

EFFICIENCY OF YAM PRODUCTION IN ONDO STATE, NIGERIA

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AEE/00/7049

B.AGRIC. (Hons) IFE



A THESIS IN THE

**DEPARTMENT OF AGRICULTURAL ECONOMICS & EXTENSION
SCHOOL OF AGRICULTURE & AGRICULTURAL TECHNOLOGY**

SUBMITTED TO THE

**SCHOOL OF POSTGRADUATE STUDIES
FEDERAL UNIVERSITY OF TECHNOLOGY, AKURE**

**IN PARTIAL FULFILMENT OF THE REQUIREMENT
OF THE DEGREE OF
MASTER OF TECHNOLOGY IN AGRICULTURAL ECONOMICS**

OF

FEDERAL UNIVERSITY OF TECHNOLOGY, AKURE.

APRIL 2006

ABSTRACT

The study examined the efficiency of yam production in Akoko North East, Akure South, Owo and Ondo West Local Government Areas of Ondo State, Nigeria. Primary data were collected from 160 yam farmers with the aid of structured questionnaire assisted with interview schedule. The farmers were selected using multistage sampling technique. The analytical techniques used in the study included descriptive statistics, Gross Margin and Stochastic Frontier Production Function analyses.

The results of the socio – economic analysis showed that the yam farmers were young with low education and quite experienced. The stochastic frontier production function analysis showed that the coefficients of farm size, labour operating expenses yam sets and age were positive and had direct relationship with the farm output, and significant at 5% level of significance except labour and age. The return to scale (RTS) of yam production was greater than unity (1.269) implying that yam production was in stage I of the production surface. The state of irrational stage in the production surface.

The results of the Technical Efficiency indicate the presence of technical inefficiency effects in yam production with technical inefficiency effects accounting for about 97 percent of variation in the output of yam of the sampled farms. The Technical Efficiency varied between 0.35 and 0.99 with a mean Technical Efficiency of 0.91 and thus showed that the yam farmers were relatively technically efficient with about 94 percent of the sampled yam farmers having TE above 0.80. It was also observed that only type of farming (adoption of sole cropping of yam) significantly increased Technical Efficiency while

other socio-economic characteristics in the inefficiency model decreased Technical Efficiency of the yam farmers.



DEDICATION

To the Trinity.

To the memory of my loving father Late Mr. J.A. Adesanmi.

To my caring mother Mrs. A.R. Adesanmi for her unyielding love and encouragement.

ACKNOWLEDGEMENT

All glory, honour and adoration be to the Lord the Rock of Ages who has been my fortress and my shelter in the time of storm, my strength in the time of weakness, the horn of my salvation and my high tower. Who is able to do and exceedingly abundantly above all that I could ever think or dream.

I heartily express my profound gratitude to my supervisor Dr. S.O. Ojo, for his guidance and fatherly and intellectual advise, whose wise counsel and constructive criticism had contributed immensely to the success of this work. I also appreciate his patience and high level of understanding exercised in the supervision of this work especially and my life in general and his sincere interest in my academic pursuit.

I am also grateful to my Lecturers in the Department Prof. Imoudu, Dr. I.A Ajibefun, Dr. Afolabi, Dr. Amos, Dr. Okunlola and Dr. Alfred for their encouragement and contribution to the success of this work.

Special thanks go to the Head of Department Prof. Ewuola for his concern and encouragement in my academic pursuit.

My sincere gratitude, appreciation and regards go to my loving and caring parents (Late Mr. J.A. Adesanmi) Mrs. A.R. Adesanmi for their love, affection, encouragement, moral and financial support in every phase of my life.

My special thanks goes to the entire family members of Dr. S.O. Ojo for their sincere love and warmth demonstrated in regarding and accepting me as a 'family member' and a friend which contributed immensely to the timely completion and success of this work by creating a conducive environment for the work.

My profound gratitude goes to my brothers Kehinde, Segun, Rotimi and Tobi and sisters Funke, Bukky, Toyin, Nneka 'Nifemi for

their sincere love, understanding and encouragement and concern morally, financially and spiritually throughout the period of my study.

I also appreciate my Uncle Engr. B.J. Oguntuase and my Pastors, Pastor Ibitoye, Pastor Osakuade and Pastor 'Bolu Awofolaju for their moral and spiritual support and to my friends, Dr. Rege and His family, Mrs Adetomiwa, Mrs, Agbede, Mrs. Ijabiken, Mr. Akinbuwa, Ayo and Mosun Famuwagun, Tobi Mogaji, Shola Alade, Desola Opoola, and Mrs. Oloye.

CERTIFICATION

I certify that Miss. B.O. Adesanmi in the Department of Agricultural Economics and Extension, School of Agriculture and Agricultural Technology, Akure, Nigeria carried out this work.



2015/06

Dr. S.O. OJO
Supervisor



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CHAPTER ONE

1.0 INTRODUCTION

1.1 Background of the study

The role of agriculture remains significant in the Nigerian economy despite the strategic importance of the oil sector. The need to restructure the agricultural sector in an effort to enhance its role in the transformation of the Nigerian economy had long been recognized in Nigeria. All of the four development plans after 1960 targeted agricultural productivity and rural welfare.

A number of Programmes have been articulated and implemented in a bid to improve agricultural output, notably National Accelerated Food Production Programmes (NAFPP) in 1973, River Basin Development Authority Integrated Rural Development Programmes and Nigerian Agricultural Insurance Scheme. Unfortunately, most of these Programmes did not record much success in improving agricultural output in Nigeria mostly because of deviations from policies and implementation problems. At times, programmes are poorly implemented and/or may not be implemented at all.

Moreover, despite the decline of agriculture in the 1970s, agriculture still remains the significant mainstay of the Nigerian economy. For instance, a greater percentage of the population depends on the agricultural sector for their livelihood and the rural economy is still basically agricultural. Of the country's estimated 120 million population, about 65 percent live in the rural areas (National Population Commission, 1991) majority of which derive their livelihood from agriculture and other related activities because it remains the primary source of employment for the country's work

force. Moreover, the oil sector, which took over from agriculture has not made much productive impact on employment: rather it has caused a dislocation of the productive capacity of the rural sector.

Furthermore, the structure of the Nigerian economy witnessed unprecedented changes since 1960 in which the agricultural sector, which had hitherto been the backbone of its economy became characterized by declining productivity and contribution to Gross Domestic Product (GDP). The agricultural share of the GDP stood at about 90 percent before independence 56 percent between 1960-1969 and declined considerably to an average of about 24 percent in 1970-1979 and 22 percent in 1980 (Ugochukwu, 1981).

The contribution of the agricultural share to the GDP declined significantly overtime due to the slower growth of the sector relative to other sectors of the economy and most especially commercial exploration of petroleum (CBN, 1997). Nevertheless, there has been some improvement in the agricultural share of the GDP especially since 1993 to an average of about 39 percent between 1993 and 2001 (CBN, 2002). Table 1 shows the contribution of total agricultural production to GDP.

The performance of the agricultural sector improved in 2003. The aggregate index of agricultural production was established at 190.9 (1990=100) compared with 179.9 in the previous year. This showed an increase of 6.1 percent, compared with the 4.0 percent recorded in 2002 and an average of 5.6 percent for the period 1999 to 2002 (CBN, 2003)

Table 1: Contribution of Agricultural Products to Nigeria's Gross Domestic Product 1981 – 2003. (At Current Factor Cost)

Years	Total GDP(N' Million) (1)	Total Agric Share (N' Million (2)	(2) As percent of 1
1981	70,395.9	24,460.7	34.8
1982	70,157.0	25,082.3	35.8
1983	66,389.5	25,009.2	37.7
1984	63,006.4	23,799.5	37.8
1985	68,916.3	27,794.3	40.3
1986	71,075.9	30,356.5	42.7
1987	70,741.4	29,389.9	41.5
1988	77,752.5	32,273.2	41.5
1989	83,495.2	33,845.5	40.5
1990	90,342.1	35,277.2	39.0
1991	94,614.1	36,520.6	38.6
1992	97,431.1	37,272.9	38.3
1993	100,015.1	37,779.8	37.8
1994	10,040.1	38,692.4	38.3
1995	103,502.9	40,110.0	38.8
1996	107,020.0	41,750.0	39.0
1997	110,400.0	43,500.0	39.4
1998	113,000.0	45,610.0	40.4
1999	116,400.0	48,040.0	41.3
2000	120,640.0	48,990.0	40.6
2001	125,720.0	50,850.0	40.4
2002	129,830.0	53,520.0	41.2
2003	136,410	55,000.0	40.3

Source: CBN Statistical Bulletin vol. II No. 2 December 2000
 CBN Annual report and statement of Account 31st December
 2003 and 2004.

1.2 World Food Security Situation

The world has made slow but significant progress in improving food security and human well being over the past three decades. Since 1970, the number of food insecure people in developing countries has declined by 17 percent to the current population in spite of the rapid population growth.

Achieving food security and sustainable supply is a daunting task which will challenge the ingenuity and adaptability of the human race as there is global concern about food security as a critical factor of economic development and growth of nations. FAO (1993), states that food insecurity manifests clearly in a situation where households lack or have impeded qualities that meet reasonable nutrition standards.

The World Bank defines food security as "Assessing all people at all times to enough food for an active, health life". The essential elements are the availability of food and the ability to acquire it. A food secure household is one, which has access to enough food to ensure the minimum necessary food intake for individual members to lead a healthy life. Availability at this level depends on net food production, net access (Purchasing power) and the household traditional cropping strategy. The United Nations Agencies in its annual report on Africa, estimated that 38 million Nigerians were engulfed in poverty in 1995. At least half of the nations 102 million population is regarded as undernourished. The 51 million ill-fed Nigerians constitute 25 percent of the 200 million under-fed in Africa alone. (Nigerian Agriculture, 1999)

According to FAO (1996), about 840 million people are chronically undernourished; around 185 million pre-school children are seriously underweight for their age and illness resulting from

exacerbated by hunger while malnutrition is widespread. The attainment of food security will be the central global challenge. Among the major driving forces influencing access to sufficient food are income levels, economic growth and movements. Investment in agricultural growth and development, timely and reasonably priced access to agricultural inputs, the condition of the natural resource base, existence of competitive markets and functioning infrastructure and domestic resources mobilization and external assistance are among the key force influencing or challenging availability of food. (IFPRI, 1995)

1.3 Food Security In Nigeria

In countries like Nigeria, where crude oil or other commodities are the major foreign exchange earners, the growing number of people in the countryside is rapidly living in poverty resulting from low agricultural production and productivity. The most promising solution to these problems is to develop agricultural sector as about 70 percent of the population depends directly on this sector both for food and cash income. Agriculture creates a little over 30 percent of the GNP of the average African country, with diverse agricultural products such as maize, sorghum, millet, rice, coffee and tuber crops. Therefore, if every country could develop a vibrant agriculture with increase productivity per unit of inputs, its people would be better fed and it could generate surplus for processing and export. In Nigeria, most agricultural policies and programmes have had as a key objective, to enhance food security by which majority of Nigerians have access to domestically produced food at affordable prices at all times. In addition, the small – scale farmers have been the centerpieces of national agricultural policies. However, whether

those principles have been translated to practice through appropriate implementation modalities is seriously in doubt. As a result of these, the concept of "sustainable development" has taken centre stage in the policies of most nations in recent times, and has been reflected in most international meetings.

This concept has been defined as development, which fulfills current needs without compromising the capacity to meet the needs of future generations. The concept has two aspects.

- i. The capacity limitation to fulfill present and future needs (or income) and the level of technology and the conditions or social organization determines this capacity.
- ii. Giving top priority to fulfilling the basic human needs of the world's poor.

The sustainable ideal, which should expectedly translate into sustainable income, strongly advocates the need for a long-term perspective and an equitable allocation of resources over several generations in resolving social and environmental distribution within the current generation as well, voicing the need for development aimed at promoting human welfare and resolving the gap between the urban and rural communities, as well as curbing the ill effects of population explosion. Moreover, achieving economic development aids in achieving sustainable income. Development implies that most socio – economic factors are in place and are long lasting. The productive factors for achieving increased output and hence increased income must be available and accessible without inhibition. These factors are land, labour, capital and entrepreneurship. The environment under which they operate and interact should be conducive. Development of the rural sector will remove the distortions in incomes between the rural poor and the urban rich. The ever –

increasing inequalities in resource endowments and quality of life will be stemmed, giving rise to equity and justice in the allocation of resources and distribution of incomes.

1.3.1 Determinants of Food Among the Rural Household in Nigeria.

Unavailability and inaccessibility to food are insecurity. The first does not ensure the second. For instance, food may be available but a household for various reasons may not have access to the food. In theory, two types of household food insecurity abound caused by the continual inability of households to acquire needed food, either through market purchases or through production. This is highly rooted to poverty. Transitory food insecurity, on the other hand is a temporary decline in households access to the required food, due to factors such as instability in food prices, production or incomes (World bank, 1996). Food insecurity refers to deficits or short falls of actual per capita daily calories intake below the required amount. The minimum per capita daily calories intake recommended by FAO and World Health organisation (WHO) for maintaining the human body is 240 kilocal / day. (Rosen and Shapouri, 1994 and Riscopoules et al 1988)

Nevertheless, the primary determinant of food insecurity are domestic food production shortfalls, declines in export earnings, sudden rises in food prices and inadequate food assistance. About 87 percent of Nigerian food problems would be solved by promoting domestic food production. This implies that food security problems could be solved through self-reliance. Moreover, food imports play negligible role in alleviating food insecurity of the rural household and

identified that export earnings and per capita income do not determine food insecurity. (Rosen and Shapouri, 1994).

The availability of food at the household level requires that food be available in the local or community markets, not just nationally. National, regional or local availability of food is determined primarily by food production, stockholding and trade at any of these levels. For instance, increased cereal production variability has been shown to significantly increase food consumption variability (Sahn et al, 1998). Fluctuations in a country's capacity to import food (which is a function of export earnings, world prices and department – service obligations etc) also contribute to food insecurity by affecting the local availability of food.

1.3.2. Consequences Of Food Insecurity Among The Rural Household In Nigeria

Food insecurity and the frequently extreme efforts being made both by government and individuals have some consequences. Food insecurity leads to substantial loss in productivity in both the short and long terms because of reduced work performance, lowered school performance and income earning ability. Food insecurity could lead to a misallocation of scarce resources and loss through sale of productive assets. The efforts of food insecure households to acquire food may also have significant implications for the environment and the use of natural resources. Many poor and food insecure households live in ecologically vulnerable areas; and any desperate attempts to be food secured may lead to inappropriate land use practices which can cause environmental degradation that can further undermine their livelihood.

In Nigeria, agricultural sector has not been able to meet up with the demand for food for the growing population. For instance, the population of Nigeria was 88.5 million in 1991 (National Population Commission (NPC), 1991) and it is expected to be 157.4 million in the year 2010 by a natural increase of 3.0 percent per annum (NPC, 1991). There is then the concern to improve the nations agricultural productivity and specifically to expand local food production to reduce the food demand and supply gap more so that the economy of the country is near total dependence on crop forever increasing population and raw material to the industrial sector of the economy. The rural population provides about 90.0 percent of the food produced in Nigeria (Okuneye and Okuneye, 1988) while the remaining 10.0 percent is assumed to be obtained through importation which means Nigeria is yet to be self-sufficient in food production.

Nevertheless, food production was and is still being controlled by a large number of small-scale farmers who are faced with low farm gate prices, low capital investment, low level of application of modern inputs such as fertilizers and chemicals and low level of production technology. These small-scale farmers are also faced with inefficient supply of agricultural inputs like fertilizers, agrochemicals and inadequate implementation of agricultural projects and programmes and poor storage, processing and transportation add to these problems. Therefore, information on the efficient utilization of farm resources would lead to increase in food production and profitability thereby leading to poverty reduction among the small-scale rural farmers.

1.3.3 Effort of the Nigerian Government at Increasing productivity and self – Reliance.

The Federal Government of Nigeria has over the years developed and launched several agricultural development programmes aimed at increasing productivity and self- reliance. In all cases, various aspects of poverty alleviation were taken into consideration and built into these Programmes. The several attempts made were geared towards increasing the level of domestic food supply through various schemes and programmes such programmes include National Accelerated Food Production Programmes (NAFPP) IN 1973, River Basin Development Authorities (RBDA) in 1973, Operation Feed the Nation (OFN) 1976 in Nigeria agricultural Insurance Company (NAIC) 1n 1984, Directorate of Food, Road and Rural Infrastructure (DIFRRI) in 1986). National Directorate of Employment (NDE) in 1986, Structural Adjustment Programme (SAP) in 1986 and National Agricultural Land Development Authority (NALDA) in 1991.

In spite of all these efforts, it has not been possible to achieve self-sufficiency in food production. Hence, this calls for serious attention in terms of research and a re-direction of policies and measures that will increase domestic food production. Consequent upon this, is the place of yam in the Nigerian diet as one of the most important groups of staple foods in Nigeria and in the tropical world at large. (Onwueme, 1982).

As a result of this, yam as a panacea for poverty reduction provides a viable option against the prevailing food insecurity in Ondo State and Nigeria as a whole.

1.4 Importance Of Yam

Traditional Importance: In Nigeria, the lives of community in yam growing areas revolve around the yam cycle. The chiefs and traditional titleholders do not touch yam until the gods have been appeased. To get married in such communities, the bridegroom's wealth is measured by the amount of yams he can produce. Till today, the tradition is that the groom must present not less than a certain number of tubers depending on the locality. This is to serve as evidence that he can provide for the wife and the future family (IITA Website). Yam harvest is a traditional festivity with masquerade dancing in the villages and prayers to thank the ancestral gods for the blessings of the land and the women's fertility. In some parts of Ibo land yam is a male totem. Women are not allow to walk in yam farms until the yam is ready for harvesting which is the exclusive duty of the women. To the people, yam is the king of all food crops (IITA Website)

Medicinal ~~importance:~~ According to the ~~George~~ Mateljan Foundation, yam plays very important roles in the world of medicine among which are the following:

(a) **Control of blood pressure** — yam is a very good source of potassium, a mineral that helps to control blood pressure. Since many people not only do not eat enough fruits and vegetables, but also consume high amount of sodium, as salt is frequently added to processed foods, they may be deficient in potassium. Low intake of potassium - rich foods especially when coupled with a high intake of sodium, can lead to hypertension. *Dioscorin*, a storage protein contained in yam may also be of benefit to certain individuals with hypertension. Preliminary research suggests that *dioscorin* can

inhibit *angiotensin* converting enzyme, which would therefore lead to increased kidney blood flow and reduced blood pressure.

(b) Relief from premenstrual syndrome and menopausal symptoms

Yam contain a unique fat-like substance called diosgenin technically classified as a hormone – like molecule and is currently being investigated experimentally for its potential anti-cancer effects. Contrary to some popular claims, the human body cannot convert *diosgenin* into the human hormone progesterone. However, yams are still a super-food for women especially since they are a good source of vitamin B6.

Blood sugar and weight control – Yam, because of its richness in fibre, it fill you up without filling out your hips and waistline. Yams are also good source of manganese, a trace mineral that helps with carbohydrate metabolism and is a cofactor in a number of enzymes important in energy production and antioxidant defences.

1.5 Problem Statement

The food problem in Nigeria has been worsened by the low level of productivity of resources used in recent times. This has necessitated the importation of food which continually depletes the nation's foreign exchange earning, efforts needs to be made by food crop farmers in Nigeria to improve total factors productivity which can raise output to meet the country's food consumption needs. Among other things, the growth rate in population has been faster than the growth rate of food production. Without any prejudice therefore, domestic food production and food imports will have to go up to meet the growing food demand. Given the problem of poverty and lack of foreign exchange, there is need to look inwards. Thus the greatest

and most urgent challenge to the government is to increase domestic food production and in order to achieve this goal, the need for improved efficiency in yam production cannot be over-emphasized.

Moreover, in a bid to improve Nigerian agricultural output, it is important to investigate the efficiency of resource – use in yam production so as to increase the yield of yam. As a result of this, there is therefore the need to carry out a quantitative research on measurement of efficiency with a view of making appropriate policy on how to improve agricultural productivity and efficiency in the country.

This study therefore answered the following research questions

- (i) What are the socio – economic characteristics of the yam farmers?
- (ii) What is the profitability of yam production?
- (iii) How efficient are the resources used by the yam farmers?
- (iv) What is the production elasticity of the yam farmers?
- (v) How are the farmers' socio-economic factors able to influence their level of efficiency?
- (vi) What policy measures can be formulated for better performance of food crops farmers in the study area?

The answers to these questions by this study would provide useful information to policy makers on resources – use efficiency of yam farmers for agricultural planning towards increased food production.

1.6 Objective Of The Study

The general objective of the study is to carry out an efficiency analysis of yam production in Ondo State, Nigeria.

The specific objectives are to:

- (i) Examine the socio –economic characteristics of the farmers.

- (ii) Estimate the profitability of yam production in the study area.
- (iii) Examine the resource – use efficiency of variables involved in yam production.
- (iv) Estimate the technical efficiency of yam farmers in the study area
- (v) Examine the influence of some farmers' demographic factors on the technical efficiency of the yam farmers.

1.7 Hypotheses Of The Study

The following null hypotheses (H_{0i}) were tested:

$H_{01}: \beta_j = 0$. The null hypothesis specifies that the estimated coefficients (β_j) of variables involved in yam production are not significantly different from zero.

$H_{02}: \gamma = 0$, The null hypothesis specifies that the yam farmers in the study area are technically efficient and that the variation in their yam output is due to random effects which is beyond the control of the decision unit.

$H_{03}: \delta_k = 0$ The null hypothesis specifies that the socio – economic characteristics of the farmers (type of farming, source of land, type of labour and distance of farm) have no significant influence on the technical efficiency of the yam farmers.

1.8 Justification Of The Study

The crucial role of efficiency in increasing agricultural output has been widely recognized by researchers and policy makers alike. It is no surprise therefore that considerable efforts have been devoted to the analysis of farm level efficiency in developing countries. An underlying premise behind much of the work on efficiency is that if

farmers are making efficient use of existing technology, then efforts designed to improve efficiency would be more cost – effective than introducing new technologies as a means of increasing agricultural output. The amount of output a farmer will produce depends to a large extent on how efficiently he is able to combine such resources. Quantitative analysis of agricultural production systems has become an important step in the formulation of agricultural policy. The analysis of efficiency of yam production would help in identifying the possibilities of increasing output given the current level of resource use. The role of increased efficiency may be viewed as a viable complement to any set of policies to stimulate domestic production and or to promote resource conservation. This study aims at finding solution to the prevailing food problem in the country. Knowing the importance of measurement of efficiency as a factor for productivity growth, the study will benefit Nigerian economy by determining the extent to which it is possible to raise productivity with the existing resource base and the available technology.

2.0 LITERATURE REVIEW

This section is discussed under three main sub – headings. Theoretical framework, Review of Analytical Techniques and Review of Empirical studies on productivity and technical efficiency using stochastic frontier production function analysis.

2.1 Theoretical Framework

2.1.1 Management of farm Business

African farm businesses are grouped under different criteria of which size or scale of operations and types of goal or management objectives readily come to mind. This is because unlike western farm management whose basic goal is maximization of expected profit. African farms are not purely run for profit alone. They exhibit different characteristics based on the criteria underlying their management, which include size or scale of operation and types of goals of production

Size or the Scale of Operations: There are large, medium and small-scale farms depending on size and scale of operations. The size of farms cultivated in Nigeria is usually small. Farms are small because the farmers have to depend entirely upon human labour for most of their farming activities. Also, the land tenure system does not encourage large holdings but fragmented smallholdings. A large proportion of the farmers have poor resource base for their farming activities due to low level of income that is prevalent among the peasant farmers. Small-scale farms are farms whose sizes range between 0.1 ha and 5.9ha. About 80.78 percent of farms in Nigeria are in this category (Upton, 1997) and they account for almost 90 percent of total agricultural production in the country (Ojo, 1991). The

small farms are majorly responsible for self-sufficiency of food in Africa and cultivation of export crops. They are also very significant in world development with 50 percent of world's population depending on them. The small farmers work 40 percent of world's cultivated land and 60 percent of all farmers are small farmers (Dillon and Hardaker 1993). The basic characteristics of small farms include:

- (i) Production for the survival needs of the farm family though surpluses are disposed off through the marketing channels (Adesimi, 1988).
- (ii) All factors of production used on the farms are produced within the household.
- (iii) The factors of production are severely limited in scope. Only labour, land and simple capital input are the mostly used. The labour force is mainly made up of family members, although communal labour may be available, while some labour is hired (Upton (1997).
- (iv) The use of capital is limited since land is cultivated with the help of a few simple tools (Adesimi, 1988).
- (v) The management of small farm is efficient in that available resources of land, labour and capital are used to the level dictated by the opportunity cost of the inputs, that is, the resources of the farm are employed in amounts that give higher unit returns than their alternative uses (Anaman 1988) Adeniyi (1988) pointed out that the productivity of land and labour was higher on small farms than on large farms in Kwara State of Nigeria.

Medium scale farms – in the Nigeria context, medium scale farms ranged between 6 and 9.99ha, and they account for about 13.59 percent of total farm holdings in Nigeria (Olayide 1880). They

are managed like the small farms in terms of allocation and use of resources.

Large scale farms starts from 10ha and above. They account for about 5.63 percent of total farm holdings in Nigeria (Olayide 1980). Large farms have distinct characteristics from small-scale farm. They are commercially oriented and managed for profit among other management objectives. They use a wider range of factors of production in significant quantities. Their labour use is dependent on hired labour, which may be skilled and unskilled. Paid managers are employed to run the farms. Large hectare of land is cultivated with the aid of mechanical devices to produce larger output and possibly reduce unit cost. Large farms find it easy to raise more capital for their operations and with good management; they enjoy economies of size, which implies that as farms get bigger, unit costs of production decline. They produce at a lower unit cost because they get price discounts for purchasing large quantities of inputs and get price advantages through selling large volumes of produce. Large farms on the other hand are more prone to risk and uncertainty because there is no insurance against crop failure which may be caused by diseases and drought. The management and technical skills, while a dearth of it may lead to inefficient use of resources leading to diseconomies of size. Also, as farms of different units become increasingly difficult, this may lead to workers producing at sub-optimum capacities. Since paid managers on behalf of their absentee and owners operate these farms, general efficiency is reduced, especially if the paid managers are not fully committed. However, in spite of the shortcomings of large farms, there is a clear need for their establishment alongside small farms for large increase in production and enjoyment of economies of size.



2.1.2 Natural Resources and Agricultural Inputs.

Food insecurity has long been perceived by some to be primary problems of insufficient food products rather than insufficient access to food with foresight and decisive action, the conditions that permit food security for all people in the coming years can be created. The actions required include increasing productivity in agricultural production which helps not only to produce more food at lower unit costs and make more efficient use of resources, but also to raise the income of farmers and others linked to agriculture and thus improve their capacity to purchase needed relevant parties – individuals, households, farmers, local communities, the private sector, civil society, national governments and the international community to work together in new or strengthened partnerships. It will require a change in behaviour, priorities and policies, and it will require strengthened cooperation between developing and industrialized countries and among developing countries. The world's natural resources are capable of supporting sustainable food security for all people if current rates of degradation are reduced and replaced by appropriate technological change and sustainable use of natural resources (Pinstrup – Andersen and Pandya – Lorch, 1996). Natural resources and agricultural inputs are critical determinants of food supply. Degradation of natural resources, such as soil, forests, marine, fisheries and water, undermines production capacity, while availability of and access to agricultural inputs such as water, fertilizer, pest control measures, research and technology, determine productivity and therefore production.

Since 1945, about 2 billion of the world's 8.7 billion hectares of agricultural land, permanent pastures and forests and woodlands

have been degraded (Alderman, 1992). Much of the degradation is taking place on agricultural lands. Soil degradation is taking place on agricultural lands. Soil degradation has affected 74 percent of agricultural lands in central America and 38 percent in Asia. (Pinstrup – Andersen and Pandya – Lorch, 1995). Overgrazing, deforestation and inappropriate agricultural practices account for most of the degradation. To a large extent, these result from or are exacerbated by inadequate, property rights, poverty, population pressure, and inappropriate technology. In the absence of efforts to protect non-degraded soils and to restore currently degraded soils, increasing population and persisting poverty will hasten soil degradation.

The degradation of natural resources is rampant in many resources – poor areas of developing countries, particularly these areas with fragile soils, irregular rainfall, high population concentration and stagnant production in agricultural areas exposed to misuse of modern farming inputs. While natural resources degradation is often a consequence of poverty, it also contributes to poverty. This downward spiral is found in many locations where low – income people reside. Food security solution that fails to effectively address natural resource issues will not be sustainable.

Research, knowledge and technology are critical inputs into poor peoples effort to increase their productivity and improve their well-being. Mismanagement of natural resources will result not only in environmental degradation but also in further poverty and food insecurity. Pro-poor economic growth and sustainable food security require that poor people have access to productive resources and employment. As 75 percent gains in agriculture, which will boost rural incomes on and off the farm, are critical considerable evidence shows that increases in farm income in developing countries promote strong

income increases in the rest of the economy. To the extent that agricultural productivity gains lead to lower food prices, they will benefit poor farm and non-farm consumers. Increasing productivity in agriculture can also slow the pace of rural – to – urban migration. In addition, the agricultural growth helps meet rising food demand. A healthy agricultural economy offers farmers incentives for conserving the natural resources base upon which future agricultural production depends and productivity gains on⁴ existing land makes farmers less likely to clear wild, marginal or forest land (IFPRI, 2002).

2.1.3 Improving Natural Resource Management

In many developing countries, poverty, low agricultural productivity and environmental degradation interact in various downward spirals. It is commonly thought that intensification of agricultural production usually leads to environmental degradation. In most developing countries, too little intensification is a major cause of natural resource degradation, as desperately poor farmers mine soil fertility and climb the hillsides in an effort to survive. Agricultural growth and poverty alleviation in much of the developing world are likely to benefit the environment. A great deal depends on specific social, economic and ecological circumstances. Agricultural development is broad – based, market – driven, particularly and decentralized and driven by appropriate technological change, which enhances productivity. Agricultural researchers must pay greater attention to sustainability of resource – poor areas and to the role of property rights and collective action in farmers' adoption of technologies and resource management practices. Nevertheless, the resource base of a country coupled with the factors limiting effective

utilization of these resources determine the success or otherwise of her agricultural development Programmes (IFPRI, 2002)

2.1.4 Resource Problems of the Rural Economy

The nature and quantities of resources employed in primary production activities in tropical Africa's rural economics are such that rely on technologies that tend to give rise to low productivity and output. The low output results in low food and related nutritional problems, which manifest in malnutrition disease and consequently, socio-political – economic discontent. Generally, resource utilization in the world over is faced with problems of under capacity in the less developed countries. The implication of this problem is that it is associated with low returns on labour resources, a situation that is absolute for under capacity. The second is that it is a focus of concern by policy makers because it has deep roots in the resource structure of agriculture. This framework is examined from the demand and supply perspectives in relation to output resulting from resource utilization. A quantitative study of this relationship within a mathematical framework will enable us to derive certain parameters from functions and those can be employed to measure resource performance and make projections.

2.1.5 Agricultural Resources

The major resources used in agriculture are free and economic resources. The free resources are termed free because they are relatively abundant in supply and hence have no cost element attached to them but they are highly essential in agricultural production. They are heat, water, air (such as carbon dioxide (CO_2), Nitrogen (N_2), Oxygen (O_2) and so on (Upton 1997). The economic

resources are scarce in supply and limiting in production. They possess high economic value. They are land, labour, capital and management (Dillon and Hardaker¹ 1993). The economic resource come into agricultural production in different dis – aggregated forms to give a more specific set of resources for example, land of different types, different categories of capital expenditure and labour, family labour, skilled or casual or unskilled labour

Land: Land is the most important resource in agricultural production. Land holds a unique place in rural economies in view of the fact that these economies are still in the infant stages of economic development. Problems of land demand in Nigeria as in other tropical African countries centre on man. Land ratio, tenure and changing agrarian structure. First, the system of bush fallowing predominantly practiced makes heavy demand on land. This implies that there is excess demand for farm – land that is a serious problem in the rural economies. The major type of land ownership and or supply is through the family either by way of inheritance from father / brother or as access to communal or family land not hitherto cultivated or both. The second source is the sale of land; a process seriously frowned at by family members. The third source of supply is a form of primitive land lease whereby the farmer plays a form of land rent. Land (farm size) is measured in hectares but the local farmers sometimes refer to the size of their farms in number of heaps cultivated.

Labour: Labour is the effort of human being that is used in making things happen in the production process. It is the second most important resource next to land in agricultural production. Labour availability is a function of the economically active proportion of the population released for agricultural activities (Ojo 2000). Farm labour on peasant farms could be from both family and hired sources

depending on the size of the farm and type of operation to be performed. In large commercial farms, farm labour is purely hired and categorized as casual, unskilled, semi-skilled and skilled labour. The quality of labour in use is a function of the level of education and training in relevant agricultural production, that is, the higher the level of training in the cultivation and management of any crop the higher, the productivity and efficiency (Ojo and Ajibefun 2000). Labour is measured in terms of the adult male equivalents, where one man-day is the work done by one adult male in eight hours, and one woman-day is equivalent of 2/3 of a man – day (Adegeye and Dittoh, 1985) Yam production is highly labour intensive as most of its operations have not been mechanized and even those mechanized are not sometimes economical due to incessant breakdown of machinery and high maintenance cost.

Capital: Capital resource comes into farm production in three forms, namely,

- ♦ Farm machinery, such as tractors and various farm tools.
- ♦ Biological capital such as fertilizers, pesticides, herbicide, improved seeds and breeding stock.
- ♦ Feed for livestock

Also, capital can be categorized on the basis of their cost on building machinery and plants, which are for farm improvement.

- ♦ Maintenance and running costs on machinery and equipment, livestock and feed expenses, feed and fertilizer purchases.

Management: Management or entrepreneur or co-ordination is the most important factor of production. In this input resides the decision making power in farm business (Olayide and Heady, 1982). It is concerned with efficient mixing of resources in the production process. An efficient resources planning and utilization ensures

attainment of the objective of the production function. Management is therefore concerned with planning, implementation and control of the farm business.

2.1.6 Agricultural Cost Functions

The expenses incurred in carrying out the production activities are called costs. It is the outlay of funds in cash and imputed terms, which farmers' incur in the operation of their farm business for inputs used in production. Costs are measured using different approaches of which the classical approach is the most significant. The classical approach looks at cost from time perspective. It classifies cost into fixed, variable and Total Cost where Total Cost (TC) is total variable cost (TVC) plus Total Fixed Cost (TFC).

The generalized cost function is usually computed as a function of output. Therefore the cost function can be derived from the production function. The cost function derivations could be exemplified as follows:

$$TC = TVC + TFC \dots\dots\dots (2.1).$$

$$TVC = P_1X_1 + P_2X_2\dots\dots\dots (2.2)$$

$$AVC = TVC / Y = P_1X_1 / Y = P_1 / APP_1 \dots\dots\dots(2.3)$$

Where Y is output, P_1 is unit price of input X_1 and APP_1 is Average Physical product.

The AVC is inversely related to APP and as APP increases the AVC is minimum.

Marginal cost (MC) is the first derivative of the Total cost function with respect to output (Y).

$$MC = dc / dy \dots\dots\dots (2.4)$$

The MC has inverse relationship to MPP. At maximum output the

$$MC = AVC \text{ and } MPP = 0 \dots\dots\dots(2.5)$$



Both the Average and marginal measures are employed in efficiency measurement analysis. (Doll and Orazen 1988). The analysis of the resources and cost functions is significant in budgeting analysis.

2.1.7 Concept of Production Function and Productivity Measurement

(i) Production Function

The basic requirement for the production of any commodity function is a mathematical method describing the input – output relationship or it is a quantitative relationship between inputs and outputs (Dillon and Hardaker 1993). Ozsabuncuoglu (1998) described agricultural production function as a bio – physical concept, which indicates the relationship between the physical quantities of a crop grown, and the set of inputs used to produce the crop. Production function is an important planning tool for producers and consumers for decision-making processes in establishing, directing and setting the size of firms in the agricultural sectors. It thus guides decision-making and planning future action. It provides a direct measurement of the parameters of resources productivity. Its goal is efficient resource allocation. There are short, run and long run production functions when time perspective is considered. In the short run, one or more inputs are held constant and others are allowed to vary but all inputs could be varied on the long run. In estimating the production function parameters, algebraic functional forms are fitted and appraised on the basis of statistical and econometric criteria for goodness of fit. These functional forms include linear, quadratic, polynomial, square-root polynomial, cobb– douglas (power) semi – log, exponential and transcendental. Of all these algebraic forms, the cobb – douglas function is easily adaptable for most agricultural studies, particularly

those relating to developing agriculture (Xu and Jeffery 1998) because it possesses some unique characteristics, which make it easy to work with. These characteristics include:

- (a) When the input and output quantities are transformed to their logarithms, the resultant function is linear in the log hence it is easy to fit data with the cobb– douglas form.
- (b) The estimated coefficients are the direct elasticities of production.
- (c) The sum of the estimated coefficients is used to infer the returns to scale (RTS) directly.

Starting with a given technical relationship between the inputs and output in a production process, the analysis of the production function is used to get the productivity of resources employed in the production process and also the optimal inputs combination as well as optimal output level.

(ii) Agricultural productivity Measurement

Agricultural productivity is synonymous with resource productivity and is definable in terms of individual resources or a combination of them. Resource productivity is the ratio of total output to the resource input being studied in other words; labour productivity is the ratio of total output to labour input. Similarly, land capital and management productivities can each be defined total output to input similarly, land, capital and management productivities can each be defined as the ratio of total output to input each of the inputs of land, capital and management (Olaide and Heady 1982). The classical approach to productivity measurement concentrated on the computation of the following important economic metrics as measures of productivity. They include, Average Product (AP). Marginal Product (MP), marginal

Rate of substitution (MRS), Elasticity of production (ep) and returns to scale (RTS) it follows that the analysis of the production function curve with the knowledge of the metrics given above could be used as a frame of reference to undertake a quantitative interpretation of the three stages of the production surface as given in figure 1. Each stage is important from the viewpoint of economic analysis and efficient resources used.

In stage 1 there is positive increasing return to factor and scale, that is, the elasticity of production of the inputs used is greater than unity and also the return to scale (RTS) is greater than unity, that is, $RTS > 1$. Production is inefficient at this stage. Therefore, the economic decision at this stage is that if the product being produced has any value at all, input use once started should be continued until stage II is reached where the productivity of such input would reach its peak.

Stage II is the stage of positive decreasing returns to scale, that is $0 < ep < 1$ the RTS is less than unity but greater than zero, that is, $0 < RTS < 1$ it is the economic relevant stage in the production function analysis because it is there that such issues as output and profit maximization are addressed. The exact point of optimal input combination and output production is determined when the choice indicators (inputs and output prices) are known together with the physical concept underlining the production functions analysis. In stage III, $ep < 0$ and $RTS < 0$. The stage has no economic relevance and production is not advisable in the stage. Efforts should be made to readjust production back to stage II once it gets to stage III. Total product decreases with each additional input used and the RTS exhibits negative decreasing returns to scale. Other form of productivity measures is the type discussed by Adeniyi (1988). He

regarded a resource allocation as optimal when the value of the marginal product (VMP) of the resources is equal for every use and for every user. There is a misallocation of a resource when the VMP of resource in one use exceeds its VMP in other uses. A reallocation of this resource (transferring units of this resource from the lower to the higher VMP uses) would increase Total Product. This reallocation is accomplished by the price mechanism. To produce any output at a minimum cost when more than one resource are involved the following criterion must be fulfilled, that is, the ratio of the Value of Marginal Product

(VMP) to the input price must be equal for all inputs.

$$VMP_1 / P_1 = VMP_2 / P_2 = \dots = VMP_n / P_n \dots\dots\dots(2.6)$$

Or

$$MR_1/P_1=MR_2/P_2=\dots=MR_n/P_n$$

Where, MR is the Marginal Product

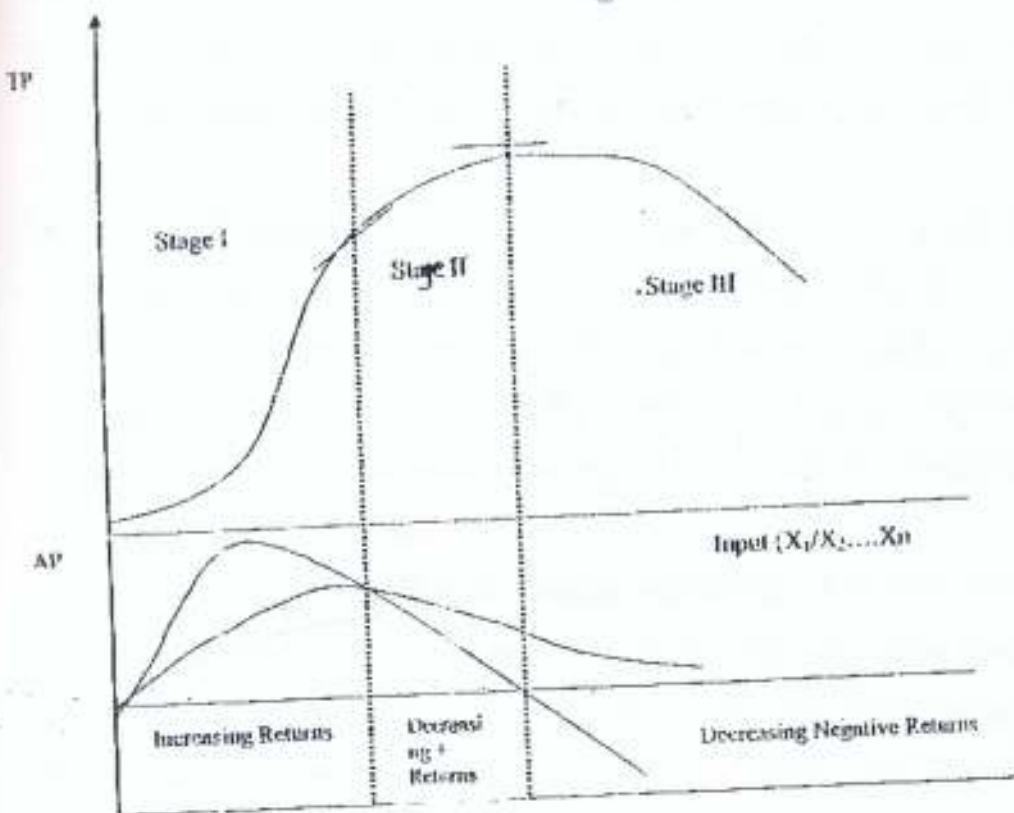


Fig1: Total, Average and Marginal product curves and the 3

Stages of production

Source: Olayide and Heady, 1982

2.1.8 Productive Efficiency Measurement

Productive efficiency means the attainment of production goal without waste. The fundamental idea underlying efficiency measures is that of the quantity of goods and services per unit of input. Hence, enterprise inefficiency involves the disproportionate and excessive usage of all inputs (Ajibefun 1999). The study of productive efficiency started with the pioneering works of Farrel in 1957. He identified three types of efficiency as technical, allocative and economic efficiencies.

- ♦ Technical efficiency (TE) refers to the achievement of the maximum potential output from a given quantity of inputs under a given technology (Xu and Jeffrey 1998).

- ♦ Allocative efficiency (AE) is the optimum allocation of resources taking into accounts the prices of the resources. In other words, it is the ability of choosing optimal inputs levels for given factors prices.
- ♦ Economic efficiency (EE) is the overall efficiency. It is the product of TE. and AE. An economically efficient input – output combination would be on both the frontier function and the expansion path (Xu and Jeffrey 1998). This implies that both the necessary and sufficient conditions for optimal combination of inputs and outputs are met.

The measurement of the Technical efficiency of a firm relative to other firms or to the best practice in an industry has long been interest to Agriculture Economists. There are two main approaches for measuring technical efficiency of a firm. They are, the classical and frontier approaches.

The classical approach is based on the ratio of output to a particular input, thus it is a partial measure of productivity, whose simplest approximation to TE. are the partial productivity indexes which relate total output to the input used to produce it. It is termed partial productivity measure because output is compared with only one input at a time (Ajibefun (1999). The principal limitations of this approach are that changes in output or input ratios are affected by changes in the combination of different inputs and by changes in productive efficiency. The variations of those partial productivity indexes cannot be interpreted as variations in the efficiency of a particular input but as changes in the use of all the inputs per unit of output.

The limitations of the classical approach led economists to develop a better approach called the frontier approach. First to break

the ground in this approach was Farrel who in 1957 suggested a method of measuring TE of a firm by estimating the production of a 'fully efficient firm.' This function represents the technical relationship of output. It implies that efficient firms are those operating on the production frontier. Any firm producing below the frontier is inefficient and it obtains less output than is technically possible. The TE level can be calculated as the relationship between the observed output (Y) and what would be attained if the units were located at the frontier (Y*) which is also called the adjusted output. The adjusted output (Y*) represents the observed output (Y) adjusted for statistical 'noise' (Xu and Jeffrey 1998) and is calculated as,

$$Y = f(X_a; \beta) + V - U \dots\dots\dots (2.8a)$$

$$Y^* = f(X_a; \beta) + V \dots\dots\dots (2.8)$$

Where X_a = actual input use

β = Vector of unknown parameters to be estimated

U and V are estimates of the inefficiency and random components respectively of over-all derivations from the frontier

Y and Y* are as defined above.

The adjusted output (Y*) and the observed output (Y) are used to calculate the technical efficiency as follows.

$$TE = Y / Y^* \dots\dots\dots (2.9)$$

$$\text{So that; } 0 \leq Y / Y^* \leq 1 \dots\dots\dots (2.10)$$

2.2 Review of Analytical Techniques

2.2.1 Budgeting Analysis

The budgeting analysis is an important tool in farm planning analysis because it can be used to calculate the overall performance. It measures the profitability of the farm. The existing types of budgeting

include complete or whole farm budgeting, partial budgeting, break even budgeting, partial cash flow, profit budgeting parametric and risk budgeting. The whole farm profit budgets are prepared in gross margin terms. The levels of the farm activity are used to calculate the total gross margin (TGM) to show the net farm earnings (Dillon and Hardaker 1993). The major statistics that are commonly derived from budgeting analysis are the gross margin and the farm profit or net returns.

The Gross margin of an enterprise is the difference between the total value of production (Total revenue) and the total variable cost of production (TVC), that is,

$$GM = TR - TVC \dots\dots\dots (2.11)$$

While the farm profit or net return (π) is the gross margin minus the fixed costs or Total Revenue minus Total Cost (TC) that is, $\pi = TR - TC$ Therefore, given the fixed cost on a farm, the larger the total gross margin from the entire enterprises o the farm the larger the farm profit (Adegeye and Dittoh, 1985).

2.2.2 The Stochastic production Function

The parametric methods consider the frontier production function as a parametric function of the input. Under this method, there are two models for estimation. They are the deterministic and stochastic frontier models.

In the deterministic frontier model, the random component of the error term is assumed to be absent and all the residuals cover technical inefficiency (V). Aigner and Chu (1968) specified a Cobb – Douglas production function of the form.

$$Y_i = f(X_{is}, \beta) \exp (- U) \dots\dots\dots(2.12)$$

Where Y_i represents the production level of the i th firm $f()$ is a Cobb – Douglas functional form, X_a is the vector of inputs, β is a vector of unknown parameters to be estimated, U_i refers to the non – negative inefficiency effects which contribute to the i th firm not attaining maximum efficiency of production. The element of the parameters β may be estimated either by linear programming or econometric techniques.

In the stochastic frontier model, it is assumed that the error term (ϵ) has two components, V and U . The V is a white noise, which covers random effects on production outside the control of the decision unit. U is an asymmetric component, which measures technical inefficiency and is assumed to be the result of behaviour factor, which come under the control of the decision unit (Apezteguia and Garate 1997). Since the independent work of Aigner et al (1977) and Meeusen and Van der Broeck (1977) to address the limitation of the DEA approach there have been considerable research efforts to extend and apply the stochastic frontier approach in agricultural economics literature. The approach has generally been preferred due to the following factors:

- ♦ The inherent variability of agricultural productions due to weather, pests and diseases.
- ♦ And also, because many firms are small, family – owned enterprises, where keeping of accurate records is not always a priority.

Hence, available data on production are subject to measurement errors. The estimation technique of stochastic frontier production function is the econometric techniques using the maximum likelihood estimation. The study used this technique to estimate the production

function parameters of yam farms and also use it to predict the technical efficiencies of farmers in the groups.

The stochastic frontier production function is defined as

$$Y_i = \exp (X_i, \beta_j) + V_i - U_i \dots\dots\dots (2.13) \quad (\text{Battese et al, 1993})$$

Where Y_i are observed output in specified units,
 X_j are inputs quantities,

The systematic component V_i captures the white noise, random variation that covers random effects on production. It is independently, identically and normally distributed with zero mean and known variance and independent of U_i . The U_i measures the technical inefficiency relative to the stochastic frontier. U_i is assumed to have a non – negative (one sided) truncation at zero or half normal distribution with the normal distribution (Tadesse and Krishnamoorthy 1997). The variances of the parameter V and U are σ_v^2 and σ_u^2 respectively and the overall model variance σ^2 are related thus,

$$\sigma^2 = \sigma_u^2 + \sigma_v^2 \dots\dots\dots (2.14)$$

The measures of total variation of output from the frontier which can be attributed to technical efficiency is gamma (γ) Battese and Corra (1977). The variability measure is thus derived as follows:

$$\gamma = \sigma_u^2 / \sigma^2 \dots\dots\dots (2.15)$$

On the assumptions that V_i and U_i are independent and normally distributed, the parameters of the production function are estimated using the maximum likelihood Estimation (MLE) technique. The farm specific technical efficiency (TE) of the i th farmer is estimated by using the expectation of U_i conditional on the random variable (ϵ) as shown by Battese and Coelli (1988). The TE of an individual farmer is defined in terms of the ratio of the observed

output to the corresponding frontier output given the available technology, that is,

$$\begin{aligned} TE &= Y_i / Y_i^* \\ &= \frac{\exp (X_{i,\beta} + V_i - U_i)}{\exp (X_{i,\beta} + V_i)} \\ &= \exp (-U_i) \end{aligned}$$

so that $0 \leq TE \leq 1$

2.3 Empirical Studies on Stochastic Frontier Production Function Analysis.

The modeling and estimation of stochastic frontier production have been important areas of economic study since Farrel's (1957) landmark work.. Following the independent works by Aigner et al (1977), Battese and Corra (1977) and Meeusen and Van der Broeck (1977), Bravo – Ureta and Pinheiro (1993) and Coelli (1995) there have been considerable research efforts to extend and apply the stochastic frontier approach.

Battese (1992) and Bravo – Ureta and Pinheiro (1993) provided surveys of applications in agricultural economics, while Battese (1992) concentrated on developed countries. Bravo – Ureta and Pinheiro (1993) focused on its application in developing countries. They also drew attention to those applications, which attempted to investigate the relationship between variables such as age and level of education of the farmers, farm size, access to credit and utilization of extension services. Most of the applications, which seek to explain the differences in technical efficiencies of farmers, use a two – stage approach. The first stage involves the estimation of a stochastic frontier production.

Battese et al (1993) estimated two models with the stochastic frontier production function for wheat farmers in four districts of Pakistan. The result reveals a high level of technical inefficiency. The Technical Efficiency ranged between 0.68 and 0.93, which meant it, was potentially possible to increase production without increasing the level of inputs.

A study of wheat farmers in Pakistan also by Battese et al (1993) applied a single stage model for estimating technical efficiencies. The inefficiency variables were identified as age of the farmers, maximum years of schooling and ratio of adult males to the total household size. These variables were incorporated along with the production variables of land, labour, and dummy variables for fertilizer, land preparation, number of ploughs and quantity of seed. The technical inefficiency effects were highly significant meaning that the traditional production function model was inadequate for the analysis of wheat production in the four district involved. The technical efficiency of wheat farmers displays considerable variation over time within each district such that, the mean technical efficiencies range from 57 percent to 79 percent in the four districts.

Ajibefun et al (1996), employed a stochastic frontier production function to analyze technical efficiency and technological change in the Japanese rice industry. The results of the study showed that the technical inefficiency effects were statistically significant but time invariant. There was evidence of neutral technological change. Technical efficiencies of the average rice farm households in the prefecture were only moderately high and the mean technical efficiency was estimated to be 74.5 percent. It was also shown that the return – to – scale parameter was not significantly greater than

unity, indicating constant returns to scale, at the average levels of the input used by the rice farmers.

In the study of Xu and Jeffery (1998) on Efficiency and Technical progress in traditional and modern agriculture: evidence from rice production in China, they estimated the efficiencies of Chinese hybrid and conventional rice production, using a dual stochastic frontier efficiency decomposition model. Results revealed significant differences in technical and allocative efficiencies between conventional and hybrid rice production. it also indicated significant regional efficiency differences in hybrid rice production but not in conventional rice production.

A study of grain production in China by Yao and Liu (1998) specified the dependent variables² as the total output of grain. The independent production variables were land, labour, machinery, fertilizer and irrigation. The inefficiency variables in their model include research and development, disaster index, rural population share and crop labour share. The results of the study revealed that considerable regional differences existed in grain yields and that there was still a vast potential for raising grain output. The short-term solution is to use more land augmenting inputs such as fertilizer and irrigation in the medium and low yield region. The low diminishing return however was in operation as more physical inputs were applied to shrinking land. Growth in grain output in the long – term must thereof rely on improvement in technical efficiency.

Seyoum et al (1998) carried out a study on technical efficiency and productivity of maize farmers within and outside the Sasakawa – Global 2000 project in Ethiopia. Their study used stochastic frontier production function analysis in which the technical inefficiency effects were assumed to be function of age and education of the farmers,

together with the time spent by extension advisers in assisting farmer in their agricultural production operation. The Cobb – Douglas stochastic frontier were found to be adequate representation of the data, given the specifications of the translog stochastic frontiers for farmers within and SG2000 project were more technically efficient than farmers outside the project, relative to their respective technologies. The mean frontier output of maize for farmers within the SG – 2000 project was significantly greater than that for the farmers outside the project

In another study in which Ojo (2000) investigated the effect of socio – economic variables on technical efficiency of small scale, oil palm farm in Ondo State, the factor productivities were low and fresh fruit bunches production was in the irrational zone of production technical inefficiency effects were present in the production and it accounted for about 21 percent of variation in the output. The technical efficiency of the farmers varied between 0.39 and 0.99 with a mean 0.51. The study revealed that the small scale oil palm farmers were technically inefficient in resource allocation and utilization with about 68 percent of them having technical efficiency that was less than 0.50. The study further showed that of all the socio – economic characteristics considered, only training in the art of cultivating oil palm had significant effect at 5 percent level of significance.

In a similar study in which Ojo et al (2001) investigated farm size and technical efficiency of oil palm farms in Ondo State, Nigeria, the results showed that farm size, age of palms and labour were significant resources in oil palm production. it was observed that plantation in small sizes were more productive in fresh bunches production and more efficient in allocation of inputs than bigger

plantations. Also, large plantations had significant inefficiency effects and were less technically efficient compare to small size farms.

Ojo et al (2001) examined the productivity and technical efficiency in comparable analysis of oil palm farms in Ondo State, using the stochastic frontier production function techniques to analyse the data collected. Result of the analysis indicated that farms in the settlement scheme were more effective in the use of factors resources that the non – settlement farms, indicating that the settlement farms were in stage one of the production surface while the non-settlement were in stage III and thus both were inefficient in the allocation and use of resources. The predicted mean technical efficiency (TE) for farms in the settlement scheme was estimated to be 0.93 while those for farm in the non-settlement scheme was 0.51, with farms in the non-settlement scheme having larger variability. This indicates that farms in the settlement scheme are more technically efficient in the use of factor resources than farms in the non-settlement scheme.

In a study in which Amos (2004) examine the productivity and technical efficiency of small scale farmers in Niger State, Nigeria, the stochastic frontier production function analysis was used. Result showed that farmers were in the rational stage of production (Stage II) as depicted by the returns to scale (RTS) of 0.27. The technical efficiency (TE) of the sole maize farmers was lower (0.5226) than that of mixed (yam /maize) cropping farmers (0.7172). A mean (TE) of 0.622 was observed for all farmers. Over 50 percent of the mixed farmers had T.E. exceeding 0.70 as compared to 100 percent sole farmers who had less than 0.60. The study further showed that years of schooling, farming experience and cropping pattern positively

affected technical efficiency while increase in the age led to decrease in technical efficiency.

Ojo (2004) investigated labour productivity and technical efficiency of farmers in food crop production in four local government areas in Ekiti State, Nigeria. Results shows that labour from source was mostly used in yam production and yam production was mostly in small-scale category. Labour for land preparation and maintenance with farm, distant and farming experience showed that negative decreasing functions to the factor and reduce yam output. The technical efficiency analysis confirmed that the presence of technical inefficiency effect in yam production as shown by significant gamma value of 0.917. Production, productivity and technical efficiency would be improved if those variables with negative elasticities of productions were improved upon.

CHAPTER THREE

3.0 RESEARCH METHODOLOGY

3.1 The Study Area

The study was carried out in Ondo State, Nigeria. Ondo State has three distinct ecological zones. The mangrove forest to the south, the rain forest in the middle and the guinea savanna to the north. The state shares boundaries with Osun and Ogun State in the West Ekiti and Kogi State in the North, Edo and Delta in the East and Atlantic Ocean in the South. Ondo State has a population of 2,249, 548 people according to the 1991 census with a total land area of 14,793, 189km²(Ondo State Ministry of Finance Economic Planning and Budget, 2000). Climatically, the State falls within the rain forest belt of the country with vast agricultural potential. The State lies between longitude 4° 3' and 6° East of the Greenwich meridian, 5° 45' and 8° 15' North of the equator. This means the State lies entirely in the tropics. The annual temperature throughout the year ranges from 21° C to 29°C, while humidity is relatively high. The annual rainfall varies from 2000mm in the southern parts to 1500mm in the Northern areas. The raining season falls within April and October while the dry season falls within November and March. This favourable climate makes about 75 percent of the population engage in farming. The state has 18 local government areas with Akure as the State capital. The State is an agrarian one and is well suited for the production of both permanent and arable crops. The majority of the farmers in the study area are small-scale farmers with an average farm size of about one hectare. Part – time farming in which farm households are involved in non – farm job is common in the study area. Farming practices in the study area involve the use of hand tools and other simple implements. However, there is substantial production of tree and cash

crop produce such as cocoa, oil palm and timber. Other major crops in the study area are rubber, cashew, kolanut and coffee. The prominent food crops grown in this area include; yams cassava, maize, pepper while sweet potato, rice, plantain, beans and cocoyam are grown in some localities in commercial quantities. Farmers in this State are predominantly small-scale farmers that still depend on traditional methods of farming. Apart from farming, the inhabitants also engage in other various occupations like trading, manufacturing and commerce. The riverine people of the State are predominantly fishermen.

3.2 Data Sources and Collection

The study involved the use of both primary and secondary data. The primary data were collected on the farm level data on food crop production in the study area with the aid of well – structure questionnaire assisted with interview schedule. The secondary data were obtained from the Federal Office of Statistic, Central bank of Nigeria, previous research report and other relevant bodies within and outside the country.

3.3 The Data

The data collected include information on the

- (i) Socio – economic characteristics of the farmers
 - (a) Age of farmers in years
 - (b) Level of education of farmers in number of years spent in school.
 - (c) Gender
 - (d) Occupational distribution
 - (e) Labour sources

- (f) Sources of land
- (g) Type of farming
- (h) Household size

The inputs – output data of the farmers for the production function analysis were also collected.

- (ii) The output data include the quantity of yam tubers and market price of yam.
- (iii) The major inputs were categorized into three groups
Land, labour and capitals

Land was designated as farm size and was measured in hectares. Hired labour was the major labour element and cost was imputed for any family labour expended using the average wage rate in the study area. A man-day is the work done by an adult male in eight hours. The adult female was estimated as 2/3 man-days and children's labour was 1/2 of an adult male man-day depending on type of task. Capital was viewed as operating expenses and cost of yam setts. The operating expenses include all cost element on items that vary with quantities of yam tubers produced. They include:

- (a) Cost of implement (N)
- (b) Cost of fertilizer and chemicals (N)
- (c) Transportation cost (N)
- (d) Labour cost (N).

3.4 Sampling Procedure

The target population for this study was the yam farmers in Ondo State. The sampling technique was the multistage sampling technique. Non – probability and probability sampling methods were used in selecting the samples. The non - probability method used was the purposive sampling. The multistage sampling techniques are

based on the selection of the sample on a combination of the two or more sampling methods. The first stage in the multi – stage-sampling method involved the purposive selection of four local government areas from the 18 local government areas in the State. These LGAs are noted for yam production in the State. The Local Government Areas involved are Akure South, Owo, Akoko North East and Ondo West. Two villages were randomly selected from each Local Government Areas (eight villages were sampled). Hence, a total sample size of 160 respondents were involved.

3.5 Method of Data Analysis

The analytical techniques involve the use of quantitative and qualitative techniques to analyse the data. The qualitative method involve the use of descriptive statistics such as mean, standard deviation, frequency distribution, percentage, minimum and maximum values to analyse the socio-economic characteristics of the yam farmers in the study area. The quantitative methods involve the use of budgeting analysis to analyse the profitability and stochastic frontier production function to analyse the productivity and technical efficiency of yam production in the study area.

3.5.1 The Budgeting Analysis

This includes Gross margin and Net Revenue analysis to analyse the profitability of yam production in the study area.

The Gross margin (GM) = TR - TVC

TR = Total Revenue

TVC = Total variable cost

(Operating expenses, which include: Cost of agro chemical, transportation cost, labour wage, cost of yam sets and cost of implement).

If $GM > 0$ then the farm is profitable

$$\begin{aligned} \text{The net revenue (NR)} &= TR - TC \\ &= TR - (TVC + TFC) \\ &= TR - TC \end{aligned}$$

Where TC = Total cost.

3.5.2 The Stochastic Frontier Production Function

The stochastic frontier was used to estimate the technical efficiency of each yam farm. It was also used to estimate the production function parameters, which were used for further economic analysis such as the productivity and return to scale analysis. The estimates of the stochastic frontier production function were subjected to the students' t ratio test and the generalized likelihood ratio test for significance of estimated coefficients and presence of technical inefficiency effects respectively.

The generalized likelihood ratio test is defined by a test statistic, chi – square (X^2)

$$X_c^2 = -2[L(H_0) / L(H_a)] \dots\dots\dots (3.1)$$

Where $L(H_0)$ is the value of the likelihood function for the frontier model, in which parameter restrictions specified by the null hypothesis, H_0 , are imposed, that is $\gamma = 0$ and $L(H_a)$ is the value of the likelihood function for general frontier model in which there are no restriction and $\gamma \neq 0$. The X_c^2 has a mixed chi – square distribution with the degree of freedom equal to the number of parameters excluded in the restricted model. This ratio test is to test for the presence of inefficiency effects in the frontier models. The decision

rule is that the null hypothesis is accepted, if the computed chi – square is less than the tabulated chi – square at 5 percent level of significance and given degree of freedom.

The student's t – ratio test is to test for significance of the estimated coefficient and the predicted technical efficiencies.

For the estimated production function parameters coefficient, the test statistics of the t – ratio is computed as

$$t_c = \beta_j / S_{\beta_j} \dots\dots\dots (3.2)$$

Where β_j are the estimated coefficients and S_{β_j} are the standard errors of the estimated coefficients. The Null hypothesis stipulates that the estimated coefficients, β_j are not significantly different from zero.

The decision rule is that H_0 is accepted if t computed is less than t tabulated at a given level of significance and degree of freedom and H_0 is rejected if otherwise.

3.6 Model Specification

Two different models were specified for each of the farm groups

- (a) Model 1: assumed that the traditional response function was an adequate representation of the stochastic frontier model and so it assumed there were no inefficiency effects in the production process (that is, $\gamma = 0$)
- (b) Model 2: it assumed that inefficient effects were present. This is the full frontier production function model, which involves no restrictions and $\gamma \neq 0$. It assumed that the traditional response function was not an adequate representation of the stochastic frontier model.

3.6.1 The General Model (farm model)

The general model for the production technology of the yam farms was assumed to be specified by the Cobb – Douglas frontier production function which when linearised is defined as follows

$$\text{Log } Y_i = \beta_0 + \beta_1 \text{Log} X_{1i} + \beta_2 \text{Log} X_{2i} + \beta_3 \text{Log} X_{3i} + \beta_4 \text{Log} X_{4i} + \beta_5 \text{Log} X_{5i} + \beta_6 \text{Log} X_{6i} + V_i - U_i$$

Where, Log = Logarithm to base 10,

i = i th farm and $i = 1, \dots, 126$

Y_i = Total farm value of yam tubers produced in Naira (N)

X_1 = Farm size measured in hectares (ha)

X_2 = Total labour (hired and /family in man-days (md)

X_3 = Operating expenses in Naira (N)

X_4 = Cost of yam sets in Naira (N)

X_5 = Age of farmers in years (yrs)

X_6 = Educational level of farmers (years of schooling)

V_i = Random error (white noise) and are assumed to be independent of U_i , identical and normally distributed with zero mean and constant variance $N(0, \sigma_v^2)$.

U_i = Technical inefficiency effects which are assumed to be independent of V_i . They are non- negative truncation at zero or half normal distribution with $N(0, \sigma_u^2)$

β^s , σ^2 and γ are unknown scalar parameters to be estimated.

3.6.2 Technical Inefficiency Model

The computed technical inefficiency of the farmers was modeled to depend on some identified farmers socio-economic

variables, which are assumed to be the determinants of inefficiencies in developing country's agriculture (Parikh et al, 1995).

The inefficiency model was specified as follows:

$$U_i = \delta_0 + \delta_1 Z_1 + \delta_2 Z_2 + \delta_3 Z_3 + \delta_4 Z_4$$

Where

U_i = Technical inefficiency effects

Z_1 = Type of farming (dummied as 10 for food /tree crop farming and 11 for only food crop farming).

Z_2 = Source of land (dummied as 10 for owned and 11 for hired)

Z_3 = Type of labour (dummied as 1 for family labour, 2 for hired labour and 3 for both family and hired labour).

Z_4 = Distance of farm from settlement (km)

δ^s = Scalar parameters to be estimated.



4.0 RESULTS AND DISCUSSION

This section presents and discusses the results of the study as spelt out in the specific objectives of the study.

4.1 Demographic Characteristics

4.1.1 Age Distribution

The age distribution of the yam farmers is presented in Table 4.1. The modal age bracket of farmers in the study area was 41 – 50 years while about 78.5 percent of the farmers were less than 50 years. The standard deviation was 14.38. The age distribution ranged between 16 years and 64 years. The analysis of the age distribution showed that majority of the sampled yam farmers were able-bodied men, with the mean age of 43 years represents a virile age for active farm operations. It enhances better vigor, interest and enthusiasm, which serve as an impetus in embracing and accomplishing farming innovations.

Table 4.1 Age Distributions Of Yam Farmers

AGE (YEARS)	GROUP	FREQUENCY	PERCENTAGE
Below 30		25	19.8
31-40		35	24.8
41-50		39	30.9
51-60		18	14.3
61-70		9	7.2
Total		126	100.0

4.1.2 Educational Level Distribution

The educational level distribution is presented in Table 4.2. The study revealed that the level of education of the yam was low with about 69 percent of sampled farmers having primary and no formal education. This situation will impede their responses to adoption and use of many of the improved agronomic practices that could improve yam production and productivity in the study area.

Table 4.2 Educational Level Distributions Of Yam Farmers

LEVEL	FREQUENCY	PERCENTAGE
No formal education	52	41.2
Primary school	35	27.8
Secondary school	39	31.0
Total	126	100.0

4.1.3 Gender Distribution

Table 4.3 shows that 83.3 percent of the respondents were males while only 16.7 percent were females. This implies that males were more engaged in yam production than females in the study area. This must have been due to the labour intensive nature of many yam operations that only males could effectively perform.

Table 4.3 GENDER DISTRIBUTIONS OF YAM FARMERS

GENDER	FREQUENCY	PERCENTAGE
Male	105	83.3
Female	21	16.7
Total	126	100.0

4.1.4 Occupational Distribution

An analysis of the major occupational distribution of the yam farmers in the study area is given in Table 4.4. The table shows that 92.9 percent of the yam farmers in the study area were full time farmers. The study revealed that the major occupation of distribution had direct effects on the level and degree of supervision of the yam farm business in the sense that the farmers would have adequate time for supervision and maintenance of the operations involved in the production process.

TABLE 4.4 Occupational Distributions Of Yam Farmers

Major Occupation	Frequency	Percentage
Farming	117	92.9
Non-farming	9	7.1
Total	126	100.0

4.1.5 Labour Source

The type of labour utilized is presented in Table 4.5. The table shows that 11.1 percent of the respondents made use of hired labour, only 42.9 percent made use of family labour only. The table further reveals that 46.0 percent of the respondents made use of both hired and family labour. The reason for the percentage of family labour could be due to inadequate finance to hire labour. On the other hand, non-availability of enough hired labour could also be responsible for this. The mean of labour (total family and hired labour) used was 395.58 with a standard deviation of 382.06. This is an indication that yam production is labour intensive considering the large variability recorded.

TABLE 4.5 Labour Sources Of Yam Farmers

Labour sources	Frequency	Percentage
Hired	14	11.1
Family	54	42.9
Hired and family	58	46.0
Total	126	100.0

4.1.6 Source Of Land

Table 4.6 shows that 55.6 percent of the yam farmers owned their yam farms while 44.4 percent hired or rented the land. This analysis revealed that land tenure system of land acquisition is still prevalent in the study area.

Table 4.6 Source Of Land Of Farmers

Source	Frequency	Percentage
Owned	70	55.6
Hired	56	44.4
Total	126	100.0

4.1.7 Type Of Farming

Type of farming of yam farmers is presented in Table 4.7. The type of farming is grouped into arable crop farming only and arable crops combined with tree crops farming. The table shows that 66.7 percent of the respondent practiced only food crop farming while 33.3 percent was engaged in food and tree crop farming. This implies that most of the yam farmers in the study area were more comfortable with arable crops.

Table 4.7 Type Of Farming Of Yam Farmers

Type of farming	Frequency	Percentage
Food crop farming	84	66.7
Food and tree farming	42	33.3
Total	126	100.0

4.2 Profitability Analysis

This section discussed the profitability analysis with respect to the Gross Margin per hectare. Table 4.8 presents the Gross Margin Analysis of yam production in the study area.

From the production performance, it was observed that the mean Total Revenue was N256, 249.50 and mean analysis showed that yam production positive value of the gross margin per hectare of N169, 235.00. However, the profitability analysis showed that the positive annual gross margin per hectare indicated that the yam farmer was able to cover his total operating expenses per hectare in the study area and this implies that yam production is a profitable venture.

Table 4.8 Gross Margin Analyses

	MEAN	STD. DEV	MINIMUM	MAXIMUM
Farm size (ha)	0.39	0.40	0.02	2.00
Transportation cost (N)	5,853.57	6,682.98	600.00	40,000.00
Operating expenses (N)	8,363.21	5,881.73	1000.0	31,450.00
Labor cost (N)	149,268.10	141,890.67	10400.00	720,000.00
Cost of Yam Setts (N)	26,762.62	26,868.51	800.00	120,000.00
Total variable cost (TVC)	190,247.50	166,304.61	19,840.00	897,850.00
Total revenue (TR)	256,249.50	210,846.36	10,000.00	1100,000.0
Gross margin (GM)	66002.00	152,028.19	-20840.00	585,000.00
GM/ha	169235.00	576,688.11	-1042000	2329,167.0

4.3 Production Function Analysis

The stochastic frontier production function is discussed under the following:

- i. Estimates of parameters of stochastic frontier
- ii. Productivity Analysis
- iii. Technical efficiency analysis
- iv The influence of the farmers' socio-economic characteristics on TE

4.3.1 Estimate Of Parameters Of The Stochastic Frontier Production Function

The estimates of the parameters of the stochastic frontier production function of yam production are presented in Table 4.9. Model 1 assumed there were no inefficiency effects hence the zero values for the inefficiency variables. Model 2 assumed the presence of inefficiency effects hence the values for the inefficiency variables.

Goodness of fit: The estimated sigma squared (σ^2) was large and significantly different from zero. This indicates a good fit of the model and the correctness of the specified distribution assumptions.

Signs And Significance Of The Estimates

Farm size: The coefficient of farm size carried positive sign for all the farms. This indicates that yam output increases with increase in farm size. This is due to the fact that since the size of farm determines the number of heaps, which consequently determines the number of yam setts to be planted, the increase in farm size will thus increase the production level. The farm size was also significant at 5 percent level for yam production.

Labour: The coefficient of this resource was positive for the farm. This implies that increased labour resource would lead to increase in yam output for the farms due to the labour intensive nature of the farming operations involved in yam production which can affect the yield adversely if not adequately and carefully carried out at the appropriate time.

Operating Expenses: The coefficient was positive for the farms implying that increased operating expenses for the farms would lead to increase in yam output. This implies that the more the money invested into yam production, the more the yield that will be realized. The coefficient was significant at 5 percent level of significance.

Yam setts: The coefficient was positive for the farms. This implies that increase in yam setts would lead to increase in yam output. This is as a result of the fact that yam setts are the ones that directly produce the yam tubers hence as the 'seed' increases, yam output will also increase. The coefficient was significant at 5 percent.

Age: The coefficient was positive for the farms. This implies that the increase in age of farmers lead to increase in output. This is due to the fact that the importance of experience, which goes hand in hand with age, cannot be over-emphasized in yam production since yam production involves so many intensive operations. Moreover, timeliness in the carrying out of these operations for maximum output is based on the previous experience of the farmers over the years. Hence, the farmer improves on his management and skills as he gains more experience year by year.

Education: The coefficient was negative for the farms. This implies that as the level of education increases, yam output decreases. This is contrary to apriori expectation. This could be due to the state of economy of the country as well as the political situation. Hence, yam farmers engage in some socio-political activities, which prevent them from giving full concentration to the farming operation, and since yam production needs adequate supervision and attention, these distractions will impede the productivity.

Table 4.9 Estimates Of Stochastic Frontier Production Function

Variables	Model 1	Model 2
General model		
constant	2.83 (5.65)	4.33* (11.24)
Farm size	0.44 (5.26)	0.78* (12.12)
Labour	0.05 (0.67)	0.03 (0.60)
Operating expenses	0.14 (1.78)	0.09* (2.51)
Yam setts	0.41 (5.15)	0.17* (2.85)
Age	0.13 (0.62)	0.20 (1.36)
Education	-0.04 (-0.98)	-0.001 (-0.03)
Inefficiency model		
constant	0	-2.13* (-3.45)
Type of farming	0	-0.53* (-3.70)
Source of land	0	0.25* (2.39)
Type of labour	0	0.58* (3.30)
Distance of farm	0	0.62* (2.56)
Variance		
Sigma square	0.03	0.15* (7.42)
Gamma	0.64	0.97* (227.07)
Log likelihood fcn	38.45	73.15
T.E. (mean)		0.91

Figures in parentheses are t – ratio

* Estimate is significant at 5% level

4.3.2 Productivity Analysis

All the estimated coefficients on the general model had positive coefficients except education, which had negative sign. This implies that farm size, labour, operating expenses, yam sets cost and age had direct relationship with the farm output. This implies that, there would be increase in yam output by the value of each coefficient as each variable input is increased by unity. For example, if the farm size is increased by one hectare, yam output would increase by N0.78. Consequently, increase in educational level would lower the totals value of yams produced by the farmers per annum because as more educated people come into yam production, the less the attention that would be devoted to supervision which is very central in yam production since many of the yam operations are labour intensive. However, farm size, operating expenses and cost of yam sets were significant at 5% level of significance in yam production.

The elasticity of production of farm size, labour, operating expenses, yam sets and age were positive and less than unity implying the use of each factor was in stage II of the production function and thus efficiently allocated and utilized (Table 4.11). Educational level showed negative returns to the factor that is, the estimated coefficient was negative ($\epsilon_p < 0$). This implies that its allocation was already in stage III of the production function indicating inefficient allocation of the factor in the production function process leading to a reduction in the total output for yam production. Nevertheless, the productivity of the factor could be improved by adopting improved yam production technologies so that the variable could move from stage III to stage II of the production surface, which is the rational zone of efficient utilization of factors. The inefficient

allocation of educational level is contrary to a-priori expectation that productivity, output and even technical efficiency would increase with increase in years of schooling and experience. Since education is expected to be positively correlated to adoption of improved technology and techniques of production. (Ojo and Ajibefun, 2000). The result may be due to the fact that the more educated the farmers, the lesser the time they would have for efficient supervision of their farms due to their involvement in other societal activities such as politics and other occupations as a way of diversification. Educated Nigerian farmers are involved in other enterprises and occupation due to the unhealthy state of the Nigerian economy whereas yam production requires very close attention and supervision.

The analysis of the Return to scale (RTS) is presented in table 4.11. The RTS is the summation of the estimated coefficients of variables used for estimation of the stochastic frontier production function. It shows the scale of operation of production in the production process. The RTS of 1.269 indicates that yam production in the study area was in stage I of the production surface, which is the stage of increasing returns to scale. This implies that yam production is in the irrational stage of production as a result; efforts should be made to expand the present scope of production to maximize the output so as to continue the optimal allocation of the resources.

Table 4.11 Elasticity Of Production And Return To Scale (RTS)

Variable	Elasticity of production
Farm size	0.78
Labour	0.03
Operating expenses	0.09
Yam setts	0.17
Age	0.20
Education	-0.001
RTS	1.269

4.3.3 Technical Efficiency Analysis

4.3.3.1 Presence Of Technical Inefficiency Effects

The summary of the generalized ratio test for the presence of technical inefficiency effects in yam production is presented in table 4.10. The null hypothesis $H_0: \gamma=0$, specified that the yam farmers were technically efficient in their production and that the variation in their output was only due to random effects which were beyond the control of the decision units hence, the average response function (OLS) was adequate to estimate the production function parameters. The result of the test revealed that the null hypothesis ($\gamma=0$) was strongly rejected with the computed (X^2_i) greater than the tabulated (X^2) at 5 percent level of significance. This is an indication that there was presence of technical inefficiency effects in yam production in the study area meaning that the traditional response function was not an adequate representation of the yam farmers' production function. Therefore, model 1 was not an adequate representation of the

production function hence; model 2 was preferred to further econometric and economic analyses.

The estimated gamma (γ) parameter of model 2 indicates that about 97 percent variation in output of yam production was due to technical inefficiency effects or differences in their technical efficiencies. This conformed to the work of Seyoum et al (1998) who investigated the technical efficiency and productivity of maize producers in eastern Ethiopia. Also, in another study Ajibefun (1998) investigated the technical efficiency of food crop farmers under the National Directorate of food crop farmers under the National Directorate of Employment (NDE) in Ondo state, Nigeria. He observed that the Cobb-Douglas function was adequate representation of the stochastic frontier production function. The null hypothesis that the farmers were fully efficient, which implied that inefficiency effects were absent from the model was rejected. It also conformed to the work of Ojo (2003) who examined the productivity and technical efficient of poultry egg production in Nigeria using the stochastic frontier production function analysis. The study revealed that technical efficiency of poultry egg farmers varied due to the presence of technical inefficiency effects in poultry egg production in Nigeria. As a result, the null hypothesis of no inefficiency effects in egg production ($\gamma=0$) was strongly rejected.



Table 4.10 Generalized Likelihood Ratio Test of Absence of Inefficiency Effects.

Null hypothesis	L (H0)	L (Ha)	X^2_c	df	$X^2_{(7,0.05)}$	Decision
$\gamma=0$	38.45	73.15	69.39	7	14.07	Reject H_0

4.3.3.2 Technical Efficiency of Yam Farmers

The summary of the technical efficiency of the yam farmers is presented in Table 4.12 The Technical Efficiency varied and ranged between 0.35 and 0.99 with the mean technical efficiency of 0.91. The decile range of the Technical Efficiencies in Table 4.13 revealed that about 93.65 percent of the yam farmers had technical efficiencies of 0.81 and above. The remaining 6.35 percent of the farmers had technical efficiencies of less than 0.80. The study revealed that the sampled farmers were relatively very technically efficient.

Table 4.12 Technical Efficiency Analysis

VARIABLE	ESTIMATES
Mean	0.91
Minimum value	0.35
Maximum value	0.99

Table 4.13 Frequency Distribution Of Technical Efficiency

Efficiency level	Technical efficiency	
Decile range of T.E	Frequency	Percentage
0.31-0.40	1	0.79
0.41-0.50	3	2.38
0.51-0.60	1	0.79
0.61-0.70	-	-
0.71-0.80	3	2.38
0.81-0.90	25	19.84
0.91-1.00	93	73.81
	126	100.00

4.3.4 The Influence Of The Farmers' Socio-Economic Characteristics On The Farm Technical Efficiency

The effects of the socio-economic characteristics of the yam farmers on their technical efficiencies are presented in Table 4.10.

Type Of Farming: The estimated coefficient for type of farming was negative which indicates that farmers that engage in food crop farming alone had higher technical efficiency than those that combined food and tree crop farming. This implies that the farmers who practiced food crop farming only were more technically efficient in yam production due to better supervision and monitoring of the farm operations.

Source Of Land: The estimated coefficient for source of land was positive. This indicates that technical inefficiency increases as a result of the sources of land. This correlates with the earlier findings that 56.6 percent of the farmers owned the land used for farming while the remaining 44.4 percent either borrowed or rented the farmland. This implies that the fewer percentage who obtained the land on rentage or borrowed were more efficient in yam production since they were conscious of the fact that they would have to pay a certain amount on it monthly or annually. As a result, they focused on the optimization of the resources so as to maximize profit while the farmers who owned their farmland could afford to be lazy and non-chalant since the land attracted less cost for its use.

Type Of Labour: The estimated coefficient for type of labour was positive for the farmers in the study area. This indicates that the type of labour increases technical inefficiency. From the earlier findings, family labour was mostly used which could result into high level of unseriousness as a result of undue familiarity between family

members whereas, with the sensitiveness of yam production operations like staking, stem tendering etc. there is the need for better supervision and co-ordination of labour.

Distance Of Farm: The estimated coefficient for distance of farm was positive. This implies that technical inefficiency increases as the distance of the farm from farmers' settlements increases. This is as a result of the fact that more transportation cost will be incurred as the distance increases which will eventually result in increase in the production cost of yam.

5.0 SUMMARY, CONCLUSION AND RECOMMENDATIONS

5.1 Summary

The study was based on data collected on the production performance of yam farmers from four Local Government Areas of Ondo State. Primary and Secondary data were collected on 126 yam farmers selected using multistage random sampling techniques. Structured questionnaire with interview schedule was used to collect the primary data. The methods of data analysis included descriptive statistics, budgeting and the stochastic frontier production function analyses.

The results of the socio-economic analysis showed that the yam farmers were relatively young, with low-level education and quite experienced. It was also revealed that majority of the farmers were full time farmers, they used family labour mostly and majority owned their farmlands while food crop farming was mostly practiced. The profitability analysis of the yam farms showed that yam production was profitable in the study area. The Gross Margin was N169, 235.00 per hectare. The stochastic frontier production function analysis showed that farm size, labour, operating expenses, yam setts and age were positive and had direct relationship with the farm output and was all significant at 5 percent level of significance except labour and age. The return to scale (RTS) of yam production was greater than unity, implying that yam production was in stage I of the production surface, that is, stage of irrational production.

The Technical Efficiency analysis revealed that there was presence of technical inefficiency effects in yam production and thus the Technical Efficiency of the yam farmers varied between 0.35 and 0.99 with a mean Technical Efficiency of 0.91. It was also observed

that only type of farming (adoption of sole cropping of yam) significantly increased Technical Efficiency while other socio-economic characteristics in the inefficiency model decreased Technical Efficiency of the yam farmers.

5.2 Conclusion

The study examined empirically the profitability, productivity and technical efficiency of yam production in four LGAs in Ondo State Nigeria and concluded as follows:

- Yam production was profitable in the study area.
- The variables employed in yam production were efficiently allocated except the variable of education that had an inverse relationship with yam output.
- Yam production was in Stage 1 of the production surface; the irrational stage of production where only scale expansion is the only way forward since inputs allocation and output production is not yet optimal. There will be a proportional increase in their output if there could be any expansion in the use of these resources, so that the increasing return-to-scale value from the study could move to stage II of production function.
- There was presence of technical inefficiency effects in yam production in the study area⁴ but the yam farmers were relatively very technically efficient and TE increased with mono cropping of yam.

5.3 Recommendations

Recommendations arising from the result of this study are:

- Farmers should be educated and encouraged through lectures, field trips and so on to specialize in either arable (food) crops or

cash (permanent) crops so as to be more technically efficient as a result of thorough and better monitoring and supervision of the farm operations.

- More lands should be made readily available to farmers who are interested in farming so as to increase their farm size for higher input since those who are in dire need of land are not landowners. More so, the poor but efficient farmers may not be financially capable of increasing their farm size.
- There should be an increase in wage rate so as to encourage hired labour since the use of family labour encourages technical inefficiency due to sensitiveness of yam production operations.
- The wide distance between the farmers settlement and farm incurred a high production cost of yam resulting in rise in output cost which will impede the move towards food security. As a result of this, the state government as well as local government should try and rehabilitate feeder roads to the farms to facilitate easy transportation of yam tubers to the market.
- Low level of education of farmers led to low adoption of improved technology and low technical efficiency, efforts should be made to expose farmers in the study area to formal education through the auspices of adult education programme of the state and local governments.

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FEDERAL UNIVERSITY OF TECHNOLOGY, AKURE
DEPARTMENT OF AGRICULTURAL ECONOMICS AND
EXTENSION

Dear Respondent,

This questionnaire is purposely to elicit your honest response on yam production. The information you provide in this questionnaire ^{are} ~~is~~ to be used purely for research purposes and will be treated with the highest confidentiality.

Thank You.

EFFICIENCY OF YAM PRODUCTION IN ONDO STATE, NIGERIA.

A. PERSONAL INFORMATION

1. Age: _____

2. Sex: _____

3. Marital Status: (a) Single (b) Married.

4. Household Composition.

(a) Number of Children _____

(b) Number of Wives _____

5. Educational background

(a) No formal education

(b) Primary education

(c) Tertiary education

(d) Other (specify)

6. What is your major occupation ? _____

7. How long have you been farming ? _____

8. What type of farming do you practice ? _____

(a) Livestock (b) Food crop (c) Permanent Crop.

(d) Food and Permanent crop (e) Permanent crop.

If food crop, what type of food crops do you plant ?

(a) _____

- (b) -----
 (c) -----
 (d) -----

9. Production.

- (i) What is your total farm size (ha) ? -----
 (ii) What is the total farm size under yam production (ha) ? -----
 (iii) In how many locations do you have your yam farms ? -----

10. Labour.

- (i) What is the source of your farm labour for yam production ?

(a) Hired (b) Family

- (ii) Please complete this table on labour use for yam production.

Operation	Family Labour Use						Hired Labour Use		
	Men		Women		Children				
	No	Days Worked in a year	No	Days Worked in a year	No	Days Worked in a year	No	Days Worked in a year	Wage/Day
Land Preparation									
Heaping									
Planting									
Weeding									
Raking									
Harvesting									
Fertilizer application									
Transportation									
Others (specify)									

11. Please complete this table on input use.

Input	Quantity	Unit Cost	Lifespan
Cutlasses			
Hoes			
Basket			

Head pan			
Others (specify)			

12. Land

(i) What is the source of land for your farming ?

(a) Inherited (b) Owned (c) Rented/Leased

(d) Purchased (e) Others (specify) -----

(ii) If rented land is used, what is the cost per unit ? N/ha/ac/200 heaps

(iii) What problem do you encounter with land acquisition ?

(a) High cost of rent on land

(b) Non-availability of land

(c) Discrimination against non-indigene

(d) Family members control of quantity of land to use.

13. Capital (Credit Source)

1. What is the source of your credit facilities ?

(a) Personal saving (b) Commercial banks

(c) Nigerian Agriculture and Rural Cooperative Bank (NARCB)

(d) Esusu/Ajo

(e) Friends and relatives

(f) Others (specify) -----

2. What is the total amount borrowed for your farming operation last season ?-----

3. How much did you pay as interest on the amount borrowed ? -----

4. What are the problems encountered in getting the credit facility ? -----

(i) High interest rate

(ii) Late disbursement of loan

(iii) Lack of collateral security

(iv) Problem of filling the loan form

(v) Others (specify)

14. Cost Estimate.

What are the inputs used for your yam production last season ?

Input type	Quantity used	Unit price	Total Amount (N)
(i) Fertilizer			