____

21) Are you aware of any improved cabbage production practice? Yes ( ) No ( )

22) If yes, how did you obtain the information about the improved practice?

i) Extension agent ( ) ii) Extension bulletin ( ) iii) Farmers' group ( )

vi) Farmer cooperative ( ) v) Others (specify

)_____

23) How often did your extension agent(s) visit your farm this cropping season?

i) Once a week ( ) ii) Twice a week ( ) iii) Once in two weeks ( ) iv) Once in four

weeks ( ) v) None at all ( ) vi) Others (specify

)_____

24) Did you use manure on your cabbage farms? Yes ( ) No ( )

25) If yes, fill the table below

	Qty used in (kg)	Unit cost in (N) or per Bag	Total cost (N)
Manure used			

26) **FARM INPUT RECORD**

FIELD NUMBER_____

Sole cabbage ( ) Crop mixtures ( ) i) cabbage ii)_____

iii)_____ iv)…….....

	Local or improved (name)	Qty used (kg)	Unit cost (₦) or /bag	Total cost (₦)	Type	Qty used (kg)	Unit cost (₦) or /bag	Total cost (₦)
i) cabbage								
ii)								
iii)								
iv)								

FIELD NUMBER_____

Sole cabbage ( ) Crop mixtures ( ) i) cabbage ii)_____

iii)_____ iv)_____

Crop Type	SEED				FERTILIZER			
	Local or improved (name)	Qty used (kg)	Unit cost (₦) or /bag	Total cost (₦)	Type	Qty used (kg)	Unit cost (₦) or /bag	Total cost (₦)
i) cabbage								
ii)								
iii)								
iv)								

FAMILY LABOUR FIELD NUMBER_____

FARM OPERATION	No OF WORKERS BY TYPE OF LABOUR MA FA LC			ACTUAL HOURS SPENT MA FA LC			No OF DAYS WORK MA FA LC		
Land clearing									
Ridging/ Ploughing Tilling									
Planting									

Fertilizer Application									
Weeding 1st wedding 2nd wedding									
Harvesting									
Transportation									
Threshing									
Bagging									
Others (specify)									

FIELD NUMBER_____ (FAMILY LABOUR)

FARM OPERATION	No OF WORKERS BY TYPE OF LABOUR MA FA LC			ACTUAL HOURS SPENT MA FA LC			No OF DAYS WORK MA FA LC		
Land clearing									
Ridging/ Ploughing Tilling									
Planting									
Fertilizer Application									
Weeding 1st wedding 2nd wedding									
Harvesting									
Transportation									
Threshing									
Bagging									
Others (specify)									

MA = Male adult, FA= Female adult, LC= Large children (8 – 15years)

HIRED LABOUR FIELD NUMBER _____

FARM OPERATION	No OF WORKERS BY TYPE OF LABOUR MA FA LC			ACTUAL HOURS SPENT MA FA LC			No OF DAYS WORK MA FA LC		
Land clearing									
Ridging/ Ploughing Tilling									
Planting									
Fertilizer Application									
Weeding 1st wedding 2nd wedding									
Harvesting									
Transportation									
Threshing									
Bagging									
Others (specify)									

FIELD NUMBER _____ (HIRED LABOUR)

FARM OPERATION	No OF WORKERS BY TYPE OF LABOUR MA FA LC			ACTUAL HOURS SPENT MA FA LC			No OF DAYS WORK MA FA LC		
Land clearing									
Ridging/ Ploughing Tilling									
Planting									
Fertilizer Application									
Weeding 1st wedding 2nd wedding									
Harvesting									
Transportation									
Threshing									
Bagging									
Others (specify)									

MA = Male adult, FA= Female adult, LC= Large children (8 – 15years)

27) **CROP OUTPUT DATA**

FIELD NUMBER _____

S/NO	Crops grown	Yield (kg)	Price / kg	Total (₦)
1. 2 3 4	Cabbage			

FIELD NUMBER _____

S/NO	Crops grown	Yield (kg)	Price / kg	Total (₦)
1. 2 3 4	cabbage			

INFORMATION ON CAPITAL, CREDIT AND MARKET

28. What is your source of capital?

    i. Personal savings ( )

    ii. Income from friends ( )

    iii. Credit ( )

    iv. Others (specify) …….

29. Do you have access to credit? Yes ( ) No ( )

30. If yes, what type of credit do you obtain? Formal ( ) Informal ( )

31. How much credit do you get per season for cabbage production?.....

32. What is the interest rate charged? ……

33. Where do you sell your cabbage

    (a) Production site (farm gate) ( )

    (b) Local market ( )

    (c) Both production site and local market ( )

    (d) Others (specify)…….

34. How far is the nearest market to you (in Km)? ……

35. How do you get to the market?

    i. treck ( )

    ii. bicycle ( )

iii motor bike ( )

iv. vehicle ( )

36. What problems do you encounter in cabbage production? ……

……

……