ECONOMIC ANALYSIS OF VEGETABLE PRODUCTION AND ITS CONTRIBUTION TO HOUSEHOLD POVERTY ALLEVIATION IN AKWA IBOM STATE, NIGERIA

By

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

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DECLARATION

I declare that thework in this thesis entitled ‘‘**Economic Analysis of Vegetable Production and its Contribution to Household Poverty Alleviation in Akwa Ibom State, Nigeria’’**has been performed by me in the Department of Agricultural Economics. The information derived from the literature has been duly acknowledged in the text and a list of references provided. No part of this thesis was previously presented for another degree or diploma at this or any other institution.

_____ _____

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CERTIFICATION

This thesis entitled ‘‘**ECONOMIC ANALYSIS OF VEGETABLE PRODUCTION AND ITS CONTRIBUTION TO HOUSEHOLD POVERTY ALLEVIATION IN AKWA IBOM STATE, NIGERIA’’** by Elizabeth Samuel **EBUKIBA** meets the regulations governing the award of degree of Doctor of Philosophy in Agricultural Economics of the Ahmadu Bello University, Zaria, and its approved for its contribution and literally presentation.

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DEDICATION

This thesis is dedicated to papa Edoho of blessed memory, my sweet mother for laying this great foundation, my late husband OJE and my lovely children for all your sacrifice.

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ABSTRACT

The study examines economic analysis of vegetable production and its contribution to household poverty alleviation. Multistage sampling technique was employed to collect primary data using structured questionnaire from 240 respondents for telferia 78, waterleaf 87, and garden egg 75 respectively from 12 villages (communities) from 6 local government areas of Akwa Ibom State. Descriptive statistics, Gross Margin, Stochastic Frontier Cobb-Douglas Production Function, Foster, Greer and Thorbecke (FGT) poverty decomposition model, Ordinary Least Squares and propensity score were used to analyse the data. The results show that the enterprise is profitable in the area of study with a net farm income of ₦122,800.87 for garden egg, ₦ 170,958.39 for telferia and ₦122,765.68 for waterleaf, with an average of return to Naira invested of ₦ 1.48, ₦ 1.64, and ₦ 1.75 respectively. The technical efficiency of the three vegetables under study were 0.40, 0.78 and 0.79 for garden egg, telferia and waterleaf respectively. In terms of cost the farmers of the three vegetables are allocatively efficient with a mean allocatively efficiency of 0.68, 0.72 and 0.75 for garden egg, telferia and waterleaf respectively. The mean economic efficiency of 0.68, 0.75 and 0.70. Poverty analysis reveals garden egg with the highest gap % of 24.12, waterleaf with 21.71% and telferia 20.17% respectively. These gaps were however alleviated with the farmers having monthly income of more than ₦ 20,000 for most of the farmers 75.34 %, 74.12% and 80% for garden egg, tellferia and waterleaf respectively. The major constraints faced by the farmers are poor market, lack of storage facilities, transportation, poor seed, pest and disease, cost of fertilizer, poor price, poor yield, and access to credit. It is recommended that access to credit, extension contact, and inputs at subsidized price, good roads which will aid transportation storage

facilities knowing the perishable nature of the product among others will increase the impact and alleviate poverty in the study area.

TABLE OF CONTENTS

Contents **Page**

Title Page……..... **i**

Declaration…….. **i**i

Certification……..

iiiDedication……

….

ivAcknowledgement…….....

... v

Abstract…….……. vii

Table of Contents……..……..... **vii**i

List of Tables……..……. **x**i

List of Figures …… xii

List of Appendices..... **x**iii

CHAPTER ONE……... **1**

1.0 INTRODUCTION……..... **1**

1.1 Background to the Study……. **1**

1.2 Statement of the Problem …… **7**

1.3 Objectives of the Study……**10**

1.4 Justification of the Study…….……**11**

1.5 Hypotheses of the Study……..……**13**

CHAPTER TWO……**14**

2.0LITERATURE REVIEW..... **14**

2.1 Vegetable Production in Akwa Ibom State…… 14

2.2 Socioeconomic Importance of Vegetable Production..... 21

2.2.1Economic of vegetable looses**.....25**

2.3 Effect of Vegetable Production on Poverty..... 26

2.4 Conceptual Framework..... 29

2.4.1 The concept of efficiency in agricultural production..... 29

2.4.2 Concept of profit efficiency..... 31

2.4.3 Concepts of poverty in Nigeria..... 32

2.5 Theoretical Framework..... 34

2.5.1 Production efficiency..... 34

2.5.2 Productivity function 38

2.6 Analytical Framework..... 41

2.6.1 Profitability analysis..... 41

2.6.2 Efficiency meaning and measurement..... 43

2.6.3 Parametric approach to measurement of efficiency..... 47

2.6.4 Frontier production function studies in Agriculture..... 49

2.7 Measurement of Poverty..... 56

2.7.1 Estimating the poverty line.....59

2.7.2 Foster, Greer and Thorbecke (1984) weighted poverty index.....60

2.7.3 Binary logistic regression model.....61

2.7.4 Empirical application of the logit model to poverty.....63

2.7.5 Impact pathway analysis.....64

2.8 Methods of Estimating Impact.....66

2.8.1 The average treatment effect (ATE) models.....68

2.8.2 Propensity score.....70

2.8.3 Propensity score methods.....70

2.9 Empirical Review of Impact of Vegetable Production on Poverty Reduction……..... 56

CHAPTER THREE…….....76

3.0METHODOLOGY……..…76

3.1 The Study Area.....76

3.2 Sampling Procedure and Sample Size…….....79

3.3 Data Collection……..…….. 80

3.4 Analytical Techniques…….....81

3.4.1Model specification…..…….…….....82

3.4.2 Technical efficiency……..…….…….....82

3.4.3 Allocative efficiency.....83

3.4.4 Economic efficiency.....84

3.4.5Determinants of efficiency.....86

3.5 Cost and Return Analysis……..…….....92

3.6Estimation of Poverty Status of Vegetable Farmers…….....93

3.7Variables Definition and Measurement…….....94

CHAPTER FOUR……..... 98

4.0 RESULTS AND DISCUSSION……..... 98

4.1 Socio-economic Characteristics of Vegetable Farmers in the Study Area…...98

4.1.1Age**……..... 98**

4.1.2Educational level**.....** 98

4.1.3Distribution of respondents based on farm sizes**.....**99

4.1.4Distribution of respondents based on household Size**.....**100

4.1.5Distribution of respondents based on extension contact**.....**100

4.1.6 Gender participation**.....**103

4.1.7 Credit status**.....**103

4.1.8 Farming experience**.....**104

4.1.9Production system**.....**105

4.2 Production Efficiency in Vegetable.....106

4.2.1.1 Technical Efficiency Level for Garden Egg Farmers.....107

4.2.1.2 Technical Efficiency Level for Telferia farmers……108

4.2.1.3 Technical Efficiency Level for waterleaf farmers……112

4.2.2 Allocative Efficiency of Garden egg Farmers……113

4.2.2.1Allocative Efficiency of Telferia Farmers……115

4.2.2.2 Allocative Efficiency of Waterleaf Farmers……118

4.2.3 Economic Efficiency of Garden egg Farmers……..119

4.2.3.1 Economic Efficiency of Telferia Farmers……120

4.2.3.2 Economic Efficiency of Waterleaf Farmers……121

4.2.4 Elasticity of Production and Return to Scale in Vegetable Production……...124

4.3 Factors influencing Efficiency in Vegetables Production……..124

4.3.1 Factors influencing Technical Efficiency in Garden egg Production……125

4.3.2 Factors influencing Technical Efficiency in Telferia Production……...127

4.3.3 Factors influencing Technical Efficiency in Waterleaf Production……129

4.4 Factors influencing Allocative Efficiency in Garden egg Production……131

4.4.1 Factors influencing Allocative Efficiency in Telferia Production……132

4.4.2 Factors influencing Allocative Efficiency in Waterleaf Production……134

4.5 Factors influencing Economic Efficiency in Garden egg Production……136

4.5.1 Factors influencing Economic Efficiency in Telferia Production……137

4.5.2 Factors influencing Economic Efficiency in Waterleaf Production……138

4.6 Elasticity of Poverty Line and Status……..……...140

4.7 Measuring the Standard of Living…….……143

4.7.1 Wealth Status……..143

4.7.2 Households Asset Ownership……..……...……145

4.7.3 Households Poverty Status……...…145

4.8 Contribution of Vegetable Production to Poverty Alleviation……..….146

4.8.1 Profitability Level of Vegetable Production……..….147

4.9 Constrains faced by Vegetable Farmers……...….149

4.10 Test of Hypothesis …….....…….....151

CHAPTER FIVE…….. 144

5.0SUMMARY, CONCLUSION AND RECOMMENDATIONS.....144

5.1 Summary……..144

5.2 Conclusion.....147

5.3 Recommendations.....148

5.4 Contribution to Knowledge.....149

REFERENCES…….…….....150

LIST OF TABLES

Tables **Page**

Table 3.1: Sampling size of respondents..... 79

Table 4.1: Socioeconomic characteristics of the Vegetable farmers……102

Table 4.2: Distribution of Socio economic Characteristics of Garden egg, Telferia and Waterleaf Farmers……105

Table 4.3: Maximum likelihood estimate of the stochastic production frontier of Garden eggproduction……..……..106

Table 4.4: Maximum likelihood estimate of the stochastic production frontier of telferia production……..…...108

Table 4.5: Maximum likelihood estimate of stochastic production frontier of waterleaf production……..…..109

Table 4.6: Maximum likelihood estimate of the stochastic frontier cost function of garden egg farmers……..…..112

Table 4.7: Maximum likelihood estimate of the stochastic frontier cost function of Telferia farmer……..…114

Table 4.8: Maximum likelihood estimate of the stochastic frontier cost function of waterleaf farmers…….……..…115

Table 4.9: Elasticity of Production and Return to Scale in vegetable Production…….119

Table 4.10: Maximum likelihood estimate of Factors Influencing Technical Efficiency Level of Garden Egg Farmers……..……..120

Table 4.11: Maximum Likelihood Estimate of Factors Influencing Technical Efficiency Level of Telferia Farmers……..……..……..123

Table 4.12: Maximum Likelihood Estimate of Factors Influencing Technical Efficiency Level of Waterleaf Farmers……..…..……..……125

Table 4.13: Maximum Likelihood Estimate of Factor Influencing Allocative Efficiency of Garden egg Farmers……..…..……..……127

Table 4.14: Maximum Likelihood Estimate of Factors Influencing the Allocative Efficiency Level of Telferia Farmers……127

Table 4. 15: Maximum Likelihood Estimate of Factors Influencing Economic Efficiency Level of Garden egg Farmers……..……..……129

Table 4.16: Maximum Likelihood Estimate of Factors Influencing Economic Efficiency in Garden Egg Farmers……..……...……..…131

Table 4.17: Maximum Likelihood Estimate of Factors Influencing Economic Efficiency in Telferia Farmers…….……...……132

Table 4.18: Maximum Likelihood Estimate of Factors Influencing Economics Efficiency in Waterleaf Farmers…….……...……133

Table 4.19 Costs and Returns in Vegetable Production…….……...……..135

Table 4.20: Poverty Gap Index…….……...……136

Table 4.21: Nutritional (calorie-based) equivalent scales…….……...……137

Table 4.22: Percentage Distribution of Households' Asset ownership……...……138

Table 4.23: Income per month from Vegetables Production…….……..... 139

Table. 4.24: Constraints encountered by Vegetable farmers…….……..... 142

Table 4.25: Log-likelihood ratio test (LR)…….……...……..... 143

LIST OF FIGURES

Figures **Page**

Fig 2.1 Telferia staked with fruits……...….18

Fig 2.2 Telferia and Waterleaf……19

Fig 2.3 Waterleaf ……...…….20

Fig 3.1 Map of Akwa Ibom State showing the Local Government Areas and Areas of Study……..78

Fig. 4.1: Distribution of Technical Efficiency Indices of garden egg, telferia and Waterleaf Farmers…….110

Fig 4.2: Distribution of Allocative Efficiency Indices of garden egg, telferia and Waterleaf Farmers……...116

Fig 4.3: Distribution of Economic Efficiency Indices of garden egg, telferia and Waterleaf Farmers……117

LIST OF APPENDIXES

Appendixes **Page**

Appendix 1: Questionnaire……...…….160

CHAPTER ONE

INTRODUCTION

1.1 Background to the Study

Vegetables sub-sector plays an important role for the development of Nigeria Economy, the last two decades have witnessed the increasing importance of vegetable production and consumption in southern Nigeria. It has become a major occupation of many small scale producers in both rural and urban communities of Akwa Ibom State (Nsikak-Abasi and Sunday, 2013).

Vegetables are herbaceous plant whose fruits, seeds, roots, leaves etc., are used as food (Etim, 2013). Nearly 100 different types of vegetables comprising both of local and foreign origins are grown in Nigeria. Vegetable is important for nutrition, economy, food security and most importantly alleviate household poverty for the small holders. Vegetables can be identified as a significant one for this economy for its noteworthy contribution in raising the foreign exchange earnings and occupies an important position among the items exported from Nigeria. Vegetables contribute 3.2% of the Agricultural Gross Domestic Product (NBS, 2014).Vegetable remains one of the leading products in international commerce which is produced in many countries through the temperate and tropical region (Asante et al. 2011). It also has significant contributions to livelihoods and food security (Idiong et al. 2005).

In agriculture, vegetables have a significant place; these crops do not only contribute to the share of agriculture in nationaleconomy, but possess a great potential and comparative advantage to compete in the liberalized economy. Vegetables are not only important as protective food and highly beneficial for the maintenance of health and

prevention of disease, increase vegetable production is also a source of livelihood for small farmers and foreign exchange earner for the national economy (Mozi, 2013).

Production of vegetables though labour intensive, it provides income support especially to small farmers and employment opportunity for landless labourers in rural areas (Badmus, *et al*, 2011). As a developing country, Nigeria is adequately suffering from the problems of poverty, unemployment and malnutrition. The poverty situation in Nigeria has been described as ‘’worrisome’’ (Oshewolo, 2010), severe and ‘’widespread’’ (IFAD, 2012). The World Bank (2015) rank Nigeria third among the world’s ten countries with extreme poor citizen. It established that Nigeria with about 170million population falls among countries with extreme poverty where over 70% of the population live on $1.00 or even less per day. Specifically, the report reveals that 7% of the 1.2billion people living below poverty line in the world are Nigerians, it has also been estimated that almost about 75% of the population lives in rural areas where poverty has been on the increase and about 65% of the total population is directly or indirectly linked with the agricultural sector (Awotide et al. 2011). World Development Report of 2015 by the World Bank, Agriculture is the main engine for overall economic growth, rural poverty reduction and food security in Africa. In Nigeria, the agricultural sector is the largest sector of the economy because of its dominant share of the Gross Domestic Product (GDP), employment of more than 70% of the active labour force and the generation of about 88% of non-oil foreign exchange earnings (Oji-Okiro, 2011). The connection between agriculture and poverty is largely documented, and it’s pointed towards a positive correlation between increase in agriculture and decrease in poverty (Goswami and Chatterjee, 2013). World Bank (2015) reported that growth originating from agriculture is four times as effective in reducing poverty as growth originating outside of agricultural sector. The report revealed that increasing agricultural productivity

has probably been the single most important factor in determining the speedand extent of poverty reduction. Improving productivity, profitability, and sustainability of smallholder farmers is therefore the main pathway out of poverty in using agriculture forDevelopment. Edet, *et al*., (2014) opined that smallholder farmers form the bulk of production in rural areas in many developing countries. Within the agricultural sector, research has shown that economy-wide growth driven by growth in vegetable is also effective at reducing poverty.

Agriculture contributes significantly to the economy of Nigeria. Not less than 70% 0f Nigerians earn their living from agriculture and it provides among others food, employment, income, foreign exchange and raw material for the manufacturing sector FAO (2010). Agriculture was the mainstay of Nigeria's economy before the oil boom (Idiong, 2009). Although the shares of manufacturing and services sectors in Gross National Product have gradually increased, yet agriculture still remained the single largest sector of national economy. Its contribution in real terms is far beyond farm output, and includes its role as supplier of raw materials to industry, income support and food security to a large number of rural households, protection of natural environment, a market for industrial products and an earner of significant portion of foreign exchange.

Poverty reduction is a major goal of economic development in many countries including Nigeria of today. Consequently, a number of measures to curbed these menace has been carried out by government and individuals targeted at increasing productivity and attaining self-sufficiency in food production. In order to alleviate poverty in Nigeria and Akwa Ibom State in particular is to be enhanced by improving efficiencies of food production in vegetable (IITA, 2004). Nigeria, a tropical country with a farming friendly topography and favourable climatic condition for all year round vegetable production,

this implies that vegetable can provide all year round income. These will also provide employment opportunities, alleviate poverty, fight against hunger and increase the state economy base through payment of tax (Edet and Nsikan, 2011). A vast majority of people in Nigeria and Akwa Ibom State live in rural areas and their livelihoods are directly or indirectly connected with agriculture (FBS, 2010). Any technological improvement or productivity enhancement in agriculture therefore, not only contributes to overall economic growth but it also provides immediate microeconomic benefit for a large number of rural households (FAO, 2013).

Vegetable sub-sector can play important role to solve these problems in the shortest possible time. The importance of vegetable can be realized from two stand points such as, economic point of view and nutritional point of view. It creates a great opportunity of employment for the large number of unemployed in the Akwa Ibom State and Nigeria in general. Vegetables compared to other food items provide low cost nutrition source. It can be produced even in small amount of land and also in homestead area. It can be grown within a short time period and more than one crop can be grown within a crop season. Leafy vegetables are an important feature of Nigerian's diet that a traditional meal without it is assumed to be incomplete. In developing countries, the consumption of vegetables is generally lower than the FAO recommendation of 75kg per year in habitant (206g per day per capita) (Badmus and Yekini, 2011). In Nigeria and Akwa Ibom state in particular vegetable production has been on -going for decades, providing employment and income for the increasing population especially during the long dry season. However, production is constrained by inadequate infrastructure, agronomic and socio-economic variables (Sabo and Zira, 2013). It has been widely demonstrated that rural dwellers, throughout the world are engaged in a range of productive activities essential to household welfare, agricultural productivity, and economic growth. Vegetable

contributes to household income and also its production has a great potential to play a crucial role in contributing to food and nutritional security, income generation, poverty alleviation and socioeconomic growth of Nigeria. Poverty alleviation is the major goal of economic development in many countries particularly Nigeria today.

Lots of poverty reduction interventions were targeted at agricultural sector with the aim of increasing the productivity and attaining self-sufficiency in food production. (Fakayode. 2009). Self-sufficiencyin food production can only be attained by increases in farm efficiency and productivity driven by recent advances in agricultural technology. For these reasonsefficiency has remained an important subject of imperial investigation particularly in developing economies where majority of the farmers are resource poor. This is because the scope of agricultural production can be expanded and sustained by farmers through efficient use of resources (Udoh.2010). It has been suggested that strategies towards improving productivity and efficiency must include most of the restoration of the agronomic factors (Oduol et al. 2011).

In Nigeria generally and Akwa Ibom State in particular, backyards are mostly used to cultivate vegetable crops in the urban and peri-urban areas by women predominantly. It also has significant contributions to livelihoods and food security (Idiong *et al.*, 2002). This is in agreement with Staatz *et al.* (2013) who argued that the majority of the poor in Nigeria as a developing country (third word) live in rural areas and because food prices are a major determinant of the real income of both the rural and urban poor the low productivity of developing countries agriculture was seen as a major cause of poverty. Thus, agriculture production and the use of natural resources are important for rural household income and food self-sufficient in Nigeria. Vegetables are not only important as protective food and highly beneficial for the maintenance of health and prevention of

disease, increase vegetable production is also a source of livelihood for small farmers and foreign exchange earner for the national economy (Mozi, 2013).

Growing vegetable is particularly suited for small scale farmers and their families, and because oftheir limited resources they can meet the cultivation requirement ofirrigation by the use of watering can (Robert, 2013). Baffour *et al*., (2011) 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. It has also been found that most farmers do not want to go into large scale production because they are apprehensive Production functions of vegetables are quite complex since different inputs with different combinations are used (Umoh. 2011).

The differences across farms in use of various factors of production and various combinations of factors of production cause changes in crop yields (May, 2011). The input use level and combinations are different across farms and regions resulting in different yields. Furthermore, there is a wide gap in yields of experimental stations and farmer fields indicating the suboptimal use of inputs (Udoh, 2012). Nigeria has a widely diversify agro-ecological condition, which makes possible the production of a wide range of agricultural products. Despite Nigeria's rich agriculture resource endorsement, however, this sector has been growing at a very low rate (Edet *et al*. 2012). Vegetables production is constrained foremost by the poor management practices, lack of improve varieties, high cost of input, lack of credit facilities particularly for small scale farmers, most importantly high quality standard by the market and lack of market strategies (Arena, 2010). Against the background so far started, this research was carried out to examine the economic analysis of three basics vegetables; telferia, garden egg and waterleaf production and its contribution to poverty alleviation in Akwa Ibom State.

1.2 Statement of the Problem

Development of vegetables farming in Nigeria in general and Akwa Ibom State in particular has been constrained by the low level of production and utilization. Efficient use of farm resources is an important part of agricultural sustainability. One way farmers can achieve sustainability in agricultural production is to raise the productivity of their farms, by improving efficiency within the limit of existing resource base, so as to cope with the predominant menace of poverty and unemployment in the area. (Obinaju*et al*. 2015). Production can be said to be efficient when resources are efficiently and timely used to maximize profit and minimize cost, avoiding wastage and also satisfying the consumer.

Vegetable production in the state is also characterised by inadequate use of corresponding production inputs, and inadequate adoption of improved technologies by farmers, this result in declining per capita production which overtime increases rural poverty, rising vegetable prices, widespread famines and increasing importation. This is further aggravated by inadequate investment in agriculture, limited access to credit by smallholder farmers, high cost and unavailability of inputs such as fertilizers and improved seeds, inefficient markets, and the absence of a conducive policy on environment (Markus, 2010).

The poverty situation is quite disturbing; both the quantitative and qualitative measurement have attested to this. Nigeria and Akwa Ibom state in particular faces more developmental challenges; this has a growing share of the absolute poor (Abang, 2010). These will result in the poverty situation among households growing at an increasing rate, and households may have to devote an extremely high proportion of their disposable income to food, between 54 per cent and 76 percent. It is obvious that this will affects the other sector of the home like education, health, etc (Udoh, 2011). These have persisted in

spite the many poverty alleviation programmes and projects that have been implemented by successive administrations with special focus on agriculture but the average national poverty incidence indicates that the poverty situation has not improved during the last 20years(World Bank, 2008; Apata *et al.* 2009).

The increasing population is also posing a threat on the land available for cultivation of vegetable in Akwa Ibom State and this makes the farmer to continue the cultivation of a crop on the same land for a long period of time, this will drastically reduce yield and subsequently price and profit. Studies carried out by Amani (2011) and (2005), Skarstein (2015) revealed that smallholder vegetable productivity in the country is suffering because most smallholders do not practice high-yield farming methods, and are subsistence farmers. The contribution of vegetable to household income and income inequality was evaluated in this study. The study was motivated not only by recent empirical evidence supporting the hypothesis that inequality is harmful for growth (Onyeawaku *et al*. 2012) but also by the fact that in some developing countries, economic growth was followed by a widening income gap between poor and non-poor, and between skilled and unskilled workers. Vegetableproduction can best address this, also its high nutritional, medicinal and economic value (Opadode and Adeboye, 2005) and this include vegetable production in Akwa Ibom State. Although estimate vary from different authors, most studies show that Nigeria's vegetable production on the aggregate has been growing at the rate of 2.5% per annum, while demand for vegetable, on the other hand has been growing at over 3.5% per annum (Ojo, 2009). Abukutsa-Onyango (2011) also observed that food situation has become critical in Nigeria, as the domestic vegetable production cannot keep pace with the growing population This is also the case with vegetables, which is one of the contributors to aggregate agricultural production, tends to

show declining productivity during the last few years. This shortfall also gives the basis for this research.

The aggregate response of farmers to positive prospect in vegetable depend on economic viability of production, hence a comprehensive economic analysis of vegetable production will provide a good guide to policy makers on "what is lacking" and "what to do" to actually consistently increase physical output. Therefore, it is important to understand the farmers' levels of production and its relationship with land factors which can greatly improve the production of vegetable. This can be achieved through investigating the socio-economic and profitability of the vegetable farmers. Farmers output needs to be increased using existing inputs and technology.

In spite of various initiatives aimed at improving the agricultural sector which includes the horticultural sub-sector, the sector still remains relatively under-developed. The horticultural sub-sector also reflects the problems in the agricultural sub-sector. These problems include inadequate knowledge and technology of production, insufficient planting materials, land tenure, poor extension services and insufficient post-harvest facilities (Babatola, 2014). Nigeria has a potential to export these products with trade liberalization under the regime of World Trade Organization (CBN 2011).Akwa Ibom State poverty incidence is 65.5 per cent as at 2010 (NBS, 2012). According to the National Bureau of Statistics (NBS, 2012) the average yield of vegetable in Akwa Ibom State is 3.22T/ha. This was lower than the supposed yield of 5.68T/ha, this means that vegetable farmers in the state are not getting maximum yield from their resources.

Empirical studies on vegetable production in Akwa Ibom State focused attention primarily on the profitability and technical efficiency(Edet and Nsikan, 2010; Udo,

2011), while a few others (Ediong, 2009; Umoh, 2012; Udoh *et al* 2011) looked at resource used efficiency. These studies revealed that vegetable production in Akwa Ibom State is profitable and technically efficient but there is gap for improvement. However, these studies paid less attention to the contribution of vegetable production to poverty alleviation.

This study in attempt to fill research gaps noticed and to compliment literature, will therefore address the problems of inefficiency in the production of telferia, waterleaf and garden egg; also the profitability level and its contribution to farmers' income which will intend alleviate poverty and food sufficiency in Akwa Ibom State. In order to achieve this, the following research questions have to be answered;

i. What are the socioeconomic characteristics of vegetable farmers in the study area?

ii. What is the level of technical, allocative and economic efficiencies of vegetable production in the studyarea?

iii. What is the level of profitability of vegetable production?

iv. What is the contribution of vegetable production to poverty alleviation among the farmers in the area?

v. What are the constraints militating against vegetable production in the study area?

1.3 Objectives of the Study

The broad objective of this study was to examine economic analysis of vegetable production in Akwa Ibom State. The study has the following specific objectives:

i. Examine the socio-economic characteristics of vegetable farmers in the study area;

ii. Determine the level of technical, allocative and economic efficiencies level and factors influencing vegetable production in the study area;

iii. Examine the profitability status of vegetable farmers;

iv. Estimate the contribution of vegetable production to poverty alleviation among farmers in the study area;

v. Describe the constraints militating against production of vegetables.

1.4 Justification of the Study

Poverty rate in Nigeria has been increasing in the last few years, similarly the population is growing annually at 3.5% while production is increasing by only 2.5%. Presently Nigeria vegetable consumption falls short of consumption demand, one of the complementary measures that could be taken is to increase vegetable production (Edet *et al*., 2013). The importance of efficiency in improving farmer's productivity cannot be overemphasized, this has led to interest in analysing farm level efficiency and its contribution to household poverty alleviation especially in developing country's' agriculture. This is done in the belief that developing efficiency is more cost effective than introducing technology in increasing productivity given the new level of adoption(Umoh, 2012).

Vegetables added about 3% to the GDP of the economy of Nigeria (CBN, 2009). Though the contribution to the GDP is very small, its importance cannot be overlooked because without it a diet is not balanced Aseyehegn et al. (2012). Vegetable production receives

little or no attention from research and Government financing processes are too rigorous and may not be timely or even not accessible, (Schmutz et al 2011), greater effort to explore the potentials of these vegetables could lead to enhanced agricultural productivity, more stable supply and income in for farm families in Akwa Ibom State, since vegetable production is an income generating activities therefore needs economic evaluation of the production efficiency and their determinants.

Vegetables are a source of income support as well as important for food security of the people of Nigeria, the per capita consumption of vegetables in Nigeria is very low (Fakayode *et al.,* 2012). People in upper income strata consume well above the national calculated average, while the bulk of rural population and large percentage of poorer strata among the urban population consume very few vegetables. Production of vegetables can be profitable if efficiency of resources is applied; nevertheless, it's labour intensive. Thus, it provides income support especially to small farmers and employment opportunity for landless labourers in rural areas (Badmus *et al.,* 2011).

The concept of farm efficiency is an important issue in developing countries in general and Nigeria in particular needs this concept for her developing economy. Evaluation of production activities of vegetable producers is imperative in the light of resource use and productive growth (Udoh, 2012). This is an important issue present, because productivity and resource use efficiency issue are the core element of sustainable production of small scale farming activities. Inefficient use of inputs can jeopardize food availability and security (Umoh, 2011).

Efficiency measurement is very important, because it's the first step in the process that might lead to substantial resource savings, and can also assist in exploring and achieving

the Nation objectivity of sustainable food production and food security, which requires that resources be used more efficiently with better attention paid to eliminate waste. The sustainability of vegetable enterprise is mainly based on efficient Production system. The qualitative and quantitative analysis of vegetable production system determines the level and extent of production efficiency (Omondi *et al*., 2010). The study will be designed and conducted, realizing the importance of structure of vegetable enterprise and its efficiency and with a view to access the complexity of vegetable production system for profitable. Efficiency measurement is also essential in the improvement of efficiency of resources use by vegetable producers in the state will be a more effective means of increasing and improving productivity in the short run. These resources savings will impart positively in farm management, policies formulation and results in higher income to the farmers hence improved livelihood standard of the people, this will further alleviate household poverty (Etim, 2008).

This study analyses the efficiency status and its determinants of vegetable production and its contribution to poverty alleviation in Akwa Ibom State on three vegetable crops which include; waterleaf (Talinum triangulare), fluted pumpkin (Teleferia occidentlis) and garden egg (Solamun melongena), this vegetable are grown in the state based on its comparative advantage geographically and economically (resources and population map of Nigeria 2010). Most importantly, achieving Nigeria's agricultural policy objectives of sustainable food production and food security, which requires that resources be used much more efficiently, with much attention paid to eliminating waste so as to achieve the goal of employment and wealth creation.

1.5 Hypotheses

The following hypotheses were tested based on the objectives of the study:

i. Farmers are fully technically, allocativelly and economically efficient.

ii. There is no significant relationship between socio-economic characteristics and the allocative, economic and technical efficiency of vegetable producers in the study area.

iii. Household size and sex does not have positive influence on technical, allocative andEconomic efficiency of vegetable farmers in Akwa Ibom.

CHAPTER TWO

LITERATURE REVIEW

2.1 Vegetable Production in Akwa Ibom State

Vegetable production in Nigeria according to Ehiagbonare (2008) is in the hands of ethno farmers (farmers of same ethnic group) this he said is the reason for demand outweighing supply. The definition of vegetable differs with writers (Mensah *et al* 2008) said vegetable is the name given to the edible parts of herbaceous garden plant that can be eaten as supporting food or main dishes and they may be aromatic, bitter or tasteless, they went ahead to acknowledge that Nigeria is endowed with large variety of vegetables consumed by the various ethnic groups for different reasons.

According to (FAO, 2009) among the vegetable producing nations, Nigeria rank fourth position in the years 2005 – 2008, with the following quantities 5,185,000; 5,651,000; 4,861,720; and 5,705,000 tonnes respectively. Vegetable production is of economic importance, it plays important role in the living standard of the people and also in the customs, tradition and food culture of households in Africa. Vegetable contains vitamins, essential acids, as well as minerals and antioxidants (Mensah, *et al*, 2008). Vegetable are the cheapest and the most available source of the most important protein, vitamins, minerals, dietary fibre and essential amino acids (Eni, *et al*, 2008

Vegetable is one of the staple food component that it production has continue to increase in most countries of the world. For instance, in Nigeria, growth rate stood at 2.18% between 1970 and 1974. It however decreased to about 5.7% between 1975 and between 1990 and 1994 about 14.0% growth rate was recorded in the sub-sector. Vegetable production constitutes about 4.64% of the total staple food production between 1970 and 2003 in Nigeria (CBN 2003).

In Akwa Ibom State specifically, production is very popular due to its high consumption. Though its production is seasonal and the produce is highly perishable, the cost per unit output is low as compare to other consuming items (Umoren, 1998; Udoh, 2005). In the State alone, about 150,000 tons of leafy vegetable was produced in 1992 (CBN 1994). In this study we want to look at the waterleaf, telfairia and garden egg.Water leaf (*Talinum triangulare*), is one of the major leafy vegetable grown by farmers in Akwa Ibom State and widely consumed by every household in the State.

Waterleaf belongs to the plant family *Portulaceae*. It is a short –lived perennial herb, growing to 30-60cm in height. The leaf is greenish in colour with succulent stem and alternate leaf arrangement. The crop is believed to have originated from tropical Central Africa or South America (Idiong, 2005). In Nigeria, it wide acceptance across various earthnic group, has earned it several local names, such as *"gare*" in Yoruba, *mmon-mmong ikong* in Efik/Ibibio among others, which is consistent with it high water content. The crop is propagated mostly by stem cutting and rarely by seed. It has a short maturity period of 35-45 days. The yield is higher when propagated by stem cutting as compare to seed planting. The short maturity period of waterleaf is an added advantage as compare to other vegetable. Hence, the turnover is rapid and farmers make quick returns in a short period (Udoh, 1993).

Telfairia occidentalis is a tropical vine grown in West Africa as a leaf vegetable and for its edible seeds. Common names for the plant include Fluted gourd, Flutedpumpkin, and Ugu. The plant is a drought-tolerant; dioeciously perennial that is usually grown trellised. The young shoots and leaves of the female plant are the main ingredients of a Nigerian soup, *Ofe Egwusi*.a popular delicacy in the Eastern, and Edikang Ikon eithin the Ibibio and Effik from the South.

The large (up to 5 cm), dark-red seed is rich in fat and protein and can be eaten whole, ground into powder for another kind of soup, or made into a fermented porridge. It is propagated using the seeds. Its seed is housed in another greater covering or hard shell which protects it from harm. It survives drought and can retain its life in the root even after many years. It is a creeping plant and grows well if staked with bamboo sticks. The fruit of the plant is large, and can weigh up to 13 kilograms (29 lb), and is edible. It is widely cultivated for its palatable and nutritious leaves which are used mainly as vegetable. The seeds are also nutritious and rich in an oil which may be used for cooking and soap manufacture. Its taxonomy, morphology and potential uses are discussed in relation to its economic importance as a tropical crop.

Garden egg (*Solanum spp*) is a vegetable with increasing popularity in the world (Pessarakli and Dris, 2003), and it originated from tropical Africa (Norman, 1992). It is an economic flowering plant belonging to the family *Solanaceae*, whose members are mostly herbaceous plants. The fruit is berry; the seeds have large endosperm, and are grown mainly for food and medicinal purposes. Nutritionally, garden egg contains water (92.5%), protein (1%), fat (0.3%), and carbohydrates (6%). Medicinally, a meal of garden egg has been proven to benefit patients suffering from raised intraocular pressure (glaucoma) and convergence insufficiency, as well as in heart diseases and

arteriosclerosis (Guardian, 2009). The crop is widely cultivated across most of the African continent, and more intensively in West and East Africa. It is consumed almost on a daily basis by urban families and also represents the main source of income for producing households in the forest zones of West Africa (Danquah-Jones, 2000).Okon et al. (2009);(Umoh, 2006) found that in Akwa Ibom state, an average vegetable farm size is 0.65ha and the labour used is mostly family labour, they also observed that morethan half of the vegetable farmers were within the age bracket of 31-50 years. Females make up the bulk of the urban faming population, with high educational attainment, this also impart on their adoption of technologies which in turn affects their output. Vegetable production in Nigeria in general and Akwa Ibom state in particular is also faced with some constraints which vary.

Waterleaf is one of the vegetables which is the daily components of diets in Akwa Ibom State and which is widely cultivated and consumed in Southern Nigeria. Water leaf (Talinum triangulare (Jacq.) wild) is an erect, fleshy, annual herb cultivated in West Africa and used as a cooked vegetable (Akobundu & Agyakwa, 1998; Udoh & Etim, 2006; Udoh & Etim, 2008; Udoh & Etim, 2011). It has swollen taproot and can be reproduced from seed, or vegetatively from stem cuttings. Waterleaf is used in combination with other indigenous vegetables such as African jointfir (Gnetum africanum welw.) Bush apple (Heinsia crinata (Afzel) G. Taylor), Bitter leaf (Vernonia amygdalina) and fluted pumpkin (Telferia occidentalis Hook F) (Udoh & Etim, 2006; Udoh & Etim, 2011).In 100 grams of fresh materials, waterleaf contains protein (2.4g), fats (0.04g), carbohydrates (40g), fibre (1.0g), calcium (121mg), phosphorus (67mg), iron (5mg), thiamine (0.08mg), riboflavin (0.18mg), niacin (0.30mg), and ascorbic acid (31mg) (Ekpenyong, 1989; Eyo, Ekpe & Ogban, 2001; Udoh & Etim, 2006; Udoh &

Etim, 2011). There has been a wide gap between the demand for waterleaf and its supply particularly during the peak of rainy season and dry seasons.



Fig 2.1 Telferia Staked with Fruits



Fig 2.2 Telferia And Waterleaf



Fig 2.3 Waterleaf Farm

2.2 Socio-economic Importance of Vegetables

Vegetables may be described as those plants, which are consumed in relatively small quantities as a side dish with the staple food. The term 'vegetable' can also be used to designate the tender edible shoots, leaves, fruits and roots of plants that are eaten whole or part raw or cooked as a supplement to starchy foods and meets (Umoh, 2006). Vegetables can be distinguished from field crops by the fact that, vegetables are harvested when the plant is fresh and high in moisture while the fields' crops are harvested at the mature stage for their grains seeds, roots and fibre. In human nutrition, vegetables are an essential protective food containing vitamins and minerals. Any balanced diet should include vegetables and fruits for this reason. The proportion of vegetables required in a balanced diet per capita per meal is of the order of 45% of the total volume of the food. Vegetables supply considerable quantities of vitamins A, B, C, D, E and K. According to Udoh *et al.* (2008) vitamin A maintains health of the respiratory and the eye tissue; vitamin B is essential for development of the nervous system; vitamin C maintains health of blood cells and tissues; vitamin D maintains health of bones and teeth; vitamin E maintains heath of the reproductive system; and vitamin K is essential for blood clotting. Iron, which is particularly plentiful in green vegetables, is part of haemoglobin which is found in the blood.

The high fibre content of vegetables is essential to maintain the health of the bowels, and a diet which is low in fruit and vegetables frequently results in constipation.Nutritionally, garden egg contains water (92.5%), protein (1%), fat (0.3%), and carbohydrates (6%). Medicinally, a meal of garden egg has been proven to benefit patients suffering from raised intraocular pressure (glaucoma) and convergence insufficiency, as well as in heart diseases and arteriosclerosis (Guardian, 2009). It is consumed almost on a daily basis by

urban families and also represents the main source of income for producing households in the forest zones of West Africa and particularly in Nigeria (Danquah-Jones, 2000). Despite the local importance of garden egg in the study area, several farm-level efficiency studies on vegetable production focused on waterleaf and fluted pumpkin (Idiong et al. (2002), Umoh, 2006; Udoh and Etim, 2006). Vegetable supply components of a balanced diet will be achieved at a comparative low price, a much better and faster returns can be obtained through vegetable cultivation than from that of other crops (Obasi, 1999).

In Africa, three major classes of vegetables are consumed. These include those that are gathered from the wild such as afang and eritan leaves; those indigenous vegetables which are often gathered but are also cultivated such as amaranthus; and imported vegetable species which are cultivated such as Lettuce, cabbage, and carrots. Udoh *et al* (2006) Leafy vegetables are an important feature of Nigerian's diet that a traditional meal without it is assumed to be incomplete. In developing countries, the consumption of vegetables is generally lower than the FAO recommendation of 75kg per year in habitant (206g per day per capita) (Badmus and Yekini, 2011). Vegetables as a whole can therefore make an impact on nutritional status of population, it has been affirmed that malnutrition is common in Africa, especially among women and children under five years old (Chahda *et al*, 2011).

In Nigeria, as in other tropical countries in Africa where the daily diet is dominated by starchy staple foods, vegetable are the cheapest and most readily available, important and essential nutrients (Okafor,2008). Vegetable production in the humid regions is important to supplement the increasing demand for fresh vegetables (Poundel et al., 1998). Yet among food crops, they are a neglected group, greater effort to explore the potential of

these vegetables could led to enhanced agricultural productivity more stable food supplies, and higher income in rural areas.

A balanced diet should contain 250-325g of vegetable and the average human requirement for vegetable is 285g/person/day for a balanced diet (Atavar, 2000). In Nigeria, vegetable consumption range from 59- 130/person/day during the months of May to July, the peak season of vegetable production (Hart et al, 2005). This range is far below the recommended average, given the recent demand for vegetable. Considering the level of unemployment and poverty among the people it becomes imperative to evaluate and analyse the profitability of production and the determinants of the efficiency of vegetable production in Akwa Ibom State.This could serve as micro entrepreneur for youth, women and men empowerment.

In Nigeria, vegetable production has been on -going for decades, providing employment and income for the increasing population especially during the long dry season. However, production is constrained by inadequate infrastructure, agronomic and socio-economic variables (Sabo and Zira, 2008). Vegetables are known to enrich some diets with nutrients including lipids, carbohydrates and vitamins. Vegetable crops are important for almost every household. According to Dittoh (1992), vegetables add flavor to the food and also provide considerable protein, vitamins and minerals. Most vegetables are low in starch content and are a good source of phytonutrients. They serve as roughage, which promotes digestion, and prevent constipation. Vegetable crops not only improve the nutritional quality of diets, the production of vegetables under irrigation also provides many people with employment in the dry season. Vegetables are the most affordable and accessible sources of micronutrient and its production is increasingly recognized as a catalyst for rural development and as a means of increasing and generating foreign

exchange in Africa (AVRDC, 2004). Apart from the income generating potential of vegetable production, it's also plays crucial role in the off-setting the food budget of a household, maximum use of land hence poverty alleviation, and the promotion of growth and development. Siesmomma et al. (2004), they also review the species of vegetables and report that indigenous vegetables are well adapted to adverse environmental conditions and general resistance to paste and pathogens.

Vegetable is also known to increase the income of the people and hence that of the state, the producers at times export it to neighbouring state and this also alleviate poverty and give them a sense of belonging. Fluted pumpkin is used as leaf vegetables. Its seed can be eaten without poison. Its roots and leaves are invented as main ingredients for making Nigerian soup whose name is "Edikang Ikong." But, its fruit is inedible. Other foods made of Fluted pumpkins are Slow Food, Butternut Squash, and Lettuce etc. Vegetables constitute a major component of the country's food sector. Though not a staple in most areas of Nigeria, the commodity occupies a significant position in the total per capita calorie intake of most Nigerians.It is estimated that about 70% of the vegetables produced in Nigeria is marketed and consumed fresh. (Danso et al., 2003).

The increasing populations of most tropical countries have led to a new awareness of the importance of vegetable crops as a source of food, accompanied by the realization that many vegetables can supply essential nutritional materials which may not be readily available from other sources (Tindall, 1983).Vegetables play an important role in income generation and subsistence. Recent surveys carried out by the Natural Resources Institute in Cameroon and Uganda provide evidence that vegetables offer a significant opportunity for the poorest people to earn a living, as producers and /or traders, without requiring large capital investments. They are important items for poor households because their prices are relatively affordable when compared to other food items (Schippers, 2000).

Vegetables are important food crops in Nigeria. They are produced on a large scale in some parts of the country. Telferia, waterleaf and garden egg are the most popular vegetables in Nigeria (Nkansah et al., 2002). In the study area waterleaf is used as a "softener" when cooking fibrous vegetables such as Afang (*Gnetum africanum*), Atama (*Heinsia crinata*), and fluted pumpkin (*Telferia occidentalis*). Ibeawuchi *et al*. (2007) noted that the leaves and young shoots are used to thicken sauce and it is consumed in large quantities in the Southern part of Nigeria. Nutritionally, waterleaf has been proven to be high in crude-protein (22.1%), ash (33.98%), and crude fiber (11.12%). It also has some medicinal values in humans and acts as green forage for rabbit feed management (Ekpenyong, 1986; Aduku and Olukosi, 1990). In addition, waterleaf production provides a complementary source of income to small-scale farming households (Udoh, 2005). Dittoh (1992) reported that dry season vegetable production in Nigeria has become a booming business. Apart from the farmer and farm labourers' who produce the vegetables.

2.2.1 Economic of vegetable losses

Estimates of production losses in developing countries are hard to evaluate. Poor harvest losses of vegetable in Nigeria have been estimated to reach 50 % (FAO, 2013). Both qualitative and quantitative losses occur in horticultural commodities between harvest and consumption (Kader *et al.*, 2011), therefore minimising post-harvest losses of already produced vegetable is more sustainable than increasing production. Post-harvest losses include the rotting of vegetables and damage during storage, packaging and transportation which leads to consumers' rejection (Kader et al., 2011). Most losses and wastes occur during the food chain through excessive processing, packaging and marketing (FAO, 2013). Post-harvest losses can then be defined as quantitative and

qualitative losses of a given product at any moment along the post-harvest chain (De Lucia *et al*, 2013).

Vegetables and root crops are much less hardy, quickly perishable except under intense care during harvest, handling and transportation. Post-harvest losses are much more painful and costlier than pre harvest losses both in terms of money and man-hours (Dasguta *et al.,* 2010). Due to absence of proper storage and marketing facilities, farmers are forced to sell their vegetables at give-away prices which make the whole process not economical and less attractive. Losses in vegetable production are also as a result of mechanical injuries, unsuitable handling, faulty transportation system and unorganised market (Prigojie *et al.,* 2011). According to (Umoh, 2012) post-harvest losses reduces returns to vegetable production and can be attributed to lack of infrastructure related to transportation and storage, also poor marketing know-how is another challenge. The magnitude of losses depends on the nature of the vegetables, the condition of the produce as the time of harvesting, distance travelled and the nature of the transport facility. In order to ensure good quality and quantity of vegetable production with high economic and marketable potential, the factors responsible for the losses must be addressed as these will enhanced food sufficiency and also alleviate poverty.

2.3 Effect of Vegetable Production on Poverty

Poverty and food insecurity have been considered for decades to be rural and urban problems. Someanalyses have shown however, that urban poverty is not only growing rapidly, but has tended to be underestimated in the past (Ekong, 2009).Poverty is the state of human beings who are poor. That is, they have little or no material means of surviving little or no food, shelter, clothes, healthcare, education, and other physical means of living and improving one's life. Poverty is associated not only with insufficient income or

consumption but also with insufficient outcomes with respect to health, nutrition, and literacy, and with deficient social relations, insecurity, and low self-esteem and powerlessness, Poverty can also be said to be the state when an individual or household is not able to meet basic needs.

According to World Bank (2000) poverty is define as "pronounced deprivation in wellbeing", where well-being is defined as the command over commodities in general and can be measured by individual or households' procession of income, health, education, assets and certain rights in the in a society such as freedom of speech. Poverty may be conceptualized either in absolute terms or in relative terms, it also be defining by using the income levels (IL) and the income positions (IP). These methods rely on defining a threshold that is relative to a widely accepted measure of well-being. In particular, they rely on a threshold that is relative to either income or expenditure. The final aim is to define a poverty line. In both cases, the "relative" definition of poverty may make the poverty line responsive to the way in which the incomes distributed among individuals as well as the mean income.

The health status of household members can be taken as an important indicator of well-beingPoverty can be relative and absolute these are defined in relation to the overall distribution of income or consumption in a country; for example, the poverty line could be set at 50 percent of the country's mean income or consumption. While absolute is anchored in some absolute standard of what households should be able to count on in order to meet their basic needs. For monetary measures, these absolute poverty lines are often based on estimates of the cost of basic food needs, that is, the cost of a nutritional basket considered minimal for the health of a typical family, to which a provision is added for nonfood needs.

Some definitions of poverty, are relative, rather than absolute, poverty reduction would not be considered to apply to measures which resulted in absolute decreases in living standards, but technically lifted people out of poverty. The poverty incidence in Nigeria increased from 65.6% in 1996 to 78.3% of the population in 2004 (FOS 2004). Furthermore, the distribution of extreme poverty by occupational category indicates that 67.4% of the poor in Nigeria were in agriculture (FOS, 1999). The rural, traditional, and mostly private agricultural sector is characterized by small-scale, poor, subsistence and semi-subsistence farmers and informal traders. The farmers cultivate small landholdings, which are often less than one hectare in size and in fragmented plots. The traditional system of agricultural production still prevails, with its characteristically low technical base, high reliance on manual labour and, hence, low resource productivity. Agricultural production is seasonal with annual output fluctuations.

Poverty alleviation can only be effective if it's multidimensional because poverty is a multidimensional phenomenon (Hulme and Shepherd, 2013). These will involves improving the living conditions of people who are already poor, particularly with respect to their income. In the context of economic theory, the income effect is the change in an individual's or economy's income and how that change will impact the quantity demanded of a good or service. The relationship between income and the quantity demanded is a positive one, as income increases, so does the quantity of goods and services demanded (Nsikan *et al.*, 2010).

In urban settings, lack of income translates more directly into lack of food than in rural settings. In all regions, urban and peri-urban agriculture is an activity in which the poor are disproportionately represented. Vegetable production in many cases is a response of

the poor to inadequate, unreliable and irregular access, and the lack of purchasing power. Engagement in farming particularly in vegetable production has also been shown to be associated with greater dietary diversity in most countries and can easily alleviate poverty (WHO, 2011). Poverty occurs in both developing countries and developed countries. While poverty is much more widespread in developing countries, both types of countries undertake poverty reduction measures. Vegetable production in Nigeria has a positive impact on income of rural household since it serves as food security and can also alleviate poverty, in areas of health, education, socials and economic purposes (Edet and Nsikan, 2012).

2.4 Conceptual Framework

2.4.1 The concept of efficiency in agricultural production

One of the strategies for increasing agricultural productivity is a combination of measures designed to increase the level of farm resources, as well as make efficient use of the resources used on farm depends on a large number of interacting factors constituting an agricultural system, and may be internal or external to the farm. Efficient use and allocation of resources thus, implies that a redistribution or re-allocation of resources to further decrease output or useless of the input produce the same output is impossible (Ihenacho, 1999).

Efficiency, as defined by the pioneering work of Farrell (1957), is the ability to produce at a given level of output at the lowest cost. Technical efficiency is the ability of the farm to produce a maximum level of output given a similar level of production inputs. Allocative efficiency is the extent to which farmers equate the marginal value product of a factor of production to its price. Economic efficiency combines both allocative and technical efficiency. It is achieved when the producer combines resources in the least

combination to generate maximum output (technical) as well as ensuring least cost to obtain maximum revenue (allocative) (Chukwuji, *et al.,* 2006). This study aims at estimating technical and allocative efficiency. Therefore, this study assumes that producers aim at maximizing output subject to existing constraints. If the farm is technically and allocativelly efficient, then that firm is said to be cost effective (Chukwuji, *et al.,* 2006). In order to promote commercialization of Agriculture from subsistence farming, these farmers have therefore to be both technically and allocatively efficient. The ultimate goal of training farmers to be both allocatively and technically efficienct is to boost their incomes by maximizing profits especially in poverty pressed countries.

Allocative efficiency is determined by calculating the ratio of the Marginal Value Product (MVP) to the Marginal Factor Cost (MFC) Olukosi and Ogungbile, 1989). The MVP is calculated from the respective regression coefficient using the appropriate formula depending on the lead equation or functional form, while the market price of one unit of the input concerned is the MFC. A ratio of 1.0 is interpreted to mean economic optimum allocative efficiency, while a ratio of less than 1.0 implies that the input is being overused. When the ratio is greater than 1.0, it means the input is underused. Heady and Dillon (1961) suggested that we compare the MVP of each resource (as worked out at the geometric mean) with its corresponding price and test the difference statistically with the help of test.

Rudra (1973), criticized the MVP and MFC or price of input approach to resource allocative efficiency. He indicated that the use of the market price to overusing resources, while the other is under-using it. In other words, every individual farmer is inefficient. Singh (1975) however, pointed out that in spite of this and other limitations of this approach, it provides a useful guide in deciding whether or not making adjustment in the

pattern of resource allocation could profitably increase the level of agricultural production in a given environment. Reedyway (1976), Mijindadi and Norman (1982) used this approach. Farrell (1957) was the first to introduce a measure of efficiency that avoids the problems associated with traditional average productive measure. He introduced the distinction between (in) efficiency and allocative (in) inefficiency. He observed from a given bundle of factors and allocative efficiency arises when factors are used in proportions, which do not lead to profit maximization.

In order to assess farm efficiency in production economics, complimentary observation of the operator's behaviour can be modelled. The operator theoretically behaves as a profit maximizer or cost-minimizer when choosing the optimal bundle for the business. The concept of efficiency is concerned with the relative performance of the process used in transforming given inputs to outputs. If the theoretical arguments as to the relative efficiency of different economic systems are to be subjected to empirical testing, it is essential to be able to make some actual measurements of efficiency. Equally, if economic planning is to concern itself with particular industries, it is important to know how far a given industry can be expected to increase its output by simply increasing its efficiency, without absorbing further resources (Farrel, 1957).

2.4.2 Concept of profit efficiency

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

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

Lau and Yotopoulos (1971) and Yotopolous and Lau (1973) therefore popularized the use of the profit function approach, in which farm- specific prices and levels of fixed factors are incorporated in the analysis of efficiency. The advantage of using this approach is that input and output prices are treated as exogenous to farm household decision making, and they can be used to explain input use.

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

2.4.3 Concepts of poverty in Nigeria

Poverty is lack of material well-being, insecurity, social isolation, psychological distress, lack of freedom of choice and action, unpredictability, lack of long-term planning horizons because the poor cannot see how to survive in the present, low self-confidence and not believing in one self (Narayan 2000) Sengupta (2003) defined poverty as not only an insufficient income to buy a minimum basket of goods and services but as the lack of basic capabilities to live in dignity. This definition recognizes poverty's broader features,

such as hunger, poor education, discrimination, vulnerability and social exclusion. In the light of the International Bill of Rights, poverty is defined as a human condition characterized by sustained or chronic deprivation of the resources, capabilities, choices, security and power necessary for the enjoyment of an adequate standard of living and other civil, cultural, economic, political and social rights (UN 2001; and Hunt, *et.al* 2004). As observed by Kankwanda, et al., (2000) poverty is either absolute or relative or both. Absolute poverty being that which could be applied at all time in all societies, such as the level of income necessary for bare subsistence, while relative poverty relates to the living standard of the poor to the standards that prevail elsewhere in the society in which they live. Related to the definition of poverty are the measurements of poverty whose importance is to know who is poor, how many people are poor, and where the poor are located. According to Foster, et.al (1984), the most frequently used measurements are: the head count poverty index given by the percentage of the population that live in the household with a consumption per capita less than the poverty line; poverty gap index which reflects the depth of poverty by taking into account how far the average poor persons' income is from the poverty line; and the distributionally sensitive measure of squared poverty gap defined as the means of the squared proportionate poverty gap which reflects the severity of poverty. Studies by UNDP also advocate the use of Human Development Index (HDI) and Capability Poverty Measure (CPM). According to UNDP (various issues) HDI combines three components in the measure of poverty which include: longevity as measured by life expectancy at birth; educational attainment as measured by a combination of adult literacy (two-thirds weight) and combined primary, secondary and tertiary enrolment ratios (one-third weight); and improvement in standard of living as measured by real GDP per capita income (PPP$). The first relates to survival vulnerability to death at a relatively early age. The second relates to knowledge – being excluded from the world of reading and communication. The third relates to a decent

living standard in terms of overall economic provisioning. On the other hand, CPM focuses on the average state of peoples' capabilities by reflecting on the percentage of people who lack basic or minimally essential human capabilities that are ends in themselves, needed to lift one from income poverty and sustain strong human development.

2.5 Theoretical Framework

2.5.1 Production efficiency

Production is processes were inputs are converted into output. What is put into the production process comes out either as a product or in form of a waste (Olukosi *et al.*, 2007). The production function is a purely technical relationship which connects factor inputs and output, it describes the law of proportion, that is, the transformation of factors inputs into products (outputs) at any particular time period (Koutsoyiannis, 1979). Efficiency as a concept is based on the neoclassical theory of production Kumbhakar, (1994), Coeli *et al.*(2005).Economic analysis is a broader concept of determining and evaluating technical, allocative and economic efficiency. It is a concept based on a systemic approach to determine the optimum use of scarce resources involving comparison of two or more alternative in achieving a specific objective under the given assumptions and constraints Idiong (2005). It is an indication of a production function that would result in maximum output given a set of resources. Kompus (2004) however, pointed out the problem of the notion of maximum. That is, it is recognized by mere observation of the level of output, but can only be assumed. He also noted that such an assumption is unrealistic since different producers produce different levels of outputs. He therefore opined that differences in observed output of different producers could only be

explained with their productive efficiency. Improve efficiency means getting more for the same inputs by allocating them in a better way.

Efficiency as a concept also dates back to the work of Farrel (1957) over four decades ago, which was based on the previous work of Debreu (1951) and Koopmans (1951) cited in Effiong (2005). In Farel's notion, efficiency was decomposed into two principal components (Technical and Allocative). Technical efficiency refers to the degree, which firms are producing on a production frontier as opposed to or below it. That is for the same amount of inputs some firms obtain higher output levels than others due to both management and labour differences and perhaps other reasons Norton and Alwang, (1993); Olayide and Heady, (1982). The failure on the part of the farm to produce on the frontier level of output given the level of input and available technology is therefore attributed to inefficiency Kumbhakar, (1994).

On the other hand, allocative efficiency relates to the degree to which farm operating on their production function employed the correct amount of inputs to equate marginal revenue with marginal cost (MR=MC) of obtaining the last unit of output Norton and Alwang, (1993); Kumbhakar 1994 and Olayide and Heady 1982. The combination of these two measures (technical and allocative) gives an indication of the overall efficiency called economic efficiency. Therefore, technical and allocative efficiency in vegetable production can be achieved if maximum output can be produced given a set of inputs and available technology as well as the choosing of the optimal input mix given the input prices. Efficiency estimation methods can be classified into three broad areas.

These are:

(1) Deterministic parametric estimation

(2) Non parametric mathematical programming

(3) Stochastic parametric estimation.

A deterministic parametric estimation method assumes a one-sided error term for a production frontier. The model is specified as:

$Y = \alpha + F(Xi; \beta) + e;\ e \geq o,\ I = 1, 2 - N$ ---------- (1)

Where

Y = output of the i^{th} farm

Xi = (Mx1) input vectors

β = vector of unknown parameters to be estimated.

F (.) =Functional form which is often the Cobb Douglas function.

E = non-negative variable representing inefficiency in production. This indicates the proportion between actual and potential output.

Those who pioneered this method are Aigner and Chu (1968), Afrait (1972), Schmidt (1976) and Seitz (1970). It shortcoming lies in its susceptibility to outliners given the definition of inefficiency Udoh, (2000).

Non-parametric mathematical programming was introduced by Charmws *et al.*(1987). He formulated Farrel's (1957) approach to frontier estimation into a mathematical programming called Data Envelopment Analysis (DEA). The advantage of these methods over the deterministic approach is that, it does not allow for the making of arbitrary assumptions regarding the functional form of Udoh, (2005). However, its lack of statistical properties to be evaluated from the estimated production frontier is the most important drawback Coelli, (1995).

In the stochastic parametric frontier method, deviation from the production frontier is accounted for by technical inefficiency, measurement error, statistical noise, and other non-systematic influences. This method was designed and used independently by Aigner *et al* (1997) and Meeusen and Van den Broeck (1997). It was modifying by Jondrow *et al*

*(*1982). The modification made it possible for individual farm level efficiency to be estimated using cross sectional data. The function is specified as:

$Y = F(Xi; \beta) \exp Vi - Ui;\ I = 1, 2, - N$---------- (2)

Where,

Yi, Xi, β (.) are as defined in equation one.

Vi = Symmetric error component that account for random effect and exogenous shock.

$Vi \leq 0$: one-sided error component that measures technical efficiency.

To estimate the model and separate technical inefficiency (U) from statistical noise (Vi) requires some assumptions about the distribution of Vi and Vi. Vi is assumed to have a normal distribution ($Vi _ N(0, \delta^2_x$ while U has half normal distribution ($Ui _ [N(0,\delta^2_u]$

The parameters of the frontier and density functions of V and U can be estimated by maximizing the log likelihood function Stated as follows:

$$Lny = N\ln(^2/\pi)^1/_2 + N\delta^{-1} + \sum_{i-1}^{N} In(1 - F(e_i\ \lambda\delta^{-1}) - {}^1/_2\ \delta^2 \sum_{i-1}^{N} e_i^2 \quad \text{----------(3)}$$

Where

e = sum of V and U

$\delta^2 = \delta^2 x + \delta^2 x$

$\lambda = \delta_u/\delta_v$

F = Standard normal distribution function

N = Number of farms in the sample.

It should be noted however that U can also assume an exponential distribution (i.e. gamma distribution with parameters λ =1 and λ>0. By estimating the means of the conditional distribution of U given V, farm level technical efficiency estimates can be derived (Coelli and Battese, 1996).

This implies that:

}

$E\left(^{ui}/_{ei}\right) = \mu + \sigma^{*}\ F(^{\mu}/\ \sigma^{*})\ [1\text{-}F(^{-\mu}\ /\ \sigma^{*})]^{-i}$---------- (4)

$\sigma^{*} = \sigma^{2}{}_{v}\ \sigma^{2}{}_{u}\ /\ \sigma^{2})^{1/2}$

$\mu_{i} = (-\sigma_{u\ ei})/\ \sigma^{2}$

F = Standard density function

One of the shortcomings of this method is the non a priori justification for the selection of any particular distribution form of U_i and the inconsistent estimate of farm level technical efficiency (Coelli, 1995, and Jondrow *et al*., 1982).

In spite of the shortcomings, the approach allows for the test of hypotheses and standard errors measurement; a condition not possible with deterministic models because of the violation of some regularity conditions of the maximum likelihood function (Schmidt, 1976, Coelli and Battase, 1996).

2.5.2 Productivityfunction

The production function represents the relationship between outputs of goods and services in real physical (“primal’’) volumes to the different inputs used, also in terms of physical volumes, which can be expressed in terms of output per unit of total input-or productivity (Kendrick et al., 1981). Productivity is the ratio of output to inputs in production; it is an average measure of the efficiency of production. Efficiency of production means production’s capability to create incomes which is measured by the formula real output value minus real input value.

Nsikan *et al*, (2010), Productivity can be measured through the use of partial productivity measures, the ratio of output to an individual input or input class or in terms of multifactor productivity (or total factor productivity), and the ratio of output to all associated inputs. Productivity is a crucial factor in production performance of firms and nations. Increasing national productivity can raise living standards because more real

income improves people's ability to purchase goods and services, enjoy leisure, improve housing and education and contribute to social and environmental programs. Productivity growth also helps businesses to be more profitable. In economics is the ratio of what is produced to what is required to produce therateatwhich goodsandserviceshavingexchangevaluearebroughtforthor produced. Productivity is the measure on production efficiency. Productivity model is a measurement method which is used in practice for measuring productivity. Productivity model must be able to solve the formula Output / Input when there are many different outputs and inputs. Productivity is directly equivalent to changes in the economic efficiency of production, in that they reflect improvements in the real cost of production over time (ABSSP, 1979). Measures of partial factor productivity are attractive because they avoid the need for monetary valuation of inputs and for the calculation of constant prices over time (Mahoney, 1980), and can be used to illustrate savings achieved over time (or variations between similar production units) in the use of particular inputs.Economics of production of minor vegetables however, received little or no attention from the research community, greater effort to explore the potential of these vegetables could lead to enhanced agricultural productivity, more stable food supply and more income for farm families in Akwa Ibom State because vegetable production is an income generating activities therefore needs economic evaluation of the efficiencies of production.

To achieve the Millennium Development Goal of having the proportion of hungry people by 2015, it is projected that 22 million people must attain food security every year. This could achieve only if the available resources are efficiently utilized. This is because food production problem has been heightened by the relatively low level of productivity of the resources used by the farmers (Ojo, 2010). In order to enhance the productive capacity of

the farmers, knowledge of the availability of the aggregate farm level resources and differences in their productivities is essential.

However, they have the potential to mislead, as they reflect not only improvements in the productive efficiency of the input in question, but also changes in output which resulted from factor substitutions made in response to changes in relative factor prices.

Labour is the major factor of production in the traditional farming systems of West Africa and as such the utilization and productivity of labour is a key element in increasing the agricultural output and incomes of small farmers. To the extent that there is underemployment of labour in Agriculture, the potential exists for increasing output, employment and incomes (Umoh, 2011).

The basic trust of the economics of agricultural production at the micro level is to assist individual farmers or group of farmers to attain their stated objectives through efficient intra farm allocation of resources during a period or over a period of time. Economics of Agricultural production is achieved either by maximizing output from given resources or minimizing the resources required for producing a given output**.** Resource productivity is definable in terms of individual resource inputs or a combination of them. Optimal productivity implies an efficient utilization of resources in production process hence productivity and efficiency are synonymous in this content besides the production function, other techniques have been used for empirical estimation of resource productivity and efficiency.

One of such techniques involves calculating input output ratios. This means that individual resource productivity in any production process is measured in terms of the ratio, which the total enterprise bears to the amount of input used. The poverty incidence in Nigeria increased from 65.6% in 2000 to 78.3% of the population in 2013 (FBS 2014). Furthermore, the distribution of extreme poverty by occupational category indicates that 67.4% of the poor in Nigeria were in agriculture (FBS 2011). The rural, traditional, and

mostly private agricultural sector is characterized by small-scale, poor, subsistence and semi-subsistence farmers and informal traders. The farmers cultivate small landholdings, which are often less than one hectare in size and in fragmented plots. The traditional system of agricultural production still prevails, with its characteristically low technical base, high reliance on manual labour and, hence, low resource productivity. Vegetable production is one such strategy that enhances food security, stimulates local economic development, and facilitates social inclusion and poverty alleviation (Keboneilwe, 2011).Vegetable production is therefore a response to the market demands resulting from rapid urbanisation, when conceived as an intervention, positively affects a wide variety of household issues. In addition to its direct contribution to food security and nutrition, vegetable production also touches on health, economicdevelopment, social inclusion as well as environmental management. As a consequence, food security will continue to increase and this remains a strategy to alleviate household poverty (Argenti, 2010).

Evidence of declining productivity of vegetable crops in Nigeria was observed by Abang et al., (2012), yet the majority of the extreme poor who live in the small and large cities in the tropical high and mangrove forest and practice farming grow vegetable as sole crop. In order for the fight to alleviate poverty to be enhanced in this region, vegetable should be cultivated in large quantity and variety since is a common income generating activity. There is an increasing interest in vegetables throughout the world, reflecting a growing trend within agriculture to identify and develop new variety for export and domestic markets; they contribute thus significantly to maintain diversity and hence more stable agro-ecosystems. The commercialization of these vegetables has contributed to improving the standard of living of the villagers. Its economic importance cannot be underestimated, especially in the area of poverty alleviation among rural people. The trade of this product established that a substantial amount of revenue can be realized from farm gate to village and urban markets (Kabuye, 2012).

Vegetable production in Nigeria by farmers at subsistence level goes a long way in providing jobs and also contributes in alleviating poverty at household level if the scarce resources are efficiently and timely managed, though these involved lots of know-how that must be put in place by the necessary bodies. (Umoh, 2011).

2.6 Analytical Framework

2.6.1 Profitability analysis

Profit maximization is one of the important goals of farm firms. Profit is generally described as the difference between Total Revenue (TR) and Total Cost (TC). The Total Revenue (TR) is the product of the output sold and the price. Cost and Return analysis usually forms the basis for farm profitability analysis, it involves itemising the cost and returns of production and using them to arrive at such estimates as return to one unite of the resources used, the gross margin as well as the and returns. According to crammer and Jensen (2011), all production cost can be divided into two general groups which are explicitly or implicit costs. An explicit cost has been incurred when money is spent to hire labour repair machinery, buy seeds fuel or other things for which cash expenditure are made; while an implicit cost has been incurred in using any resource for which there was of cash outlay during the period that the resources was being used example of such cost includes the use of tractor that may be purchased with the full purchase price paid on delivery and which its cost cannot be charged against one year's operation. Total cost is traditionally divided into fixed and variable costs. Fixed costs are those costs incurred on fixed inputs, which cannot be used up during one production process (Olukosi *et al.* 1988). On the other hand, variable costs are those costs associated with variable inputs and do change with changes in output level.

The opportunity cost of fixed input is zero in the short run. Therefore, the farmers need to only maximize the returns to fixed inputs, that is, the sales value of output less the cost of variable inputs. This is the concept of gross margin analysis (GM). According to Olukosi and Erhabor (1988), gross margin is a very useful planning tool in situation where fixed cost is a negligible portion of the farming enterprises as is the case of subsistence agriculture. It is easily computed and represents the most relevant economics indicator to draw the attention of the farmers to the problem of his farm and offer solutions to them.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 farmer's farm income. It has the advantage of being simple as well as useful in the analysis of the profitability of small farms that have small fixed costs (Sam, 2011).

Profit made is the differences between total revenue and total cost;

$\pi = TR - TC$ ---------- (5)

Where

π=Profit

TR=Total Revenue in Naira/ha

TC=Total Cost in N/ha

The various profitability ratios computed from the above analysis includes: benefit-cost ratio, rate of return, expenses structure ratio, gross margin ratio and grossrevenue ratio. (Kennedy *et al* 2013)

2.6.2 Efficiency meaning and measurement

Efficiency is at the core of economic theory. Rahman (2013) defines farm production efficiency as the ability of a farm to produce a given level of output with the lowest amount of resources. The efficient method of producing a product is the one which uses

the least amount of resources to get a given amount of output. The theory of production in economics is concerned with optimization, and optimization implies efficiency (Baumol, 2008). Decision-makers are presumed to be concerned with the maximization of some measure of achievement such as profit or efficiency. The analysis of efficiency in general, focuses on the possibility of producing a certain level of output at lowest cost or of producing the optimal level of output from given resources. Therefore, efficiency measurements that show the scope for improved performance may be useful in the formulation and analysis of agricultural policy (Russell and Young, 1983).Several aspects of production efficiency in the literature for measuring farm performance. For instance,Farrel (1957)distinguished three types of efficiency as technical efficiency, price or allocative efficiency and economic efficiency which is the combination of the first two.

Technical Efficiency:

Technical efficiency is defined as the minimum factors by which a vector of inputs can be rescaled and still allow the production of a given vector of outputs (Debreu 1951 and Farrel 1957).The concept technical efficiency shows the success of a farm enterprise, as it indicates an ability of a farm to produce maximum output from a set of input mix .From Farrell analysis, a farm that is technically efficiency in resource use operates on a production frontier, while a technically inefficient farm in resources use operates below the production frontier. Hence, the position of individual farm relative to the frontier could be influenced by factors ranging from climatic, socio-economic and marketing etc (Sail 2006 and Hoppe2009). It relates to the degree in which the farmer produces the maximum feasible output from a given bundle of inputs (an input oriented measurement), or uses the minimum feasible level of inputs to produce a given level of output (an input oriented measurement) (Rahman, 2013). A firm is said to be efficient when it's operating

on the production frontier (Ali and Byerlee, 1991), on the other hand a firm is said to be technically inefficient when it fails to achieve the maximum outputs, or fails to operate on the production frontier

Mathematically, Farrell's production frontier function begins by considering a stochastic production function with a multiplicative disturbance term of the farm.

$Y = f(Xa,;)\, e^{E}$---------- (6)

Where y = output; X = vector of input, = vector of parameter, e = error term; E is stochastic disturbance term consisting two independent element "V" and "U". Hence.

E = U + V ---------- (7)

The symmetric element V account for random variation in output quantity attributed to factors outside the farmer's control (such as disease, weather). A one – sided component U < O reflects technical inefficiency relative to the stochastic frontier. Thus U = O for farm output that lie on the frontier (i.e. 100% technical efficiency in resource use) and U < O for farm output below the frontier as $N \sim (o, \hat{O}_u^2\, v)$. Thus equation (1) becomes

$Y = f(X;,)\, e^{u+v}$---------- (8)

Conventionally, the performance of a firm is judged utilizing the concept of economic efficiency, which is made up of two components-technical efficiency and allocative efficiency (Kalarijan and Shand, 1999). According to Vensher (2001) a firm is said to be technically efficient when it produces as much output as possible with a given amount of inputs or produces a given output with the minimum possible quantity of inputs. Similarly, Ellis (1988) defines technical efficiency as the maximum possible level of output attainable from a given set of inputs, given a range of alternative technologies available.

According to Koopmans (1951), a production procedure is technically efficient if it cannot increase one output without decreasing another output or increasing at least one input. Debreu (1952) and Farrell (1957) noted that a production unit is efficient as long as

it operates on the production frontier, but not necessarily by the Koopmans definition. If a production unit operated on a part of the production frontier that is parallel to an output axis, it would be able to increase the output associated with the axis without decreasing any other output. Hence, the production unit is not efficient in the Koopmans definition. First a gap exists between realized efficiency and theoretical assumption of full technical efficiency. It has been observed by Bauer (1990) and Kalarijan and Shand (1999) that where technical inefficiency exists, it will exert a negative influence on allocative efficiency with a resultant effect on economic efficiency.

AllocativeEfficiency (Price Efficiency)

Farrell (1957) defines allocative efficiency as the ability to choose optimal input levels given factor prices. According to Kalarijan and Shand (1999), the willingness and ability of an economic unit to equate its specific marginal value product is referred to as allocative efficiency. In effect, allocative efficiency refers to the adjustment of inputs and outputs to reflect relative prices (price efficiency) under a given technology (Ellis, 1988).Unlike technical efficiency concept that only consider the process of production, allocative efficiency concepts pertain to the idea that society is concerned with not only how an output is produced, but also with what outputs and balance of output are produced (Hensher, 2001).

The allocative efficiency index measure a production unit's ability to choose the input combination that minimises cost given the best available technology. It is the ratio between the minimum cost requirement to produce a certain level of output and the unit's production cost if it were technically efficient (Fletsher and Zepeda, 2002). It is thedegree to which the farmer utilizes inputs in optimal proportions given the observed inputs prices (Coelli *et al,* 2002). Allocative efficiency implies substituting or intensifying the

use of inputs bases on their prices, inefficiencies therefore may stem from unobserved prices (e.g., undervalued management or labour time), from incorrectly perceived prices, or from lack of accurate or timely information (Aquilar, 1998).

Economic Efficiency

Economic efficiency is derived from the product of the technical and allocative efficiency (i.e Technical efficiency x Allocative efficiency) (Rahman, 2013). Economic efficiency is concern with the realisation of maximum output in monetary terms with the minimum available resources. It occurs when a farm chooses and enterprise in such a way to attain economic optimum (Ellis, 1988; Akinwumi and Djato, 1997). A farm that is economically efficient should by definition be boththechnically and allocatively efficient. However, this is not always the case as Akiwumi and Djato (1997) pointed out.

Rahman (2013) further explain that it is possible for a farm to have either technical or allocative efficiency without having economic efficiency. The reason may be that the farmer, in this case, is unable to make efficient decisions as far as the use of inputs is concerned. In some cases, a farmer may fail to equate marginal input cost to marginal value of product. If technical and allocative efficiency occur together they both necessary and sufficient conditions for economic efficiency. This assumes that the farmer has made right decisions to minimise cost and maximise profits implying operating on the profit frontier.

2.6.3 Parametricapproach tomeasurement of efficiency

Parametric approaches to the measurement of efficiency are the stochastic frontier production function (Aigner*et al*., 1976; Aigner *et al*., 1977; Meeusen and Van den Broeck, 1977) and the metafrontier production function would be considered here.

Stochastic Frontier Approach

The stochastic frontier production function independently proposed by (Aigner et al., 1976; Aigner et al .,1977; Meeusen and Van den Broeck, 1977) assumes that maximum output may not be obtained from a given input or a set of inputs because of the inefficiency effects. The production frontier model without random component can be written as;

$Y_i = f(x_i: \beta_i)\exp(v_i - u_i)\ i = 1, \ldots .. n$---------- (9)

Where y_i is the observed scalar output of the producer*i*,$x_i$is the vector of N used by the producer*i*, f (x_i: β_i) is the production frontier, andβ_i is the vector of technology parameter to be estimated. The two component v_i and $u_i$are said to be independent of each other, where v_i is a two-sided, normally distributed random error(vi –N(O,σ_v^2) and it accounts for pure random factors on production, which are outside the farmers control such as whether, diseases, etc. *ui* are non-negative, one-sided efficiency component with a half-normal distribution (u_i –N (O,σ_v^2) which captures the effects of inefficiency and hence measure the shortfall in the output. The parameter of the frontier model is estimated such that Gamma (y) =$\sigma^2_u/\sigma^2_u + \sigma^2_{v,}$ so that $0 \leq y \leq 1$ and represent the total variation in outputs from the frontier attributable to technical efficiency.

Sigma square $\sigma^2 = \sigma^2 u + \sigma^2 v$, the technical efficiency of a firm is defined in terms of the observed output (y_i) to the corresponding frontier output (y^*_i) given the available technology is expressed as;

$TE = \frac{yi}{yI} = f(xi; \beta_i)\exp(V_i - U_i) / f(x_i;\beta_i)\exp(Vi)$ ---------- (10)

$= \exp(-Ui)$ ---------- (11)

Where: $0 \leq TE \geq 1$

The inefficiency effects model is specify as follow;

$Ui = \sigma_0 + \sum_{d=1}^{n} \sigma_d W_d + E_1$----------(12)

Where Ui is farm specific insufficiency; W_d is a set of explanatory variables associated with the insufficiency effect of the farm. σ_0 and $\sigma_d$are parameters to be estimated E_1 is the error term.Assume that = f (x_i; β_i) takes the log linear Cobb Douglas form, the model can be written as;

$In\ y = \beta_o + \sum_n \beta_n \text{In} x_{ni} + v_i - u_i$---------- (13)

Test of several null hypotheses for the parameters in the frontier production function can be performed using the generalised likelihood ratio test statistics define by

= -2{In [$L(H_0)/ L(H_1)$]}---------- (14)

Where*L(H0) and L(H1)*denotes the values of the likelihood function under the null (Ho) and alternative (Ho) hypothesis respectively. If the null is true, the test statistic has approximately a chi-square or the mixed chi-square distribution with degree of freedom equal to the difference between the numbers of the parameters involved in the alternative and null hypothesis. If the inefficiency effects are absent the model, as specify by the null hypothesis, Ho = γ = 0, whereγ and sigma-square (σ^2) are as specify above, then () is approximately distributed according to a mixed chi-square distribution with at least 10 degrees of freedom. In this case, critical values for the generalised likelihood ratio test are obtained from Table 1 of Kodde and Palm (1986).

The Cobb-Douglas functional form is used in the study because the coefficients estimated directly represent the elasticity of production and has been widely applied in estimating farm efficiencies (Ogundari and Ojo, 2007; Hussain *et al*,.2012; Omondi and Shikuku, 2013).

The stochastic frontier production as an economic method of measuring efficiency has the advantage of allowing simultaneous estimation of individual technical efficiency of the respondent farmers as well as determinants of technical efficiency (Battese and Coelli, 1995). The main strength of the stochastic frontier approach is in its ability to deal

with stochastic noise and permits statistical test of hypothesis pertaining to production structure and the degree of inefficiency.

2.6.4 Frontier production function studies in Agriculture

In the estimation of efficiency in agricultural production, two broad groups of work abound. The mathematical programming and econometric estimation (non-parametric and stochastic frontier method).However, measurement of efficiency using the non-parametric approach has not been widely done despite its usefulness even where there is data limitation and the production technologies are less understood (Llewelyn and Williams, 1996). The estimation of efficiency using mathematical programming (especially static linear programming models) has been carried out in Africa. These include studies of Clayton (1961); Ogunfowora (2000); Belete *et al* (2013). Llewelyn and Williams (2006),Villana, (2005), Ogundari, (2006) and Linh (2007) measured technical efficiency for irrigated rice farms also using a linear programming technique. Their technique was able to allow for the decomposition of inefficiency into pure technical and scale inefficiencies.

Several empirical studies have made use of parametric approach in measuring inefficiency (Battese, 1992). The use of stochastic frontier production function in estimating efficiency is associated with agricultural production function studies in both developing countries. These studies, which are based on Cobb-douglas or flexible translog function can be specified as either production or cost function and could, make use of cross sectional, time series or panel data.

Udoh and Nsikan (2005) analysed technical efficiency of waterleaf production in uyo metropolis using stochastic frontier production function. The estimation revealed that family and fertilizer would significantly lead to increase in the yield level of small farmers. It was also found that educational level of the farmers was negatively and

significantly related to technical inefficiency. Battese and Corra (1977) were the pioneers. Others who had also made use of this model include Kalirajan (1981) and Bagi (1984) who used the Cobb-Douglas function. Bagi *et al* (1993) utilized the trans-log frontier function in estimating technical efficiency and showed a range of 0.52 to 0.91 for crop farms. Kalirajan et al (1983) also used the trans-log frontier function to estimate technical efficiency and got a technical efficiency estimate of 0.38 to 0.91. In Africa agriculture, studies by Adesina *et al* (2007) used a profit function to determine the relative efficiency of women as farm managers. Their findings showed a similarity in their efficiencies Ajibefun *et al* (2010) estimate the technical efficiency of crop farmers in the National Directorate of Employment in Ondo State that range between 0.22 and 0.88. Heshmatti *et al* (1996) estimated technical efficiency for Ugandan Matoke producing farmers and obtained a mean efficiency of 65percent while Ajebefun *et al* (2003) reported a mean technical efficiency of 0.76, 0.72, and 0.70 for vegetable, maize and rice farmers respectively in South West Nigeria. The few studies that have gone beyond the measurement of technical efficiency to include allocative and economic efficiency are that of Ali et al (1990) who got estimates of 0.84, 0.61 and 0.51 as mean technical, allocative and economic efficiency indices respectively for vegetable farmers in Pakistan. Bravo-Ureta et al (1991) obtained the mean values of 0.83, 0.85 and 0.70 for technical, allocative and economic efficiency respectively for dairy farms in the United State of America. Taylor et al (2006) estimated technical, allocative and economic efficiency for traditional vegetable farmers in Brazil and obtained mean values of 0.17, 0.74 and 0.43 respectively for cotton farmers. While reporting 0.58, 0.88 and 0.52 for technical, allocative and economic efficiency indices for cassava farms in Paraguay. Xu *et al* (1995) in their studies of conventional and hybrid rice production in China obtained mean efficiency estimates of 0.91, 0.86 and 0.79 as technical, allocative and economic respectively in conventional rice production. They however obtained mean efficiency

estimates of 0.79, 0.68 and 0.54 respectively in onion production. Bravo-Ureta et al (1997) Dominican Republic and obtained estimates of 0.70, 0.44 and 0.31 respectively. It should be noted however that these later studies are outside the Africa continent. The following studies are within Africa and Nigeria in particular include Ajebefun et al. (2013), Nwara (2014), Onyeawaku et al. (2014), Oniah, 2014), Idiong, (2014).

Determinants of Efficiency

Various studies on efficiency have considered certain attributes of the farmer and other factors as the possible causes of inefficiency. They have used the Ordinary Least Square (OLS) and Tobit models to show this relationship. Hesnmati and Mulugata (2006) accessing the effect of some socioeconomic factors on technical efficiency differentials between small and medium scale tobacco farmers in Uganda, reported the educational level, credit accessibility and extension services positively influenced farmer's efficiency. Seyoum *et al* (2008) and Weir *et al* (2000) also reported that education had a positive impact on technical efficiency. They opined that education is an externality on production since it enhances the adoption and spread of innovations that causes a shift in the production frontier. Amaza *et al.* (2000) reported a positive and significant effect on technical efficiency of food crop farmers in Gombe State, Nigeria. While farming experience and animal traction had a positive relationship with efficiency but were not significant. They also reported a positive and significant relationship technical efficiency and extension contact. Ajibefun *et al.* (2013) reported that age and family size had a negative effect on technical efficiency of food crop farmers in Western Nigeria. They however, found education, credit and farming experience to be positive and significant in influencing technical efficiency. Bravo-Ureta *et al* (1994) asserted that there was a weak association between education and extension contact on efficiency.

They reported as inconsistent with expected result. They however reported that their findings agreed with that of Antiporta (1978), Cotlear (1987) and Azhar (1991) who opined that elementary education has no effect on farmer's productivity. They reported a positive and significant relationship between credit and technical, economic and allocative efficiency, confirming earlier findings by Lingard *et al* (1983). However, they found no significant relationship between farm size and technical efficiency. Amaza *et al* (2000) also reported a mean positive influence of education and extension contact on allocative and economic efficiency. Xu et al. (1995) also asserted that there was a positive and significant relationship between education and economic and allocative efficiency but not with technical efficiency. Land size was significant and positive in one region with respect to technical and economic efficiency but negatively related to economic and technical efficiency in the other two regions. Bravo-Uretta *et al* (1997) found out that tenure arrangement has a significant and positive effect on technical and allocative efficiency of farmers in Dominican Republic. However its effect on technical efficiency was positive but not significant. They also reported a significant and positive relationship between farm size and allocative and economic efficiency, the relationship between age and efficiency (technical, allocative and economic) was significant and positive while household size had a negative and significant effect on allocative and economic efficiency but positive and non-significant relationship with technical efficiency Empirical applications of stochastic frontier to efficiency studies

Socio economic Factors Influencing Efficiency

Several factors including socio-economic and demographic factors, plot level characteristics, environmental factors and non-physical factors are likely to affect the efficiency of smallholder farmers. Lall (2000) studied many countries in relation to their economic performance. One of his conclusions was that human capital is a crucial

element whose importance grows as technology becomes more advanced.Parikh *et al* (2011) using stochastic cost frontiers in Pakistani agriculture in a two- stage estimation procedure find that education, number of working animals, credit per acre and number of extension visits significantly increase cost efficiency while large land holding size and subsistence significantly decrease cost efficiency.

Coelli and Battese (1996) in a single estimation approach of the technical inefficiency model for Indian farmers find evidence that the number of years of schooling, land size and age of farmers are positively related to technical inefficiency. Wang *et al* (2006) using a shadow price profit frontier model to examine the productive efficiency of Chinese agriculture find that household's educational levels, family size and per capita net income are positively related to productive efficiency but off farm employment is negatively related to efficiency.

Tadesse and Krishnamoorthy (2007) find significant differences in technical efficiency across the farm size groups with paddy farms on small and medium sized holdings operate at a higher level of efficiency than large sized farms. They argue that because accessibility to institutional finance depends on asset position particularly land, small farms will be forced to allocate their meagre resources more efficiently. Seyoum *et al.* (2010) were using the one-stage technical inefficiency model find technical inefficiency to be a decreasing function of education of farmers and hours of extension among farmers participating in the modern technology project while education does not significantly affect the efficiency of farmers using traditional farming methods. Wadud and White (2000) using stochastic trans log production frontier in both one stage and two-stage technical inefficiency model find that inefficiency decrease with farm size and farmers with good soils were significantly more technically efficient. Weir (1999) and Weir and Knight (2000) investigate the impact of education on technical efficiency in Ethiopia and

find that household influence the level of technical efficiency in cereal crop farms. Mean technical efficiencies of cereal crop farmers are 0.55 and a unit increase in years of schooling increases technical efficiency by 2.1 percentage points.

Nonetheless, one limitation of the Weir (1999) and weir and Knight (2000) is that they only investigate the levels of schooling as the only source of technical efficiency. Ajibefun and Daramola (1999) have shown that the significant determinants of technical efficiency of block-makers and saw-millers in Nigeria are age of operator, level of education, business experience, and the number of employees and level of investment. Obwona (2000) has shown that the significant determinants of tobacco growers in Uganda are the family size, level of education, health status, hired workforce, and credit accessibility, fragmentation of land and extension workers.Owens et al (2001) explore the impact of agricultural extension on farm production and find that access to agricultural extension services raised the value of production by 15 percent in Zimbabwe. Mochebelel and Winter-Nelson (2000) investigate the impact of labour migration on the technical efficiency performance of farms in the rural economy of Lesotho. Using the stochastic production function (translog and Cobb-Douglas), the study finds that households that send migrant labour to south African mines are more efficient than households that do not send migrant labour with mean inefficiencies of 0.36 and 0.24, respectively. In addition, there is no statistical evidence that the size of the farm, the gender of the household head affects the efficiency of farmers.

Mochebelel and Winter-Nelson (2000) concluded that remittances facilitate agricultural production, rather than substitute for it. This study does not consider the many other household characteristics that may affect technical efficiency such as education, farmers' experience, and access to credit facilities, and advisory services and the extent to which households that export labour receive remittance.Russell and Young (1983) applied a

deterministic Cobb-Douglas frontier model to a cross-section of 56 farms in England. The results indicate technical efficiencies ranging between 0.42 and 1.0, with a mean technical efficiency of 0.73. Kontos and Young (1983) in their study used deterministic frontier production function to estimate data on 83 Greek farms during the 1980-81 cropping year. The predicted technical efficiencies range between 0.30 and 1.00, with a mean technical efficiency of 0.57. Kalirajan (1981) applied the stochastic frontier Cobb-Douglas function using data from 70 rice farmers in India. The variance of inefficiency effects was found to be a highly significant component in describing the variability of rice yields.

Bagi (1982) estimated a stochastic frontier Cobb-Douglas production function to determine whether there were any significant differences in the technical efficiencies of crop and mixed enterprise farms in west Tennessee. The variability of inefficiency effects was found to be highly significant and the mean technical efficiency of mixed enterprise farms was smaller than that of crop farms (0.76 and 0.85) respectively. Bagi and Huang (1982) estimated a translog stochastic frontier production function using same data on the farms considered in Bagi (1982).

The Cobb-Douglas stochastic frontier model was found not to be adequate representation of the data, given the specification of the translog stochastic frontier for both crop and mixed farms. The mean technical efficiencies of crop and mixed farms were estimated to be 0.73, 0.67, respectively. Battese and Coelli (1988) applied panel data model in the analysis of data for dairy farms in New South Wales and Victoria for three years. The estimated technical efficiencies ranged between 0.55 to 0.93 for New Wales farms and between 0.39 and 0.93 for Victoria farms. Battese et al, (1996) applied the stochastic frontier production function using panel data of wheat farmers in four districts in Pakistan.Thier results show that the technical inefficiency effects are highly significant.

The results also indicate that technical efficiency tends to be smaller for older farms and those with greater formal schooling. It was also discovered that the levels of wheat production of farmers tend to approach their potential frontier production levels over time, though there was no evidence of technical change. The technical efficiencies were found to vary considerably over time such that the mean technical efficiencies ranged from 57% to 79% in the districts.

2.7 Measurement of Poverty

The World Bank report of (2005) identify a number of conceptual approaches to the measurement of welfare, the commonest approach being to measure the economic welfare based on household consumption expenditure or household income. Consumption expenditure is prefer over income because is only one of the elements that will allow consumptions of goods and consumption will reveal information about incomes at other dates in the past and future. Incomes vary over time in fairly predictable way, particularly in agrarian economics. For instance, exclusion of income used for input purchased for agricultural production from the farmer's revenue and large share of income are not monetized if household consumed their own production or exchange it for other goods Coudouel *et al.* (2012). Income as a measure of living standard is often questioned on the grounds incorrect rendition of being understand by the respondents because people may forget, are reluctant to disclose their income for fear of tax purposes andthose incomes earned illegally and some parts of income are difficult to observe (the extent to which the family buffalo has risen in value) (Ravallion, 1998). The use of income as a poverty measure has its own advantages. For example, measuring poverty by income allows for a distinction to be made between source and income.

Omonona (2009) analysis of poverty in Nigeria starts with the derivation of a poverty line, Okunmadewa (1999) define poverty line as a predetermined or well-defined standard of income or value of consumption, which is deemed to represent the minimum requirement for a productive and active life or even survival. Everyone at the poverty line is taken to be equally badly off, and all those below the line are worse off than all above it. The two ways of doing this are; the welfare ratio approachwhere the money income or the total expenditure is deflated by the poverty line, *z* so that the ratio (*y/z*) is the welfare ratio or the equivalent expenditure method which utilizes two-third of the mean household expenditure. In the literature economists use two major approaches to determine a poverty line. These are the absolute approach and the relative poverty approach. Under the absolute the approach a household a household is considered poor if its consumption level is insufficient to acquire a given level of goods and services regarded as an essential minimum standard of living. The poverty line from this approach usually has a fixed value. The popular methods for estimating these poverty lines include the Direct Calorie Intake (DCI) approach, the food-energy intake (FEI) approach and the cost-of-basic needs (CBN)method. The direct calorie intake method to measure poverty considers as poor any household not meeting the requirement that satisfies basic human consumption needs for good health. The difficulty with this method is the equating of poverty with malnutrition or a proxy thereof. The weakness with the direct intake method with the direct calorie intake method is that it consider as a lack of access to basic goods and services. Ravalion (1998)looked at measuring poverty solely by calorie intake is unlikely to adequately represent the multifaceted state of deprivation that those in poverty and provides a lack of consistency of the threshold of poverty line.

According to the FEI approach, poverty line is set by finding the consumption expenditure or income level at which food energy intake is just sufficient to meet

predetermined food energy requirement. This represents a methodological improvement in terms of representativeness because the food energy intake method provides a monetary rather purely nutritional concept of poverty. However, the method suffers from major deficiencies in terms of consistency, the poverty lines generate might not represent an identical level of welfare (specifically, an identical purchasing poor parity in real term) overtime or across groups and, hence, poverty comparism may not be validor comparable. An example of this is that the poverty line is estimated by dividing household expenditure by the number of people in the household. This is the simplest way of calculating the poverty line, but does not take into consideration the fact that different individual have different needs. For example a young child typically needs less food than an adult. The CBN method is anchored in estimating the cost of attaining a predetermined level of food energy of calories intake requirements and also meeting basic non-food requirements. The limitations of this approach are that determining the minimum food basket that represents the food habits of a poor household and the choice of appropriate price index to reflect their current food expenditure is hard estimate consistently. Poverty is defined as failure to meet basic needs including failure to meet daily minimum food calorie to sustain a healthy life.

This studies uses the cost of basic need approach to construct basic poverty lines. The relative poverty approach, on the other hand, defines the poor relative theirs in the same society or economy. A relative poverty line varies as the average of total population's consumption varies. The fixing of poverty line as the two-thirds of the mean per capita household expenditure is an example of relative poverty approach. According to Olaniyan (2000) the relative poverty line both subjective and arbitrary and need to be standardised against some cost of basic needs in the economy (such as the cost of

recommended dietary intake or some internationally acceptable measures like US$1 per day).

2.7.1 Estimating the poverty line

Poverty line in this study was estimated with the use of per capita consumption expenditure. This approach has been judge by past studies to be the most appropriate because of its consistency and does not change over time when compared to income. The poverty line was defined as two-third of the mean value of per capita household consumption expenditure of the sampled vegetable (garden egg, telferia and waterleaf) farmers in the study area. This approach has been used in several related studies (NBS, 2006; Omonona, 2009; Adekoya, 2014) using the cost of basic needs methodology, the per capita household consumption expenditure was arrived by estimating household food and non-food consumption expenditure. Respondents were asked to provide estimated for their expenditure basic food item necessary to satisfy their daily calorie requirements. Where such food items were from the farmers' output, the quantity consumes was stated and their costs evaluated using their average market prices. Non-food consumption item includes expenditure on fuel, electricity, clothing, education, and health, transportation, rent among others. Respondent were asked the cost of renting an accommodation or is owned by them or how much revenue would have gotten if they were rented. These responses were used as the houses rental expense. Other durable goods and assets were excluded to avoid complexity in deriving their usage values. Farm households were then categorised into poor and non-poor group using two-thirds of the mean per capita expenditure. Household whose mean consumption expenditure falls below the poverty line are regarded as being poor while those with their expenditure above the benchmark are non- poor. The model is specified as follows;

$P = \frac{2}{3}$ x *MPCHE* ---------- (15)

Where; PCE = TCE/HHS

MPCHE = THHE/TNR Per Capita Expenditure

TCE = Total Consumption Expenditure

HHS = Household Size

TNR = Total Numbers of Respondents

THHE = Total Households Expenditure

MPCHE = Mean Per Capita Household Expenditure

P = Poverty Line Value.

2.7.2 Foster, Greer and Thorbecke (1984) weighted poverty index;

This is a measure of poverty proposed by Foster, Greer and thorbecke (1984)also called the FGT measure can be used to decompose poverty into various levels or indices and it is expressed as;

$P\alpha = \frac{1}{N}\sum_{i=1}^{N} \left(\frac{Gi}{Z}\right)^{\alpha}$ with $\alpha \geq 0$ ---------- (16)

The parameter **α** is a measure of sensitivity of the index to poverty. The poverty gap for individual *i* is given by

Gi = z – yi (with *Gi = 0* if *yi > z*)

Head-count index*:* When the parameter α = 0, the measure is equation boils down to the head-count index. This is define as the percentage of people falling below the poverty line and is currently the most commonly used measure of poverty index (Ravallion, 1996; Deaton, 1997). The poverty headcount index measures the proportion of families actually lying below the poverty line. The head-count index is helpful since it allows one to calculate the marginal impact of additional spending, output etc. on the number of people

lifted out of poverty (Ravllion, 1996). The problem with the head-count index is that it ignores concerns about the distribution of income among the poor.

Poverty Gap index: When $\alpha = 1$, it is refer to the depth of poverty also called poverty gap index. This measures how far poor individuals are from the poverty line. It helps to provide information on the cost or budget requireslifting all the poor out of poverty.

Squared poverty gap*:* when $\alpha = 2$, we have the poverty severity index or squared poverty gap. This takes into account the distribution of poverty amongst the poor and place greater weight on those furthest away from the poverty line rather than the poverty gap index. Therefore, it shows not just how many people are poor and how poor they are but also the degree of income inequality among poor households.

Although the Foster, Greer and Thorbecke measure provides an elegant unifying framework for measures of poverty,it leaves unanswered the question of what is the best value of α. Moreover, some of these measures also lackemotional appeal. However, the measures of depth and severity of poverty gives us complementary information on the incidence of poverty. Thus some income groups might have higher poverty incidence but low poverty gap, while other income groups might have lower poverty incidence and higher poverty gap, in such cases intervention models can be used.

2.7.3 Binary logistic regression model

Binary logistic regression estimates the probability that a characteristic is present (for example, estimate probability of 'success') given the values of explanatory variables, in this case a single categorical variable; $\pi = pr\,(Y = 1/X = x)$. Examples of binary of binary logistic models are the logit and probit models. Only logit model was used because of its inherent advantage.

Dichotomous Logistic Regression Model

Let = $p_i = p_r (Y = 1/X = x_i)$---------- (17)

The logistic regression model can be written in terms of the odds (odds are the probability of a 'success' outcome divided by the probability of a 'failure' outcome), called the logit expressed as follows;

$log \left(\frac{pi}{1-pi}\right) = log\ it\ (p_i) = \beta_o + \beta_1 X_i$---------- (18)

where X_i is a vector of explanatory variables. The logit is just the natural logarithm of the odds and the range of values that the left hand side of equation is between $-\infty$ and $+\infty$. Alternatively, the above model in terms of the odds is;

$\left(\frac{pi}{1-pi}\right) = exp\ (\beta_o + \beta_1 X_i)$---------- (19)

The range of values that are right handed side of the above equation can assume is between 0 and ∞. The underlying probability of a success outcome is given by;

$pi = exp\ (\beta_o + \beta_1 X_i)\ /(1 + exp\ (\beta_o + \beta_1 X_i))$ ----------(20)

Conversely, the probability of the outcome not occurring (failure) is;

$(1-pi) = 1/\ (1 + exp\ (\beta_o + \beta_1 X_i))$ ----------(21)

Equation (19) and (21) are usually computed, since it provides not only the logit estimate but also the probability of success.Categorical regression such as logit and probit can be used to measure the performance of alternative targeting indicators for social programmes and transfer. This is an important issue because government uses proxies for accessing the level of income or consumption of a household or individual in order to access eligibility for programs benefit and for the selection of the poor and non-poor.

Probit and logit has been criticized especially in the context of modelling poverty on the grounds that they are estimated under the assumption that the actual consumptions are not observed. Rather an artificial construct is used as adependent variable that supresses the

consumption expenditure and related information on the household who lie above the poverty line and treat them as one homogeneous group and censored data (Datt and Jolliffe, 1996). Consequently information about the actual relationship between the level of consumption and the independent variable is sacrificed. In addition probit /logit regression are much more sensitive to specification error than linear regressions. The same argument holds for tobit models which the poverty gap (difference between the poverty line and the household's per capita income) is the endogenous variable. Again, the use of tobit implies that the income distribution is artificially truncated (coudouel *et al*, 2002).

2.7.4 Empiricalapplication of the logit model to poverty

Adekoya (2014) analysed farm household's poverty status in ogun state, Nigeria using Foster, Greer and Thorbecke poverty (FGT) indices and logit regression model on a survey data involving 117 households' randomly selected using multistage sampling technique. The mean per capita consumption expenditure among the farm households was ₦9,103.85 with the FGT poverty incidence, poverty gap and severity of poverty estimated to be 78.1percent 55.8 percent and 43.0 percent respectively. Poverty incidence was found to be higher among the male headed 60 percent and farming 63.9 percent households and those having over five members 66.1 percent. The logit regression further indicates that the likelihood of being poor were more with large households, non-educated farm household's head and household s without access to credit and other non-farm income.

Olawuyi and Adetunji (2016) analysed the incidence, severity and the determinants of household poverty in Ogbomosho Agricultural zone of Oyo state in south west Nigeria with one hundred and twelve as sample size, with the use of multistage sampling

technique. They found that the poverty rises with an increase in household size while it reduces with increase in level of education, farm size and participation in non-farm jobs as alternative source of livelihood (livelihood diversification). Gender, household size, years spent in school, farm size and non-farm jobs to be important and significant factors determining poverty in the study area.

Etim and Ukoha (2010) investigated poverty among rural farming householdsusing Foster, Greer and Thorbecke (FGT) weighted poverty index. Farm level survey data from one fifty farming households were selected through multistage sampling technique. They found the monthly mean per adult equivalent household expenditure (MPAEHE) of the household to be ₦1,652.82 and poverty line of ₦1,101.88 was constructed. Their result of FGT decomposition reveals that poverty incidence for the study area is 0.57. Poverty incidence, depth and severity increases with increase in age of household heads, poverty incidence is highest (0.69) and lowest (0.31) when households are headed by persons within the age of 61- 80 and 21-24 years respectively, they further revealed that poverty incidence and severity increases with increase in size of household members tis ranged between 0.28, 0.51, 0.72 and 0.06, 0.28, 0.51 for households with 1 - 5 and 11 – 15 respectively.

2.7.5 Impact pathway analysis

According to world bank poverty Group (2008) impact evaluation assesses the changes that can be attributed to a particular intervention, such as a project, programme or policy, both the intended ones, as well as the unintended ones. Impact evaluation seeks to answer cause-and-effect questions. In other words, they look for the changes in the wellbeing of individuals that can be attributed to a particular project, programme or policy (Gertler *et al*., 2011). It is also structured to answer the question; how would outcome such as

participant well-being have changed if the interventions have not been undertaken? This involves counterfactual analysis, that is, "a comparison between what actually happened in the absence of the intervention" (White, 2006). However, the difficulty in impact evaluation is the estimation of the counterfactual. The reason is that it is not possible to observe a beneficiary in the situation where he or she is not in the programme or in the project either self-sponsor or government.

This is what Ravallion (2008) referred to as "problem of missing data" in impact evaluation, given that it is physically impossible to measure outcomes for someone in two states of nature at the same time (participating in a program and not participating). However. It is believed that if individuals who are not in a programme arc similar to those who did with respect to their observed characteristics, then these two groups could be compared so that the observed difference would be an unbiased and consistent estimate of the causal effect of the programme.

The first step in assessing impact according to Ravallion (2008) is to be clear on the observable outcome indicator most relevant to the program's objectives. For instance, the objective for anti-poverty programme is defined in terms of household income or expenditure (on consumption) normalized by a household-specific poverty line (reflecting differences in the prices faced and in household size and composition).

Let this indicator be a random variable, Y, with population mean E(Y) and Y_i represent income per capita for household i . Also let T_i= 1 denotes participants or the treated and T_i = 0 for the non-participants or the untreated. The value of Y_i under the treatment is represented by $Y_i(I)$ and $Y_i(0)$ for the non-participants or the untreated. If $Y_i(0)$ is used across non-participating households as a comparison outcome for participant outcomes

$Y_i(l)$, the impact or causal effect of a programme on the outcome is given by the basic impact evaluation formula:

$$D = E(Y_i(1) / T_i = 1) - E(Y_i(0) / T_i = 0) \quad (22)$$

This formula says that the causal impact (D) of a programme on an outcome Y is the difference between the outcome Y with the programme (in other words, when T =1) and the same outcome Y without the programme (that is, when T = 0).This implies that we want to measure the outcome at the same point in time for a particular unit, say, household, but in two different states of the world. The problem now is that it is impossible to measure an individual or unit in two states of nature at the same time. At each unit any moment in time, an individual either participated in the programme or did not participate. This is called 'the counterfactual problem'. In the basic impact evaluation formula above, the term (Y / T = 0) represent the counterfactual. This is considered as "what would have happened if the participant did not participate in the programme" in other words the counterfactual is what the outcome Y would have been in the absence of the programme. The counterfactual cannot be directly observed for the programme participants. In order to estimate the counterfactual, comparism group (sometime called control group) are used. The key challenge then is to identify the key comparism a valid group that has the same characteristics as the treatment group. If this can be done, then the difference in outcomes must be due to the programme except that the group participates in the programme and the other dose not.

2.8 Methods of Estimating Impact

According Khanker *et al*. (2010) several methods have been used in the literature to examine the impact of non-randomized programme or an intervention on the beneficiaries and to address the fundamental question of the missing counter-factual

situation (i.e. what would have been the situation in the absence of the programme/project. This will help to deal appropriately with the problem of selection bias caused by selection on observables or unobservable present in cross-sectional or non-experimental studies. These methods are: double difference (DD), multivariate regression, regression discontinuity design, instrumental variables (IV) methods and propensity score matching (PSM).

The Difference-in-difference or double difference (DD) estimators require longitudinal or baseline data and is not applicable to this study where cross-sectional data would be collected. In addition, the DD method faces two problems. The first problem is that, in practice, one sometimes does not know at the time the baseline survey is implemented who will participate in the programme. In most cases baseline data are not available. The second problem is that the DD assumption of time-invariant selection bias is implausible for many anti-poverty programs in developing countries (Ravallion, 2008; Khandker *etal,*.2010 and Gertler *et al,*.2011). The consequence is that DD will then be a biased estimator, since the subsequent outcome changes are a function of initial conditions that also influenced the assignment to treatment.

The use of multivariate regression is faced with the problem of endogeneity in the outcome equation and fails to deal appropriately with the self-selection bias and selection on the unobservable attached to observational data collected through household survey (Rubin, 1974; Rosembaum and Rubin, 1983; Heckman and Robb, 1985; Rosembaum, 2002: Nguyen, 2003; Imbens, 2004; Lee, 2005; Heckman and Vytlacil, 2005; Imbens, and Wooldridge, 2009). The use of regression also makes conditional independence (exogeneity) assumption and imposes arbitrary functional form assumptions concerning the treatment effects and the control variables.

The best method to deal with endogeneity is the use of instrumental variables regression (IV). However, the challenge to the application of the IV approach is that it is difficult to find an instrument that is both highly correlated with the treatment condition and independent of the error term of the outcome regression (Lipton*el al*., 2003; Ravallion. 2008; Khandker *et al*., 2010). IV estimation procedure also impose a linear functional form assumption which is arbitrarily ad hoc in that coefficients on control variables are restricted to be the same for participants and non-participants. On the other hand, a parametric solution that allows a full set of interaction effects via the Heckman's selection correction model within an "endogenous switching regime model" come at the cost of imposing strong distributional assumptions.

Recently, there has been increasing interest in methods based on the propensity score matching (PSM) technique to reduce or eliminate the effects of cofounding when using observational data, examples of recent use of this method are Mendola (2007), Wu *et al* (2010). Javier and Awudu (2010),Asfaw *et al*. (2011),Nkata *et al*. (2014), among others. Although PSM faces the problem of identification, which is, finding credible groups that look alike, was used in this study. The validity of PSM technique is based on two conditions or assumptions: (1) conditional independence (also called un-confoundedness) assumes that unobserved factors do not affect participation and, (2) presence of sizeable "common support'" or overlap in propensity scores across the participant and non-participant samples. If selection bias from unobserved characteristics is negligible, then PSM provide a good comparison with randomized estimates. PSM as a semi-parametric method imposes fewer constraints on the functional form of the treatment model and assumptions about the distribution of the error term. Also PSM does not require a baseline or panel survey.

2.8.1 The average treatment effect (ATE) models

The (ATE) is a measure used to compare treatments (or interventions) in randomized experiments and evaluation of policy interventions. The ATE measures the difference in mean (average) outcomes between units assigned to the treatment and units assigned to the control. In a randomized trial (i.e. an experimental study), the average treatment effect can be estimated from a sample using a comparison in mean outcomes for treated and untreated units. However, the ATE is generally understood as a causal parameter (i.e., an estimand or property of a population) that a researcher desires to know, defined without reference to the study design or estimation procedure.

Under the "potential outcome framework" developed by Rubin (1974) each farming household has ex-ante two potential outcomes: an outcome when participating in irrigated rice production programme denoted by y_1 and an outcome when it is a non-participant that vie denote byy_0. If we let the binary outcome variable q stand for vegetable production programme status with q = 1 meaning participation and q = 0 non-participation, we can write the observed outcome y of any farming household as a function of the two potential outcomes: $y = qyi+ (1 - q) y_o$. For any household, the causal effect of the participation on its observed outcome y is simply the difference between its two potential outcomes: $y_l - y_0$. But, because the realizations of the two potential outcomes are mutually exclusive for any household (i.e. only one of the two can be observed ex-post), it is impossible to measure the individual effect of participation on any given household. However, one can estimate the mean effect of participation on a population of farming households: $E (y_l - y_0)$, where *E* is the mathematical expectation operator. Such a population parameter is referred to as the average treatment effect (ATE) in the literature. It is also possible to estimate the mean effect of participation on the sub-population of participants: $E (y_1- y_0/ q = 1)$, which is called the average treatment effect on the treated and is usually denoted by ATEI (or ATT). The average treatment effect on

the untreated: E (y_1 - y_o/ q = 0) denoted by ATEO is also another population parameter that can be defined and estimated.

2.8.2 Propensity score

A propensity score is the probability of a unit being assigned to a particular treatment given a set of observed covariates. Propensity scores arc used to reduce selection bias by equating groups based on these covariates. The propensity score is defined as the conditional probability of treatment exposure given the observed covariates, that is,

$p(x) - Pr (T = 1 / X = x)$ ---------- (23)

The propensity score is a balancing score. This means that it balances all pre-treatment group differences in observed covariates *X*. Covariates are balanced if the joint distribution of *X* is the same in the treatment and control group, that is

$P(X / T = 1) = P(X /T = 0)$ ---------- (24)

If the treatment and control group are accordingly balanced, all overt bias—the bias that is due to observed covariates—can be removed. Hidden bias that is due to unobserved covariates cannot be removed by matching or conditioning on the observed covariates or PS. Hidden bias results when the strong ignorability assumption is not met.

The *PS P(X*) can be estimated from the observed data via binomial regression models (logistic regression or probit models) or other semi- or nonparametric methods. In this study the Logistic regression was used because of its inherent advantage over linear probability model (LPM) of making estimated probability to lie between 0 and 1. The logit of the PS is given as*:*

$I(X) = log \{p(x)/ (1 – p(x))$---------- (25)

2.8.3 Propensity score methods

There are several methods of PS used in the literature to estimate average treatment effects and can be classified into four (4) categories as PS matching, PS sub-classification, inverse propensity weighting (IPW) and PS regression or covariate adjustment (Imbens, 2004; Lunceford and Davidian, 2004; Rubin, 2006; Morgan and Winship, 2007: Guo and Fraser, 2010). Propensity score matching is considered appropriate for this study because several studies have demonstrated that propensity score matching eliminates a greater proportion of the systematic differences in baseline characteristics between treated and untreated subjects. It is used mostly when the causal estimand of interest is ATT and when the pool of control units is large.

ATEBased on Propensity Score Matching (PSM)

Propensity score matching (PSM) estimates the effect of a treatment, policy, or other intervention by accounting for the covariates that predict receiving the treatment. PSM reduces selection bias due to confounding variables that could be found in an estimate of the treatment effect obtained from simply comparing outcomes among units that received the treatment versus to those that did not. Matching attempts to mimic randomization by creating a sample of units that received the' treatment that is comparable on all observed covariates to a sample of units that did not receive the treatment. PSM is a quasi-experimental method and estimates the programme impact by comparing the average outcomes of a treatment or enrolled group and the average outcome among a statistically matched subgroup of units, the match being based on observed characteristics available in the data at hand. PSM employs a predicted probability of group membership e.g., treatment vs. control group—based on observed predictors, usually obtained from logistic regression to create a counterfactual group. The identification of the ATE depends on two assumptions: conditional independence assumption and common support or overlap assumption.

Conditional Independence Assumption: This assumption states that conditional on Confounding variables, the potential outcomes are stochastically independent of the treatment. !f Y (0) and Y (l) denote the potential outcomes under control and treatment respectively and X denotes a vector of observed covariates, then

Y (0), Y (1) – T/ X.---------- (26)

Where 1 denotes statistical independence.

This conditional independence assumption is called "ignorability," "unconfoundedness" or "selection on observables." This assumption requires that all confounding factors associated with the potential outcomes as well as the participation decision are observed. Rosenbaum and Rubin (1983, 1984) show that when the ignorability assumption holds true, it is sufficient to condition on the propensity score as a function of *X*(propensity score theorem).Thus

Y (0),Y(l) -i T / P(T = 1/ X)---------- (27)

Where *P (T =1/ X*) is the propensity score, the probability of treatment that summarizes all the relevant information in covariates *X*.

The Common Support or Overlap Assumption: This assumption requires that the probability of receding the treatment, the so-called propensity score, lies strictly between zero and one (0 and 1) i.e., $0 < P(T_i = 1/ X_i) < 1$. In other words, each unit in a defined population has a positive probability of being treated and of not being treated.

2.8.3.2 Propensity Score Matching Techniques

There are several techniques to match participants and non-participants on the basis of propensity scores. These are the: Nearest Neighbour Matching, Caliper and Radius

Matching. Stratification and Interval Matching, Kernel Matching and Local Linear Matching. This study utilized Kernel matching because the other matching techniques (apart from Local Linear Matching) use only a few observations from the comparison group to construct the counterfactual outcome of a treated individual. Consequently, only a small subset of nonparticipants will ultimately satisfy the criteria to fall within the common support and thus construct the counterfactual outcome.

Propensity Score Based on Kernel Matching Estimator

Kernel matching (KM) is a non-parametric matching estimator that use weighted averages of all individuals in the control group to construct the counterfactual outcome. The major advantage of KM approach is the lower variance which is achieved because more information is used.

If P_i is the propensity scores for participant i and P_j is the propensity score for non-participant j. the weights for kernel mulching arc given by:

$$W(i,j)\ KM = \frac{k\left(\frac{pj-pi}{an}\right)}{\sum kEC\ K\left(\frac{pk-pi}{an}\right)} \quad \text{---------- (28)}$$

Where *w(i,j)* is the weight used to aggregate outcomes for the matched non-participants j , K(.) is a kernel function and *an* is a bandwidth parameter.

2.9 Empirical Review of Impact of Vegetable Production on Poverty Reduction

Literature that examined the impact of vegetableproduction on household income and poverty alleviation reported mixed results. In Tigray region, Ethiopia, Berhanu and Fender (2002) showed that the impacts of vegetable production controlling all other factors were insignificant. But Lipton *et al*. (2003) has shown some areas with high level

of efficiency in vegetable pr0duction has experienced the greatest poverty reduction. The study identified some inter-related areas by which vegetable production reduce poverty to be: (1) increase in agricultural production and income for households, and reduction of food prices. This helps very poor households meet the basic needs associated with improvements in household overall economic welfare, (2) enhancement in the use of yield-enhancing farm inputs. The uses of such farm inputs improve the agricultural production and income and. (3) creation of additional employment where household and or labourers are engaged in the vegetable farming that helps to increase the labour productivity.

Recent studies have found vegetable production to be of great significance for poverty alleviation. For instance, Getaneh (2011) assessed the Impact of Selected Small-Scale vegetable production on Household Income and the Likelihood of Poverty in Ethopia. A semi-structural interview and focus group discussions were used to obtain information from 180 randomly-selected household heads. Descriptive statistics and econometric modelling were used to assess the impacts of vegetable production on household income and the likelihood of a household being classified as poor. The results revealed that households in the study area had statistically significantly higher mean gross household income than households not participating in the production of vegetable. A censored regression model developed to estimate the marginal impact of small-scale vegetable production on gross household income controlling for other important factors that affect income indicated that access to small-scale vegetable production increased mean annual household income significantly. Results of descriptive analysis of the impact of vegetable production access on the likelihood of poverty suggested that these households had a lower probability of being poor than non-vegetable producer's households.

Omilola (2009) estimated the effects of new agricultural technology on poverty reduction by employing the "double difference" method on data collected in rural "Nigeria. A systematic random sampling was used to select an approximately equal number of observations of the treatment group and the control group. A total of 400 respondents comprising of 200 adopters and 200 non-adopters of the technology were selected for the study. The results showed that farmers who adopted agricultural technology received approximately 31.4 percent more farm income from irrigation than the non-adopters on average. Adoption of new agricultural technology tends to have led to a larger increase of agricultural income from the adopters than the non-adopters. The results of the effect of the new technology on poverty reduction revealed although there were disproportionately more poor people among the adopters than the non-adopters both before and after technology adoption, the technology adopters fared slightly better than the non-adopters in terms of poverty reduction. In other words, technology adoption led to a slight reduction in poverty headcount levels of the adopters and also narrowed their income gap and slightly improved the income of the poorest adopters over the non-adopters ".The coefficient of the unconditional treatment effect of the agricultural technology is negative and statistically insignificant using the poverty headcount ratios. This result indicates that the differences in poverty outcomes between the technology adopters and non-adopters are not significant.

Sikwela and Mushunje (2013) assessed the role played by Vegetables Farmer Support Programmes in addressing income and welfare of smallholder farmers in South Africa. Using a Tobit and Propensity Score Matching technique, potential diffusion effects were eliminated between farmers supported by Farmer Support Programmes and farmers that do not receive support services. Findings showed that household size and distance to the nearest market were significant at 5% while education level of household head was

significant at 10%. Farmer Support Programmes and collective market activities such as the collection and sale of members" output have a significant and positive impact on smallholder welfare of those farmers engaged in them. They recommended the focus of development efforts towards the promotion of marketing cooperatives rather than any type of cooperatives and research to identify key factors behind the choice to form either marketing or a defensive cooperative, as well as governance and managerial practices to maximize the sustainability of collective marketing activities over time.

CHAPTER THREE

METHODOLOGY

3.1 Study Area

The study was conducted in Akwa Ibom State located in the South South geo-political zone of Nigeria and is situated 55km inland from the coastal plain of south Eastern Nigeria, the area lies within the humid tropical rainforest.The state comprises of thirty-one (31) Local Government Areas (LGAs), with Uyo as the state capital. The state is grouped into three (3) Senatorial District and also made up of six (6) Agricultural Zones namely Abak, Eket, Etinan, Ikot Ekpene, Oron and Uyo. Akwa Ibom State is located in the rain forest of Nigeria and lies within Latitude 4^0 $33^{'}$ and $5^0 33^{'}$ North and Longitude $7^0 25^{'}$ And $8^0 25^{'}$ East. The ecological condition of the State supports an impressive distribution of livestock such as goat, cattle, sheep, pig, fish, poultry and others. Farming is the main occupation of the people, given the diverse vegetation and climatic condition of the State, crop production is diverse. In the riverine area of the State (Eket, Ibeno, Esit Eket, Udung Uko,Onna, Eastern Obolom, Mkpat Enin, Ikot Abasi, Mbo, Oron Urueoffong Oruku and Okobo LGAs) fishing is the main stay of the people, mixed cropping system of sweet yam, water yam, cassava, melon maize, vegetables(wet and dry season) and rice in the swamp.

The central part of the State comprising of Uyo, Etinan, Uruan, Nsit Atai, Ibesikpo-Asutan, Nsit Ibom, Nsit Ubium, Itu, Uruan, and Ibiono Local Government Areas cultivate crops like oil palm, plantain, cassava maize and vegetables like pumpkin, cucumber, garden egg and water leaf. The northern part of the State comprises of Ikot Ekpene, Essien Udim, Abak, Ika, Etim-Ekpo, Ikono, Ini, Obot Akara, Uruk Anam, and Ukanafun. Farming is the main occupation of the people, and this is the vegetable producing zone of the State and is cultivated in the swamp, while upland cultivation occurs in the same locations during the wet season. The State has a population of 2,359,736 people (NPC, 1991). The predominant soil of the area is sandy loam while the vegetation is tropical rainforest. Being located in the rainforest zone of the country, it is characterized by two distinct seasons (the dry and wet season), the dry season last from November to March, while the wet season lasts from April to October.This support the massive production of vegetable, which can be carried out all year round with the aid of local irrigation facilities and some can be grown in *FADAMA* areas. Commercial activities are also carried out to compliment sources of family income. The importance of vegetable production in the state will add value to the family income and also increase economic activities in the state thereby increasing the standard of living of the people. It also increases the economic base of the state.



Fig 3.1: Map of Akwa Ibom State showing the Local Government Areas and the Areas of study in green

Table 3.1: Sample Size of Vegetable Farmers in the Study Area

Senatorial District	L.G.A	Villages	Telferia Farmers	Waterleaf Farmers	Garden Egg Farmers
Eket	Onna	Ukat	6	8	6
		Mpok	7	8	5
	Mkpat enin	Nyadiong	6	9	5
		Ikot usop	8	8	4
Ikot Ekpene	Esien udim	Ukana iba	8	7	5
		Nto nsek	6	7	7
	Abak	Eriam	5	5	10
		Oku abak	9	5	6
Uyo	Uraun	Ndon ebom	6	8	6
		Idu	7	7	6
	Ibesikpo Asutan	Ndung udoe	9	5	6
		Okop ndua	6	7	7
TOTAL			78	87	75

3.2 Sampling Procedures and Sample Size

The study made use of multi-stage sampling technique in the selection of respondents for data collection. A purposive sampling of the three Agricultural zones where vegetable is produced out of the six zones was carried out in the first stage; this was based on the comparative advantage these zones possessed over others in vegetable production. This area also has agronomic characteristics which support the farming and large markets for the three vegetables under study. The zones are Eket, Ikot ekpene and Uyo. In Eket zone the vegetable producing Local Government are Eket, Onna, Mkpat enin, and Ikot abasi; Ikot- ekpene zone the vegetable producing Local Government are Essien- udim, Ikot-ekpene, Abak, and Oruk-anam; In Uyo zone the vegetable producing Local Government

Areas include, Uyo, Uruan, Ibesikpo-asutan and Nsit-ibom. In the second stage two Local Government Areas in each of the selected zone were randomly selected, randomisation here was as based on the fact that all the local government in these zone are vegetable producers giving a total of 6LGAs, the Local Government Areas are Onna, Mkpat enin in Eket zone; Essien udim and Abak in Ikot ekpene zone and in Uyo zone Uraun and Ibesikpo asutan local government areas were selected. The third stage involved the purposive selection of two (2) villages from each of the local government areas giving a total of twelve (12) villages, these was also based on their comparative advantage in vegetable production, in this stage twenty (20) farming households per village were randomly selected making a total of two hundred and forty (240) respondents were used with respect to the three vegetables under study (telferia, water leaf and garden egg) production, each of the vegetable under study had 78, 87 and 75 respondents respectively (Table 3.1). The villages used for the survey consist of households which produce at least two of the vegetable under study as monocropping and data for the three vegetables for this study were taken separately with different questionnaire on household basis and the type of vegetable produced.

3.3 Data Collection

Primary data were collected by conducting field survey with the use of structured questionnaire administration. Data were collected from three vegetables under study (telferia, water leaf and garden egg) quantity of vegetables in kg. Famers' fields were visited in order to get understanding, observations and perceptions about the production systems in the study area. Information on socio-economic characteristics, input use and output levels were also collected. The questionnaire were pre-tested, data that were collected include socioeconomic characteristics of the farmers such as sex, marital status, age, educational level (years of schooling), method of land acquisition, household size,

membership of farmers association/cooperatives, extension contact, vegetable production system practiced, source of credit, amount borrowed, farming experience, income level (agricultural and non-agricultural), household expenses including food and non-food expenses, welfare indicators such as ownership of farmland, house, livestock, radio, television, access to electricity, portable water, medical facility, types of farm tools (capital equipment) used, years of purchase and their prices. Quantity of fertilizers used labour and cost per day as well as output of vegetable and its prices per kg. The units of these variables were as they are obtained in the area but were later converted to standard S.I units by the researcher. The capital equipment was depreciated using the straight-line method of depreciation.

3.4 Analytical Techniques

Data collected were analysed using both descriptive and inferential statistics. Descriptive statistics were used in analysing the farmers' socioeconomic characteristics. This was done with the use of means, standard deviation and percentage and was used to achieve objective one (1). To estimate the efficiency level (technical, allocative and economic efficiencies) as well as their determinants of vegetable farmers in Akwa Ibom State, Southern Nigeria, the Cobb-Douglas functional form using stochastic frontier production and cost function model, were used. Determinant of technical, allocative andeconomic efficiency were estimated by the use of the Ordinary Least Square regression technique (OLS) these tool was used to achieved objective two and five ((ii) & (v)).This is consistent with agricultural production efficiency empirical studies done by Bravo-Ureta *et al* (1994), Kumbhakar (1994) and Bravo-Ureta *et al.* (1997). The approach has some advantages over other methods in that it allows for statistical noise instead of attributing all deviations to efficiency differences; it's relatively straight forward in computation and interpretation Xu and Jeffrey, (1995) and Udoh, (1999).The Maximum Likelihood

technique (ML) were also used to estimate the parameter of stochastic frontier and the predicted technical, economic and allocative efficiencies/inefficiencies of the vegetable farmers.

Cost-return analysis was also carried out to know the profitable vegetable production is in the area of study, and was used to achieve objective four (iv)

3.4.1 Model specification

Thetechniques that were used to analyse the data collected (the analysis in this study was carried out on each class of vegetable i.e garden egg, telferia and waterleaf)in the realisation of the research objectives are presented and specified below. The econometric specification in this study follows the Cobb-Douglas functional form because of its wide application in farm efficiency for the developing and developed countries. For the vegetable farmers in the study area, the specification is:

3.4.2 Technical efficiency

The stochastic frontier (Cobb-Douglas) production function was used to achieved this objective

$$InYi = \beta_0 + \beta_1 lnX_1 + \beta_2 lnX_2 + \beta_3 lnX_3 + \beta_4 lnX_4 + \beta_5 lnX_5 + \beta_6 lnX_6 + Vi - Ui \text{--- } 29$$

Where;

In = the natural logarithm yi = Total quantity of vegetable produced (output) (kg) (Grain Equivalent Vegetable Leafy =0.06, Vegetable Fruity = 0.01)

X_1 = Farm size in hectares

X_2 = The quantity of seeds in kg

X_3 = The labor input in mandays

X_4 = Fertilizer used in kg

X_5 = Other input(s) (pesticides, herbicides) in litres

v_i = Error term not under the control of farmers (two-sided: positive or $_{negative}$)

u_i = Error term under the control of a farmers (non-negative: measures of inefficiency)

β_0 = Intercept

β1 - β0 = parameters to be estimated

3.4.3 Allocative efficiency

The stochastic frontier Cobb Douglas cost function was used to estimate the cost efficiency level of the vegetables under study was employed and is specify as follows

$$inC_i = a_o + \delta inY + a_1 Inp_1 + a_2 Inp_2 + a_3 Inp_3 + a_4 Inp_4 + a_5 Inp_5 + V_i + U_i \ldots\ldots\ldots\ldots 30$$

Where:

In = natural logarithm

C_1 = total cost of vegetable production (₦)

Y_1 = output of vegetable (kg)

P_1 = average cost of land

P_2 = average cost of fertilizer

P_3 = average cost of seed

P_4 = average cost of agrochemical

P_5 = average cost of labour

a_o = intercept

δ = total cost elasticity with respect to output

a_1– a0 = total cost elasticity with respect to the price of the i^{th} input

v_1 = two-sided (positive/negative) stochastic error term follows a normal distribution

u_1 = non-negative error term (measure of inefficiency) which follows a half distribution.

Here EE takes values between 0and 1. Hence, a measure of farm specific AE is thus obtained from technical and economic efficiencies, the allocative efficiency level of vegetable farmers

CE = AE/ TE ---------- (31)

Were then estimated as below

AE = Allocative Efficiency

CE = Cost Efficiency (economic efficiency)

TE = Technical Efficiency

3.4.4 Economic efficiency

The economic efficiency of vegetable farmers was estimated using as followsStochastic frontier cost function was used to estimate the economic efficiencies of vegetable farmers. The farmers' frontier cost function model is explicitly expressed as:

$\ln C = \alpha 0 + \alpha_1 \ln Q_1 P_1 + \alpha_2 \ln Q_2 P_2 + \alpha_3 \ln Q_3 P_3 + \alpha_4 \ln Q_4 P_4 + \alpha_5 \ln Q_5 P_5 + \alpha_6 \ln Q_6 P_6 + \alpha_7 \ln Q_7 P_7 + \alpha_8 \ln Q_8 P_8 + V + U$ ……. 32

Where:

Ci = total input cost of ith farm (₦)

Qi = output quantity of the ith farm (kg)

P1 = cost per man-day of labour (₦)

P2 = cost of inorganic fertilizer (₦/ kg)

P3 = cost of organic fertilizer (₦/kg)

P5 = cost of agrochemicals (₦/lit)

P6 = depreciations of farm tools (₦)

P7 = cost of seed/seedling (₦)

P8 = cost of farm tools (₦)

$\alpha 0$ = constant

$\alpha 1 - 8$ = estimated parameter

V = random variable assumed to be independently and identically distributed as μ (0, $\sigma 2v$) and independent of Uis; that represent the stochastic effect outside the farmer's control U = one sided (Ui $\geq$ 0) efficiency component that represents economic inefficiency in production which is assumed to be independently and identically distributed as truncation (at zero) of the normal distribution with mean, Ki σ and variance $\sigma u2$ ($|\mu Ki\sigma, \sigma 2u|$).

The economic inefficiency model is explicitly expressed as:

$U= \sigma_1 lnK_1+\sigma_2 lnK_2+ \sigma_3 lnK_3+ \sigma_4 lnK_4+ \sigma_5 lnK_5+ \sigma_6 lnK_6+ \sigma_7 lnK_7 + \sigma_8 lnK_8 + wi$ …… 33

Where:

μ = economic inefficiency

K1 = farming experience (years)

K2 = formal education (years)

K3 = extension contact (number of visit)

K4 = credit availability (Dummy = 1 if available and 0 otherwise)

K5 = Age of farmers (years)

K6 = membership in association (years of membership)

K7 = household size (number)

K8 = off-farm income (₦)

$\sigma 1- 8$= parameters estimated

w = random variable defined by the truncation of the normal distribution with zero mean and variance $\sigma 2u$ such that the point of truncation is Kiσi, iewi $\geq$- Ki σ.

The coefficient of explanatory variables in the cost function such as wage rate, cost of planting material, cost of agrochemical, cost of farm tools and cost of seedlings are a priori expected to be negative. The signs of coefficients of variables in the inefficiency

model such as farming experience, Age of farmers,membership ofassociation, level of formal education, extension contact, credit availability, fuel and household size are also a priori expected to be positively related to cost efficiency.

Ui provides information on the level of economic efficiency of the ith farm. The economic efficiency of individual farmer is expressed in terms of the ratio of the predicted minimum cost (Ci*) to the observed cost (Ci) as:

EE = Ci*/Ci …….34

= exp (Ui)

The maximum likelihood estimate (MLE) of the parameters of the model defined by equation (1) and (2) and farmer specific EE defined in above were estimated using FRONTIER version 4.1 (Coelli, 1994).

In the process, the variance parameters σ2u and σ2v are expressed in terms of parametization as:

σ2 = (σ2u+ σ2v) (4) ɣ = (σ2u /σ2) ---------- 35

Where,

ɣ = total variation in output from the frontier which is attributed to economic inefficiency.

The value of γ ranges between zero and one. When γ equals zero, variation in cost is due to factors not directly under the control ofthe farmers. The economic inefficiency ranges between zero and one indicating the extent of producers' deviation above the frontier.

3.4.5 Determinants of efficiency

Cobb–Douglas stochastic production frontier approach was used to estimate the production function and the determinants of technical, allocative and economic efficiencies among vegetable farmers in the area. The stochastic function assumes the presence of technical inefficiency of production. The specification involves a function

specified for cross-sectional data, which has an error term, with two components, one to account for technical inefficiency.

According to Ogundari (2007), an input-oriented approach to measure EE yields three sets of inputs: (1) the observed set, Xo, (2) the technically efficient set, Xte and (3) economically efficient set Xee. The gross products of these inputs sets the price vector which yields the costs of the observed technically efficient and economically efficient input set respectively. These costs can be used to devise measures of TE_i, AE_i and EE_i as shown hereby:

$TE_i = PX_{te}/PX_o$ 36

$EE_i = PX_{ee}/PX_o$ 37

$AE_i = PX_{ee}/PX_{te}$ (i.e.,EE/TE)..... 38

Where PX_{te} and PX_{ee} are corresponding technically and economically efficient cost of production respectively while PX_o is the actual cost of production for any particular firm's observed level of output. Aigner *et al.,* (1977), Meeusen and Van de Broeck (1977) and Battese and Corra (1977) independently developed the stochastic frontier production function to provide basis for estimating productive efficiency of firms. Their model can be summarized as:

$y = f(X; \beta) + \varepsilon$ 39

Where y is scalar output, X is a vector of inputs and β is a vector of technology parameters. Hereε = v-u which is the decomposed error term (Aigner *et al.*, 1977). The two components v and u are assumed to be independent of each other, where v is the two-sided normally distributed random error ($v_i \sim N(0,\sigma_v^2)$, and u is one-sided efficiency component with a half-normal distribution ($u_i \sim N(0,\sigma_u^2)$. The Maximum Likelihood Estimation (MLE) of (equation 4) yields estimates for β and λ. Jondrow *et al.*, (1982) have demonstrated that the farm specific measure of technical inefficiency can be determined from the conditional expectation of u_i given as:

$E(U_1/\varepsilon_i) = \frac{\sigma u \sigma v}{\sigma}\left\{\frac{f(\varepsilon 1\lambda/\sigma)\varepsilon\lambda}{1-f(\frac{\varepsilon\lambda}{\sigma})\sigma}\right\}$ 40

here λ=σ u /σ v , σ 2 =σ 2 u +σ 2 v , while *f* and F represents the standard normal density and cumulative distribution function respectively evaluated at ε i λ/σ. Battese and Corra (1977) defined γ = σ u 2 /σ 2 such that 0≤ γ ≤1 and represent the total variation in output from the frontier attributable to differences inefficiency. The farm specific technical efficiency is defined in terms of observed output (Y i) to the corresponding frontier output (Y i *) using the available technology derived from the result of equation (5) above as:

$TE = \frac{Y_1}{Y_1^*} = \frac{E(Y_1/u_1,x_1)}{E(Y_1/U_1=O_1x_1)}$ = E (exp(- U_1/ε).....41

Therefore, TE=exp(-Ui)TE takes values within the interval zero and one where 1 indicates a fully efficient farm. According to Bravo-Ureta and Pinhero (1997), assume that the production frontier in equation (4) is self-dual (e.g. Cobb-Douglass) and that the corresponding cost frontier can be expressed as:

C = h(P, Y; α) 42

Where C is the minimum cost to produce output Y, P is a vector of input prices, and α is a vector of parameters. Applying Shephard's lemma, the system of minimum cost input demand equations can be obtained by differentiating the cost frontier with respect to each input price. This demand equation for the ith input (Xdi) is equal to:

δC/δPi = Xdi = f(P, Y; ψ) 43

Where ψ is a vector of parameters. From the input demand equations, we can obtain the economically efficient input quantities, X i e, by substituting the firm's input prices P and output quantity Y into the above equation

Furthermore, the farm specific EE is defined as the ratio of minimum observed total production cost (C*) to actual total production cost (C) using the result of equation 5 above. That is:

$$EE=\frac{C1}{C*1}\frac{E\left(\frac{C_1}{U_1}=O,YiPi\right)}{E\left(Y1/U1,Y1P\right)}$$= E (exp (-Ui/ε) ……....44

Here EE takes values between 0 and 1. Hence, a measure of farm specific AE is thus obtained from technical and economic efficiencies estimated as:

AE = $\frac{EE}{TE}$…….. 45

The econometric specification in this study follows the Cobb-Douglas functional form because of its wide application in farm efficiency for the developing and developed countries. For the vegetable farmers in the study area as follows:

InY i = βo +β 1 InX 1 i +……..+ β 6 InX 6 i + Vi -Ui … …….. 46

Where: Y = Output of vegetables (kg) (grain equivalent)

X 1 = Farm Size in hectares

X 2 = Family labour in workdays

X 3 = Hired labour in workdays

X 4 = vegetable seeds/ Seedling (in number of bundles used, a bundle is

50 stands for garden egg)

X 5 = Fertilizer in Kg

X 6 =Pesticides in litres

Vi and Ui are as described earlier.

The inefficiency model is specified thus:

$\mu = \delta_0 + \delta_1 W_1 + \delta_2 W_2 + \delta_3 W_3 + \ldots z + \delta_8 W_8$ …… 47

Where, W_1 = Age of farmer in years

W_2 = Educational level of farmer (number of years spent in school)

W_3 = Household Size

W_4 = Farming experience

W_5 = Extension contact (1 if the farmer has extension contact, 0 if otherwise)

W_6 = Access to credit (1 if farmer has access to credit, 0 if otherwise)

W_7 = sex of farmer

W_8 = = membership of association (years of membership)

Cobb-Douglas cost frontier function for vegetable farms in the study area was specified as:

$InCi = \alpha_0 + \alpha_1 InP_1 i + \alpha_2 InP_2 i + \alpha_3 InP_3 i + \alpha_4 InP_4 i + Vi + Ui$ …… 48

Here C is total production cost of vegetable per farmer for the season; P 1 is the rental value of land per hectare for the season, P 2 is the wage rate of labour/ workday, P 3 is the price of seeds/seedling bundle; P 4 is the price of fertilizer / kg; P 5 is the price of pesticide / litre; αs were parameters estimated. The frontier cost function was estimated using MLE methods. The computer programme FRONTIER version 4.1 was used and it should be noted that this programme estimates the cost efficiency (CE), which is computed originally as the inverse of equation (9).

Hence, farm–level EE was obtained using the relationship:

EE = 1/ CE (Coelli et al., 1998)

The determinant of efficiency for the technical and economic efficiencies was modelled in terms of socio-economic variables of the farmers and other factors. The technical and economic efficiencies in the model was simultaneously estimated with their determinants. The determinants of technical and allocative inefficiency, (μi), is defined by

$\mu i = f(Zi ; \delta)$ …….....49

Where

μi = technical inefficiency

Zi = vector of farmer's specific factors

δ = vector of parameters to be estimated

$\mu i = \delta o + \delta i \text{ In } Zi + \delta 2 \text{ In } Z_2 + \delta 3 \text{ In } Z_3 + \text{----------} + \delta 6 \text{ In } Z_6 + \delta 7 \text{ In } Z_7 \ldots$ 50

Z_1 = age of farmers (years)

Z_2 = farming experience in vegetable production (years)

Z_3 = years of formal education (years)

Z_4 = extension visits in the cropping season (number)

Z_5 = household size (number)

Z_6 = membership of association (years of membership)

Z_7 = access to credit (Naira)

Finally, Economic Efficiency (EE) was estimated as the product of technical efficiency (TE) and allocative efficiency (AE). Economic Efficiency = Technical Efficiency × Allocative Efficiency

$Exp(-\mu) = \beta_0 + \beta_1 Z_1 + \beta_2 Z_2 + \beta_3 Z_3 + \beta_4 Z_4 + \beta_5 z_5 + \beta_6 Z_6 + \beta_7 Z_7 + \beta_8 Z_8 + \beta_9 Z_9 + \beta_{10} Z_{10} + \varepsilon_1$

..... 51

$Exp(-\mu)$ defined by;

Where;

$Exp(-\mu)$ = Inefficiency of the i^{th} farm

Z_1 = Age of the farmer (in years)

Z_2 = Level of education (years of schooling)

Z_3 = sexGender (male = 1; female = 0)

Z_4 = Farming experience (in years)

Z_5= Extension contact (1 = contact, 2 = on contact)

Z_6 = Access to credit (naira)

Z_7 = Membership of farmersfarmers' cooperative (numbers of years)

Z_8 = Household size (numberso)

Z_9 = Production system (intercrop= 1, sole = 0)

Z_{10} = Farm size (in hectares)

ε1 = Error terms

The b's are the parameters to be estimatedε_1, this represents the random error term which account for random variations in the farmers yield due to factors outside the farmers' control. These include natural factors like nature of soil, climatic condition, pest and diseases. It gives an indication of the goodness of fit as well as the specified assumptions of the distribution of the corresponding error term (ε1). Also is γ which is an indication that the influences which are not explained by the production function, are the major sources of random errors.

Allocative efficiency was regressed against the set of farm specific factors for each of the vegetable under study differently so as to obtained the determinants of allocative efficiency according to (Kaliranjan, 1981).

3.5 Cost and Return Analysis

Cost andreturn analysis was used to calculate the profitability level of vegetable production by considering the total cost of production and the total revenue generated. Profit made is the differences between total revenue and total cost;

Cπ=TR-TC …….. 52

Where

π= Profit

TR = Total Revenue in Naira/ha

TR = Total Cost in N/ha Gross Margin Analysis;

TC=Total Fixed Cost (TFC) + Total

Variable Cost (TVC)

TC=TFC+TVC

The various profitability ratioscomputed from the above analysis includes: benefit cost ratio, rate of return, expenses structure ratio, gross margin ratio and gross revenue ratio.

3.6 Estimation of Poverty Status of Vegetable Farmers

The FGT was used to decompose into different poverty status, and is given by;

$P_\alpha = \frac{1}{n}\sum_{i=1}^{q}\left[\frac{Z-Y}{Z}\right]\alpha$ 53

Where;

$\alpha \geq 0$ = the FGT index and takes values 0,1,2.

n = total number of households

q = number of households below the poverty line

Z = poverty line

Y = household expenditure

When $\alpha = 0$, P_0 gives the incidence of poverty (Headcount Index); $\alpha = P_1$ gives the depth of poverty (Poverty Gap) and $\alpha = 2$, P_2 gives the poverty severity (squared Poverty)

The study used two-thirds of the mean household expenditure on consumption of the sampled vegetable farmers as a poverty line value to estimate the Weighted Poverty Index and the model is specified as follows :$Z = \frac{2}{3}$ x MPCHE

Where:

PCE = TCE/HHS

MPCHE = THHE/TNR

PCE = Per Capital Expenditure

HHS = Household Size

TNR = Total Number of Respondent

THHE = Total Household Expenditure

MPCHE = Mean Per Capital Households Expenditure

Z = Poverty Line Value.

3.7 Variables Definition and Measurement

Vegetable Output: this refers to the total amount of vegetables (telferia, garden egg and waterleaf) harvested by the farmer in the year under study. This was measured in kg using the grain equivalent for leafy is 0.06 and fruity vegetables is 0.10 (Oyenuga, V.A, 2009) as the case may be, this was carried out by direct weighing of the three vegetables under study.

Labour: this is made up of hired and family labour, family labour served as substitute for hired labour. Labour was measured in man-day for all farm operations carried-out during the production period. Estimated labour are those used for land preparation, planting, weeding, watering, fertilizer and other chemical application harvesting. Labour expended wasmeasured using Norman's (1973) conversion ratio; one day of woman and child work were estimated at 0.75 and 0.5 man-day respectively. 1 man-day is eight hours of man work.

Land:farmland is the major input for agricultural production in rural households. It's the household land devoted to vegetable production which may be owned and or rented, gift and is measured in hectares.

Seed: this is the quantities of planting materials planted and can also be broadcaston the garden egg and waterleaf on the field. It is measured in kilograms. Increasing the seed planted is expected to increase the output.

Fertilizer: this provides additional fertility to the soil and measured in kilograms. It is expected to influence rice output positively.

Agrochemicals: this include herbicides and pesticides as improve farm practice in vegetable production for weeds and pest control. Measured in litres, the input is expected to be positively related to the various vegetables output.

Income: income is defined as the output of activities and it measures both in cash and in kind contributions. All the goods and services produce in activities are valued at market producer price regardless of their use. So, all own-farm products are valued at the same price as if they were sold. Income are modelled as 1, if the household is above the poverty line and 0, if the household is below the poverty line.

Total cost of vegetable output:total cost is the sum of all the input costs used for vegetable production by a farmer in the period under study. These inputs are labour, land, seeds, fertilizer and agrochemicals. It is the dependent variable in the stochastic frontier cost function. It was measured in naira.

Cost of labour: this is the cost incurred in hiring labour for vegetable production. The labour hours multiply by the unit cost is the cost of labour.

Cost of land: this is the amount spent in renting land used for vegetable production and was measured in naira.

Cost of seed: it is the amount spent in acquiring vegetable seeds and it is measured in naira.

Cost of fertilizer:it is the amount spent in acquiring the quantity of fertilizer used in vegetable production. It is measured in naira.

Cost of agrochemical: it is the amount incurred in acquiring herbicides and pesticides used in the vegetables production. It is the quantity used multiplied by the unit cost expressed in naira.

Gender/Sex: this was counted as numbers of adult male or female in each household. Household with higher numbers of male are to have higher income in terms of labour inputs and consequently out of poverty.

Age of farmer: age is a continuous variable and measured in years. Age is one of the factors that determine decision making in a person. Advanced age household heads are more reluctant to accept nor adopt new technology and agricultural techniques than younger household heads. Age also affect the productivity of human labour. It is expected that farmers in their active age are productive than the elder farmers.

Access to credit: credit refers to the amount or its money value equivalent obtained by the farmer from lending agencies (banks, government, friends, money lenders, relatives) for production activities. According to Norton *et al*, (1970), credit help farmers purchase inputs such as seeds, fertilizers and chemicals. Access to credit was measured as a dummy variable with 1 = access, 0 = otherwise.

Education: this was measured by the numbers of years of formal school attended. It is likely that educated farmers would readily adopt vegetables planting innovations and may be easier to train through extension.

Membership of Association: this is a dummy variable with 1 for membership of association and 0, if otherwise. This empowers farmers and improves their economic status and production activities as they can access input markets easily, information, assistance and training from government and non-governmental organisations.

Household size: household size was measured in number of people living together under one roof and eating from the same pot. In rural household, family labour is the major input used in agricultural production. Household with large family size have more labour for agricultural production. Where families' members are productive this can affect income positively. High dependency ratio increases the profitability of being poor.

Extension contact: this refers to whether the farmers had contact with extension agentor not and it is a dummy variable. 1 if the farmer has contact with extension agent and 0 if otherwise.

Farming Experience: farming experience is expectedto have a positive relationship with efficiency. It was measured in years. Experience in farming and information obtained from extension agents determines a farmer's capability. This enables him/her to predict problems and possible solution to them.

Productive Asset: this variable include all assets that are categories under agricultural activities. This is a continuous variable measured in Naira. Productive asset holding enables farmers expand production and increase their total income. Productive asset can increase farmers' income positively.

Non-farm activities: this is where farmers are engaged in other productive non-farm business activities. This was measured in a dummy variable with 1, if the farmer is engaged in non-farm activities and 0, if otherwise.

CHAPTER FOUR

RESULTS AND DISCUSSION

4.1 Socio-economic Characteristics of Vegetable Farmers in the Study Area

Particular reference was given to age, education, farm size, household size, extension contact, access to credit, gender farming experience, membership of farmer association, non-farm activities are some of the socioeconomic characteristics of the sampled vegetable farmers, these result is with respect to the three vegetable (garden egg, telferia and waterleaf) under study.

4.1.1 Agedistribution of vegetable farmers

The results presented in Table 4.1 showed the age distribution of vegetable farmers in the study area, the average ages were 48, 44 and 46 years for garden egg, telferia and water leaf farmers respectively. These results imply that vegetable farmers in the study area were still in their active productive age group. This implies high level of adoption of technology because youth are so adventurous which will result in increased efficiency, this will result to more income which intend alleviate poverty of the farmer's household.The results also showed that about 9.59, 11.6 and 6.67percent of Garden egg, Telferia and water leaf famers respectively were within 21-30 years. Those that were within 31-40 years constitute 30.14, 27.10 and 28.00 percentfor garden egg, telferia and

water leaf farmers respectively. For 41- 50, the results showed 30.27, 30.59 and 30.67 percent of Garden egg, Telferia and water leaf famers respectively.

4.1.2 Educational level

Distribution of the farmers by their educational level in Table 4.1 indicates that the mean completed years for formal education is 7, 9 and 7 for garden egg, telferia and waterleaf farmers respectively. These results showed that vegetable farmers in the study area had one form of formal education or the other. These implied that the level of awareness and adoption of agricultural innovations among vegetable farmers could be very high. Educational attainment is directly related to adoption and these will enhance the efficiency level of the farmers there by increased to their income, this will in tend alleviate poverty and enhance food security. The results also revealed 4.11 percent of garden egg farmers had adult education, 28.77 percent had primary education, and 57.80 percent had secondary education. Those that had tertiary education constitute 12.33 percent. Among the telferia farmers 19.59 percent had adult education, 23.58 percent had primary education, and 50.29 percent had secondary education while only 15.30 percent had tertiary education. Water leaf farmers had the following results 14.67, 32.00, 40.00 and 13.33 percent.

4.1.3 Distribution of respondents based on farm sizes

The distribution of the respondents by their farm size is shown in Table 4.1. The results revealed that the mean farm size among garden egg, telferia and water leaf farmers was 1.50, 1.71 and 1.60 respectively. The minimum farm size was found to be 0.1 hectare for garden egg farmer with maximum value of 4 hectares. On the other hand the minimum value of farm size for telferia farmer was 0.19 while the maximum value was 9 hectares and for water leaf farmer the minimum farm size was found to be 0.5 hectare and maximum value of 7 hectares. The implication of this finding is that vegetable farmers

are predominantly small-scale farmers with low level of income which can only sustained them at the subsistence level. For vegetable farming to make meaningful contribution to poverty alleviation the farm sizes have to be increased. The result also indicated that more than three quarter (42.47) percent of garden egg farmers had farm size of between 0.1-1.0 hectares, 30.14 percent had between 1.1 and 2.0 hectare. Among the telferia farmer's majority (40.00 percent) had farm size between 0.1-1.0 hectares. Water leaf farmers are not different as 42.67 percent farmers had farm size of between 0.1-1.0 hectares, 25.67 percent had between 1.1 and 2.0 hectare.

4.1.4 Distribution of respondents based on household Size

Household size is an important source of family labour. Table 4.1 showed that garden egg, telferia and waterleaf has the mean household sizes of 3.0, 4.0 and 3.0 respectively, a relatively large household size may not guarantee for increased efficiency since family labour which comprises mostly children of school age are mostly in school. It may reduce the cost of labour in the long run.These farmersalso have household size of between 1 to 5 persons account for 39.73 percent, 6- 10 persons 43.84 and 16persons and above has 2.74 percent for garden egg farmers. Telferia farmers in the study area has about the same household size, 1-5 persons account for 37.65 percent, 6- 10 persons has 41.18 percent and 3.53 percent for household size more than 16 persons. Water leaf also account for 2.67 percent for household size of 16 persons and above, 1-5, and 6- 10 persons has 40.0 percent respectively. The mean household size for garden egg farmers was 6 persons, telferia 7 persons and waterleaf 7 persons. The above result revealed that vegetable farmers in the study area have small household sizes which do not enhance availability of family labour which may result in reduction in the cost of labour.

4.1.5:Distribution of respondents based on extension contact

Contact with extension agents enable farmers' access to information and facilitates training and adoption of new innovation. The distribution of farmers in terms of contact with extension agent is poor as shown in Table 4.1, Most of the garden egg farmers (59.00 percent) do not have access to extension contact in the study area, and about 13.00 percent only had contact once in a year.Telferia farmers has 57.30 which represent more than half of the farmers have no access to extension contact, while 15.30 percent only had contact once a year, and the water leaf farmers is with same trend of 60.00 having no extension contact, while 14.67 has once a year. This imply that only more than halveof the vegetable (garden egg, telferia and water leaf) farmers in the study area had no access to extension agents, who are the main source of farmers' information on improved agricultural technologies. Umar *et al.* (2009) argued that higher extension contacts would increase adoption of improved farm production technologies.

High extension contact will enhanced allocative and technical efficiency of the vegetable farmers, the implication of the low or no extension contact from the findings will reduced the contribution of vegetable production to alleviate poverty.

Table 4.1: Socioeconomic characteristics of the Vegetable farmers

Age (Years)	**Garden Egg (N=73)**	**Telferia (N=85)**	**Water Leaf (N=75)**
21-30	7(9.59)	10 (11.76)	5 (6.67)
31-40	22(30.14)	23 (27.10)	21 (28.00)
41-50	25 (30.27)	26 (30.59)	23 (30.67)
51-60	15 (20.55)	19 (22.35)	20 (26.67)
61-70	4 (5.45)	7 (8.24)	6 (8.00)
Mean	48	44	46
Education			
No education	3(4.11)	9 (10.59)	11(14.67)
Primary education	21(28.77)	20 (23.58)	24(32.00)
Secondary education	40(57.80)	43 (50.29)	30(40.00)
Tertiary education	9(12.33)	13 (15.30)	10(13.33)
Mean	7	9	7
Farm size			
0.1-1.0	31 (42.47)	34(40.0)	32(42.67)
1.1-2.0	22 (30.14)	22(25.90)	20(26.67)
2.1-3.0	13 (17.81)	15(17.65)	14(18.67)
3.1-4.0	5 (6.85)	9(10.59)	5(6.67)
≥ 4.0	2 (2.74)	5(5.90)	4(5.33)
Mean	1.5	1.7	1.6
Household			
1-5	29(39.73)	32(37.65)	30(40.00)
6-10	32(43.84)	35(41.18)	30(40.00)
11-15	10(13.70)	15(17.65)	13(17.33)
≥ 16	2(2.74)	3(3.53)	2(2.67)
Mean	3	4	3
Extension contact			

No contact	43(59.00)	47(57.30)	45(60.00)
Once a year	10(13.00)	13(15.30)	11(14.67)
Twice a year	10(13.00)	10(11.76)	10(13.33)
Four times a year	10(13.00)	15(17.64)	9(12.00)
Total	73(100.00)	85 (100.00)	75(100)

Figures in parentheses are percentages

4.1.6 Gender participation

The participation of farmers by gender as shown in table 4.1.1 shows that garden egg farmers had a breakdown which shows that more than half (57.53 percent) of the farmers are female, while 42.47 percent are male. The results of the telferia farmers reveal that 43.53 percent are male and 56.47 percent female. Water leaf farmer in the study area also has similar results of 73.33 percent female and36.67 percent male. The result agreed with Udoh (2005) and Abang (2012) that asserted that women are keener than men in planting vegetable for family consumption and cash income, though in small scale and low know-how which often results in small profit margin. Another possible explanation for large numbers of women participation is that female can easily form cooperative group than the male, vegetable farming is not labour intensive.

4.1.7 Credit status

The data on credit status presented on table 4.1.1 shows that majority of the farmers about 68.49 percent of the garden egg farmers in the study area had no access to credit facilities while only31.51 percent were able to get credit assistance. The other two vegetables under study are teleferia and water leaf, and their result reveals 65.88 percent and 64.00 percent respectively represent farmers with no access to credit facilities. The result also shows that telferia and water leaf farmers with access to credit are 34.12 and 36.00 percent respectively. Obwona (2008) opined that lack of credit facilities particularly for small scale farmers' act as a constraint to efficient production, and credit accessibility contributes positively to the improvement to efficiency which can hardly increase their income above subsistence level

4.1.8 Farming experience

Experience in farming enhances farmers' performance as it enables them to make the right decisions and handle difficult situations and risk.Statistics on farming experience on table4.1.1 depicted that the mean farming experience for the three vegetables under study are 6, 8 and 7 representing garden egg, telferia and waterleaf respectively. And the results also show 31.5, 35.30 and 26.67 percent of garden egg, telferia and waterleaf farmers respectively have over five years of farming experience and about 23.29, 22.35 and 25.33percent of the vegetables under study have been in the vegetable production business for the period of five years or less.With the average farming experience of nine years. The farmers are therefore described as experienced and are expected to have higher efficiency. Nwara (2009) reported that farmers count more on their experience than educational attainment in order to increase on their productivity. Njoku and Odili (2010) also found out that farming experience enhances efficient use of scarce resources by smallholder farmers in Nigeria.

Table 4.2 Socioeconomic characteristics of Garden egg, Telferia and Waterleaf Farmers

Sex	**Garden Egg (N=73)**	**Telferia (N=85)**	**Water Leaf (N=75)**
Male	31(42.47)	37(43.53)	20(26.67)
Female	42(57.53)	48(56.47)	55(73.33)
Credit status			
Access to credit	23(31.51)	29(34.12)	27(36.00)
No access to credit	50(68.49)	56(65.88)	48(64.00)
Farming Experience			
1-5	17(23.29)	19(22.35)	19(25.33)
6-10	23(31.51)	30(35.30)	20(26.67))
11-15	15(20.55)	26(30.29)	15(20.00)
16-20	10(13.70)	10(11.76)	12(16.00)
≥20	8(10.96)	10(11.76)	9(12.00)
Mean	6 {4.84}	8 {6.10}	7{5.30}
Production system			
Sole cropping	33(45.21)	38(44.71)	35(46.67)
Mixed cropping	40(54.79)	47(55.29)	40(53.33)

Figures in parentheses are percentages

4.1.9 Production system

Table 4.2 revealed the production systems available in the study area. A greater percentage of the sample respondent about 54.79, 55.29 and 53.33 percent respectively for the three vegetables (garden egg, telferia and water leaf) under study practice mixed cropping while; the rest practiced sole vegetable cropping system. Many farmers continue to intercrop vegetable with other crops, may be probable because of relatively small land sizes and diversification of investment in crops to reduce risk of total crop failure, also to increase their farm income so as to alleviate poverty. Kibaara (2009) reported that there might exist a higher efficiency under mono-crop system, which may affect household income and this will further affect food security and poverty level negatively.

4.2 Production Efficiency in Vegetable

Technical, allocative and economic of the three vegetables: garden egg, telferia and water leaf were discussed based on the outcome of the analysis from the field as follows:

4.2.1.1 Technical Efficiency Level for Garden Egg Farmers

Maximum likelihood estimate of the Cobb Douglas stochastic production frontier of garden egg production is presented in Table 4.3 It can be seen that, the estimate of sigma-square ($\sigma 2 = 0.052$) is significantly different from zero. Kebede (2011), obtained similar results in their different studies. The gamma (y) which is as high as 0.77 and significant at the 5 percent level. It indicates that 77 percent of the variation of the output of the garden egg farmers in the state is as a result of technical inefficiency. Therefore, the presence of error component in the model is confirm, hence the normal conventional production function (Ordinary Least Square, OLS) is an inadequate representation of the data.

Table 4.3: Maximum likelihood estimate of the stochastic production frontier of garden egg production

Variable	Unit	Coefficient	Standard error	t-ratio
Constant		6.9454	3.8593	1.8*
Hired labour	M-D	0.7457	0.2457	3.04***
Family labour	M-D	0.5561	0.2035	2.913***
Farm size	Ha	0.0582	0.0196	2.96***
Fertilizer	Kg	0.0986	0.0523	1.89*
Seed	kg	0.5176	0.234	2.54***
Agro chemicals	lt	0.0928	0.0656	2.3017**
Variance Parameters				
Sigma squared	($\sigma 2$)	0.0052	0.2	2.54***
Gamma	(γ)	0.77	0.988	2.14**
LR test		21.66		
log likelihood function		-55.69		

Note: *** Significant at 1%, ** Significant at 5%, * Significant at 10%;

The result also indicates that a greater percent of the coefficient are appropriately signed. The coefficient of labour carries positive sign and is significant at 1 percent level, and elasticity (0.75) is the largest signifying its importance in influencing garden egg output. The coefficient of farm size was also positive and significant at 1 percent level. This coefficient, which is also the elasticity indicate that a10 percent increase in the farm size will lead to a 0.5 percent increase in the output. This is an indication that there is allowance in increasing output by expanding the farm size. Udoh *et al* (2011) obtained similar result. The coefficient of fertilizer and seed were also positive and significant at 5 percent level, the elasticity indicates that a 10 percent increase in these inputs will lead to 0.99 and 5 percent increase in the output of garden egg respectively. The study had shown that the mean seed per ha used was more than the recommended rate which is (65kg/ha), while fertilizer used per ha was less than the recommended rate of 250kg/ha Akinsanmi (2010). Therefore, increasing fertilizer will result in increased output.

4.2.1.2 Estimate of Stochastic Production in telferia Production

Table 4.4 depicts the Maximum Likelihood Estimate of the Cobb Douglas Stochastic Production frontier result for telferia production and their level of significance. The coefficients of the variables are important in the analysis of data. As expected, the signs of the slope coefficient of the stochastic frontier were positive. This implies that any increase lead to an increase, which agrees with the a priori expectations. Farm size has a coefficient of 0.69 with a significant level of 1 percent probability; this level is also applicable to fertilizer application. The coefficient for agrochemicals used was positive but not significant; this could be that some of the respondent must have been using manual weeding, not much awareness and cost of agrochemicals. The estimate of the fitness was also significantly difference from zero indicating a good fit and the

correctness of the distributional assumption specified. Gamma (γ) variance ratio which was significantly different from zero showed that the farm specific variable contributed about 0.8176 implies that 81.76 percent variation in yield among the respondents, which means that about 81.76 percent of the differences between the observed and maximum production frontier output were due to differences in farmers' levels of technical inefficiency and not related to random variability. These factors are under the control of the farmers and the influence of which can be reduced through enhanced technical efficiency of the telferia farmers.

Table 4.4: Maximum likelihood estimate of the stochastic production frontier of telferia production

Variable	unit	Coefficient	Standard error	t-ratio
Constant		4.5811	2.1931	2.089**
Hired labour	M-D	0.2598	0.0823	3.157***
Farm labour	M-D	0.3274	0.0961	4.120***
Farm size	Ha	0.6912	0.0912	7.576***
Fertilizer	Kg	0.0656	0.033	1.989*
Seed	kg	0.5491	0.0971	4.254***
Agrochemicals	lt	0.1257	0.0467	2.691***
Variance Parameters				
Sigma squared	(σ2)	0.3009	0.1022	2.9366***
Gamma	(γ)	0.8176	0.2704	3.0240***
LR test		83.92		
log likelihood function				

Note: *** Significant at 1%, ** Significant at 5%, * Significant at 10%

4.2.1.3 Estimate of Stochastic Production in waterleaf Production

Maximum likelihood estimate of the Cobb Douglas stochastic production frontier of waterleaf Production is presented in Table 4.5 It can be seen that, the estimate of sigma-square (σ2 = 0.90) is significantly different from zero. Kebede (2011), obtained similar results in their different studies. The gamma (y) which is as high as 0.73 and significant at the 5percent level,. It indicates that 73 percent of the variation of the output of the waterleaf farmers in the state is as a result of technical inefficiency. Therefore, the

presence of error component in the model is confirm, hence the normal conventional production function (Ordinary Least Square, OLS) is an inadequate representation of the data.

The result also indicates that a greater percent of the coefficient are appropriately signed. The coefficient of labour carries positive sign and is significant at 1 percent level and 10 percent respectively for family and hired labour, and elasticity (0.75) is the largest signifying its importance in influencing waterleaf output. The coefficient of farm size was also positive and significant at 1 percent level. This coefficient, which is also the elasticity indicate that a10 percent increase in the farm size will lead to a 0.5 percent increase in the output. This is an indication that there is allowance in increasing output by expanding the farm size. Udoh et al (2011) obtained similar result. The coefficient of fertilizer and seed were also positive and significant at 10 percent level, the elasticity indicates that a 20 percent increase in these inputs will lead to 0.99 and 5 percent increase in the output of waterleaf respectively. The study had shown that the mean seed per ha used was more than the recommended rate which is (65kg/ha), while fertilizer used per ha was less than the recommended rate of 250kg/ha Akinsanmi (2010). Therefore increasing fertilizer will result in increased output.

Table 4.5: Maximum likelihood estimate of stochastic production frontier of waterleaf production

Variable	**Coefficient**	**Standard error**	**t-ratio**
Constant	5.6013	1.007	5.562***
Hired labour	0.4627	0.135	3.427***
Family labour	0.417	0.1298	3.212***
Farm size	0.5964	0.2146	2.779***
Fertilizer	0.0209	0.0134	1.559
Seed	0.1214	0.597	0.203
Agro chemicals	0.1301	0.2141	0.607
Variance Parameters			

Sigma squared	0.9	0.06	15.002***
Gamma	0.73	0.2605	2.802***
LR test	76.88		
log likelihood function	6.497		

Note: *** Significant at 1%, ** Significant at 5%, * Significant at 10%

4.2.1.4 Distribution of Technical Efficiency for Garden Egg, Telferia and Waterleaf Farmers

The results in figure 4.1 present the frequency distribution of technical efficiency indices. The results indicate that technical efficiency index ranged from a minimum of 0.62 to a maximum of 1.00, with a mean of 0.78 for garden egg farmers, this implies that garden egg farmers have the potentials to improve their production efficiency technically using existing technology by 22 percent (because of the mean of 0.78). The result also indicates that, for an average garden egg farmer to attend the technical efficiency level of he/her most efficient partner, they will realize about [1- (0.78/1.00) 100] which is 22 percent cost saving in garden egg production in the study area. The result revealed that only 10.96 percent of garden egg farmer attained between 0.9 -1.00 technical efficiency levels. Majority of the garden egg farmers, above 70 percent attained technical efficiency level of above 0.61.this means that most of the garden egg farmers in the area are producing below the frontier. About 10.96 percent of the farmers are in an efficiency range of (.09-1.0).

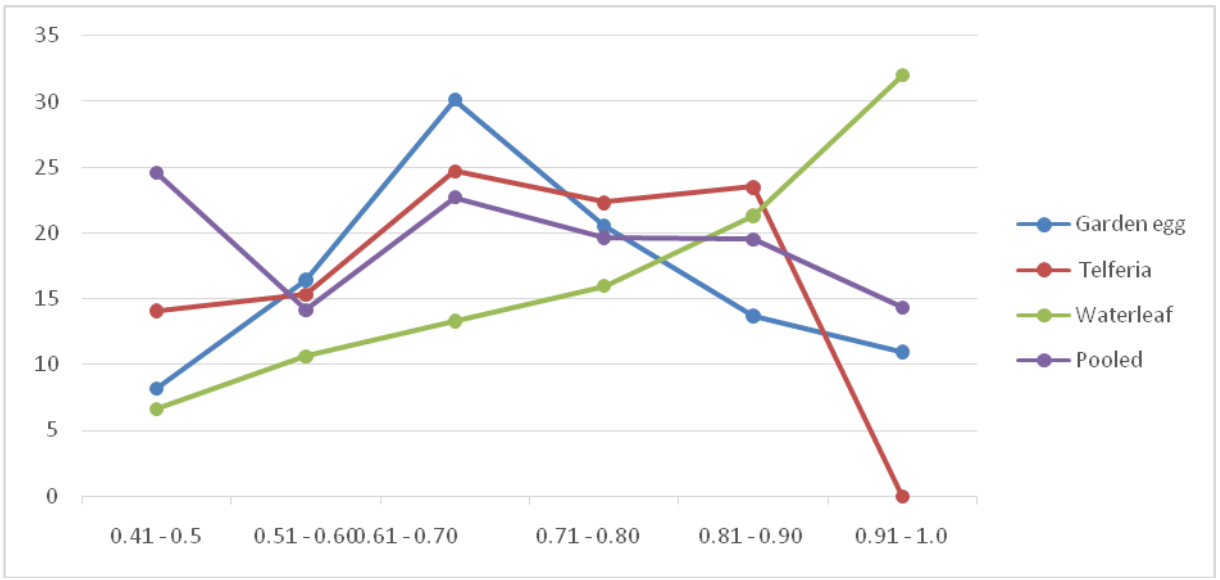


Fig. 4.1: Distribution of Technical Efficiency Indices of garden egg, telferia and Waterleaf Farmers

Further, as also shown in figure 4.1 on the mean technical efficiency of Telferia farmers is 0.77 while the maximum value is 0.98 and minimum is 0.53. These implied that if the average telferia farmers in the study area were to achieve technical efficiency of their most efficient counterparty. Majority of the telferia farmers, about 85.9 percent attained technical efficiency level of above 0.61. The implication of the results is that the technical efficiencies of all sampled telferia farmers are less than 1, as indicated on fig 4.1. This means that telferia farmers in the study area are producing below frontier. The result also indicates that, for an average telferia farmer to attend the technical efficiency level of his/her most efficient partner, they will realize about [1- (0.77/0.98) 100] which is 21.4 percent cost saving in garden egg production in the study area.

However, The results in figure 4.1. also indicate that technical efficiency index varied from one farmer to another and ranged from a minimum of 0.44 to a maximum of 0.99, with a mean of 0.75 for waterleaf farmers. The result also indicate that, for an average waterleaf farmer the technical efficiency level of his/her most efficient partner, they will realize about [1- (0.75/0.99) 100] which is 24.2 percent cost saving in waterleaf production in the study area. The result revealed that only 32 percent of waterleaf farmer attained between 0.9 -0.99 technical efficiency levels. Majority of the waterleaf farmers 82.66 percent attained technical efficiency level of above 0.61. The implication of the results is that the technical efficiencies of all sampled waterleaf farmers are less than 1, which implies that no farmer reached the frontier of production.

4.2.2.1 Allocative Efficiency of Garden egg farmers

The maximum likelihood estimate of the stochastic frontier cost function for garden egg farmers is presented in Table 4.6 as shown the estimated parameter of sigma squared is 0.004 and is statistically significant at 1 percent probability level. This indicate a good fit and correctness of the specify assumption of the Composite error term distribution. The

gamma estimate of 0.526 is also statistically significant at 1 percent level of probability. This means that 52.6percent variation in total cost of garden egg production is due to farmer's inefficiency. The generalised likelihood value was statistically significant at 1percent of probability implying that the Cobb-Douglas cost function is good representation of the data. The mean allocation efficiency of the garden egg farmer is 67percent. This means that the garden egg farmers are allocatively efficient. These imply that increases in output can be achieved if certain corrective measures (such as intensification of extension, it should be noted that it appeared that allocative efficiency contribute more to gains in economic efficiency than technical efficiency. This means farmers generally take good decisions as relate to resource allocation in cost minimization strategies.All the cost variables seeds, fertilizer, agrochemicals and labour has expected a priori signs and are statistically significant at 1% level of probability. This means that the total cost of producing garden egg can be increased with more output and as the quantity of seeds, labour, fertilizer and agrochemicals are used. This further means that if the quantity of garden egg output, seeds, fertilizer, labour and agrochemical used in garden egg production increases by 1%, the total cost of production increases by 0.66, 0.28, 0.031, 0.70, and 0.41 respectively. This means that labour cost is still a dominant cost in garden egg production as confirmed by Udoh (2012)

Table 4.6: Maximum likelihood estimate of the stochastic frontier cost function of garden egg farmers

Cost model	**Coefficient**	**Standard error**	**t-ratio**
Constant	2.423	0.203	11.73***
Output	0.066	0.021	2.965***
Cost of labour	0.702	0.012	57.876***
Cost of agrochemical	0.1298	0.417	1.194
Cost of seeds	0.028	0.009	3.140***
Cost of fertilizer	0.031	0.1174	4.100***
Variance Parameters			
Sigma squared	0.004	0.001	5.01***

Gamma	0.5267	0.0605	29.06 **
LR test	87.76		
log likelihood function	131.114		

Note: *** Significant at 1%, ** Significant at 5%, * Significant at 10%

4.2.2.2 Allocative Efficiency of telferia Farmers

The maximum likelihood estimate of the stochastic frontier cost function for telferia farmers is presented in table 4.7 as shown the estimated parameter of sigma squared is 0.091 and is statistically significant at 1 percent probability level. This indicate a good fit and correctness of the specify assumption of the Composite error term distribution. The gamma estimate of 0.497 is also statistically significant at 5 percent level of probability. This means that 49.7percent variation in total cost of telferia production is due to farmer's inefficiency. The generalised likelihood value was statistically significant at 1percent of probability implying that the Cobb-Douglas cost function is good representation of the data. The mean allocation efficiency of the telferia farmer is 72percent. This means that the telferia farmers are efficient in terms of allocative efficiency, with greater room for improvement. All the cost variables seeds, fertilizer, agrochemicals and labour has expected a priori signs and are statistically significant at 1% level of probability. This means that the total cost of producing telferia can be increased with more output and as the quantity of seeds, labour, fertilizer and agrochemicals are used. This further means that if the quantity of telferia output, seeds, fertilizer, labour and agrochemical used in telferia production increases by 1%, the total cost of production increases by 0.81, 0.78, 0.76, 0.98, and 0.32 respectively. This means that labour cost is still a dominant cost in telferia production as confirmed by Umoh (2014)

Table 4.7: Maximum likelihood estimate of the stochastic frontier cost function of Telferia farmer

Cost model	Coefficient	Standard error	t-ratio
Constant	3.122	0.352	14.53***
Output	0.814	0.172	3.341***
Cost of labour	0.981	0.07826	2.83***
Cost of agrochemical	0.321	0.1971	2.934***
Cost of seeds	0.0781	0.432	4.91***
Cost of fertilizer	0.0763	0.0984	5.75***
Variance Parameters			
Sigma squared (σ2)	0.091	0.032	6.58***
Gamma (γ)	0.497	0.184	32.21 **
LR test	9.87		
log likelihood function	98.97		

Note: *** Significant at 1%, ** Significant at 5%, * Significant at 10%

4.2.2.3 Allocative Efficiency of Waterleaf Farmers

The maximum likelihood estimate of the stochastic frontier cost function for telferia farmers is presented in table 4.8 as shown the estimated parameter of sigma squared is 0.071 and is statistically significant at 1 percent probability level. This indicate a good fit and correctness of the specify assumption of the Composite error term distribution. The gamma estimate of 0.780 is also statistically significant at 5 percent level of probability. This means that 22.0percent variation in total cost of waterleaf production is due to farmer's inefficiency. The generalised likelihood value was statistically significant at 1percent of probability implying that the Cobb-Douglas cost function is good representation of the data. The mean allocation efficiency of the waterleaf farmer is

75percent. This means that the waterleaf farmers are efficient in terms of allocative efficiency

Table 4.8: Maximum likelihood estimate of the stochastic frontier cost function of waterleaf farmers

Cost model	Coefficient	Standard error	t-ratio
Constant	2.987	0.284	12.64***
Output	0.672	0.195	4.500*
Cost of labour	0.791	0.0652	32.91*
Cost of agrochemical	0.541	0.1691	3.22***
Cost of seeds	0.29	0.511	2.13**
Cost of fertilizer	0.181	0.0654	2.43**
Variance Parameters			
Sigma squared ($\sigma 2$)	0.071	0.022	4.616***
Gamma (γ)	0.78	0.142	5.492 **
LR test	7.9		
log likelihood function	82.98		

Note: *** Significant at 1%, ** Significant at 5%, * Significant at 10%

4.2.2.4 Allocative Efficiency Distribution of Garden Egg, Telferia and Waterleaf Farmers

As shown in fig. 4.2, the mean allocative efficiency of garden egg farmers is 0.67 while the maximum value is 0.96 and minimum is 0.22. These implied that if the average garden egg farmers in the study area were to achieve allocative efficiency of their most efficient counterpart, then the average farmer could realize 51 percent cost savings i.e. {1– (0.67/0.96) x 100} A similar calculation for the most allocative inefficient farmer reveals cost savings of 77.1 percent {i.e., 1 – (0.22/0.96) x 100}. The allocative efficiency distribution shows that majority of the garden egg farmers in the study area (46.60) attained efficiency levels of 20 to 30 percent. Only about 48percent of the farmers attained efficiencies above 50 percent. Garden egg farmers are inefficient in allocating their resources in spite of having higher technical efficiencies. Therefore, only focusing on

technical efficiency would have is not enough to make maximal increase in output that would have been gotten by improving allocative efficiency also. To maximise output, there must be holistic improvement in efficiency.

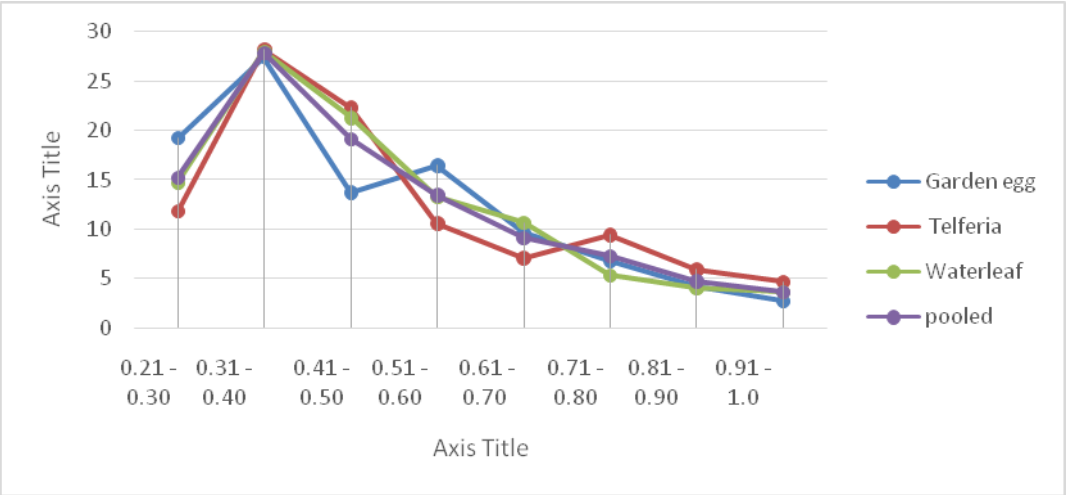


Fig 4.2: Distribution of Allocative Efficiency Indices of garden egg, telferia and Waterleaf Farmers

Furthermore, the mean allocative efficiency telferia farmers was 72 percent as presented in fig 4.2, the results indicate that the average telferia farmer will enjoy a cost savings of about 32 percent [1-(.68/1.00) x 100], if he/she attains the level of the most efficient farmer in the sample. The most allocative inefficient farmer will have an efficiency gain of 76 percent [1- (.24/1.00) x 100], if he/she is to attain the efficiency level of the most allocatively efficient farmer in the sample. The allocative efficiency distribution shows that majority of the telferia farmers (62.30 percent) attained efficiency level of less than 50 percent. Telferia farmers in the study area were fairly efficient in allocating their scarce resources in the production process at a given level of output the cost minimizing input ratio.

Figure 4.2 also shows that the allocative efficiency range between 20 percent to 100 percent with mean allocative efficiency was 0.74.the result indicate an average waterleaf farmer in the state will enjoy cost savings of about 26.0 percent [1- (0.74/1.00) x 100], if

he/she attains the level of the most efficient farmer among the respondents. The most allocatively inefficient farmer will require an efficiency gain of 77 percent [1- (0.23/1.00) x 100] in waterleaf production if he/she is to attain the efficiency level of the most allocatively efficient farmer in the state. About 37 percent of waterleaf farmers in the state have allocative efficiency of 50 percent and above. Waterleaf farmers in the state can be described as fairly efficient in allocating resources during production.

4.2.3 Economic Efficiency Level

The stochastic frontier Cobb-Douglas production function and cost function were used to estimate the technical and allocative efficiency of the three vegetables (garden egg, telferia and waterleaf) production respectively. Economic efficiency is the product of the first two functions. The frequency distribution of the three vegetables are as given below.

The economic efficiency estimates are presented in fig 4.3. It shows a range from 0.21 to 1.00 for garden egg production, the mean economic efficiency of garden egg farmers is 0.68. The estimates also show that for the average garden egg farmer to attain the level of the most economically efficient farmer, he/she will experience a cost savings of 32 percent [1 - (.68/1.00) x 100]. However, the least economically efficient garden egg farmer in the state will experience efficiency gain of 77 percent [1 - (.23/1.00) x 100] to attain the level of the most economically efficient farmer. The garden egg farmers in the state were economically inefficient as a result of allocatively inefficiency

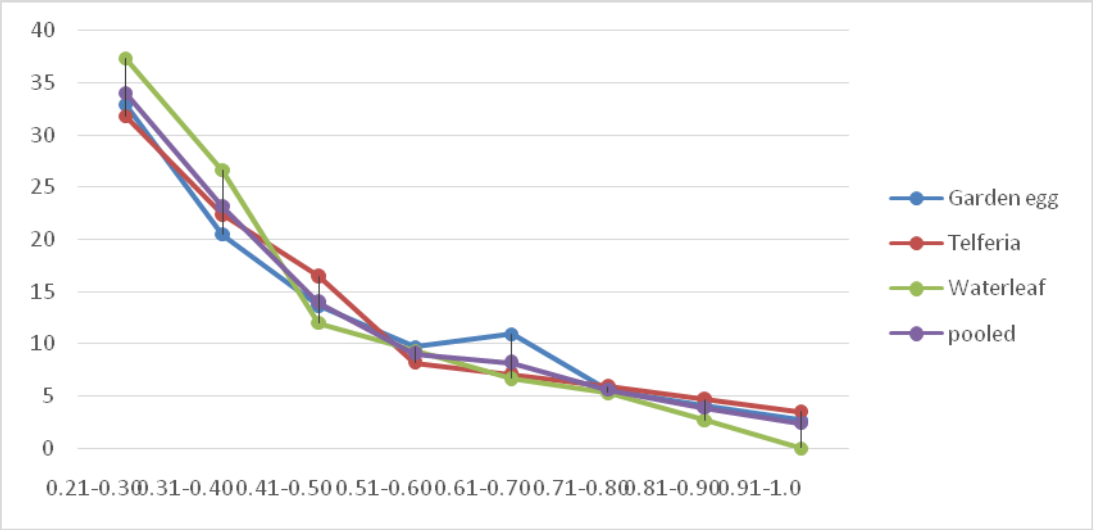


Fig 4.3: Distribution of Economic Efficiency Indices of garden egg, telferia and Waterleaf Farmers

Fig 4.3 also showed that there was presence of economic inefficiency in telferia production in the study area. About 75 percent of telferia farmers had economic efficiency less than 50 percent. This implies that less number of telferia farmers had economic efficiency level greater than 50 percent. The mean economic efficiency of the farmer is 0.25, and maximum economic efficiency of the farmer was 1.00. This means that if the average telferia farmers in the study area were to reach the economic efficiency level of his most efficient counterpart, then the average farmer could experience a cost savings of 28 percent [1 – (0.72/1.00) x 100]. The same computation for the most economically inefficient telferia farmer suggests a gain in economic efficiency of 75 percent {1 – (0.25/1.00) x 100}. It is evident from these results that economic inefficiency constitutes a more serious problem than technical and allocative inefficiencies in the study area.

The results showed that there was presence of economic inefficiency in waterleaf production in the study area (fig. 4.3). About 76 percent of waterleaf farmers had economic efficiency less than 50 percent. This implies that less number of waterleaf farmers (24 percent) had economic efficiency greater 50 percent. The mean economic efficiency of the farmer is 0.60, and maximum economic efficiency of the farmer was 0.89. This means that if the average telferia farmers in the study area were to reach the

economic efficiency level of his most efficient counterpart, then the average farmer could experience a cost savings of 32.5 percent [1 – (0.60/0.89) x 100]. The same computation for the most economically inefficient waterleaf farmer suggests a gain in economic efficiency of 75.3 percent {1 – (0.22/0.89) x 100}. It is evident from these results that economic inefficiency constitutes a more serious problem than technical and allocative inefficiencies in the study area

4.2.4. Elasticity of production and Return to Scale in Vegetable Production

The results in Table 4.9 show the elasticities of production and returns to scale in vegetable production in the study area. The estimated input elasticities of production for hired labour, family labour, farm size, fertilizer and agro-chemicals are less than 1, indicating that vegetable output increased less than proportionately with any increase in farm size, hired labour, family labour, fertilizer and agro-chemicals.

The sum of the elasticities of production of the five variable inputs were 2.0685 for garden egg, 2.0188 for telferia and 1.6885 for water leaf indicating increasing returns to scale. This means that an equal percentage increase in all the inputs showed positive relationship results in a greater percentage increase in output. This further goes to explain that there is an increasing return to scale in the area under study, implying that there will be increase in income of vegetables farmers which will enhance contribute to household poverty alleviation.

Table 4.9:Elasticity of Production and Return to Scale in vegetable Production

Elasticity of Production	**Garden egg**	**Telferia**	**Water leaf**
Hired labour	0.7457	0.2598	0.4627
Family labour	0.5561	0.3274	0.417
Farm size	0.0582	0.6912	0.5964
Fertilizer	0.0986	0.0656	0.0209
Seed	0.5176	0.5491	0.1214
Agro chemicals	0.0928	0.1257	0.1301
RTS	2.0685	2.0188	1.6885

4.2.5 Factor Influencing Technical, Allocative and Economics Efficiencies in Garden Egg, Telferia and Waterleaf

The inability of the vegetables under study to operate at their frontier could be as a result of some factors, which will include technicalproduction constraints and even socioeconomic factors. Udoh and Akintola (2011) had opined that in subsistence agriculture, scarce input might often be allocated to their various uses based on their marginal product, thus making it difficult for the farmers to operate on the efficiency frontier. On the other hand some socioeconomic characteristics can also affect the farmers' ability to use the available technology. It is on this basis that the farmers' characteristics on their efficiencies were determined.

4.2.5.1 Factors influencing Technical Efficiencies in Garden Egg Farmers

Table 4.10 provide the Maximum Likelihood Estimate of the influence of some socioeconomics Variables on technical efficiency of garden egg farmers in the study area.

Table 4.10: Maximum likelihood estimate of Factors Influencing Technical Efficiency Level of Garden Egg Farmers

Variables	Coefficient	Standard error	T- Ratio
Constant term	34.359	3.8268	8.98***
Age	-0.1359	0.0734	-1.85*
Education	0.6575	0.2467	2.67***
Gender	0.0802	0.3233	1.33
Farm experience	0.315	0.115	2.7400***
Extension visit	0.1173	0.0695	1.063
Access to credit	1.7579	0.3837	4.5800***
Mem. of cooperatives	0.2829	1.3477	0.2100
Household size	1.6109	0.3352	4.8100***
Farm size	0.9417	0.3383	2.7800***
Production system	2.07	1.0248	2.01**

*** Significant at 1%, **significant at 5%, * significant at 10%

The result reveals that coefficient of age carried the negative sign and age was significant at one per cent level. The negative relationship between age and efficiency implies that the older farmers are less efficient than the younger ones. This according to Nwara

(2011) isbecause younger farmers are able and willing to bear risk, be innovative and has the physically strength to do the manual farm work unlike the older farmer. Also Udoh (2013) had reported that the older farmers are less likely to have extension contact and therefore, less willing to adopt improve technology that would enhanced their technical efficiency. However, the result is at variance with that obtained by Idiong (2012), in rice production and also age was use as a proxy for experience. The coefficient of gender was not significant even at ten percent level.

On the other hand the coefficient of education, farm size, extension visit, access to credit, membership of cooperatives, household size, farming experience and production system were all positive, production system was not significant even at ten percent. Education and farm size were significant at five percent level.This impliesthat technical efficiency increases as these variables increases, also a high level of education results in an increase in technical efficiency of garden egg farmers, this is expected since the level of a farmers' education determines the level of his/her managerial competence. An educated farmer has the capacity to understand and adopt improve technology that would shift he/her production frontier ahead. The coefficient of farm size was also at five percent level of significant indicating that increasing farm size in garden egg production will significantly increase technical efficiency. Access to credit and farming experience were significant at one percent level of significant, these shows that increase in experience in garden egg production would increase technical efficiency. Farmers' experience could be associated with skill accumulation which could enhance productivity and resource allocations thereby reduce technical inefficiency. The significant of the access to credit also implies that garden egg farmers' access to credit will positively influence his/her technical efficiency, since it will remove the constraints of timely acquisition and use of improve production inputs.

The coefficient of the extension visit though positive, was not significant this may be as a result of non-regularity of the extensions visit to the farmers as was observed in the area, where they were regular visits farmers also complained of high cost of the improve technology. Membership of cooperative and household size were at ten percent level of significant, the implication of this is that garden egg farmers who have large household sizes are more technically efficient. This may be due to farmers access to family labour because as the number of people in a household increases, a pool of family labour becomes available and this could lead to specialization. Also membership in cooperatives affords the farmers opportunities of interacting with one another, thereby exchanging information on improve technology in garden egg production.

4.2.5.2: Factors Influencing Technical Efficiencyof Telferia Farmers

The results in Table 4.11 show the influenced of some socioeconomic variables on technical efficiency oftelferia farmersin the study area. The study revealed that age of the farmer was negative and significant at 10 percent. This implies that as the age of farmer increases technical efficiency also decreases. This may be due to the fact that the older the farmer the less the willingness to take risk and try innovation that may increase telferia output. Also older farmers are less receptive to innovation unlike younger farmers.

Table 4.11: Maximum Likelihood Estimate of Factors Influencing Technical Efficiency Level of Telferia Farmers

Variable	Coefficient	Standard Error	t- ratio
Constant term	2.613	0.16787	0.34
Age	-0.1359	0.0734	-1.92*
Education	0.31611	0.1382	2.17**
Gender	1.8689	1.0564	1.80*
Farm experience	0.5162	0.2151	2.81***
Extension visit	0.1173	0.4379	1.2
Access to credit	0.9042	0.3184	2.90***
Mem. of cooperatives	0.428	0.1352	3.17***
Household size	0.8654	0.3247	2.63***
Farm size	0.9004	0.3383	2.78***
Production system	2.21	1.244	2.32**

*** Significant at 1%, **significant at 5%, * significant at 10%

Years of education and other variables showed a positive relation with technical efficiency, this implies that an increase in these variables leads to an increase in the technical efficiency level of telferia farmers in the area. Education is significant at five percent level for the telferia farmers, and the positive coefficient of education reveals that a high level of education results in a reduction in technical inefficiency of telferia farmers thereby increasing their efficiency. The coefficient of farm size was also at five percent level of significant indicating that increasing farm size in telferia production will significantly increase technical efficiency. The coefficient of the extension visit though positive, was not significant this may be as a result of non-regularity of the extensions visit to the farmers as was observed in the area, where they were regular visits farmers also complained of high cost of the improve technology. Access to credit and farming

experience were significant at one and five percent level of significant, these shows that increase in experience in telferia production would increase technical efficiency.

Membership of cooperative was positive and significant at 0ne percent level for telferia farmers. The implication is that membership of association increases technical efficiency in the production of telferia. Cooperative association organize training for members on new innovation as well as inputs usage.

Furthermore, farmer experience was also positive and significant at five percent, this implies that experience increase technical efficiency. This suggests years of experience of the farmers are an important factor for attaining a higher level of technical efficiency, which will further increase the farmer's income and will alleviate poverty. Production system and gender were positive and only gender was atten percent significant level.

4.2.5.3: Factors Influencing Technical Efficiency of Waterleaf Farmers

The results in Table 4.12 show the influence of some socioeconomics variables on the technical efficiency level of waterleaf production in Akwa Ibom State. It was revealed that most of these variables (farm size, education, access to credit, extension contact) of the farmer was positive and significant. These imply that as these variables has a positive relationship with technical efficiency, and an increases in them will result in an increase in the technical efficiency level of waterleaf farmers in the area of study. On the other hand ageof farmer is negatively related to technical efficiency, this implies that older waterleaf farmers turn to stay away from innovations and technology that can increase their technical efficiency. This may be due to the fact that the older the farmer the less the willingness to take risk and try innovation that may increase waterleaf output. Also older farmers are less receptive to innovation unlike younger farmers.

Table 4.12: Maximum Likelihood Estimate of Factors Influencing Technical Efficiency Level of Waterleaf Farmers

Variable	Coefficient	Standard Error	t- ratio
Constant term	3.2145	1.9867	5.998***
Age	-0.5532	0.1876	-1.92*
Education	0.6575	0.2467	2.67***
Gender	1.1102	0.5673	1.4510
Farm experience	0.2151	0.604861	2.812***
Extension visit	0.1173	0.0695	1.063
Access to credit	1.432	0.3982	4.6750***
Mem. of cooperatives	0.2952	1.4016	0.3198
Household size	1.6109	0.3352	4.759***
Farm size	0.9417	0.3383	2.7800***
Production system	2.29	1.1501	2.307**

*** Significant at 1%, **significant at 5%, * significant at 10%

Years of education showed a positive relationship with technical efficiency and are significant at 5% level. The positive coefficient of education reveals that a high level of education results in a reduction in technical inefficiency of waterleaf farmers. This implies that the level of a farmers' educational attainment increases the level of technical efficiency.

Experience in waterleaf production was positive and significant at 5 percent. This shows that increase in experience in waterleaf production would increase technical efficiency. Farmers' experience could be associated with skill accumulation which could enhance productivity and technical skills thereby reduce technical inefficiency.

Household size showed a positive relation with predicted technical efficiency and is significant at 5 percent level. The implication of this is that waterleaf farmers in Akwa Ibom State with large household sizes are more technically efficient. This may be due to

farmers access to family labour because as the number of people in a household increases, a pool of family labour becomes available and this could lead to specialization. Membership of cooperative was positive andsignificant at one percent level for farmers; the implication of this is thereduction of technical inefficiency in waterleaf production. Cooperative association organize training for members on new innovation as well as inputs usage. Furthermore, farmer accessibility to credit was positive with one percent significant and this implies that access to credit facility was found to reduce technical inefficiency. This suggests that availability of credit is an important factor for attaining a higher level of technical efficiency, by making use of credit to purchase needed inputs and new technological innovations.

On the other hand farm size, gender and production system were positive and the later was not significant even at ten percent level while farm size, and gender were significant at five and ten percent level of significant. This implies that technical efficiency is positively influenced by farm size.

4.2.6.1 Factors Influencing Allocative Efficiency of Garden Egg Farmers

Table 4.13 shows results of influence of some socioeconomic factors on garden egg farmers' allocative efficiency. The results indicate household size and gender carried negative sign and only household size was significant at ten percent level, while the coefficient of education, farm experience, extension contact and membership of cooperative were positive and significant at five percent level, this implies that these socioeconomic factors has positive relationship with allocative efficiency of garden egg farmers in effect an increases in them will increase garden egg farmers allocatve efficiency.Age was positive and significant at ten percent level, showing that older farmers are more efficient in allocating their resources than the younger ones. Farm size and production system were both positive but not significant even at ten percent level.

Table 4.13: Maximum Likelihood Estimate of Factor InfluencingAllocative Efficiency of Garden egg Farmers

Variable	Coefficient	Standard Error	t- ratio
Constant term	2.7543	0.9867	1.968*
Age	0.7253	0.3935	1.79*
Education	2.7041	0.6754	2.83***
Gender	-0.1296	0.7908	-0.16
Farm experience	0.3421	0.4318	2.32**
Extension visit	0.1173	0.6928	1.34
Access to credit	1.392	0.3092	3.814***
Mem. of cooperatives	0.7354	0.5387	1.15
Household size	-0.1898	0.0792	- 2.21**
Farm size	0.4793	0.3125	1.89*
Production system	3.901	1.001	2.19**

*** Significant at 1%, **significant at 5%, * significant at 10%

4.2.6.2 Factors influencing the Allocative Efficiencies ofTelferia Farmers

The results in Table 4.14 show the estimates of the allocative efficiency model for telferia farmers. It was revealed that farmers' age was positive and significant at fivepercent. This implies that increase in age would increase allocative efficiency. It means that older farmers are more allocatively efficient in the use of resources and cost reduction of the inputs. It could be attributed to the fact that older farmers tend to be more efficient in financial expenditure that could increase their allocative efficiency.

Table 4.14: Maximum Likelihood Estimate of Factors Influencing the Allocative Efficiency Level of Telferia Farmers

Variable	Coefficient	Standard Error	t- ratio
Constant term	4.3951	1.8268	0.9512
Age	3.113	1.4213	2.340**
Education	1.5612	0.9128	1.430
Gender	0.9815	0.4319	0.292
Farm experience	0.7619	0.319	1.97*
Extension visit	0.1392	0.4923	1.69*
Access to credit	1.1929	0.3791	2.95***
Mem. of cooperatives	0.3298	1.281	1.33
Household size	-0.4211	0.0325	-2.01**
Farm size	0.8591	0.3417	1.72*

Production system	2.741	1.102	3.02***

*** Significant at 1%, **significant at 5%, * significant at 10%

The estimated coefficient of education was positive and significant at five percent. The positive coefficient for education means that allocative efficiency increases as this factor increases. This implies that educational attainment is very important in allocative efficiency in telferia production. The estimated coefficient for gender and household size was negative and not significant even at 10 percent, these variables have a negative relationship with farmers allocative efficiency;Experience among the farmers carries a positive sign and was significant at five percent. This shows that increase in experience in telferia production would increase efficiency. A rise in farming experience could enhance the skill of the farmers which in turn increase their efficiency.

Extension contact and access to credit carries positive sign and were both significant at one percent level, which implies these factors increase farmer's allocative efficiency. Year of cooperative membership had positive sign and is statistically significant at five percent level of probability; this means that it increases allocative efficiency. The longer the years of cooperative, the lesser the farmer's allocative inefficiency, as they organize training for farmer's capacity building in skills acquisition.

Farm size was positive and statistically significant at ten percent level of probability, and the coefficient of production system was negative and not significant even at ten percent. On the other hand gender shows a negative relationship with allocative efficiency, this means that the garden egg farmers who are mostly females has less allocative knowledge, that cannot allocate the scares resources appropriately for a better output.

4.2.6.3 Factors influencing the Allocative Efficiencies of Waterleaf Farmers

The results in Table 4.15 show the estimates of the allocative efficiency model for waterleaf farmers. It was revealed that farmers' age was positive and statistically significant at onepercentlevel. This implies that increase in age would increase allocative

efficiency, and means there is a positive relationship with allocative efficiency of waterleaf farmers. This further explain that older farmers are more allocatively efficient in the use of resources and cost reduction of the inputs. It could be attributed to the fact that older farmers tend to be more efficient in financial expenditure that could increase their allocative efficiency.

The estimated coefficient of education was positive and significant at five percent level. The positive coefficient for education implies that allocative efficiency increases as this factor increases. This implies that educational attainment is very important in allocative efficiency of production.

Table 4. 15: Maximum Likelihood Estimate of Factors Influencing Economic Efficiency Level of Garden egg Farmers

Variable	**Coefficient**	**Standard Error**	**t - ratio**
Constant term	3.1832	2.2411	2.97***
Age	2.4216	1.1213	2.51***
Education	1.3271	0.9163	3.82***
Gender	-0.1332	0.2451	-0.353
Farm experience	2.2751	0.8291	2.84***
Extension visit	0.6312	0.4431	1.62
Access to credit	0.5254	0.2872	2.37**
Mem. of cooperatives	0.6113	0.4956	1.89*
Household size	0.3192	0.1937	2.61***
Farm size	0.1723	0.7344	1.833*
Production system	1.4983	1.3254	2.67***

*** Significant at 1%, **significant at 5%, * significant at 10%

Experience in waterleaf production was positive and significant at five percent level. This shows that increase in experience in waterleaf production would increase allocative efficiency. Gender showed a negative relation with allocative efficiency and was not even significant at ten percent level.Year of cooperative membership had positive sign and is statistically significant at five level of probability; this means that it increases allocative efficiency therefore, longer the years of cooperative the better the farmers' allocative efficiency.

Extension contact and access to credit had positive and statistically significant at one and five percent probability respectively, these imply that access to extension and credit increases allocative efficiency. Production system was also positive but not significant even at ten percent probability level.

4.2.7.1 Factors influencing Economic Efficiencies of Garden Egg Farmers

The results presented in Table 4.16 show the influence of some socioeconomic factors on the economic efficiency in garden egg production in the study area. Theresults revealed that the coefficient of age, farming experience and extension contact were positive and significant at 5 percent. This implies that the older a farmer becomes, the more he/she is able to combine his/her resources in an optimal manner given the level of available technology. The more the experience farmers acquired in garden egg production the more they are economically efficient, this is because experience would help farmers in decision making process with respect to resource allocation as a result of skill accumulation in production business. That of extension contact implies that there is a positive relationship between contact and economic efficiency that is increase in extension contact will increase economic efficiency level of the farmers, through the dissemination of vital information that can impact positively on yields and income.

Education was positive and statistically significant at one percent level. The implication of this is that education increased economic efficiency among garden egg producers in the study area. Education is important in skill enhancement and technical competency. This might influence farmers' production management techniques in resource utilization. The result also revealed that access to credit was positive and statistically significant at one percent level, this implies that farmer's access to credit enhanced economic efficiency. The estimated parameters for membership of cooperative and farm size were positive and significant at tenpercentlevel; this shows that these socio economics factors

increases economic efficiency of garden egg farmers. Gender and production system were negativeand statistically significant at 10 percent level.Male farmers are said to be more economic efficient than their female counterpart, the reasons are given the labour intensive nature of garden egg production, the male will contribute to family labour and also coordinate the household and take good economic decisions.

Table 4.16: Maximum Likelihood Estimate of Factors Influencing Economic Efficiency in Garden Egg Farmers

Variable	Coefficient	Standard Error	t- ratio
Constant term	0.5686	0.3459	1.64
Age	1.7808	0 .84147	1.89*
Education	0.6301	0.2125	1.92*
Gender	-0.2197	0.1851	-1.24
Farm experience	0.0869	0.0378	2.30**
Extension visit	0.0875	0.1215	1.72*
Access to credit	1.684	0.3919	4.29***
Mem. of cooperatives	0.0157	0.847	1.19
Household size	5.632	1.7245	3.07***
Farm size	0.4952	0.2012	1.42
Production system	-5.632	1.7245	3.27***

*** Significant at 1%, **significant at 5%, * significant at 10%

4.2.7.2 Factor Influencing Economic Efficiencies of Telferia Farmers

The results of the analysis on Table 4.17 showed that the coefficient of age of the farmers, farming experience, extension access and access to credit were positive and significant at five percent level of probability. This implies thatthese socioeconomic factors have positive influence on economic efficiency amongst the farmers sampled; older farmers managed their resources more efficiently than younger farmers, this will enhances their income levels. Education was positive and statistically significant at one

percent level. The implication of this is that education increased economic efficiency among telferia farmers in the study area. Education is important in skill enhancement and technical competency. This might influence farmers' production management techniques in resource utilization.

However, the coefficient of membership of association was significant at ten percent level and carried a positive sign. Gender, household size and production system were not significant even at ten percent level, only household size was positive. Farm size was also positive but not significant even at ten percent.

Table 4.17: Maximum Likelihood Estimate of Factors Influencing Economic Efficiency in Telferia Farmers

Variable	Coefficient	Standard Error	t - ratio
Constant term	2.1271	0.7807	2.97***
Age	0.7015	0.0434	1.65*
Education	0.9656	0.1208	7.959***
Gender	-0.0435	0.0437	0.996
Farm experience	0.0911	0.044	2.09**
Extension visit	0.0505	0.0518	1.97*
Access to credit	0.2212	0.087	2.54***
Mem. of cooperatives	0.0115	0.0327	1.42
Household size	0.0627	0.0253	0.981
Farm size	0.452	0.25	1.81*
Production system	-1.8376	0.4919	0 .736

*** Significant at 1%, **significant at 5%, * significant at 10%

4.2.7.3 Factors Influence Economic Efficiencies in Waterleaf

The results presented in Table 4.18 show how socioeconomic factors influences economic efficiency of waterleaf production in the study area. The results revealed that the coefficient of age was positive and significant at five percent. This implies that the older a farmer becomes, the more he/she is able to combine his/her resources in an optimal manner given the level of available technology. Education,experience in

waterleaf production and extension contact was positive and significant at one percent for waterleaf farmers in the area. The implication of this is that education increased economic efficiency among waterleaf producers in the study area.

Table 4.18: Maximum Likelihood Estimate of Factors Influencing Economics Efficiency in Waterleaf Farmers

Variable	Coefficient	Standard Error	t- ratio
Constant term	3.2677	0.6825	2.88***
Age	0.3019	0.0265	1.374
Education	0.0889	0.0382	2.329**
Gender	0.2521	0.3713	0.676
Farm experience	0.0822	0.0325	2.528***
Extension visit	0.2402	0.0318	4.563***
Access to credit	0.6459	0.3318	1.949*
Mem. of cooperatives	0.8705	0.3084	2.82***
Household size	-0.5543	0.0814	6.8095**
Farm size	-0.3866	0.5589	0.6971
Production system	-2.3462	0.5007	4.6301***

*** Significant at 1%, **significant at 5%, * significant at 10%

Education is important in skill enhancement and technical competency. This might influence farmers' production management techniques in resource utilization. This also implies that the more the experience farmers acquired in waterleaf production the less the economic inefficiency, this is because experience would help farmers in decision making process with respect to resource allocation as a result of skill accumulation and better economic decisions in waterleaf production business.

The estimated parameters for membership of cooperative were positive and significant at five percent for waterleaf farmers. Access to credit was positive and significant**; t**his shows the importance of farmers' access to credits,this can impact positively on yields

and income. Gender and farm size carry positive sign but were not significant even at ten percent, also household size and production system were negative and significant at five and one percent level of significant respectively, this shows that household size is inversely and significantly related to economic efficiency. Since the waterleaf farmers in the area of study operate small size farms and utilize more of family labour, they will always pay more to paid labour, wages that are more than their marginal product values and therefore would be economically inefficient due toallocative inefficiency.

4.3 Profitability Level of Vegetable Farmers

The results in Table 4.19 show the returns and costs associated with vegetable (garden egg, telferia and waterleaf) production per hectare. The total variable cost (TVC) amounted to ₦58,741.16 for garden egg, ₦74,761.35 for telferia and ₦50, 248.75 for waterleaf. Total fixed cost (TFC) for garden egg was ₦24,340.57, ₦29,780.94 for telferia and waterleaf had ₦19,889.37. The estimated Gross returns were ₦205,882.60,₦275,500.68 and ₦192,903.80 for garden egg, telferia and waterleaf respectively. Net farm income was ₦122,800.87 for garden egg, ₦170,958.39 for telferia and ₦ 122,765.68 for waterleaf production per hectare respectively, which imply that vegetable Production is profitable in the study area.

Average rate of return obtained was ₦1.48, ₦1.64, and ₦ 1.75 for respectively. This implied that on every ₦1 invested on garden egg production, there was a return of 48 kobo, for telferia production there was a return of 64 kobo on every N1 invested and also there was a return of 75 kobo on every ₦1 invested for waterleaf production. The high returns for waterleaf production is probably attributable to factor like easy propagation, resistance to pest and disease infestation and large market. Generally vegetable production is a very profitable agricultural enterprise in the study area. This result agrees

with the finding of Mbanasor *et al.* (2012) who confirmed that vegetable production is profitable businesses.

Table 4.19 Costs and Returns in Vegetable Production (₦/Ha)

Variable inputs	**Garden egg**	**Telferia**	**Waterleaf**
Seed (kg)	6783.85	7650.65	6169.08
Labour (man-day)	32820.75	44650.7	28868.47
Fertilizer (kg)	16808.73	19584.45	13266.22
Agro-chemical	2327.83	2875.55	1944.23
Total Variable Cost	58741.16	74761.35	50248.75
Land Rent	12190.57	11385.85	7369.37
Depreciation on fixed item			
Farm tools	850	830	720
Total Fixed Cost	24340.57	29780.94	19889.37
Total Cost	83081.73	104542.3	70138.12
Output (₦/ha) Gross return	205882.6	275500.7	192903.8
Net Farm Income	**122800.9**	**170958.4**	**122765.7**
R of R on Investment (%)	**1.48**	**1.64**	**1.75**

4.4 Estimation of the Poverty Line and Poverty Status

The poverty line used for this study was calculated from the monthly MAHE of the sampled households. A poverty line of ₦4,560.00 based on the prices, is two-thirds of the MAHE, and was expected to meet the monthly minimum basic requirements (food and non-food) of an adult in the study area. Households with a MAHE below this poverty line were classified as poor, while those with a higher MAHE were classified as being non poor. Based on this poverty line, 24.12, 20.17 and 21.71 percent of the households producing garden egg, telferia and waterleaf respectively were classified as poor while 75.88, 79.83 and 78.29 percent of the three vegetables were classified as non-poor.

Table 4.20: Poverty Gap Index

	Garden egg	Telferia	Waterleaf
Expenditure	3460	3640	3570
Poverty Gap	1100	920	990
G/z	24.12	20.17	21.71

Calculating the Poverty Gap Index, with a poverty line of ₦4,560

This measure is the mean proportionate poverty gap in the producers of garden egg, telferia and waterleaf are 24.12 percent, 20.17 percent and 21.71 percent respectively, (where the Non poor have zero poverty gaps). The above result also shows clearly the gap that existed and the subsequent results will now show the contributions of the various vegetables to poverty alleviation in the study area have assisted to close the gap. Some people find it helpful to think of this measure as the minimum cost of eliminating poverty (relative to the poverty line), because it shows how much would have to be transferred to the poor to bring their incomes or expenditures up to the poverty line (as a proportion of the poverty line).The minimum cost of eliminating poverty using targeted transfers is simply the sum of all the poverty gaps in a population; every gap is filled up to the poverty line. However, this interpretation is only reasonable if the transfers could be made perfectly efficiently, for instance, with lump sum transfers, this is implausible. Clearly, this assumes that the policy maker has a lot of information; At the other extreme, one can consider the maximum cost of alleviating poverty, From the form of the index, it can be seen that the ratio of the minimum cost of alleviating poverty with perfect targeting (that is, Gi) to the maximum cost with no targeting (that is, z, which would involve providing everyone with enough to ensure they are not below the poverty line) is

simply the poverty gap index. Thus, this measure is an indicator of the potential savings to the poverty alleviation budget from targeting: the smaller the poverty gap index, the greater the potential economies for a poverty alleviation budget from identifying the characteristics of the poor using survey or other information so as to target benefits and programs.

The headcount index (P0) measures the proportion of the population that is poor. It is popular because it is easy to understand and measure. But it does not indicate how poor the poor are. The poverty gap index (P1) measures the extent to which individuals fall below the poverty line (the poverty gaps) as a proportion of the poverty line. The sum of these poverty gaps gives the minimum cost of eliminating poverty, if transfers were perfectly targeted. The measure does not reflect changes in inequality among the poor

Table 4.21: Nutritional (calorie-based) equivalent scales

Years of age	Male	Female
0–1	0.27	0.27
2–3	0.45	0.45
4–6	0.61	0.61
7–9	0.73	0.73
10–12	0.86	0.78
13–15	0.96	0.83
16–19	1.02	0.77
20 and above	1	0.73

Source: FBS (2016).

4.4.1 Measuring the Standard of Living

The standard of living of households in the study area were measured based on the expenditure of the household's producers of garden egg, telferia and waterleaf. The household expenditure was converted into per capita expenditure by dividing it by the number of members of the household. This was further converted into adult equivalents based on the nutritional requirement, sex, and age of household members, using the nutrition-based adult equivalent scales provided by FBS (2012) shown in Table 4.29 By

multiplying the nutrition equivalent scales by the number of household members that fall in any of the age-by-sex categories, the monthly mean/adult equivalent household expenditure (MAHE) for the sampled households was calculated.

4.4.2 Households' Asset Ownership

Hassan and Babu (2011) have found that the level of asset ownership in a household is an indication of its endowment and provides a good measure of household resilience in times of food crisis, resulting from famine, crop failures, or natural disasters. This is because a household can easily fall back on its assets in times of need by selling or leasing them. Table 4.30 presents the assets owned by garden egg, telferia and waterleaf farmers households covered in the study. Radios/television sets were the most common asset owned by households, followed by motorcycles and mobile phones. This is indicative of improved economic welfare among the households. The small proportion of households that owned sewing machines and in all of these there was no improved equipment in the area, these suggests that most farming households did not practice mechanized or semi mechanized farming. Instead, they still relied on hand implements in their farming activities.

Table 4.22: Percentage Distribution of Households' Asset ownership

Asset	Garden egg	Telferia	Waterleaf	Average
Radio/TV sets	21	28.2	27.1	25.8
Mobile phones	15.3	15.9	18	16.7
Extra land	18.6	16.3	14.7	16.2
Bicycles	21.9	15.1	14.4	16.5
Motor cycles	12	19	19	17.2
Sewing machines	6.3	3.2	5.5	5.1
Motor vehicles	4.6	2.2	1.4	2.5
Others (guns, etc.)	0.2	0	0	0.1

Total	100	100	100	100

4.4.3 Contribution of Vegetable Production to Poverty Alleviation

Based on the poverty status classification using the PCA and WI approach described earlier, the incidence of poverty follows the vegetable production potential of the different farmers' production potential waterleaf the highest poverty incidence. Telferia producers have the lowest poverty incidence followed by the garden egg producers.

Table 4.23: Income per month from Vegetables Production

Income sources	**Amount**			
Vegetables income received per season	< ₦20,000	> ₦20,000	< ₦20,000	> ₦20,000
Garden egg	18 (24.66)	55 (75.34)	65 (86.67)	8(10.96)
Telferia	22 (25.89)	63 (74.12)	70 (82.4)	15(17.64)
Waterleaf	15 (20.00)	60 (80.00)	68(90.67)	7(9.33)

Table 4.23 presents the proportion of the income that is due to vegetables producers in the study area and it also presented the contribution of vegetables to income of the participating farmers and the extent to which they alleviate poverty can be inferred. Most about (75.34 percent) of the farmers were in the income category of ₦ 20, 000 and above, for the garden egg farmers. Telferia farmers' contribution was 74.12 percent above ₦20,000 to alleviate poverty, also the waterleaf farmers contribution to income was 80 percent. It is noteworthy however that for all income categories, the least proportion of contribution by vegetables was 20 percent. This implies that vegetables are major sources of income among the respondents. Similarly, for all categories of income a greater

proportion of the farmers had more than 50% contribution from vegetables to their income, contribution from other sources had greater percentage from less than 20,000 category meaning that there is greater dependency on vegetable production. Shei (2008) noted that although vegetables are not well known and documented, the few that have been identified and analyzed within the scope of the current research prove to have profound nutritional, economic and medicinal potential which if well exploited would possibly open up new markets for the global commercialization of vegetables likewise, encourage the local and global cultivation, consumption and conservation of many other n vegetables, especially those which are presently facing the threat of extinct. The production of vegetables in the area can be said to contribute more than 50 percent to income and this contribution has been able to alleviate poverty, this can be seen in the results of income contribution. The proportion of vegetables to farmers' income is significant and thus the inference that they help alleviate poverty. Their commercialization in the domestic markets would result in raising the standard of living of those involved in it trading activities, in both the rural and urban centres. It is clear that through the volume of production each season; these vegetables will strongly contribute to income thus help alleviate poverty by increasing the disposable income available to farmers.

4.5 Constraints Encountered by Vegetable Farmers in Akwa Ibom State

The results in Table 4.24 revealed the constraints faced by vegetable farmers in the study area. As, shown in the table, the constraints were ranked in order of priority. About 41.10 percent of garden egg farmers, 41.18 percent of telferia farmers and 50.67 percent of waterleaf farmers had problem of storage and this problem was ranked first among the constraints facing the farmers while it was first can be attributed to the perishable nature of the product Poor storage could increase post-harvest losses, it could also reduce quality

and quantity of vegetable thereby reduce the market gain of the farmers. The problem of storage is rank first because of the perishable nature of the product and also it can readily affect the income of the farmers negatively and by implication increase in poverty instead of alleviating.

Transportation is also a major problem confronting garden egg farmers and telferia farmers in the study area. About 38.36 percent of garden egg farmers and 35.29 percent of telferia farmers had this problem. This was ranked second among the constraints faced by these farmers while it was third constraint among the problem faced by waterleaf farmers. This problem mostly occurs at harvest time due to bad roads this can alsoincrease production cost, which will decrease the profitability or even wipe out. Vegetable production without outlet to markets is detrimental to the alleviation of poverty because without sales income cannot be achieved.

Paste and disease was also noted by the farmers among the constraints limiting their production. About 27.40 percent of garden egg farmers and 12.94 percent of telferia farmers had this problem which was rank fourth and fifth respectively. This problem was ranked sixth among the constraints facing water leaf farmers, vegetable needs to be good to attract the buyer, in the case of the three vegetables any attempt of neither pest nor disease render it not marketable and the farmer will be running at a loss. The occurrence of these can also be handling depending on the intensity and this will increase the production cost.

High cost of fertilizer is another major constraint facing vegetable production in the study area, as it ranks fourth, third and second among garden egg, telferia and waterleaf farmers respectively with 27.40 percent, 30.59 percent and 32.00 percent. Lack of fertilizer will affect the output negatively so it’s a necessity, but the high cost increases the cost of production and by implication the farmers’ income.

Poor price is also a major problem confronting garden, telferia egg and waterleaf farmers in the study area. About 24.66 percent of garden egg, 12.94 percent of telferia and 13.33 percent of waterleaf farmers had this problem. This was ranked fourth amongthe constraints faced by telferia and waterleaf farmers while it was fifth constraint among the problem faced by garden egg farmers. This problem mostly occurs at harvest time due to glut that reduces market price, and also the farmers' income, the problems discussed is the main determinants of the farmers' output and income if not properly managed. Middlemen are not paying prices that are attractive enough to keep the farmersproducing

Table. 4.24: Constraints encountered by Vegetable farmers.

Constraint	Garden egg freq	Ranking	Telferia Freq	Ranking	Waterleaf freq	Ranking
Pest & disease	20(27.40)	4	10(11.76)	5	03 (4.00)	6
Transportation	28(38.36)	2	30(35.29)	2	23 (30.67)	3
Poor Price	18(24.66)	5	11(12.94)	4	10(13.33)	4
Market	12(16.44)	8	05(5.90)	8	04 (5.33)	5
Storage problem	30(41.10)	1	35(41.18)	1	38(50.67)	1
Poor yield	15(20.55)	6	02(2.35)	9	01(1.33)	8
Bad seeds	21(28.77)	3	07(8.24)	7	02(2.67)	7
Cost of fertilizers	26(30.59)	4	24(32.00)	2		
Germination failure	13(17.81)	7	01 (1.33)	8		

Figures in parenthesis (percentage). Multiple response was allowed

4.6 Test of Hypotheses

The log likelihood ratio test (LR) was used to test the three stated null hypotheses. The generalized likelihood ratio test at 1% level of significant rejects the three stated null hypotheses (H_o), and thus accepts the alternative (H_A) Table 4.27). This thus confirms that:

i. Vegetable farmers in Akwa Ibom State are not allocatively, technically and economically efficient.

ii. Vegetable production is not efficient,

iii. Socio-economic and institutional characteristics of vegetable producers has no significant influence in productivity efficiency and

iv. Vegetable production in Akwa Ibom State is profitable.

This reveals that there is technical, economic inefficiency in vegetable production in the state

Table 4.25: Log-likelihood ratio test (LR)

Null hypotheses		**λ**	***Critical value**	**Decision**
Efficiency model(TE)				
H_0 λ = 0	Garden egg	21.66	11.91	Reject H_0
	Telferia	23.83	11.91	Reject Ho
	Waterleaf	26.28	11.91	Reject Ho
Efficiency model(EE)				
	Garden egg	87.90	11.91	Reject Ho
	Telferia	102.31	11.91	Reject Ho
	Waterleaf	98.87	11.91	Reject Ho
H_0 λ = 0				

* Critical value is significant at 1% level of probability

CHAPTER FIVE

SUMMARY, CONCLUSION AND RECOMMENDATIONS

5.1 Summary

The study evaluates the technical, allocative and economic efficiency of vegetable production and its contribution to household poverty in Akwa Ibom State of Nigeria.Specifically,socio-economic characteristics of the farmers in the study area were described, level of technical, allocative and economic efficiencies of the various vegetable were estimated.The determinants of technical, allocative and economic efficiency of production of the three vegetables were determinedand its profitability of level. The poverty statue of the farmers was determined, also the contribution of vegetable in alleviating it.

Multi-stage sampling technique was employed in selecting the respondents. Primary data for the study were collected using structured questionnaire, administered to 73 garden egg, 85 telferia and 75 waterleaf farmers during the 2014 vegetable production season.Analytical tools such as mean, standard deviation, percentages and frequency tables were used in analyzing the socioeconomics characteristics of the farmers. Stochastic frontier Cobb Douglas using maximum likelihood estimate technique was also used in estimating the technical, economic and allocative efficiencies of the farmers producing the three vegetables under study. The same likelihood technique was used to

determine the effect of farmers' socioeconomics characteristics on their efficiency. A generalized likelihood ratio test was used to test the hypothesis of the null technical, allocative and economic efficiencies in the production of garden egg, telferia and waterleaf respectively. Cost and return functions and Gross Margin was used in the profitability analysis.

Results of the study indicated that about 82 percent, 80 percent and 85 percent of garden egg, telferia and waterleaf famers respectively were within 22-60 years. The average age was 40, 44 and 38 years for garden egg, telferia and waterleaf farmers. Majority of the vegetable farmers had farm size less than two hectares, about 73, 70 and 69 percent of garden, telferia and waterleaf farmers had farm size less than two hectares respectively. About 85, 73 and 72 percent had primary and secondary education for irrigated garden egg, telferia and waterleaf farmers.

The result also indicated that most of the vegetable farmers were female, garden egg farmers had 57 percent female, telferia 56 percent females and waterleaf had 55 percent. Majority of the vegetable farmers had access to extension only once a year, garden egg farmers about 68.49 percent, telferia 68.88 percent and waterleaf 64 percent. Also, the result of Maximum Likelihood Estimates (MLE) for the production showed that the estimated coefficient for farm size for garden egg, telferia and waterleaf were positive and statistically significant at five, one and one percent level of probability respectively. The estimated parameter of hired labour for garden egg was positive and significant at five percent, the coefficient for hired labour for telferia was positive significant at onepercent and that of waterleaf was also positive and significant at one percent probability level. The coefficient of family labour for garden egg, telferia and waterleaf were positive and significant at ten, five and ten percent level. Fertilizer, agrochemicals and seed were positive but not significant even at ten percent for waterleaf production.

The estimated mean technical efficiency for garden egg farmer was 0.68, telferia was0.78 and for waterleaf it was 0.79. The mean allocative efficiency of garden egg farmers is 0.47. On the other hand the average allocative efficiency for telferia farmer is 0.50 and for waterleaf farmers it was 0.48. The mean economic efficiency of garden egg farmer is 0.44, telferia farmers had average economic efficiency of 0.45 and waterleaf farmers had a mean economic efficiency of 0.40. Determinants of technical efficiency in garden egg, telferia and waterleaf production were age, year of education, experience in production, household size, and membership of cooperative, access to credit, farm size and extension contacts.

Furthermore, Estimates of the allocative efficiency model for the three vegetables farmers revealed that farmers' age, experience in production, household size and cooperative membership are significant factors influencing allocative efficiency. The significant socio-economic factors influencing economic efficiency of garden egg, telferia and waterleaf production were experience in production; extension contact, membership of cooperative and access to credit, age, education.

Moreover, the results of returns and costs associated with garden egg, telferia and waterleaf production show that the gross margin was ₦205, 882, 60, ₦275,500.68 and ₦192,903.80 per hectare respectively. Average rate of return obtained was1.48 for garden egg production, 1.64 for telferia and 1.75 for waterleaf respectively.

The constraints faced by vegetable farmers in the study area were ranked in order of priority and these include pest and disease infestation, poor price, problem of storage, poor yield, adulterated seed, high cost of fertilizer, transportation, and market and germination failure. A significant contributor to increased incomes is the production and sales of soybean. The major driver for

Poverty reduction in the project area is related to developments in the active participation of the farmers though with no or less technology can still have an income to close the poverty gap. Vegetable production was non-existent on a commercial scale, but could improve the livelihood standard of the participating household. These resulted in property ownership, improved nutrition, and increased incomes through sales to output.

5.2 Conclusion

The analyzed socio-economic characteristics of vegetable farmers in the study area revealed that vegetable farmers were mostly female and married within the active age bracket of 22-53 years of age; also they are literate with long years of farming experience in vegetable production. Increase in the use of variable inputs can bring about an increase in production.Vegetable production in the state is under small-scale production and subsistence in nature, also it operates within stage one of production; hence resources were under-utilized. Technical, allocative and economic efficiencies ratings were high amongst the vegetables under study; this implied that there is optimal utilization of resources. Analysis of determinants of efficiency revealed that technical, allocative and economic efficiencies ratings among vegetable farmers were high and more profitable with high rate of return to investment. Furthermore, the production of vegetable could be increased if appropriate solutions are found to identify constraints. Vegetable production increases their income level which further alleviates household poverty; there is still room for improvement if resources are efficiently and effectively managed. Vegetable production has contributed positively on the household poverty status of the farmers using their per capita income and assets as proxy for poverty.

Since vegetable production is profitable and had impacted significantly on the household poverty status of the farmers is therefore concluded that vegetable (garden egg, telferia and waterleaf) production is a veritable tool for employment for the teaming population, wealth creation, poverty reduction and improvement in the wellbeing and living standard of the rural farmers.

5.3 Recommendations

Based on the findings of this study the following recommendations are made in order to improve vegetable production in the study area:

i. The study showed that there is presence of technical, allocative and economic inefficiencies in the production of vegetable. In order to raise efficiency level government and non-governmental organizations should assist in the provision of modern agricultural inputs to farmers at affordable prices.

ii. Vegetable farmers should organize themselves into cooperatives and this will enable them to pull their resources together to purchase modern farm inputs and hire additional labour for their farm operations

iii. Problem of storage and transportation was reported as a major constraint in vegetable production. Government and institutions should enable to come to the aid of farmers with feeder roads and storage facilities

iv. The problem of poor market and price for vegetable can be addressed through contract farming as farmers will produce based on market agreement. This can be achieved if agro-allied industries are involved in vegetable production business.

v. Government policies should encourage farmers by providing financial assistance, as this will increase their productivity which will further alleviate poverty and give employment. Credit makes it possible for farmers to acquire production inputs and on time, it therefore enhances productivity vis a vis technical, allocative and economic efficiencies of vegetable producers.

vi. Since education is an important variable that positively influence efficiency, the encouragement of farmers to acquire formal education to at least secondary through the adult and continuing education centres in the area should be pursue vigorously.

5.4 Contribution of the Study to Knowledge

i. Vegetable production is profitable in the study area with a return on investment of 1.48, 1.64, and 1.75 percent for garden egg, telferia and waterleaf respectively.

ii. Technical, allocative and economic inefficient effects were present in vegetable (garden egg, telferia and waterleaf) production. For an average vegetable farmer can still improve technical efficiency by 22 percent, 21.4 percent and 24.2 percent for garden egg, telferia and waterleaf respectively. Allocative efficiency can be improve by 51 percent, 32 percent and 26 percent for garden egg, telferia and waterleaf respectively. Economic efficiency can also be improved by 32 percent, 28 percent and 26 percent for garden egg, telferia and waterleaf respectively.

iii. Poverty gap of 0.24, 0.44 and 0.13 for garden egg, telferia and waterleaf farmers respectively.

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ECONOMICS ANALYSIS OF VEGETABLE PRODUCTION AND TIS CONTRIBUTION TO HOUSEHOLD POVERTY ALLEVIATION IN AKWA IBOM STATE.

Dear Respondent,

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

SECTION 1: General information

Name of farmer (optional)	House NO (optional)
Tel No (optional)	Date of interview
State	Name of interviewer
LGA	Name of Supervisor
Village	Date of interview

SECTION 3: Socioeconomic Characteristics

S/N	Characteristics	Codes			Answers
1	Sex of household head	1 = male, 2 = female			
2	Age	Years			
3	Family Size	No of people living under same roof and sharing meal			
4	Level of Education	No. of years completed formal education			
5	Main activity	1 =vegetable farming, 2 = livestock rearing, 3 = commerce, 4= labourer, 5 = civil servant, 6 = technician, 7 = others (specify)			
6	How long have been farming vegetables (garden egg, telferia or waterleaf)	Years			
7	How do you get your land	1 = inheritance, 2 = rented, 3 = bought, 4 = gift, 5 = others (specify)			
8	What was the plot size you used for vegetable last year	Plots	size	unit	amount
9	During vegetable production do you use credit	1 = yes, 2 = no			
10	If yes, did you access credit during you last production season	1 = yes, 2 = no			
11	If yes, what was the	1 = commercial banks, 2 =			

	amount of credit you last use and source	BOA, 3 = cooperatives society, 4 = friends/ family, 5 = money lenders' 6 = others (specify)	
12	Is the credit timely for agricultural activities	1 = yes, 2 = no	
13	Did you invest the credit in vegetable farming	1 = yes, 2 = no	
14	Do you have extension contact	1 = yes, 2 = no	
15	If yes state the no of visits		
16	Do you combine your vegetable with other crops or you grow sole	1 = yes, 2 = no	
17	Do you belong to farmers association	1 = yes, 2 = no	
18	If yes, how long and in how many of the associations.	No of years of membership	
19	What are the benefits of the association and what is your role in that association		

SECTION 3: Vegetable Production

S/NO	Types of vegetables	Total Production(kg)	Quantity sold	Price	Home consumption(kg)	Quantity saved for seeds(kg)	Others
1	Garden egg						
2	Telferia						
3	Waterleaf						
4	Pepper						
5	cucumber						
6	Others						

SECTION 4: Inputs used for Vegetable Production

a; Land

Plot no	Size	Unit	Amount
1			
2			

b; Seeds acquisition

Plot no	Seeds/cuttings/seedlings	Quantity	Unit	Cost of transportation	Value of quantity purchased in naira
1					
2					

C; Fertilizer acquisition

Plot No	Fertilizer type	Quantity	Unit	Cost of transportation	Value of quantity purchases
1					
2					
3					

d; Agro chemical

Plot No	Type of Agrochemical	Quantity	Unit	Cost of transportation	Value of quantity purchases
1					
2					
3					

e; Labour input

i) Land preparation

Plot No	Hired Labour			Family Labour		
	No of people	Man-day	Cost(#)	No of people	Man-day	Cost (#)
1						
2						

ii) Planting

Plot No	Hired Labour			Family Labour		
	No of people	Man-day	Cost(#)	No of people	Man-day	Cost (#)
1						
2						

iii) Fertilizer application

Plot No	Hired Labour			Family Labour		
	No of people	Man-day	Cost(#)	No of people	Man-day	Cost (#)
1						
2						

iv)First weeding

Plot No	Hired Labour			Family Labour		
	No of people	Man-day	Cost(#)	No of people	Man-day	Cost (#)
1						
2						

v) Second weeding

Plot No	Hired Labour			Family Labour		
	No of people	Man-day	Cost(#)	No of people	Man-day	Cost (#)
1						
2						

vi). Harvesting

Plot No	Hired Labour			Family Labour		
	No of people	Man-day	Cost(#)	No of people	Man-day	Cost (#)
1						
2						

SECTION 5: Livestock Production

i) Do you own Livestock; Yes = 1, No = 2

If yes, please fill the table below,

S/N	Types of Animals	No of Animals	Price	Sales, if any		Remark
				Quantity	Amount(#)	
1	Cattle					
2	Goat					
3	Sheep					
4	Pig					
5	poultry					
6	dog					
7	Others (specify)					

SECTION 6: Non/Off Farm Income

i) Is any member of your family involved in any non/off farm activities in the last one year?

1 = Yes, 2 = No

If yes, please fill the table below;

S/No	Off/Non- Farm Activities	Amount(#)	Remark
1	Working on other farms		
2	Rent from wilbarrows, motor cycle, bicycle, farm tool, house and others		
3	Daily labourers		
4	Artisan		
5	Sales of firewood/charcoal		
6	Transportation business(car, motor cycle, bicycle, boat)		
7	Sales of fish		
8	Hair dressing		
9	Tailoring		
10	Salary from temporary/permanent employment		
11	Trading		
12	Oil palm processing		
13	Others(specify)		

SECTION 7: Indicators of Poverty Status

i) What type of house do you live in? 1 = Block, 2 = Mud

ii) Do you have Agricultural equipment/assets? (Tractor, water pump, oil palm mill, palm fruit harvester, vegetable carrier etc.) 1 = Yes, 2 = No, if yes please fill the table below.

S/No	Type of Equipment	Value(#)	Status; Operational (1 = Ye; 2 = No)
1	Tractor		
2	Water Pump		
3	Vegetable Carrier		
4	Oil palm mill		
5	Harvester		
6	Others(specify)		

B) Other Assets

S/No	Asset	Value(#)	Status; Operational (1 = Yes; 2 = No)
1	Extra land (ha)		
2	House/s		
3	Radio/ Television		
4	Vehicle		
5	Motorcycle		
6	Bicycle		
7	Sewing Machine		
8	Block moulding machine		
9	Others(specify)		

C) Did you hire/borrow any type of agricultural equipmentfrom others last year? 1 = Yes; 2 = No.

D) If yes, indicate

type……purpose……cost(#)……

SECTION 8: Household Consumption

Please indicate your Expenditure in the last one month/year on the following item or more in your disposal.

S/No	Items	Quantity/Unit	Amount(#)
1	Rent		
2	Petroleum (PMS, Kerosene, Diesel, Gas, Charcoal, Firewood)		
3	Water		

4	Electricity		
5	Food		
6	Clothing		
7	School fees for self, wards/children		
8	Transportation		
9	Medicals		
10	Household items (Television, Radio, Furniture, Kitchens etc.)		
11	Ceremonies (marriage, child dedication/ naming, burial, remembrance, thanksgiving etc.)		
12	Others(specify)		

Thank you for your cooperation.