# ECONOMICS OF COCOYAM FARMING BY CROPPING SYSTEMS IN ONITSHA AGRICULTURAL ZONE IN ANAMBRA STATE, NIGERIA


**BY**

**ONYEOMA, URUCHUKWU MARY [B. Agric. Tech. ]**
**20114774498**


**A THESIS SUBMITTED TO THE POSTGRADUATE SCHOOL**

**FEDERAL UNIVERSITY OF TECHNOLOGY, OWERRI**

**IN PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR THE AWARD OF MASTER OF SCIENCE, M.Sc. IN**

**AGRICULTURAL ECONOMICS**

**MAY, 2016**

## CERTIFICATION

I certify that this work "Economics of Cocoyam Farming by Cropping Systems in Onitsha Agricultural Zone, Anambra State, Nigeria" was carried out by Onyeoma, Uruchukwu Mary ( Reg No: 20114774498 ) in partial fulfillment for the award of Master of Science Degree in Agricultural Economics, in the Department of Agricultural Economics, of the Federal University of Technology, Owerri,

| | |
|---|---|
| Prof. C. C. Eze<br>Principal Supervisor | 23rd May, 2016<br>Date |
| Dr. S. U. Onyeagocha<br>Co-Supervisor | 23-05-16<br>Date |
| Prof. P. C. Obasi<br>Head of Department<br>Agricultural Economics | 24th May, 2016<br>Date |
| Prof. B. O. Esonu<br>Dean SAAT | 27/05/16<br>Date |
| Prof. (Mrs.) K. B. Oyoh<br>Dean Post Graduate School | Date |
| External Examiner | Date |



ii

# DEDICATION

This piece of work is dedicated to God Almighty and to my dear husband and children.

**ACKNOWLEDGEMENT**

My special and profound gratitude goes to God Almighty for his love, protection, faithfulness and his infinite mercy throughout the duration of this programme.

I wish to express my sincere gratitude to my principal supervisor, Prof C.C. Eze and my Co-supervisor Dr.S.U.O. Onyeaguocha who spared their precious time, energy and other resources to supervise and direct this work. May God reward you and grant you your good heart desires,amen .

I am also grateful to Prof. P.C. Obasi, the Head of Department Agricultural Economics FUTO; for his effort in seeing that this work is completed. I also appreciate the contributions of Prof. J.S. Orebiyi, Prof. M.A.C.A. Odii, Prof. N. N. O. Oguoma,, Prof. J. I. Lemchi, Prof. U. C. Ibekwe, Dr. D. O. Ohajianya, Dr. O. C. Korie, Dr. N. C. Ehirim, Dr. C. A. Emenyonu, Dr. N. G. Ben-chendo, Dr. A. Henri -Ukoha, , Dr. F. O. Nwosu, Dr. C.S. Onyemauwa, Dr. I. U. Nwaiwu and all the academic and non academic staff of the Department Agricultural Economics, FUTO, who in one way or the other contributed to the success of this work.

My utmost gratitude goes to my husband, Engr. Sanctus Onyeoma and my children,Chizirim, Chiemerie, Onyedikachi, for their love and understanding. I also appreciate the efforts of my parents Barr. and Late Mrs. G.C. Izunobi, my siblings, Alex, Tony, Ngozi, Ebere, and my sister inlaws, Chinyeaka and Nnso all through the period of this study.

Finally, I wish to thank my class members for their contributions to the success of this work.

## Table of Content

Content Page

## LIST OF TABLES

## ABSTRACT

*This study evaluated the economics of cocoyam farming by cropping systems in Onitsha Agricultural zone Anambra State. The specific objectives were to identify the socio-economic characteristics of cocoyam producers , estimate the average quantity of cocoyam produced from the different cropping systems in the study area, estimate net return of cocoyam production under different cropping systems, determine the factors that influence cocoyam output in the different cropping systems, determine the socio-economic factors that influence net returns from cocoyam production and assess constraints faced by cocoyam producers in the study area. The hypotheses of the study stated that there is no significant relationship between age, gender, educational level, household size, farming experience, and farm size of cocoyam farmers and net returns from cocoyam production. Primary data were collected using a set of structured questionnaire from 142 farmers who were selected from the agricultural zones using multistage sampling technique. Data were analysed with descriptive statistical tools (mean, frequency distribution, and percentage), multiple regression, net returns and output per hectare model. The field results showed that majority of cocoyam farmers in the study area were aged, experienced and relatively educated. Again, the field results showed that cocoyam sole cropping system recorded the highest output (5t/ha) of cocoyam, while cocoyam/maize, cocoyam/cassava, cropping systems recorded 4.4t/ha and 4t/ha respectively. From the field results, cocoyam sole cropping systems recorded the highest net return of about ₦741,225, relative to cocoyam/maize, cocoyam/cassava cropping systems which recorded ₦642,725, ₦508,225 respectively. The results of multiple regression showed that factors that influenced the output of cocoyam positively were farm size, labour input, quantity of cocoyam setts and quantity of fertilizer. while cost of implements, negatively influenced output. However the hypothesis tested showed that age, educational level, household size, farming experience, and farm size of cocoyam farmers significantly influence net returns from cocoyam production in the area except of gender . The major perceived constraints recorded were labour scarcity and high cost of input. It was concluded that the output of cocoyam is influenced by cropping systems practised as there may be competition for light, nutrients, and water depending on the cropping system practiced and also that cocoyam enterprise is profitable. Therefore, it was recommended that Programmes should be constantly organized so as to keep cocoyam farmers abreast with improved technologies in production. Through these programmes, the result of agricultural research involving maintenance of soil fertility under effective crop combination that will result in optimum crop output per unit area of land will easily be transferred to the farmers.*


Keywords: Cocoyam, Cropping system, Farmers, Output

# CHAPTER ONE

# INTRODUCTION

## 1.1 Background of the Study

Cocoyam is a tuber crop intensively cultivated and consumed by resource poor families in South Eastern and South-Southern parts of Nigeria (Shiyam *et al*., 2007). It is a stem tuber that is widely cultivated in both tropical and sub-tropical regions of the world (Yahaya *et al.,* 2013).The two main Species commonly cultivated in Nigeria are *Xanthosoma* called tannia and *Colocasia* called taro (Okoye *et al*., 2009). *Xanthosoma* spp. and *Colocasia* spp. belong to the family Aracae that is made up of 100 genera and 1500 species (Kadurumba and Emerole, 2014).) Cocoyam grows from fleshy corm (tuber) that can be boiled, baked and used as staple food. The flour from Cocoyam is used for preparation of soup, beverages, biscuits, bread and pudding. Iwuoha and Kalu (2000) stated that Cocoyam flour is highly digestible and therefore, suitable for feeding invalids and making baby food. The conversion of cocoyam into flour and chips improves the keeping quality for food security.

Nutritionally, cocoyam is superior to cassava and yam in terms of possession of higher protein, minerals and vitamins (Tambong *et al.*, 1997; Onwubuya and Ajani, 2012). The starchy corms and cormel of cocoyam provide a cheap source of carbohydrate and essential mineral nutrients namely; potassium, phosphorus, magnesium, calcium, iron and zinc (Mwenye *et al.*, 2011). Its tubers are found to contain good level of provitamin A. carotenoids (Mwenye *et al.*, 2011, and Englberger *et al.,* 2008). It contains 70-80% water, 20-25% starch and 1.5-3% protein. Cocoyam leaves are nutritious spinach-like vegetable which gives a lot of minerals, vitamins (A and C), and thiamine (Tambong *et al*., 1997 and Onwubuya and Ajani, 2012).

Although they are seen as less important than other tropical roots crops such as yam, cassava and sweet potatoes, they are major staple in some parts of the tropics and sub-tropics (Opara, 2003 and Ojinaka *et al*., 2009). Cocoyam plays a significant role in bridging the food gap between the time of plenty and scarcity and also has rich economic and socio-cultural connotations. In the south-east and south-south regions of Nigeria, cocoyam production, marketing and consumption are interwoven enterprises that sustain many rural dwellers (Onyeka, 2014). In general, cocoyam represents a prime mover of socioeconomic development and activities in most households where it is produced for food and/or market (Onyeka, 2014). Socio-economic factors such as the level of education, farm size and number of years of experience, technological and institutional factors, and gender affect the net returns from cocoyam production , depending on their location (Fasoranti, 2008; Oyewo and Fabiyi, 2008; Enete and Okon, 2010; Ajah and Nmadu, 2012).

Nigeria is the largest producer of cocoyam in the world with annual output of 4.55million metric tonnes representing 61.2 % and 43.1 % total production in West Africa and Africa, respectively (FAO, 2012). It is a cash crop and a foreign exchange earner, as well as an important component in the rural development of many areas and individuals (Mwenye, 2009). According to Okoye *et al.,* (2006), a cost and return analysis of cocoyam production at the National Root Crops Research Institute Umudike showed that the enterprise is profitable. The results of the profitability analysis showed that cocoyam production is profitable by returning N1.80 to every N1.00 spent.

The crop is among the tuberous roots very well adapted to most agro-ecological zones of Nigeria. It is available all the year round, making it preferable to most other root and tuber crops. It is also resistant to drought and tolerant to a variety of climatic and soil conditions (Ogunniyi, 2008). Despite its wide adaptability as well as it's nutritional and economical values, cocoyam output performance in the country has remained below expectation ranging between 5 and 7.5 tonnes per hectare (Onyeka, 2014). Although there have been significant increases in the total output of cocoyam in West and Central Africa in recent times, these, however, are due to increased harvested area rather than increase in output per land area (Onyeka, 2014).According to Baruwa and Oke, (2012) the technical efficiencies of the farmers were found to be fairly high with a mean of 84.3% which suggests that average cocoyam output falls 15.7% short of the maximum possible level.

The ignorance of the nutritive value and diversities of the food forms from cocoyam by a large percentage of the populace is a major constraint to the general acceptability and extensive production of the crop. Also, the bulk of cocoyam production in Nigeria is in the hands of rural resource poor farmers, who are characterised by small holdings (usually from 0.05 – 3.0 hectares per farmer), low capitalization and low output per hectare (Olayemi, 1994; Adepoju and Awodunmuyila, 2008; Amusa *et al*., 2011). These small holder farmers have no intensive management such as fertilization and the use of improved varieties for commercial cormel (Osundare and Fajinmi, 2013). However, farmers consider the current cocoyam output as low and still declining due to factors like declining soil fertility, unavailability of planting materials and improved varieties, weeds, pests and diseases, limited land for expansion, unavailability of labour and lack of deliberate research and extension efforts to support cocoyam production, utilization and consumption (Talwana, 2009). Furthermore the type of cropping system practised by smallholder farmers can influence output of cocoyam as there may be competition for light, nutrients, and water depending on the type of cropping system used.

**1.2 Statement of Problem**

The growth of population in relation to farm output in developed countries is stable but there is no compensation for this by the total farm output in developing countries like Nigeria (Adepoju and Awodunmuyila, 2008). The growth rate of agricultural production has either stagnated or failed to keep pace with the country's rapid population growth rate of about 3.2 percent resulting in perennial food shortage, continuous increase of food prices and massive importation of food by government (Kareem *et al*., 2013). While food production increase at the rate of 2.5%, food demand increases at a rate of more than 3.5 percent (Anyanwu and Ezedinma, 2006). Therefore, the need to develop a sustainable food production level that is capable of meeting the increasing food demand in Nigeria is inevitable (Adepoju and Awodunmuyila, 2008). This can be achieved by increasing the output of important staples like cocoyam.

Cocoyam is one of those crops neglected and underexploited. Despite the very important roles cocoyam plays as basic diets and source of income in many African countries, the production of the crop is not encouraging as the output per hectare is still low ranging between 5 and 7.5 tonnes per hectare (Onyeka, 2014). Although Nigeria is leading in cocoyam production in the world, the average output per hectare has remained relatively low (5-7.5 tonnes per hectare). This is far below the obtainable yield of 17.5 to 19 tonnes per hectare in China and 23.5 to 35 tonnes per hectare in Egypt (Onyeka, 2014). There is limited information on the cultivation of the crop, which perhaps contributes to the scarcity of cocoyam (Ojinnaka, Akobundu and Iwe, 2009). Also resource allocation to cocoyam is significantly low when compared to crops such as yam and cassava (Okoye,2006). Rural households are rapidly abandoning cocoyam which is an indigenous staple root and tuber crop for other root and tuber crops like yam and cassava, as a result the crop is going extinct.

In Nigeria a dimension of rural poverty is low level of income (Ugwu, 2006). This is as a result of low productivity which can be attributed to the small scale level of production and also ignorance of the nutritive value of some important crops like cocoyam. Despite the high cost of cocoyam and how profitable cocoyam enterprise is, farmers show little or no interest in the production of the crop. Expansion in cocoyam production has the potential of bridging the wide gap of demand and supply and enhancing income of rural farmers.(Amusa.*et al.,* 2011). According to Harsch (2004), a higher output would directly reduce hunger and bring down the costs of food import as well as have wider economic benefits, stimulating rural incomes and provide raw material for African countries.

Cocoyam is seen as women's crop (Okoye *et al.*, 2009). Amusa *et al*., (2011) observed in their work that majority of cocoyam farmers were women who have gained interest in the production, processing and marketing of cocoyam, essentially because of the rapid increase in its share of the urban market in Nigeria . These women have limited access to farmlands and credit facility, especially in areas were it is believed that a woman doesn't own land and that only the head of the family has access to credit (FAO,2011).

Concerted efforts have been made to increase the output of cocoyam by governments over the years through the formulation and introduction of different programmes. These programmes were formulated to enlighten the society on the economic importance of cocoyam and also improve the output of the crop. Among such programmes were, root and tuber expansion program (RTEP) and cocoyam Re-birth Initiative launched in 2007 by the national root crops research Institute (NRCRI), Umudike, (Chukwu *et al*., 2014). Despite these efforts, the output of Cocoyam is still below expectation. This can be attributed to the low research interest to boost production of cocoyam (Enwelu et al., 2014). Farmers and researchers focus on a comparatively small number of crops to meet the various needs for food and industrial raw materials, as a result most useful crops such as cocoyam are neglected and underexploited. To promote and support cocoyam production and make a major contribution to food security and the economy at large, farmers require baseline data which will help focus on cocoyam research and development. It is therefore imperative to analyse the economics of cocoyam farming by cropping systems.

## 1.3 Objectives of the Study

The broad objective of this study was to examine the economics of cocoyam farming by cropping systems in Onitsha agricultural zone of Anambra State, Nigeria.

The specific objectives were:

i. identify the socio-economic characteristics of cocoyam producers in the study area;
ii. estimate the average quantity of cocoyam produced from the different cropping systems ;
iii. estimate the net return of cocoyam production in the area under different cropping systems;
iv. determine the factors that influence cocoyam output in the different cropping systems;
v. determine the socio-economic factors that influence net returns from cocoyam production; and
vi. assess constraints faced by cocoyam producers in the study area.

## 1.4 Hypothesis of the study

The hypothesis tested in this study is;

i There is no significant relationship between age, gender, educational level, household size, farming experience, and farm size of cocoyam farmers and net returns from cocoyam production.

## 1.5 Justification of the study

This study on the economics of cocoyam farming by cropping systems is geared towards bringing to limelight the factors that influence the output of cocoyam and how these factors can be used to increase the output of cocoyam so as to help solve the problem of food insecurity, increase the GDP (gross domestic product) and hence improve the economy of the country. In other words the findings of the study will be beneficial to government, policy makers, industries, youths, and cocoyam farmers.

Slow growth in agricultural production has been a serious problem challenging domestic policy makers in Nigeria. Accelerating that growth will require important contributions from research. In other words this study will help government make policies that will encourage farming business and also invest more in cocoyam production by making land accessible, providing planting materials, extension services and assisting cocoyam farmers through grants and subsidies.

To the industries, the fineness quality of cocoyam granules aid digestion, and qualifies cocoyam as a composite in the manufacturing of infant meals, confectionaries and beverages. An increase in the output of cocoyam will provide raw materials for these industries and also reduce their cost of production.

Also increased research on cocoyam production will not only bring to light the importance of this woman's crop to man and society, more so, it will encourage the youth to tap the many opportunities inherent in cocoyam production and hence make young people self-employed, and at the same time contributing to food and nutrition security. The information from this study will enlighten cocoyam farmers on how to handle the constraints associated with cocoyam production, thereby increasing output and this will in turn increase their standard of living.

**1.6 Plan of the study**

This thesis is divided into five chapters, chapter one is the introduction under which the following were discussed, statement of the problem, objectives of the study and justification of the work.

In chapter two, conceptual literature discussed on, concept of cocoyam, cocoyam cropping systems, and output. The theoretical literature discussed , determination of optimum level of input, determination of optimum level of output, cost theory, and profit theory. Furthermore analytical literature discussed multiple regression, descriptive statistics, net return, and output per hectare model .The empirical literature discussed socio-economic characteristics of cocoyam farmers, ecology of cocoyam, resource use in cocoyam production, fertilization, common pest and diseases, preservation and storage, factors that influence cocoyam output, economic importance of cocoyam, cocoyam consumption, and cocoyam production constraints.

Chapter three, which is the methodology of the study comprised of information on the study area, sample selection, method of data collection, and method of data analysis .

In chapter four, the field results of the survey were presented and discussed. While chapter five summarised the major findings and made conclusion and recommendations based on the findings of the study.

# CHAPTER TWO

# LITERATURE REVIEW

## 2.1 Conceptual Framework

This section discussed major concepts relevant to this study.

### 2.1.1 Concept of Economics

Economics is the study of how individuals ,governments, firms, and nations make choices on allocating scarce resources to satisfy their unlimited wants(www.investopedia.com). It is also the science concerned chiefly with description and analysis of production, distribution, and consumption of goods and services (www.merriam-webster.com)

### 2.1.2 Definition and Origin of Cocoyam

Cocoyams are herbaceous perennial crop grown primarily for their edible roots. *Xanthosoma* (tannia) is a native of tropical central and south America and the Carribean, while Colocasia is a native to South Indian and south east Asia (Montaldo, 1991 and Guillermo, 2006). Alamu and David, (1978), Mbouobda, *et al.*, (2007) states that cocoyam (*xanthosoma)* is a food crop from tropical America introduced to tropical Africa around 1840. Today it is cultivated in the Caribbean, central and tropical America, west and central Africa, South East Asia, Oceania and New Caledonia (Giacometti and leon, 1994, and Mbouobda *et al*., 2007). He further states that Colocasia originated from India and south East Asia about 2000 years ago was spread to Egypt and hence Europe. Cocoyam reached West Africa at the 16$^{th}$ and 17$^{th}$ centuries and was spread further by traders, missionaries and other travellers (Bown, 2000 and Guillermo, 2006).

The etymology of the genus *Xanthosoma* comes from the Greek. *Xanthos* = yellow, and *soma* = body, due to the yellowish colour of the corm and cormel pulp characteristic of several species (Guillermo, 2006)

### 2.1.3 Characterisation of Cocoyam

Cocoyams are characterised morphologically by subterranean stems, corms, enclosed by dry scale like leaves ( Darkol *et. al*., 2014).They are generally comprised of a large spherical corm (swollen underground storage stem) from which a few large leaves emerge (www.plantvillage.com, 2014). The petioles of the leaves stand erect and can reach lengths in excess of 1m (3.3ft), with leaf blades that are large and heart shaped and can reach 50cm (15.8 inch) in length. The corm produces lateral bud which give rise to tubers or cormels and suckers or stolons. "New Cocoyam" (*Xanthosoma Sagittifolium*) can be identified by the presence of a corm which is absent in "old cocoyam (Rodriguez *et al*., 2009). Mwenye, (2009) further states that the main distinguishing feature between the two common types of cocoyam i.e *C. Esculenta* and *X. Sagittifolium* is the position of the leaf attachment on the petiole. In *C. esculenta*, the attachment of the petiole to the lamina is not at the edge of the lamina, but at some point in the middle of the lamina. While in *X. sagittifolium*, the petiole is attached to the indentation and extends from the leaf and constitutes the midrib and the plants are usually large.

### 2.1.4 Taxonomy

The taxonomy of cocoyam is a bit complicated. The different names the crop is known for further add to the confusion. Its names are tannia, tania, yautia, cocoyam, tanier, taioba, mangareto, mangarito, arri, kachu, taro, eddoe, dasheen, elephant ear (Mwenye, 2009 and Manner, 2010). Nevertheless, each variety has its common names, *Colocasia esculenta* is called true cocoyam, old cocoyam or taro while *Xanthosoma sagittifolium* is called tannia, yatuia, Malanga, eddoe,dasheen, coco or new cocoyam (Manner, 2010). Cocoyam belongs to the kingdom: Plantae (plants), subkingdom: Tracheobionta (vascular plants), Type: fanerogamas, Subtype: Angiospermae, Super division: Spermatophyta (seed plant) ,Division: Magnolio phyta (flowering plants) Class: Liliopsida (monocotydons), Subclass: Aracidae, Order: Arum, Family: Araceae, Genus: *Alocasia*, *Colocasia*, *Xanthosoma* (National Plant Data Base, 2003 and Rodriguez *et al.*,2009)

### 2.1.5 Farm

Farm is a piece of land used for growing crops or raising animals (www.merriam-webster.com)It is also an area of land, together with a house and buildings, used for growing crops and/or keeping animals as a business (dictionary.cambridge.org). Oxford dictionary further define farm as an area and its buildings, used for growing crops and rearing animals.

### 2.1.6 Cropping Systems

A cropping system may be defined as a community of plants which is managed by a farm unit to achieve various human goals (food, fibre and other raw materials, wealth and satisfaction) (FAO, 2013) .The term cropping system refers to the crops and crop sequences and the management techniques used on a particular field over a period of years. You can choose from many different types of crops, and you can plant them in different combinations such as:

**a) Monocropping**

This is where the field is used to grow only one crop season after season (FAO, 2013). It is an agricultural practice in which the same crop is planted year after year, without practicing crop rotation or resting the soil. This has several disadvantages: it is difficult to maintain cover on the soil; it encourages pests, diseases and weeds; and it can reduce the soil fertility .

**b) Crop rotation**

This means changing the type of crops grown in the field each season or each year (or changing from crops to fallow (FAO, 2013)). Crop rotation is a key principle of conservation agriculture because it improves the soil structure and fertility, and because it helps control weeds, pests and diseases

**c) Sequential cropping**

This involves growing two crops in the same field, one after the other in the same year. In some places, the rainy season is long enough to grow two crops: either two main crops, or one main crop followed by a cover crop.

**d) Intercropping**

This means growing two or more crops in the same field at the same time (FAO, 2015). It is possible to do this in different ways;

- Broadcasting the seeds of both crops, and dibbling the seeds without any row arrangement. This is called mixed intercropping. It is easy to do but makes weeding, fertilization and harvesting difficult. Individual plants may compete with each other because they are too close together.
- Planting the main crop in rows and then broadcasting the seeds of the intercrop (such as a cover crop).
- Planting both the main crop and the intercrop in rows. This is called row intercropping. The rows make weeding and harvesting easier than with mixed intercropping.

  A possible problem is that the inter-crop may compete with the main crop for light, water and nutrients. This may reduce the yields of both crops.

e) **Strip cropping**

This involves planting broad strips of several crops in the field. Each strip is 3–9 m wide (FAO, 2013). On slopes, the strips can row intercropping with alternate rows of a cereal and a grass cover crop row intercropping with alternate rows of maize and beans

Mixed intercropping: no rows be laid out along the contour to prevent erosion. The next year, the farmer can rotate crops by planting each strip with a different crop.

Strip cropping has many of the advantages of intercropping: it produces a variety of crops, the legume improves the soil fertility, and rotation helps reduce pest and weed problems. The residues from one strip can be used as soil cover for neighbouring strips. At the same time, strip cropping avoids some of the disadvantages of intercropping: managing the single crop within the strip is easy, and competition between the crops is reduced.

f) **Relay cropping**

This is growing one crop, and then planting another crop (usually a cover crop) in the same field before harvesting the first (FAO, 2013). This helps avoid competition between the main crop and the intercrop. It also uses the field for a longer time, since the cover crop usually continues to grow after the main crop is harvested.

### 2.1.7 Output

Output is the amount of energy, work, goods, or services produced by a machine, factory, company, or an individual in a period. (www. businessdictionary.com) Output in economics is the "quantity of goods or services produced in a given time period, by a firm, industry, or country, whether consumed or used for further production. Output is usually measured as the market value of final output, this output value may be compared to many different types of inputs such as labour and land. Crop output is the measurement of the amount of a crop that was harvested per unit of land area and is normally measured in metric tons per hectare or kilograms per hectare. World Bank, (2010) defined crop output, as one of the essential indicators for agricultural development. In essence, crop output is defined as:

Crop output = (amount of harvested product) / (crop area) 2.1

The estimation of crop output thus involves both estimation of the crop area and estimation of the quantity of product obtained from that area. According to FAO, (1982); Fermont and Benson, (2011 ) , crop cuts and farmer estimates are the two methodologies most commonly used by scientists and statisticians to estimate crop production. Crop cuts is a method for estimating crop output developed by pioneers in sampling and survey design in the late 1940s, and was quickly adopted as the standard method recommended by the Food and Agriculture Organization of the United Nations (FAO) to measure crop production in the 1950s (FAO, 1982; Fermont and Benson, 2011). Crop cuttings involve direct physical measurement (weighing) or measurements in a central plot or in one or more subplots. Crop output is calculated as total production divided by total harvested area in the crop cut plot or sub-plots. While farmer estimates involves estimating crop production through farmer interviews which involves asking farmers to estimate for an individual plot, field, or farm what quantity they did harvest or what quantity they expect to harvest. The first is commonly known as farmer recall, whereas the second is referred to as farmer prediction. As harvest quantities are farmer estimations, they are generally expressed in local harvest units instead of kilogrammes or tonnes, which will need to be converted to standard units (Fermont and Benson, 2011).

In Nigerian farms, output of between 3-10t/ha of cocoyam is obtainable (IITA,1973). According to Kouyaté *et al., (*2012), the type of cropping system practiced has a significant effect on the output per hectare. This is consistent with the findings of Chinaka *et al.,(*1987),which reported that cocoyam sole yielded 9.6t/ha, cocoyam/maize/groundnut inter crop gave 9.01t/ha and cocoyam/maize/potato inter crop gave 8.9t/ha.

### 2.1.8 The Concept of Profitability

Profitability means ability to make profit from all the business activities of an organization, company, firm, or an enterprise. It is the primary goal of all business ventures. Without profit the business will not survive in the long run. Profitability measures the ability of farmers to cover their costs and shows how efficiently the management can make profit by using all the resources available in the market. It is an important concept, because it provides incentives for entry into and longevity in the farming business.( Liverpool-Tasie *et al.,* 2011) . In general, Nigerian farmers can be described as rational profit maximizers who respond to price instruments (Ajani 2000) .

Currently, small-scale farmers are generating modest profits from cocoyam cultivation. According to Quaye *et al.,* (2010), to increase profit levels from cocoyam production, promotion of labour efficient farming technologies is recommended. Use of labour efficient farming practices will significantly reduce production cost and increase profits from cocoyam farming. High cost of transportation of raw agricultural produce and cocoyam in particular from the farm gate to consumption centers could also be significantly reduced through post harvest processing and value addition at the farm gate (Quaye *et al.*, 2010)

## 2.2 Theortical frame work

This section discussed various theories relevant to this study.

### 2.2.1Production theory

Production function is a technical and mathematical relationship describing the manner and the extent to which a particular product depends upon the quantities of inputs or services of input, used at a given level of technology and in a given period of time (Debertin ,1986). A production function can be expressed as:

$$Q = f(X_1, X_2, X_3, \ldots, X_n) \qquad 2.2$$

Where $Q$ is the quantity of output and $X_1, X_2, X_3, \ldots, X_n$ are the quantities of factor inputs (such as capital, labour, land or raw materials). A firm's production function could exhibit different types of returns to scale in different ranges of output. Typically, there could be increasing returns at relatively low output levels, decreasing returns at relatively high output levels, and constant returns at one output level between those ranges

#### 2.2.1.1 Increasing returns to scale

An increasing returns occurs when the output increases by a larger proportion than the increase in inputs during the production process

#### 2.2.1.2 Decreasing returns to scale

This is an increase in all inputs that leads to a less than proportional increase in output.

**2.2.1.3 Constant returns to scale**. It is when output increases by that same proportional change as all inputs change

**2.2.1.4 The "Law" of Diminishing Return** Increases in the amount of any one input, holding the amounts all other inputs constant, would eventually result in decreasing marginal product of the variable input (Mankiw, 2014).

The definition of certain concepts use

d in the analysis of this relationship will aid understanding. They are:

**2.2.1.5 Total physical product** (TPP)

The total amount of output obtained by using different units of inputs (Mankiw,2014 )

**2.2.1.6 Average physical produc**t (APP)

The average amount of output produced by each corresponding unit of input (Mankiw,2014 ).

$$APP = \frac{\text{Total physical product}}{\text{input level}} = \frac{Y}{X} \quad 2.3$$

**2.2.1.7Marginal physical product** (MPP)

The additional quantity of output, added by an addition unit of input ie, the change in output as a result of change in variable input (Reddy *et al*.,2009).

$$MPP = \frac{\text{change in total physical product}}{\text{change in input level}} = \frac{\Delta Y}{\Delta X} \quad 2.4$$

**2.2.1.8 Elasticity of production** (Ep)

It is defined as percentage in output as a result of percentage change in input (Reddy *et al*.,2009).

$$Ep = \frac{\text{percentage change in output}}{\text{percentage change input}} \quad 2.5$$

Ep can also be defined in terms of relationship between APP and MPP

$$Ep = \frac{MPP}{APP} \qquad 2.5.1$$

According to Reddy *et al*., (2009) the classical production function can be divided into three stages. This is done to identify the stage in which production decision are rational.

stage I: This stage starts from the origin and ends where MPP=APP. TPP increases at an increasing rate up to the point of inflection and APP is increasing throughout the stage. MPP increases up to the point of inflection and MPP is greater than APP. Elasticity of production is less than one and technical efficiency of variables and fixed resources keeps increasing. This stage is called irrational or sub-optimal stage. At this stage MR is greater than MC.

Stage II: This stage starts from where APP is maximum and ends where MPP is zero. TPP increases at a decreasing rate, APP and MPP decreases but MPP is less than APP and Ep is less than one. The technical efficiency of variable resources decreases but that of fixed cost increases. Also variable resources are abundant and fixed resources are scarce. This is the rational or optimal stage of production. In this stage there is no scope for reorganization of resources and MR=MC

Stage III: This stage starts from where MPP is zero or TPP is maximum. Tpp decreases at increasing rate while APP decreases. MPP becomes negative and Ep less than zero. The technical efficiency of variable and fixed resources decreases with variable resources in excess capacity. This is the supra- optimal or irrational stage of production with the scope for reorganisation of resources.MR is less than MC in this stage.

**2.2.1.9 Determination of optimum level of input.**

The extent of variable resource can be determined by comparing marginal value product Marginal (MVP) and marginal input cost (MIC).

**2.2.1.10 Marginal value product** (MVP) This is an additional income received from using an additional unit of input ( Debertin ,1986).

$$MVP = \frac{\text{change in total value product}}{\text{change in input level}} = \frac{\Delta TR}{\Delta X} \qquad 2.6$$

**2.2.1.11 Marginal input cost (MIC)**

This is the change in the total input cost by using an additional unit of output ( Debertin ,1986).

$$MIC = \frac{\text{change in total input cost}}{\text{change in input level}} \qquad 2.7$$

As more input is added and profit increases, it will get a point, the optimum level of input where MVP becomes equal to MIC. After this point, further addition of input will lead to profit reduction.

**2.2.1.12 Determination of optimum level of output**

It is pertinent to find out the level of output which maximizes profit. This is done by comparing Marginal revenue (MR) and marginal cost (MC)

**2.2.1.13 Marginal revenue (MR)**

The additional income obtained from producing one more unit of output

$$MR = \frac{\text{change in total income}}{\text{change in total physical product}} = \frac{\Delta TR}{\Delta Q} \qquad 2.8 \text{ (Debertin,1986)}$$

MR is always equal to price per unit output. If MR > MC, the additional unit of output enhances the profit and if MR<MC, the production of additional unit of output decreases profit. When MR=MC is the optimum level of output. This analysis reveals that whether it is the equality of MVP and MIC or MR and MC, the result as well as decision-making is the same ie, there is only

one profit maximizing level of input and output for the given information of technical coefficient and prices.

### 2.2.2 Cost Theory

There are two types of costs associated with production – fixed cost and variable cost. In the short-run, at least one factor of production is fixed, so firms face both fixed and variable cost (Koutsoyiannis, 1979). The shape of the cost curves in the short run reflect the law of diminishing returns. In the short run diminishing marginal returns results from adding successive quantities of variable factor to a fixed factor. In the long run increase in capacity can lead to increasing, decreasing and constant returns or scale. There are seven cost, which explains the behaviour of the firm in production.

#### 2.2.2.1 Fixed Cost

Fixed Cost remain invariant in the short run but in the long run there are no fixed cost as all the inputs can be varied (Koutsoyiannis, 1979). Fixed cost includes cost like taxes, insurance, depreciation on machine implements, salaries, tools, buildings. These are also known as indirect cost, sunk cost and overhead cost. The summation of all these costs is called total fixed cost (TFC).

#### 2.2.2.2 Variable cost

This vary with the level of output. They are raw materials, labour, power, charges on manchine, maintenance etc (Koutsoyiannis, 1979) . These are also known as working costs, operating cost, and direct cost, prime cost, circulating and running costs. The summation of these costs refer to total variable costs (TVC)

**2.2.2.3 Total Cost.**

This is the sum of total fixed cost and total variable cost

$$TC = TVC + TFC \qquad 2.9$$

**2.2.2.4 Average variable cost** (AVC)

It is the amount spent on the variable inputs to produce a unit of output (Reddy, 2009)

$$AVC = \frac{TVC}{Q} \qquad 2.10$$

Where Q is the Output

**2.2.2.5 Average fixed cost** (AFC)

It is the cost of fixed resources or inputs required for producing one unit of output (Mankiw,2014).

$$AFC = \frac{TFC}{Q} \qquad 2.11$$

**2.2.2.6 Average cost** (ATC)

This is calculated by dividing TC by output (Mankiw,2014).

$$ATC = \frac{TC}{Q} = \frac{TVC+TFC}{Q} \qquad 2.12$$

**2.2.2.7Marginal Cost** (MC)

This is the change in the total cost due to the change in output (Mankiw,2014).

$$TC = \frac{\Delta TC}{Q} \text{ or } \frac{\Delta TVC}{Q} \qquad 2.13$$

Only TC or TVC can be used because TFC can't be change

### 2.2.3 Theories of Profit

Various authors have propounded different theories on profit

**a). Rental theory of profit:** This theory states that just like rent arising for a piece of land due to its fertility status, an entrepreneur also gets rent for his managerial ability ie profit (Jhingan, 1982). As rents for different lands differ, so also the profit recovered . So profit does not enter price, as price is determined based on the cost of production of the product attributed to marginal entrepreneur.

**b). Wage theory of profit:** This theory explains that just as labourer receives wages for his service, an entrepreneur too gets profit for his services (Jhingan, 1982). Only the services differ in the two cases, as it is physical service in the former and organising capacity in the latter. From this comparison, this theory concludes that profit is a type of wage.

**c). Dynamic theory of profit:** Profit is defined as the excess of price of goods over their cost. Profits arise only due to dynamic change that takes place in a society, and profit do not vary much in a static society (Jhingan, 1982). The reason being that in a static society, the parameters which influence an economy like population, technology, desire of individual, available capital etc remain the same i.e everything is certain in an economy. While dynamic economy is associates with the same parameter as indicated above of a static economy, but these are subject to change overtime. The enterprenuer who takes advantage of changing demand and supply conditions of a commodity makes profit. Enterprenuers with different efficiencies make different profit levels.

**d). Risk theory of profit:** Those who are prepared to take great risks are rewarded with great profits. The profits that is obtained through risk taking exceeds ordinary return on capital (Dewett and Chand, 1997).

**e). Uncertainty -bearing theory of profit:** Profit arises due to uncertainty bearing but not due to risk bearing (Dewett and Chand, 1997). The greater the uncertainty bearing, the higher would be the level of profit.

**f). Innovations theory of profit:** This states that profits accrue to the enterprnuer as a result of innovations that are created in the production process and also in the marketing of the product (Dewett and Chand, 1997).

**g). Monopoly theory of profit:** Firms under monopoly will be having high market power (Tewari and Singh, 1996). They would be price makers rather than price takers. They make their best effort to safe guard their interest and keep their profit at high levels. Also in other to maintain their monopoly power, the firms will prevent the entry of new firms into their business in the form of several barriers, therefore the basic source of profits is the monopoly power of the firm

### 2.3 Analytical frame work

#### 2.3.1 Multiple regression model

Multiple regression analysis is a statistical technique used for predicting the unknown value of a variable from the known value of two or more variables (Hebden,1988). Multiple regression analysis studies the relationship between one dependent variable and several independent variables (called predictors). The regression equation takes the form:.

$$Y = b_0 + b_1 X_1 + b_2 X_2 + \ldots\ldots\ldots\ldots + b_k X_k + e \qquad 2.14 \text{ (Hebden,1988)}$$

Y is called the dependent variable , $X_1, X_2, \ldots, X_k$ are called independent variables and e is error due to the fact that the postulated independent variable do not completely explain Y. $b_0$ , $b_1, b_2, b_3, .., b_k$ are called regression coefficients of independent variable.

The four functional forms of the model, linear, semi log, double log and exponential function will be fitted so as to determine the lead equation after running the regression and this will be on the basis of having the highest value of the coefficient of multiple determination ($R^2$), highest number of significant variables and conformity with a prior expectations (Hebden,1988). Coefficient of multiple determination ($R^2$**)** is the percent of the variance in the dependent variable, explained by the independent variables (Hebden,1988). It is the proportion of variance in the dependent variable that can be explained by the independent variables , the higher the value, the better the fit. The direction of the relationship between variables, are interpreted from the signs (plus or minus) of the *B* coefficients. If a *B* coefficient is positive, then the relationship of this variable with the dependent variable is positive, if the *B* coefficient is negative then the relationship is negative.

### 2.3.2Descriptive statistics

Descriptive statistics are numbers that are used to summarize and describe a set of data. It is a set of brief descriptive coefficients that summarize a given data set, which can either be a representation of the entire population or a sample (Investopedia, 2015). Examples are mean, frequency distribution, percentages, etc.

### 2.3.3 Net returns

Net returns are used to measure profit. It is net income from an investment after deducting all expenses from the gross income generated by the investment. Depending on the analysis required, the deductions may or may not include income tax and/or capital gains. It is useful where the value of the fixed cost is negligible as it is the case with cocoyam production which is operated mostly at small scale level (Arene and Mbata, 2008).

It is calculated thus:

$NR = TR - TC$ 2.15

$TC = TFC + TVC$ 2.16

Where;

NR = Net Return

TR = Total Revenue

TC = Total Cost

TVC = Total Variable Cost

TFC = Total Fixed Cost

### 2.3.4 Output per Hectare

This is done by measuring out $40m^2$ and doing destructive harvesting on the mapped out area. Weighing scales were used to measure the harvested quantity and the output per $40m^2$ was used to solve for output per hectare ( Hahn, 1987; Ezumah and Okigbo, 1980; Eze, 1991 as follows )

$$Y(/ha) = \frac{\text{observed kg}}{40m^2} \times \frac{10{,}000m^2}{1000kg} \qquad 2.17$$

## 2.4 Empirical Framework

### 2.4.1 Socio-Economic Characteristics of Cocoyam Farmers

Various studies on the analysis of socio-economic characteristics of cocoyam producing households in many countries revealed that cocoyam farmers are mostly women who depend on the crop to support their families (Scott *et al.,* 2000; Azeez and Madukwe, 2010; Quaye *et al.*, 2010; Adisa and Okunade, 2011; Ugbajah, 2013). Scott *et al.,* (2000) also stated that many studies show that output from farm enterprises managed by women are lower than those managed by men. This is not because women are worse farmers than men. Women simply do not have access to the same inputs. If they did, their output would be the same as men's, they would produce more and overall agricultural production would increase. Rural women suffer systematic discrimination in the access to resources needed for socio-economic development. Credit, extension, input and seed supply services usually address the needs of male household head (FAO, 2005).

The composition and size of farming family is also one of the most important factors affecting the level of production and productivity on peasant farms. The more the family size, the more labour available to work in the farm and this in turn affects productivity positively. Cocoyam farmers are smallholder farmers who depend on their family for labour. The size of household is a good indicator of labour available for farm work in smallholder farming.

Age is said to be a primary latent characteristic in adoption decisions (Okoye *et al,* 2009). The ability of a farmer to bear risk, be innovative decreases with age (Nwaru, 2004;Okoye *et al.*, 2009). Okoye *et al*, (2007) observed that more than 50 percent of cocoyam farmers in Anambra state comprise of those that have attained the age of fifty years and above. This age might not be appropriate for strenuous farm activities like weeding, planting and heap making and as a result may negatively affect production by leading to technical inefficiency (Obasi *et. al.*, 2013).

The level of education influences participation in agricultural productive activities, adoption, transfer and application of innovations. Low level of education makes introduction of improved technologies by extension agents difficult (Bzugu *et al.*, 2005; Idrisa *et al.*, 2007; Babatunde *et al.*, 2007; Azeez, 2009,Okoye *et al.*, 2006). Exposure to education permits an individual to control the rate of message input and develop the ability to store and retrieve information for later use (Sheba, 1997; Umunna, 2010). Lack of awareness among traditional farmers in Nigeria can be attributed to the high level of illiteracy, which in turn contributes to the low level of adoption of agricultural production technology (Ozowa, 1995; Umunna, 2010). According to Umunna (2010), it is widely acknowledged that farmers with basic education are more likely to adopt new technology, and become more productive.

Baruwa and Oke, (2012) observed that farm size has direct relationship with output. This indicates that increase in farm size will increase the output of cocoyam. The easy accessibility to farm land will likely reduce cost of production and allow farmers to expand their scale of operation. According to Oguniyi, (2008) Loss of profit in cocoyam production can be reduced significantly by increasing farm size. When farmers have access to reasonable hectarage of land, this will enable mechanization and with good management, better resource allocation can be employed by farmers to bring about the much desired increase in food production and food security (Azeez and Maduekwe, 2010).

**2.4.2 Cocoyam Production**

Cocoyam is vegetatively propagated using the corms and to a lesser extent cormel (Udealor *et al.*, 1996, and Barawa and Oke, 2012,) . The use of the apical pieces of the corm was predominant purportedly because it does not entail the utilisation of much of the edible material; they establish very quickly and result in vigorous plants. However, they are best suited to situations where planting occurs shortly after harvesting, since they deteriorate with long storage time. The corm pieces and side suckers were used when there was a long time between the previous harvest and the next planting (Talwana, 2009).

Cocoyam is frequently grown in inter cropping system together with permanent crops such as banana, coffee, coconut, cocoa, maize, plantain. (Barawa and Oke, 2012). It is commonly grown amongst small scale farmers who operate within the subsistence economy. However, in traditional farming system planting is done immediately when the rains become regular. Land preparation for planting cocoyam involves; clearing the bush (if it is a virgin land). If it is a ploughable land, plough twice at 15 days interval (IITA, 2007). The land allotted to cocoyam cultivation are cleared and ploughed using rudimentary tools, mainly a machete or hand hoe. The reason advanced for using the machete or hand hoe was that the tools help to conserve soil moisture, particularly during the dry season (Talwana, 2009). A whole cormel or cut sett from corms (100 -15g) is planted at about to 5-7cm deep on the crest of the heaps or ridges at 1m X 1m apart on row with a seed rate of 10,000 corms \ha. (IITA, 2007). Cocoyam plant development consists of three major stages namely; plant establishment (from planting to about 2months after planting), rapid vegetative growth (2-5months) and a third stage (after5 or 6 months) characterized by tuber development and maturation (Adiobo *et al.*, 2011 and Asumadu *et al*., 2011 ). Most cocoyam varieties mature in about 8 months from planting (IITA, 2007) and cultural practices such as distance between plants and between rows, result in increased leaf area or usually also result in increased output (Guillermo, 2006). Normally close spacing between plants increase the corm and cormel yield per hectare, but yield per plant is higher at wider spacing. Anne et al., (2012) and Chen and Adams, (2001) states that vegetatively propagated commercial varieties are highly susceptible to the cocoyam root rot disease caused by *pythium myriotylum* and Dasheen mosaic virus that is found in the leaves, corms and cormels.

According to Anne *et al.*, (2012) trials have been made using conventional procedures to rapidly increase cocoyam planting materials. Micropropagation is an efficient method to mass propagate good quality materials that substantially improves production. It involves the use of defined growth media supplemented with appropriate growth regulators that enables morphensis to occur from naturally growing plant parts and this helps in producing a large number of plants from a single individual in short time and in limited space (Anne *et al.*, 2012)

**2.4. 3 Ecology**

Output of roots on farmers' field vary according climate and the crop (Sagoe, 2006).He further stated that climate has been identified as a principal factor that control crop distribution and growth though some crops have stable genotype and therefore do not react to variation in environmental changes. The main abiotic stress factors affecting cocoyam are drought, water logging, temperature extremes, solar radiation extremes and nutrient imbalance.

Cocoyam thrive better on a well-drained soil and in a climate where rainfall is well distributed throughout most of the year Mathew, (2002). He further noted that the crop can be grown in a range of PH of 5.5 to 6.5 and temperatures between $20^0$ to $35^0$C.

**2.4.4 Resource use in cocoyam production**

Cocoyam is produced mainly by smallholder farmers who produce at small scale. The farm-level efficiency of smallholder resources has important implications for the agricultural development of a nation (Eze *et al.*, 2010). Efficient farms make better use of existing resources and produce their output at the lowest cost. The efficient method of producing a product is that which uses the least amount of resources to get a given amount of the product (Eze *et al*, 2010). According to Talwana *et al*., (2009) increasing returns to scale in cocoyam production is expected if resources are efficiently used, for example, by proportionately spending on all factors of production rather thn only on extra labour (Ajijola, 2003; Echebiri, 2004; Eze and Okorji, 2003)

Farm size is greatly influenced by the system of land tenure prevalent in an area. According to Eze *et al*., (2011), Land Tenure in Nigeria can broadly be classified into three main types namely; communal, individual (private) and public (state controlled). Communal land is such that is held under an arrangement that provides for joint or communal use of land. Under individual tenure, land is available to the individual owner for agricultural purpose, but may be given out to other farmers on a rental basis, especially for cultivation (Arua and Okorji, 1997; Eze *et al*., 2011). State-held (public) lands are usually made available to individuals or private investors, cooperative societies and other organizations or groups of individuals on request if approved by the state governor (Arua and Okorji, 1997; Land Use Act 1978; Eze *et al*., 2011). According Tenaw *et al*., (2009) land tenure and property rights affect the application of technologies for agricultural and natural resource management. Secured property rights give sufficient incentives to the farmers to increase their efficiencies in terms of productivity and ensure environmental sustainability. It is natural that without secured property rights farmers do not feel emotional attachment to the land they cultivate, do not invest in land development and will not use inputs efficiently (Tenaw *et al.*, 2009). Farmers that owned parcels of land on which they farmed were more productive than non-landowning farming households. This was understandable since farmers that owned land on which they farm were ready to make huge investments on such land through the adoption of new technological packages which enhance productivity levels (Ajani, 2000; Akinseinde, 2006; Oni *et al*., 2009). Also women had a lower level of productivity than men because they had far less access to land and other productive inputs (Oni *et al*., 2009).

Human labour is about the only main source of labour available to small-holder farmers in Nigeria (Akanni and Dada, 2012). Cocoyam producers are smallholder farmers who depend mainly on their families for labour. According to Oluyole and Sanusi (2009), labour is a major constraint in small scale production especially during planting, weeding and harvesting. Farm dudgery and migration of the youths from rural to urban area in search of better standard of living and white collar jobs, leaves the labour force in rural area to be comprised mainly of old men and women, thus having a negative impact on agricultural productivity. Again, the seasonal relationship between the periodical changes in labour use patterns and different labour operations meant to be timely performed exert a limit to the proportion of household labour that can be depended upon. Nearly all farm works are concentrated in the wet season. A slight delay will be costly, particularly at very short wet season. At such times, demand for labour becomes most alarming. Labour supply becomes the conspicuously scarce factor of production (Akanni and Dada, 2012). Labour costs, which have been estimated to be between 70 and 90% of the total produuction costs in smallholder farming is a critical constraint under the present cocoyam production system which is manual in nature (Ezedinma, 2006; Okoye *et al.*, 2008). Labour productivity or output per worker derives its importance from relationship to economic well being of a nation. For economic growth to result in an increased standard of living, it is necessary for output to grow faster than the labor force in the population, which implies that labor productivity must grow (Ukoha, 2000, Okoye *et al*., 2008). With increase in population, rural urban migration, the ageing of the rural population and the feminization of agriculture, rural farm labor is likely to remain inelastic and expensive (Ezedimma, 2006, Okoye *et al.,* 2008)

Lack of capital has been identified as one of the constraints faced by smallholder farmers. Credit is considered as a catalyst that activates other factors of production and makes under used capacities functional for increased production (Ijere, 1998; Ojonugwa and Idoko, 2013). It is a major factor necessary for technological transfer in traditional agriculture (Ojonugwa and Idoko, 2013). Farm credit plays a crucial role in agricultural and rural development as it enables farmers reap economies of scale, venture into new fields of production, employ new technologies and empower them to provide utilities for a widening market (Ojonugwa and Idoko,2013). According to Okojie *et al.,* (2010), the lack of bank accounts, collateral, and information regarding the procedure for accessing credits from banks limit peasant farmers and rural women's access to credit from formal institutions.

### 2.4.5 Fertilizer Application

Judicious combination of organic resources (dead leaves, compost manure, etc), with inorganic fertilizers (NPK) can ensure immediate nutrient release for Cocoyam as well as the long-term build up of soil nutrients (Shiyam, 2007). According to Shiyam, (2007), joint application of sawdust mulch and NPK fertilizer promoted cocoyam growth and output. NPK fertilizer can be applied at the rate of 15:15:15 at 5 to 6 beer bottle capful in a ring form about 10cm to the plant in a depleted soil (IITA, 2007). The leaf growth and cormel output are increased by addition of fertilizer, and high fertilize application reduces time required for cormels to reach maximum size (IITA, 2007).

### 2.4.6 Weed Control

Weed control is one of the constraints the smallholder farmers in Nigeria must contend with in the cultivation of root and crop tubers, especially when the cormels start to grow, weed competition has a detrimental effect on yields.

Losses in cocoyam due to weed infestation could be substantial (Oluwafemi, 2013). Different methods of weed management have been employed in Nigeria to combat weed infestation in cocoyam production, these include cultural control by hand pulling, hand slashing hoeing and mowing of weeds (Ikeorgu, 2000). According to Oluwafemi, (2013), in Nigeria, farmers seldom rely on the use of herbicides to fight weed menace. The reason for this was attributed to high cost of herbicide which seems too expensive to the resource poor farmers. Various research show report that there is a higher net economic return using chemical weeding than hand weeding. Oluwafemi, (2013) also observed in his work that the plot where both Diuron and hand weeding where used had lower weed density than plots where only hand weeding was used.

### 2.4.7 Harvest

The condition of the leaves is a good maturity index for assessing the readiness of corms for harvest (Opara, 2003). According to Opara, ( 2003) to edible aroids are mature for harvesting when leaves begin to turn yellow and start to wither. Taro matures 240-300 days from planting but the eddoe (tania) type matures in180-210 days (Opara 2003). Harvest is done by shaking up the plant and uprooting it and bringing out the cormels, while those that remain in the soil are dug out. Manually harvesting is carefully done to avoid bruising the corm for proper storage. Simple tools such as hoe, shovel and knife are used to remove the soil around the corm. Cocoyam is also harvested mechanically using a machine called cocoyam tractor-mounted harvester which was designed at Federal University of Technology Akure (Akinbamowo *et al.*, 2011). This implement is designed to work as the second stage of a three stage harvesting operation for cocoyam. The major components of this machine are the blade, ridge roller, variable angle, barel gear and a cleaning web. (Akinbamowo *et al.*, 2011). After harvesting it is important that the harvested corm is cured before long-term storage to promote a rapid wound repair process (Opara, 2003). According to Opara, (2003) curing slows down the rates of physiological and pathological deterioration which leads to losses in quality and quantity.

### 2.4.8 Common Pests and Diseases

A number of pests and diseases are encountered by farmers in cocoyam production.

*Phytophthora* leaf blight: The symptoms are small brown, circular, water soaked lesion, (Mbong *et al.*, 2013).According to Mbong *et al.,* (2013), the main causal agent is a fungus known as *phytopthora colocasia* and can be managed by planting resistant varieties. Chemical control using fungicide spray can also be used.

*Phyllosticta* leaf spot: It's symptoms are oval or irregular beige to reddish brown spots on leaves, dark brown spots with chlorotic area around lesion, holes in leaves where lesion centers have dried and dropped out. This disease is caused by fungi called *phyllosticta colocaslophia* and it can be managed by removing and destroying diseased leaves (Manner, 2010).

*Pythium* Root and Corm Rot: It's symptoms are; root system may be completely destroyed, plants stunted with shortened leaf stalks, leaves curled, crinkled and yellowish in colour (Tambong and Hofte, 2001).

Dasheen mosaic (DSMV): This is caused by virus called Dasheen mosaic virus. Its symtoms are leaf distortion, vein chlorosis, mosaic feathering along the veins and in severe cases stunted plant (Nelson, 2008). DSMV is transmitted by three metods; by vectors like aphids, vegetatively through suckers, corms or infected cuttings used for propagation, mechanically by plant sap on knives or shears (yet Dmsv is not transmitted by incidental contact or natural rubbing of leaves between plants) (Nelson, 2008). Dmsv can be controlled using integrated pest management principle (IPM) which involves avoiding introduction or transmission of the virus during vegetative propagation, preventing the introduction and spread of this diseases on new host and control of aphids and ants where aphids transmission of Dmsv is a problem (Nelson, 2008).

Alomae-bobone: This is caused by virus called colocasia bobone disease virus (CBDU).It's symptoms are thickened rolled and brittle leaves, leaf veins are prominent and develop enations, leaf petioles are shortened and also develop enations. Removing and burning affected plants, is a way to manage this disease. (www.plant village .com, 2014)

Other common pests are; giant snail (achatina fulica), namatodes, mealy bug, wooly aphids, beetles, red spider and caterpillar (Manner, 2010)

**2.4.9 Preservation/Storage**

Corm starts rotting as early as two weeks after harvest with tannia suffering less than taro (Passam 1982, Owusu-Darko *et. al.,* 2014). Microbial decay can be controlled by pre-storage fungicide and sodium hypo chlorite application as dips, normally between 24 hours after harvest (Passam 1982, Owusu-Darko *et. al.,* 2014). Cocoyams store best in a cool, dry and well ventilated environment with optimum storage temperature of 7$^{o}$c for up to 4 months (FAO, 2006). Traditional storage methods are simply heaping the corms or cormels under shade or covering them with straw or plantain leaves. Also storage in pits is carried out with the pits covered with leaves and soil (FAO, 2006). These methods have been ineffective due to high percentage of losses ascribed to pathogens and micro-organisms which bring about rottening of the corns (Chukwu *et al.,* 2008).

Efforts to reduce loss of cocoyam in storage at the NRCRI ((National Root Crops Research Institute) Umudike, led to the practice of burying cocoyam in swamps but this also has it's disadvantage. The stored cocoyams usually sprouted and starts normal growth within four weeks. The Gocing storage method for cocoyam is an improved and sustainable method of storing cocoyam developed at the NRCRI, Umudike Nigeria). Chukwu *et al.,* ( 2009) described the gocing barn as a structure constructed from mulch, brick or cement and consist of a dwarf wall of about 1-1.5m high made up with wire mesh to the roof which guarantee adequate ventilation. There is no direct rain or sunlight into the store and the floor is mulched with wood shavings to a depth of 10cm thick and water adequately (50-70% moisture) with humidity of 60-80% and temperature 20-80$^{o}$C is maintained. In the store, the cocoyams are spread on the mulched floor and water sprinkled on the corms and cormels two to three times week. The gocing storage is a panacea to the endermic problem of storability of cocoyam. It is cheap to construct and this increases its potential for adoptability by resource poor and commercial cocoyam producers.

Afoakwa *et al.,* (2014) observed that cocoyam leaves can be preserved by canning . This involves blanching time, treatment of the leaves with sodium metabisulphite, process time. Blanching was effective in reducing browning and increasing the degree of liking for colours of the canned leaves. Treatment of leaves with sodium metabisulpite solution significantly reduced the microbial load and the degree of likeness of the different sensory attributes of the canned product. While increasing processing times led to decreas in microbial load and the degree of liking for colour of canned cocoyam leaves (Afoakwa *et al.,* 2014) cocoyam leaves can be picked with its stalks placed in a bowl of water and kept in a cool place, it will last for a few days

### 2.4.10 Factors that influence cocoyam output

According to Amaza *et al.,* (2006), farm size, fertilizer, labor, seeds, age, education, credit, extension services are significant factors associated with changes in crop output. This in line with the findings of Deininger and Okidi, (1999); Ildephonse Musafiri and Alisher Mirzabaev; (2014), that farm size, the use of seeds and fertilizers are important factors of agricultural output growth. Also, Azeez and Madukwe, (2010) stated that quantity of seed planted, farm size, family labour utilized, hired labour , cropping pattern and gender of the farmer all have direct relationship with cocoyam output. Adequate availability of cultivable land to farmers has been reported by many authors to have positive relationship with output (Fabiyi et. al, 2007). The easy accessibility to land will likely reduce cost of production and allow farmers to expand scale of operation .Further more, farmer's experience is relevant to agricultural productivity. Farming involves a lot of risks and uncertainties; therefore to be competent enough to handle all the vagaries of agriculture, farmers must have stayed in farming business for quite some time (Ogundele and Okoruwa, 2006).

### 2.4.11 Economic Importance

Cocoyam is a good base for food preparation for infants because of the high digestibility of its starch, reasonable content of calcium and phosphorus (for bone building), B-complex vitamins and pro vitamin A (Onwueme, 1987 and Elege, 1987;  Ojinnaka *et.al.,* 2009). Recent studies also show that cocoyam starch can be incorporated in the development of weaning food which is easily digestible and accessible to low-income earners in developed countries (Oti & Akbundu, 200; Ojinnaka *et. al.,* 2009) . Furthermore, cocoyam corms and cormels are rich in mucilage, which can be utilized in the paper industry and in medicinal tablet manufacture (Azeez and Maduekwe, 2010).

Cocoyam is recognized as cheaper carbohydrate sources than grains or other tubers. It is used as alternative energy source in animal feeds (Rodriguez *et.al.,* 2009). Medicinally cocoyam is used to manage diabetes (Eleazu *et al.,* 2013). It also contains B-Carotene, Iron and folic acid, which protect against anemia (Sukamoto, 2003; Enwelu *et. al.,* 2014). They further stated that consumption of micronutrient rich foods such as cocoyam is important for building a strong Immune system that help the body to utilize protein, carbohydrates and other nutrients. In Brazilian popular medicine (Pernabucostate, North East region, capotea aestuans (L) chew Uricaceae and *Xanthosoma Sagittifolium* known locally as "Urtiga-venelha" and "taioba", respectively are used to reduce the symptoms of Osteoporosis (Laise Andrade, (2012). Recent research revealed its potential in the prevention of prostate and breast cancer (Chukwu *et al.*, 2014).

Cocoyam have numerous value added products like crips, soup thickener, cocoyam fufu, flour, Achicha, chin-chin, cocoyam queens cake, doughnut, chips etc. This value product help make more money from cocoyam, reduce spoilage in storage, Diversify uses of cocoyam by categories of people, widen market for cocoyam, increase cocoyam product and encourage the edible growth of subsidiary industries (Chukwu *et al.*, 2013). The use of Cocoyam as a raw material for brewing has been reported by Onwuka and Enneh, (1996.)

**2.4.12 Cocoyam Consumption**

According to Chukwu, (2011); Chukwu *et al., (*2014), among all the root and tuber crops in Nigeria, cocoyam is the only tuber crop that all the parts are edible because the corms and cormels are eaten in various food forms while the leaves and flowers are commonly used as spice to garnish and flavour food.

Cocoyam must always be eaten cooked because, it is toxic when raw (lumur and katangole, 2011). In order to reduce the effect of anti nutrients, which may have some health hazards proper processing before consumption is necessary. Cooking can also be effective in reducing the anti-nutritional factors in foods (Hang *et al.*, 2011). Cooking improves digestibility, promote palatability, improves keeping quality and also makes root crops safer to eat. However cooking may reduce the nutritive value of root crops as a result of losses and changes in major nutrients during cooking ( Akpan and umoh, 2004) .

### 2.4.13 Cocoyam Production Constraints

According to Onwubuya and Ajani, (2012), the major constraints to cocoyam production and processing were high cost of inorganic fertilizer, high cost of hired labour, scarcity of planting materials, lack of finance, low soil fertility, poor extension agent farmers' contact, scarcity of farmland, weed problem and unavailability of organic fertilizer. Abdulrahman *et al.,* (2015) showed that three constraints factors were critical. The factors include; agronomic (pest and disease, unimproved seed and shortage of labour), marketing (high cost of inputs and access to market) and socio-cultural (inadequate capital) problems. Further more, sex discrimination in land acquisition and inefficient allocation of scarce resources are also among factors limiting cocoyam production .

# CHAPTER THREE

# METHODOLOGY

## 3.1 Study Area

This research was conducted in Onitsha Agricultural Zone of Anambra State, Nigeria. Anambra State is made up of four agricultural zones, namely; Aguata, Anambra, Awka and Onitsha. Onitsha agricultural zone was chosen because it is the only zone where cocoyam is intensively grown in the State (ASADEP, 2015). The Zone is located on the Southern part of Anambra State within Latitude $6^0$ $05^1$ - $8^0$ $21^1$N of Equator and Longitude $6^0$ $44^1$- $7^0$ $41^1$E of Greenwich Meridian (ASADEP, 1992). The Zone is made up of seven Local Government Areas; Onitsha South , Onitsha North, Idemili North, Idemili South, Ekwusigo, Ogbaru and Ihiala. The land scape of the area is a low land with humid temperature of $87^0$ C. It experiences two major seasons, the rainy season which starts at the end of the month of march and lasts till end of October and the dry season which starts in the month of November and ends in the month of February. Among food crops grown in the area are, yam, cassava, cocoyam, pepper, palm produce etc. (Obiora, 2013).

The State records about 3000mm of rain fall per annum (www.nacd. gov.ng/ Anambra State Geographical_ location.htm, 2014). This makes the area suitable for agricultural production. The cocoyam based cropping combinations in the study area are as follows , Cocoyam sole cropping system , Cocoyam /Maize cropping system, Cocoyam/Cassava cropping system, Cocoyam/ Plantain/Cassava cropping system, Cocoyam/Yam/Maize/Vegetable/Cassava, Cocoyam /vegetable /Cassava. However, Cocoyam Sole, Cocoyam and Maize, Cocoyam and Cassava cropping systems were chosen because they were the predominant cocoyam crop combinations found in the study area.

### 3.2 Sampling Selection

Multi- stage sampling technique was employed in selecting the respondents. This enabled the survey to cover the entire Zone. The list of the cocoyam farmers in the zone was compiled from Anambra State Agricultural development program and they were purposively selected based on their experience and scale of production. Onitsha Agricultural zone is made of seven blocks which is represented by the seven Local Government Areas that make up the zone . Each block is made up of eight circles or cells and each circle is comprised of eighty cocoyam farmers making it a total number of 4480 cocoyam farmers. The first stage was purposive selection of Four blocks out of the seven blocks in the zone. The second stage was the random selection of four cells from each block. The third stage involved the random selection of ten respondents from each cell making it forty respondents per block and 160 respondents in all.

### 3.3 Data Collection Method

Primary data for this study were collected through the administration of questionnaire and personal observations of the researcher. Data were collected on variables such as the socio-economic characteristics of cocoyam farmers, average quantity of cocoyam produced from the different cropping systems, net returns of cocoyam production under different cropping systems, factors that influence output of cocoyam and the problems associated with cocoyam production. The data for this study were collected between August and October 2015.

### 3.4 Data Analysis

The data collected were analysed using simple descriptive statistics and other appropriate statistical and econometric tools. Objectives (i), and (vi) were realised using descriptive statistics (frequency distribution, percentages and mean). Output per hectare model was used to realise objective (ii) which showed the average output of cocoyam from the different cropping system in the study area. When the output of cocoyam per hectare from the selected farms was calculated, then the average was taken. The multiple regression model was used to realise objectives (iv) and (v), whereas the net returns model was used to realise objective (iii)which estimated the net returns of cocoyam production.

## 3.5. Model Specification

### 3.5.1. Net returns model

This is mathematically specified as follows:

NR = TR - TC 3.1

TC = TFC + TVC 3.2

GP= TR- TVC 3.3

Where;

NR = Net Return

TR = Total Revenue

TC = Total Cost

TVC = Total Variable Cost

TFC = Total Fixed Cost

GP = Gross profit

The following fixed costs (cost of cutlass, cost of hoe, cost of knife, cost of basket) were depreciated using straight line depreciation method derived as:.

$$\frac{(\text{Purchase Price} - \text{Salvage Value})}{\text{Years of Useful Life}} \qquad 3.4$$

The salvage value was assumed to be zero and years of useful life was taken as 5 years

### 3.5.2 Output per hectare model

The quantity of cocoyam per hectare was determined using Hahn, (1987); Ezumah and Okigbo (1980); Eze, (1991) as follows:

$$Y(/ha) = \frac{\text{observed kg}}{40m^2} \times \frac{10{,}000m^2}{1000kg} \qquad 3.5$$

### 3.5.3 Multiple Regression Model

The multiple regression model was used to analyse factors that influence cocoyam output in the different cropping systems and factors that influence net returns from cocoyam production.

### 3.5.4 Factors that influence cocoyam output in the different cropping systems

$$Y_i = f(x_1, x_2, x_3, x_4, x_5, e) \qquad 3.6$$

Where i represents the cropping systems; i = 1 for Cocoyam sole cropping system, i = 2 for Cocoyam and Maize cropping system, i = 3 for Cocoyam and Cassava. cropping system

Y = quantity of cocoyam produced (kg)/ha

$X_1$ = Farm size (hectare)

$X_2$ = labour input (man days)

$X_3$ = quantity of cocoyam setts (kg)

$X_4$ = depreciated cost of farm implements (naira)

$X_5$ = quantity of Fertilizer (kg)

e = error term

The female gender was given one because most of the cocoyam farmers are female.

A priori expectation:

The coefficients of $x_1, x_2, x_3, x_5 > 0$; $x_4 < 0$

The regression model was fitted for the four functional forms of Linear, Semi-log, Double-log, and Exponential to determine the lead equation on the basis of the highest value of the coefficient of multiple determination ($R^2$), highest number of significant variables and conformity to a priori expectations.

labour input has a direct relationship with output. Cocoyam producers are smallholder farmers who depend mainly on their families for labour. As a result, labour input in cocoyam farms are below expectation. Fon, (2013), observed that the marginal products of labor were positive indicating that increases in labor will yield positive marginal products. Also when farmers have access to reasonable hectarage of land, this will enable mechanization and with good management, better resource allocation can be employed by farmers to bring about the much desired increase in food production and food security (Azeez and Maduekwe, 2010). Further more, making fertilizer available to farmers can improve cocoyam output as fertilizer improves technical efficiency of farmers . This is in line with the findings of Okoye *et al.*,( 2008) that fertilizer, an improved technology, shifts the production frontier upwards leading to higher technical efficiency.

### 3.5.5 Factors that influence net returns from cocoyam production

$Y = f(x_1, x_2, x_3, x_4, x_5, x_6, e)$ Equation 3.7

Where

Y = Net return(Naira)

$X_1$ = Age (years)

$X_2$ = Gender of the farmer (dummy variable, 0 = male, 1= female)

$X_3$ = Educational qualification (years)

$X_4$ =Household size(No. of persons)

$X_5$ = Experience in farming (years)

$X_6$ = Farm size

e = error term

a prior expectation:

The coefficients of $x_2$, $x_3$,$x_5$,$x_{6,}$>0; $x_1$ $x_4$,<0

The regression model was fitted into the four functional forms of Linear, Semi-log, Double-log, and Exponential to determine the lead equation on the basis of having the highest value of the coefficient of multiple determination ($R^2$), highest number of significant variables and conformity to a priori expectation.

Okoye *et al*, (2007) observed that more than 50 percent of cocoyam farmers in Anambra state comprise of those that have attained the age of fifty years and above. This age might not be appropriate for strenuous farm activities like weeding, planting and heap making and as a result may negatively affect production by leading to technical inefficiency (Obasi *et. al.*, 2013). Many studies show that output from farm enterprises managed by women are lower than those managed by men (Scott *et al.*, 2000). This is not because women are worse farmers than men. Women simply do not have access to the same inputs.

The literacy level greatly influences the decision making and adoption of innovation by farmers, which may bring about an increase in production of the crop (Abdularham *et al*.,2015). Farmers with large household size tend to dissipate most of their resources on upbringing and education of their children and this reduces net returns . Also experienced farmers are expected to have higher efficiency. This in line with findings of Nwaru (1993) that farmers count more on their experience than educational attainment in order to increase their productivity.

The easy accessibility to farm land will likely reduce cost of production and allow farmers to expand their scale of operation(Baruwa and Oke, 2012 )

### 3.6 Test of Hypothesis

The hypothesis which states that there is no significant relationship between age, gender, educational level, household size, farming experience, and farm size of cocoyam farmers and the net return from cocoyam production was tested by comparing t-ratios obtained by fitting the ordinary least square multiple regression model in the relationship between net returns and cocoyam producers socioeconomic characteristics, with t-tabulated values at specified alpha level and degrees of freedom

## CHAPTER FOUR

## RESULTS AND DISCUSSION

### 4.1 Socioeconomic Characteristics of Respondents

The socio-economic characteristics of the respondents examined were age, sex, household size, level of education , farm size ,experience, and marital status,

#### 4.1.1 Age of Respondents

Table 4.1 shows the percentage distribution of the respondents according to their age.

**Table 4.1 Percentage Distribution of the Respondents by Age**.

| Age (years) | Frequency | Percentage |
|---|---|---|
| 25-34 | 10 | 7.04 |
| 35-44 | 15 | 10.56 |
| 45-54 | 37 | 26.06 |
| 55-64 | 68 | 47.89 |
| 65-74 | 12 | 8.45 |
| Total | 142 | 100 |
| Mean | 55 years | |

*Source: field data, 2015.*

The data presented in table 4.1 showed that 47.89% of the respondents are in the age group of 55-64 years while only 7.04% and 10.56% fell between the age group of 25-34 and 35-44years respectively. This meant that majority of the farmers were old and only a small percentage fell within the work force age group . This could be as a result of the commercial nature of the city and less attention being given to farming by residents, hence the aged find farming as a worthwhile business, and this in turn affects agricultural production negatively. This is line with the findings of Obasi *et al.*, (2013) that this age (51 years and above) might not be appropriate for strenuous farm activities like weeding, planting and heap staking and as a result may negatively affect production by leading to technical inefficiency. According to Okoye *et al*., (2009) Age is said to be a primary latent characteristic in adoption decisions. Nwaru (2004) found out that the ability of a farmer to bear risk and be innovative decreases with age.

#### 4.1.2 Sex of respondents

Table 4.2 shows the percentage distribution of the respondents according to their sex.

**Table 4.2 Percentage Distribution of the Respondents by sex**.

| Sex | Frequency | Percentage |
|---|---|---|
| Female | 105 | 73.94 |
| Male | 37 | 26.06 |
| Total | 142 | 100 |

*Source: field data, 2015.*

Table 4.2 shows that 73.94% of the respondents were female while 26.06% were male. This impliesgggee that women constitute a greater percentage of those involved in cocoyam production in Anambra State. This finding confirms the general believe in the communities that cocoyam is a woman's crop. This is in line with the findings of Quaye *et al*., (2010); Adisa and Okunade,( 2011); Ugbajah, (2013). It confirms the findings of Azeez and Madukwe, (2010), that women participate actively in cocoyam production. Farm enterprises managed by women produce lower output than those managed by men (Scott *et al*., 2000). This is simply because they do not have access to the same inputs (land and credit facility).

#### 4.1.3 Household Size of Respondents

Table 4.3 shows the percentage distribution of the respondents by household size.

**Table 4.3 Percentage Distribution of respondents by household size**

| House hold size (No. of persons) | frequency | percentage |
|---|---|---|
| 1-3 | 12 | 8.45 |
| 4-6 | 85 | 59.86 |
| 7-9 | 45 | 31.69 |
| Total | 142 | 100 |
| Mean household size | 6 persons | |

*Source: field data, 2015.*

Table 4.3 shows that 59.86% of the respondents have household size of 4-6 persons, with a mean of 6 persons . This result implies that the respondents have access to family labour and hence, this is expected to reduce cost of production. Sule *et al*., (2002) stressed that household size has a great role to play in providing family labour for agricultural production.This is consistent with the findings of Obasi *et al.*, (2015) that large household means that the farmers may not need to spend so much money on hired labour since the family could provide the much needed labour input. This is in line with the findings of Ibekwe and Orebiyi (2012), which says that with large household size, most of the labour force can be sourced within the household. This finding agrees with Effiong (2005), and Idiong (2006) who reported that a relatively large household size enhances the availability of labour though large household sizes may not guarantee increased efficiency since family labour, which comprises mostly children of school age, are always in school and are not available for farming activities in most cases

### 4.1.4 Level of education of Respondents

Table 4.4 shows the percentage distribution of the respondents according to their level of education.

**Table 4.4 Percentage Distribution of respondents by level of education**

| level of education (No of years spent in school) | Frequency | Percentage |
|---|---|---|
| 0(No formal Education) | 14 | 9.86 |
| 1-6 | 56 | 39.44 |
| 7-12 | 64 | 45.07 |
| 13-18 | 8 | 5.63 |
| Total | 142 | 100 |
| Mean | 7.5 | |

*Source: field data, 2015.*

Table 4.4 shows that majority (45.07%) of the respondents spent 7-12 years in school. The result also shows that 39.44% and 5.63% of the respondents spent 1-6 and 13-18 years in formal education respectively. This implies that the average farmer had basic education. According to Okoye *et al*, (2004) educated farmers are expected to be more receptive to improved farming techniques. This agrees with the findings of Ugbaja, (2013) that level of education influences participation in agricultural productive activities, adoption, transfer and application of innovations. The literacy level greatly influences the decision making and adoption of innovation by farmers, which may bring about an increase in production of the crop (Abdularham *et al*., 2015). The educational level of farmers does not only increase their productivity but also increase his ability to understand and evaluate new techniques. This is in line with the findings of Umunna (2010), that it is widely acknowledged that farmers with basic education are more likely to adopt new technology, and become more productive. Education affects productivity through effective resource use, allocation and choice of inputs for production activity.

### 4.1.5 Farm size of Respondents

Table 4.5 shows the percentage distribution of the respondents according to their farm size

Table 4.5 **Percentage Distribution of respondents by farm size**

| farm size (ha) | Frequency | Percentage |
|---|---|---|
| 0.01 – 0.06 | 12 | 8.45 |
| 0.07-0.12 | 5 3 | 37.32 |
| 0.13-0.18 | 77 | 54.23 |
| Total | 142 | 100 |
| Mean | 0.16 ha | |

*Source: field data, 2015.*

Table 4.4 shows that 54.23% cultivated 0.13-0.18(ha) while 8 .45% and 37.32% cultivated 0.01 – 0.06 and 0.07-0.12 respectively . This implies that cocoyam production in the study area is dominated by small-scale producers given the average farm size of 0.16ha for the area. This can explained by the fact that majority of the farmers were female and these women don't have access to land in the area. According to Baruwa and Oke, (2012) farm size has direct relationship with output. This is consistent with the findings of Azeez and Maduekwe, (2010) which says that when farmers have access to reasonable hectarage of land, this will enable mechanization and with good management, better resource allocation can be employed by farmers to bring about the much desired increase in food production and food security.

### 4.1.6 Farming Experience of Respondents

The percentage distribution of the respondents according to their level of experience is shown in Table 4.6

**Table 4.6 Percentage Distribution of respondents by level of experience in cocoyam production**

| farming experience (years) | Frequency | Percentage |
|---|---|---|
| 5-15 | 46 | 32.39 |
| 16-26 | 75 | 52.82 |
| 27-37 | 21 | 14.79 |
| Total | 142 | 100 |
| Mean | 16years | |

*Source: field data, 2015.*

Table 4.6 shows that about 32.39% of the respondents had 5-15 years farming experience while 52.82% and 14.79% had 16-26 and 27-37 years of farming experience respectively . The mean farming experience was 16 years. This implies that the respondents have been in production of cocoyam for quite a long time.They are therefore described as experienced and are expected to have higher efficiency that will help to boost their productivity. This is in line with the findings of Okoye *et al.,* (2009) that with more experience, a farmer can become less aversed to the risk implied by adopting a new technology.

### 4.1.7 Marital Status

Table 4.7 shows the percentage distribution of the respondents according to their marital status

**Table 4.7 Percentage Distribution of respondents by marital status**

| Marital Status | Frequency | Percentage |
|---|---|---|
| Married | 95 | 66.90 |
| Single | 5 | 3.52 |
| Widow/Widower | 35 | 24.65 |
| Divorced | 7 | 4.92 |
| Total | 142 | 100 |

*Source: field data, 2015*

Table 4.7 shows 66% of the respondents were married and 24.65% are widow/widower. While 3.52% and 4.92% are single and divorced respectively. This implies that married people dominate in agricultural activities in the study areas. This shows that most of the respondents had family members who can serve as source of labour in their cocoyam farms. This is consistent with the findings of Adepoju and Awodunmuyila (2008),that marital status is an important factor in production in terms of family labour.

### 4.1.8 Labour Source

The percentage distribution of the respondents according to their labour source is shown in Table 4.8

**Table 4.8 Percentage Distribution of respondents by labour source**

| Labour Source | Frequency | Percentage |
|---|---|---|
| Family Labour | 80 | 56.34 |
| Hired Labour | 40 | 28.17 |
| Both | 22 | 15.49 |
| Total | 142 | 100 |

*Source: field data, 2015*

Table 4.8 shows that majority(56.34%) of the respondents made use of family labour while 28.17% used hired labour . This means that they respondents are mainly smallholder farmers who depend to a large extent on their family for labour supply. This is in line with the findings of Akanni and Dada ,(2012), that cocoyam producers are smallholder farmers who depend mainly on their family for labour.

## 4. 2 Cropping system practices and Output Produced

### 4.2.1 Cropping Systems

The percentage distribution of the respondents according to the Cocoyam cropping systems practiced is shown in Table 4.9

**Table 4.9 Percentage Distribution of respondents by cropping systems practiced**

| Types of cropping systems | Frequency | Percentage |
|---|---|---|
| Cocoyam sole | 23 | 16.2 |
| Cocoyam and maize | 28 | 19.7 |
| Cocoyam and cassava | 45 | 31.7 |
| Cocoyam/Plantain/Cassava | 13 | 9.2 |
| Cocoyam /vegetable /Cassava | 18 | 12.7 |
| Cocoyam/Yam/Maize/Vegetable/Cassava. | 15 | 10.6 |

*Source: field data, 2015*

Table 4.9 indicates that Cocoyam sole, Cocoyam/ maize and Cocoyam / cassava cropping systems were the predominant cropping systems practiced in the study area. Also the table shows that majority (31.7%) of the respondents engaged in cocoyam and cassava cropping system .This can be attributed to the fact that cassava as a root tuber is widely accepted by local farmers in the area and identified as the most important among the tuber crops cultivated and consumed in Nigeria (Oguoma and Nwosu, 2009).

### 4.2.2 Estimated Cocoyam Output from the Cropping Systems

The average quantity of cocoyam produced per hectare under different cropping systems was examined and presented in table 4.10

**Table 4.10 Estimated Cocoyam Output from the cropping systems**

| S/No | Cropping Systems | Mean Output/ha |
|---|---|---|
| 1 | Cocoyam Sole | 5t/ha |
| 2 | Cocoyam/Maize | |
| | Cocoyam | 4.4t/ha |
| | Maize | 1.2t/ha |
| 3 | Cocoyam/Cassava | |
| | Cocoyam | 4t/ha |
| | Cassava | 9t/ha |

*Source: field data, 2015*

Table 4.10 shows that Cocoyam Sole , Cocoyam/Maize, Cocoyam/Cassava, cropping systems gave output of 5t/ha ,4.4t/ha, 4t/ha of cocoyam respectively. This results shows that cocoyam sole cropping system has the highest output when compared to other cropping systems.This supports the observation that competition exists more often in mixed cropping system than in sole cropping system for most crops thereby reducing yield. (Chinaka *et al.*,1987). This is in line with the findings of Elena ,(2013) which reported that cropping system practiced by farmers can influence crop output as there may be competition for light, nutrients and water.

## 4.3 Net return of cocoyam production under different cropping system

### 4.3.1 Net return of cocoyam sole cropping systems

The net return of cocoyam sole cropping system was examined and represented in table 4.11

Table 4.11: Net return of Cocoyam sole cropping system

| item | Average rate /ha | Total value ₦ /ha |
|---|---|---|
| Return (cocoyam) | 5 tonnes at ₦ 200/kg | 1,500,000 |
| Gross return | | 1,500,000 |
| cost item | | |
| Land clearing | 20 mandays/₦ 1500/md | 30,000 |
| Land preparation | 30 mandays/₦ 1500/md | 45,000 |
| Planting material (cocoyam) | 1000kg at ₦ 500/kg | 500,000 |
| Fertilizer | 400kg(NPK) at ₦ 8500/50kg | 68000 |
| Labour for fertilizer application | 5 Manday at ₦ 500 | 2500 |
| Labour for planting | 20 manday at ₦ 1200/md | 24,000 |
| Labour for weeding (twice) | 30 manday at ₦ 1500/manday | 45,000 |
| Harvesting | 10 manday at ₦ 500/md | 5,000 |
| Transport | | 5,000 |
| Total variable cost | | 724,500 |
| Gross profit | | 775,500 |
| Fixed Cost: | | |
| Depreciation fixed assets | | 4,275 |
| Rent on land | | 30,000 |
| Total fixed cost | | 34,275 |
| Total Cost | | 758,775 |
| Net return | | 741,225 |

*Source: field data, 2015*

Table 4.11 indicated that cocoyam production is profitable and capital intensive with net return of ₦ 741,225, gross profit of ₦ 775,500 and cost of ₦ 758,775/ha. This is consistent with the findings of Okoye *et al.*, (2009) that cocoyam enterprise is profitable. Total cost were computed from values of variable and fixed inputs used . Fixed inputs such as farm implements (matchet, hoes, baskets, knife) were depreciated and summed up to give a total of ₦ 4275.

Family labour, though not paid for was valued based on average wage rate for 2014/2015 farm year.

### 4.3.2 Net Return of Cocoyam and Maize Cropping System

The net return of cocoyam and maize cropping system was examined and represented in table 4.12

Table 4.12 Net return of cocoyam and maize cropping system

| item | Average rate /ha | Total value ₦ /ha |
|---|---|---|
| Return (cocoyam) | 4.4 tonnes at ₦ 300/kg | 1,320,000 |
| (maize) | 1.2tonnes at ₦ 80/kg | 96,000 |
| Total revenue | | 1,416,000 |
| cost item | | |
| Land clearing | 20 mandays/₦ 1500/md | 30,000 |
| Land preparation | 30 mandays/₦ 1500/md | 45,000 |
| Planting material (cocoyam) | 1000kg at ₦ 500/kg | 500,000 |
| Planting material maize | 20kg at ₦ 500/kg | 10,000 |
| Fertilizer | 400kg(NPK) at ₦ 8500/50kg | 68,000 |
| Labour for fertilizer application | 5 Manday at ₦ 500 | 2,500 |
| Labour for planting | 25 manday at ₦ 1200/md | 30,000 |
| Labour for weeding (twice) | 30 manday at ₦ 1500/manday | 45,000 |
| Harvesting | 15 manday at ₦ 500/md | 7,500 |
| Transport | | 5000 |
| Total variable cost | | 743,000 |
| Gross profit | | 673,000 |
| Fixed Cost: | | |
| Depreciation cost of fixed assets | | 4,275 |
| Rent on land | | 30,000 |
| Total fixed cost | | 34,275 |
| Total Cost | | 773,275 |
| Net return | | 642,725 |

*Source: field data, 2015*

Table 4.12 shows that cocoyam and maize cropping system is more expensive than cocoyam sole cropping system with total cost of production of ₦773,275/ha and also less profitable having a net returns of ₦ 642,725/ha and gross profit of ₦ 673,000/ha. This is in line with the findings of Yusufu *et al.*, (2008) which reported that sole cropping system is more profitable than mixed cropping system. This higher cost is attributed to the inclusion of maize production which will require increase in variable inputs (labour and maize planting material) and the less profit is as a result of the cheap cost of maize output when compared to that of cocoyam.

### 4.3.3 Return of Cocoyam and Cassava Cropping System

Table 4.13 Net return of cocoyam and cassava cropping systems

| item | Average rate /ha | Total value ₦ /ha |
|---|---|---|
| Return (cocoyam) | 4 tonnes at ₦ 300/kg | 1,200,000 |
| (cassava) | 9 tonnes at ₦ 600/50kg | 108,000 |
| Gross return | | 1,308,000 |
| cost item | | |
| Land clearing | 20 mandays/=₦ 1500/md | 30,000 |
| Land preparation | 30 mandays/=₦ 1500/md | 45,000 |
| Planting material (cocoyam) | 1000kg at ₦ 500/kg | 500,000 |
| Planting material (cassava) | 60 bundles at ₦ 500 each | 30,000 |
| Fertilizer | 8bags(NPK) at ₦ 8500/50kg | 68,000 |
| Labour for fertilizer application | 5 Manday at ₦ 500 | 2,500 |
| Labour for planting | 25 manday at ₦ 1200/md | 30,000 |
| Labour for weeding (twice) | 30 manday at ₦ 1500/manday | 45,000 |
| Harvesting | 20 manday at ₦ 500/md | 10,000 |
| Transport | | 5,000 |
| Total variable cost | | 765,500 |
| Gross profit | | 542,500 |
| Fixed Cost: | | |
| Depreciation cost of fixed assets | | 4,275 |
| Rent on land per year | | 30,000 |
| Total fixed cost | | 34,275 |
| Total Cost | | 799,775 |
| Net return | | 508,225 |

*Source: field data, 2015*

Table 4.13 shows that cocoyam and cassava cropping system has a gross return of ₦ 1,296,000 and gross profit of ₦ 542,500. Total cost incurred was ₦ 781,775/ha with a net return of ₦508,225/ha. Also the table revealed that 20 man-day labour was employed during harvest. This is explained by the fact that harvesting both cassava and cocoyam is more strenuous than harvesting cocoyam and maize or only cocoyam. This is consistent with the findings of Philip, (2009) that the highest average labour use was found in the intercrop plots than sole cropping.

**4.3.4 Summary of cost and returns per hectare in the different cropping systems**

**Table 4.14 Summary of cost and returns in the different cropping systems**

| Item | cropping systems | | |
|---|---|---|---|
| | cocoyam | cocoyam/ maize | cocoyam/ cassava |
| Gross return/ha (N) | 1,500,000 | 1,416,000 | 1,308,000 |
| Total cost/ha(N) | 758,775 | 773,275 | 777,775 |
| Gross Profit/ha(N) | 775,500 | 673,000 | 542,500 |
| Net Returns/ha(N) | 741,225 | 638,725 | 508,225 |
| labour input (mandays) | 115 | 125 | 130 |
| Gross return/manday(N) | 13,043.47 | 11,328 | 10,061.53 |
| Gross return/ Total cost(ratio) | 1.97 | 1.83 | 1.68 |
| Net Returns/ Total cost(ratio) | 0.97 | 0.83 | 0.65 |

Source: Derivation from table 4.13

Table 4.14 shows that the three cropping systems; cocoyam, cocoyam/maize, cocoyam/cassava recorded gross return/total cost ratios of 1.97:1, 1.83:1, 1.65:1, respectively. This implies that for every Naira invested in each cropping system , cocoyam sole, cocoyam and maize, cocoyam and cassava, 97 kobo,83 kobo, 65 kobo, were realized respectively. This is in line with the findings of Okoye *et al.,* (2006) that cocoyam production is profitable by returning ₦ 1.80 to every ₦ 1.00 spent. Furthermore although cocoyam sole cropping system recorded the gross return/total cost ratio of 1.97:1, the farmers preferred intercropping cocoyam with other crops. This is due to the risks involved in sole cropping (losing the whole crop in case of disease outbreak). This risk can be avoided if Government provide high yielding and disease resistant variety to the farmers and enlighten them on the economic importance of cocoyam as this will encourage cocoyam producers to engage more in cocoyam sole cropping system.

Gross return/manday shows that for every manday of labour employed in cocoyam production under cocoyam sole, cocoyam and maize, cocoyam and cassava, the sum of ₦ 13,043.47, ₦ 11,328, ₦ 10,061.53 were realized respectively. These values are substantially higher than the average wage rate for labour in the study area. This implies that labour resources were productive under the different cropping systems but most productive under cocoyam sole cropping system. The lowest labour input was recorded under cocoyam sole cropping system(115 mandays). This can be explained by the fact that it is only one crop that is involved.

## 4.4 Factors that influence the output of cocoyam in different cropping system

### 4.4.1 Sole cropping system

Table 4.15 shows the regression result of the factors affecting cocoyam production in sole cropping system. It shows the four functional forms. Based on the highest values of co-efficient of multiple determination( $R^{2)}$, F-statistics and conformity with the a priori expectations, the double log function was chosen as the lead equation.

**Table 4.15 Estimated Results of the factors affecting output of cocoyam in sole cropping system**

| Variables | Linear | Exponential | Semi -log | Double -log |
|---|---|---|---|---|
| **Constant** | 3.0345 | 1.10983 | 636.646 | **597.6084** |
| | (3.81836) | (0.9475) | (4.05958) | (5.602) |
| Farm size($x_1$) | 35.9557 | 35.3408 | 31.5602 | 29.3415 |
| | (4.8701)* | (3.2479)* | (4.15297)* | (5.677)* |
| Labour input($x_2$) | 0.02279 | 0.034134 | 0.18729 | 0.1209 |
| | (2.6490)** | (2.69167)** | (2.8933)*** | (2.7447)** |
| quantity of cocoyam | 0.000077 | 0.000109 | 0.20931 | 0.14895 |
| setts($x_3$) | (1.8025)*** | (1.74385)*** | (1.8644)*** | (1.9502)*** |
| Depreciated | | | | |
| cost of implements($x_4$) | -0.00077 | -0.00069 | -62.575 | -58.6557 |
| | (-4.1419)* | (-2.51322)** | (-4.0544)* | (-5.5865)* |
| Quantity of fertilizer($x_5$) | 0.01977 | -0.0274 | -0.29122 | 0.2009 |
| | (2.3608)** | (-2.21658)** | (-2.4225)** | (2.45655)** |
| **$R^2$** | **0.7479** | **0.7409** | **0.7540** | **0.7594** |
| **Adjusted $R^2$** | **0.6732** | **0.6641** | **0.681144** | **0.6881** |
| **F-value** | **10.010** | **9.6514** | **10.346** | **10.650** |

* significant at 1%; ** significant at 5%; ***significant at 10%

1Source: Field data, 2015

The coefficient of multiple determination ($R^2$) was 0.7594. This implies that 75.94% variability in the output of cocoyam production was explained by the model, while the remaining 24.06% was unexplained, and could be attributed to error and omitted variables. The results showed that farm size($x_1$), labour input ($x_2$), and Quantity of fertilizer ($x_5$) , quantity of setts($x_3$) were significant at 1%,5% and 10% respectively and positively affected cocoyam production in sole cropping system; while depreciated cost of implements ($x_4$) was significant at 1% and negatively affected cocoyam production in sole cropping system;

Farm size ($x_1$), was found to be significant and positively related to the output of cocoyam . This means an increase in farm size will increase output. This is in conformity with a priori expectation that the size of a farm is a strong determinant of the expected output. Oluyole and Sanusi (2009) had similar findings on a study carried out in Cross River State; they reported that with the desired agronomic/management practices, increased farm size will improve farm output. labour input($x_2$) was significant and positvely related to output. This implies that an increase in the labour input will increase output . Quantity of setts($x_3$) was significant and positively relate to output. This means that an increase in the quantity of setts will increase output. This is consistent with the findings of Okoye *et al.,* (2008). Depreciated cost of farm implements($x_4$) is significant and negatively influence output. This shows that an increase in cost of farm implements will reduce output. Quantity of fertilizer ($x_5$) was significant and positively relate to output. This implies that an increase in the Quantity of fertilizer used will increase output.The sum of factor coefficient was -30.28. This is below unity which implies that there was decreasing returns to scale in cocoyam sole cropping system in the study area.

### 4.4.2 Cocoyam and maize cropping

Table 4.16 shows the regression result of the factors affecting cocoyam production in cocoyam and maize cropping system . It shows the four functional forms. Based on the highest values of co-efficient of multiple determination( $R,^2$) F-statistics and conformity with the a priori expectations, the double log function was chosen as the lead equation

**Table 4.16 Estimated Result of the factors affecting output of cocoyam intercropped with maize.**

| Variable | Linear | Exponential | Semi-log | Double-log |
|---|---|---|---|---|
| **Constant** | -1.15183 | -19.304 | **-17.3026** | -1.5945 |
| | (-2.55566) | (-2.25603) | (-4.17324) | (-1.7133) |
| Farm size($x_1$) | -5.249483 | -0.05371 | -0.41299 | 8.01232 |
| | (-1.74608)*** | (-0.14943) | (-2.37139)** | (1.29067) |
| Labour input($x_2$) | 0.0001983 | -0.62404 | 0.99759 | -0.00052 |
| | (1.61136) | (-0.79015) | (2.60685) *** | (2.0467) ** |
| quantity of cocoyam setts($x_3$) | 0.00000047 | 0.033211 | 0.01475 | 0.0000016 |
| | (0.03056) | (0.196223) | (0.17984) | (0.0505) |
| Cost of implements($x_4$) | 0.0001087 | -2.642552 | 0.902634 | -0.000397 |
| | (3.85858)* | (-5.84443)* | (4.11997)* | (-6.82509)* |
| Quantity of fertilizer($x_5$) | -0.006815 | -0.18955 | -0.09191 | -0.01294 |
| | (-2.10825)** | (-1.68783) | (-1.68898) | (1.9380)** |
| **$R^2$** | **0.5677** | **0.5824** | **0.4737** | **0.6051** |
| **Adjusted $R^2$** | **0.4397** | **0.4587** | **0.3178** | **0.4814** |
| **F-value** | **24.144** | **31.219** | **23.355** | **32.2034** |

* significant at 1%; ** significant at 5%; ***significant at 10%

Source: Field data, 2015

The coefficient of multiple determinations ($R^2$) was 0.6051. This implies that 60.51% variability in the output of cocoyam production was explained by the model, while the remaining 39.49% was unexplained, and could be attributed to error and omitted variables. The results showed that labour input and quantity of fertilizer (5) were positiive and significant at 5% . while depreciated cost of implements($x_4$), was negative and significant at 5%.

This implies that increase in labour input and quantity of fertilizer (5) increases the output of cocoyam. while cost of implements($x_4$) is indirectly related to output. This is in line with the a priori expectation and the findings of Enete *et al.,* (2011) which reported that at the societal level, the results of the factor analysis show that the major constraining factors to cocoyam production were economic/institutional factor such as high cost of farm implements. The sum of factor coefficient was -3.28 This is below unity which implies that there was decreasing returns to scale in cocoyam and maize cropping system in the study area.

### 4.4.3 Cocoyam and cassava

Table 4.17 shows the regression result of the factors affecting cocoyam production in cocoyam and maize cropping system. It shows the four functional forms. Based on the highest values of co-efficient of multiple determination( $R^2$), F-statistic and conformity with the a priori expectations, the double log function was chosen as the lead equation

**Table 4.17 Estimated Result of the factors affecting output of cocoyam intercropped with cassava.**

| Variable | Linear | Exponential | Semi-log | Double-log |
|---|---|---|---|---|
| **Constant** | -0.46696<br>(-4.8502) | -4.3222<br>(-11.1029) | **-6.52406**<br>(-9.87739) | -29.8132<br>(-11.1919) |
| Farm size($x_1$) | -0.08454<br>(-2.2181)** | -0.41468<br>(-2.69071)** | -0.03679<br>(-2.18092)** | 0.182759<br>(2.6863)** |
| Labour input($x_2$) | 0.0000924<br>(2.061295)** | -0.00023<br>(-1.26667) | 0.73626<br>(3.31158)* | 2.25044<br>(2.50981)** |
| quantity of cocoyam setts($x_3$) | 0.0000162<br>(1.05248) | 0.0000763<br>(1.225063) | 0.023622<br>(1.017278) | 0.103907<br>(1.109504) |
| Cost of implements($x_4$) | -0.000005<br>(-0.15725) | 0.000101<br>(0.787254) | -0.05589<br>(-0.28641) | -0.653858<br>(-0.830809) |
| Quantity of fertilizer ($x_5$) | -0.00781<br>(-2.13786)** | 0.026384<br>(1.786542)*** | -0.1388<br>(-2.46009)** | 0.491209<br>(2.158671)* |
| **$R^2$** | **0.8465** | **0.8703** | **0.8544** | **0.8776** |
| **Adjusted $R^2$** | **0.8011** | **0.8318** | **0.8113** | **0.8413** |
| **F-value** | **18.618** | **22.643** | **19.811** | **24.196** |

* significant at 1%; ** significant at 5%; ***significant at 10%

Source: Field data, 2015

The coefficient of multiple determinations ($R^2$) was 0.8776. This implies that 87.76% variability in the output of cocoyam production was explained by the model, while the remaining 12.24% was unexplained, and could be attributed to error and omitted variables. The results showed that quantity of fertilizer sett($x_5$), farm size($x_1$) and labour input were significant at 1% and 5% respectively and positively related to output in cocoyam and cassava cropping system. Farm size ($x_1$) is significant and positively affect output of cocoyam. This implies that increases in farm size, increase output. This is in line with the findings of Maikasuwa and Ala, (2013)which reported that farm size had significant positive effect on output. Quantity of fertilizer sett($x_5$) was significant and positively related to output. This means that as the quantity of fertilizer used is increased, output will increase.The sum of factor coefficient was -1.26. This is below unity which implies that there was decreasing returns to scale in cocoyam and cassava cropping system in the study area.

The sum of factor coefficient in the three cropping systems were all below unity. This implies that cocoyam production in the study area was in stage three of production curve. Stage three is a region of decreasing returns to scale in the enterprise. This is an inefficient stage because additional inputs add less to total product than the preceding unit of input. This means that cocoyam producers are inefficient at their level of production and their income and output can be improved if less input is utilized

### 4.5 Factors influencing Net Return from Cocoyam Production

Table 4.18 shows the multiple regression result of the factors influencing net returns from cocoyam production for the four functional forms. Based on the values of $R^2$, F-statistic and the a priori expectations, the double log function was chosen as the lead equation.

**Table 4.18 Estimated Results of The factors influencing Net Returns From Cocoyam Production**

| Variables | Linear | Exponential | Semi-log | Double-log |
|---|---|---|---|---|
| **Constant** | -206667 | 8.652222 | -2478969 | -20.825 |
| | (-2.61457) | (5.079565) | (-4.97413) | (-1.95988) |
| Age($X_1$) | 0.782099 | 0.014675 | 28411.11 | -2.25044 |
| | (2.14408)** | (1.95067)** | (1.660619)** | (-2.71501)** |
| Gender($X_2$) | 5222.906 | 0.082645 | 5656.584 | 0.106936 |
| | (1.156998) | (0.849582) | (1.234723) | (1.094802) |
| Educational level($X_3$) | 0.01977 | -0.0274 | -0.29122 | 0.2009 |
| | (2.3608)** | (-2.21658)** | (-2.4225)** | (2.45655)** |
| Household size($X_4$) | -1146.55 | -0.03721 | -10359.1 | -0.38401 |
| | (-2.07493)** | (-5.12464)* | (-2.81964)** | (-3.16381)* |
| Farming experience($X_5$) | 625.116 | 0.015139 | 7211.465 | 0.204143 |
| | (1.720116)** | (1.93319)** | (1.301489) | (1.72803)** |
| Farm Size($X_6$) | 0.0000924 | -0.00023 | 0.73626 | 2.25044 |
| | (2.061295)** | (-1.26667) | (3.31158)* | (2.50981)** |
| **$R^2$** | **0.6371** | **0.6413** | **0.6753** | **0.6859** |
| **Adjusted $R^2$** | **0.6153** | **0.6198** | **0.6558** | **0.6670** |
| **F-value** | **29.189** | **29.729** | **34.577** | **36.297** |

* significant at 1%; ** significant at 5%;

Source: field Data, 2015.

The coefficient of multiple determinations ($R^2$) was 0.6859. This implies that 68.59% variability in the net returns from cocoyam production was explained by the model, while the remaining 31.41% was unexplained, and could be attributed to error and omitted variables.

The results showed that all the included variables were significant either at 1% or 5% except gender. Therefore, explanatory variables such as age, educational level, household size, farming experience, and farm size have a strong influence on net-returns from cocoyam production.

It could be seen from the results that age($X_1$) is negatively related to net returns. This is an indication that the higher the age, the less efficient the farmer becomes and this in turn decreases the net returns from cocoyam production. This in line with the findings of Obasi *et. al.*, (2013), that old age might not be appropriate for strenuous farm activities like weeding, planting and heap making and as a result may negatively affect production

The level of education($X_3$) was positively related to net returns showing that the more educated the farmers were, the more productive they become. This is in line with the findings of Evbuomwan, (2012) which reported that education has been adjudged a key factor in determining the productivity of labour and as such, the success and profit levels of enterprises as education improves the skills and technical know-how of the farmers. On the other hand household size ($X_4$) was negatively related to net returns, this implies that increase in household size decreases the net returns from cocoyam production, since the farmers have more mouth to be fed and more responsibilities which reduces the net returns. Farming experience ($X_5$) was positively related to net returns. This means that the more experienced the farmer is, the more productive he becomes and this will increase net returns. Increased years of farming experience exposes the farmers to more efficient ways of allocating resources at profit. Also farm size($X_6$) is positively related to net returns. This means that the larger the farm size, the more the output produced and hence the increase in net returns. This assertion agrees with the results of Oguniyi, (2008). Therefore the hypothesis that there is no significant relationship between age, gender, educational level, household size, farming experience, and farm size of cocoyam farmers and net returns from cocoyam production is rejected with respect to age, gender, educational level, household size, farming experience, and farm size, but accepted with respect to gender.

**4.6 Constraints Faced by Cocoyam Producers in the study area.**

The various constraints limiting the production of cocoyam in the study area are presented in table 4.19

Table4.19: Distribution of respondents according to perceived constraints to cocoyam production

| Perceived Constraints | Frequency | Percentage |
|---|---|---|
| High cost of inputs | 75 | 52.8 |
| low soil fertility | 38 | 26.8 |
| Land tenure problem | 47 | 33.1 |
| labour scarcity | 92 | 64.8 |
| Inadequate storage facility | 30 | 21.2 |
| Unavailability of planting materials | 40 | 28.2 |
| Pest and diseases | 51 | 35.9 |
| Ignorance of the nutritive value of cocoyam | 45 | 31.7 |
| Poor extension services/research | 63 | 44.4 |

*Source: field data 2015*

Table 4.19 shows that majority (64.8%) of the respondents perceived labour scarcity as a major constraint . Onitsha is a commercial city with the biggest market in the country, this makes trading a major occupation in the city. In other words, most able bodied active men and women migrate to the city transact business leaving farming for the old men in the rural areas. Futher more, high cost of inputs, poor extension services and research, ignorance of the nutritive value of cocoyam, land tenure problem which accounted for 52.8%, 44.4%, 31.7%,33.1% respectively are also important constraints limiting cocoyam production .Other identified constraints were low soil fertility ,unavailability of planting material, pest and diseases, Inadequate storage facility which also accounted for 26.8%, 28.2% , 35.9%, 21.2%, respectively. This is consistent with the findings of Adepoju and Awodunmuyila,(2008), Enwelu et al.,(2014) which reports that labour scarcity, unavailability of planting material, low research interest and ignorance of nutritive value of cocoyam are major problems limiting cocoyam production. This is in conformity with the finding of Dixon, Ngeve and Nukenine (2002) who had asserted that root and tuber crops suffer heavy yield losses in some area in Nigeria as a result of pest and disease infestation. Also unavailability of improved seeds make farmers use seeds from previous harvest and this could jeopardise productivity. This consistent with the findings of Ekong, (2003), that most farmers have little or no access to improved seeds and continues to recycle seeds that have become exhausted after generations of cultivation.

# CHAPTER FIVE

# SUMMARY, CONCLUSION, AND RECOMMENDATIONS

## 5.1 Summary

This study examined the economics of cocoyam farming by cropping systems in Onitsha agricultural zone of Anambra State. The specific objectives were to: identify the socio-economic characteristics of cocoyam producers ; estimate the average quantity of cocoyam produced from the different cropping systems ; estimate net income of cocoyam production in the area ; determine the factors that influence cocoyam output in the different cropping systems ; determine the socio-economic factors that influence net returns from cocoyam production in the study area; and assess constraints faced by cocoyam producers in the study area. The hypotheses was that there is no significant relationship between socio-economic characteristics of cocoyam producers and net returns from cocoyam production.

Data for this study were collected with the aid of structured questionnaire from 142 farmers who were selected using multistage sampling techniques from the Agricultural Zone. Data were analysed with descriptive statistical tools (mean, frequency distribution, and percentage), multiple regression, net returns and output per hectare model.

The results of the study, showed that majority of the respondents (51.4%) were aged 51-60 years, they were relatively educated with a mean of 16 years farming experience . Majority of the farmers((73.9%) were female farmers and were married with a mean household size of 6 persons.

The results of output per hectare of cocoyam under different cropping systems showed that cocoyam sole cropping system had the highest output per hectare (5t/ha) of cocoyam while other cropping systems: cocoyam and maize, cocoyam and cassava, produced 4.4t/ha, and 4t/ha of cocoyam respectively.

The net returns from the three cropping systems revealed that cocoyam sole cropping system had the highest net returns of about ₦741,225, while cocoyam and maize, cocoyam and cassava, recorded ₦642,725 and ₦ 508,225 respectively. The results of the multiple regression analysis showed Farm size, cost of labour, quantity of fertilizer , quantity of setts, depreciated cost of implements were factors that significantly affect the output of cocoyam in the different cropping systems.

The results of the constraints limiting cocoyam production showed that majority of the respondents (64.8%) perceived labour scarcity as the major constraint while inadequate storage facility was the least (21.2%) perceived constraint.

However, the result from the test of hypothesis showed that the socio-economic characteristics of cocoyam producers do significantly influence their net returns in the area.

## 5.2 Conclusion

This study concluded that although Farm size, labour input, quantity of fertilizer , quantity of setts, depreciated cost of implements, are factors that affect output of cocoyam, the type cropping system practised by cocoyam farmers as well as the farmers' socioeconomic characteristics affects the performance of cocoyam farmers. It could be concluded also that cocoyam production is profitable in the various cropping systems. The believe that cocoyam is a woman's crop holds. Also, technological innovations and well packaged extension services can raise entrepreneurship on cocoyam and lead to higher output, increase the GDP (gross domestic product) and hence improve the economy of the country.

### 5.3 Recommendations

Based on the findings of this study, the following recommendations were made;

i. Labour scarcity is a major constraint limiting the production of cocoyam. Provision of required infrastructural facilities or basic amenities by government in the rural areas will go a long way to stop the migration of youths to the urban areas, abandoning farming activities to the old men and women .

ii. The ignorance of the nutritive value of cocoyam is also a factor limiting the production of cocoyam. Awareness creation on the nutritive value and economic importance of cocoyam would be a necessary step towards increased cultivation and production of cocoyam. There is also the need to assign more extension agents to attend to the farmers as this particular crop has not been given much attention by government.

iii. The study shows that age and gender had a negative relationship with the performance of cocoyam farmers. This result calls for government policies aimed at encouraging younger and more active new entrants especially the youths to cultivate cocoyam and the experienced ones to remain in farming. Women play a significant role in cocoyam production in the study area, therefore free education programme especially for the girl child is advocated as well as policies designed to improve women access to fertilizer, credit, agricultural extension services and new technologies.

iv. Access to large hectarage of land will enable mechanization and with good management, better resource allocation can be employed by farmers to bring about the much desired increase in food production and food security. Farm size can be increased by incorporating changes in land tenure system which allow equal ownership of land holdings by men and women. Farmers especially females should not be discriminated against in land acquisition so as to enable them cultivate more land area for the crop as well as other crops. To this end, the land use act should be appropriately amended. Farmers are also to take appropriate measures in allocating their scarce resources such as land and reducing amount spent on labour.

v. Prices of farm inputs such as fertilizers should be made affordable so that farmers can afford to buy them for use in their farms. Cocoyam farmers are also enjoined to form themselves into co-operative society so as to pool resources together to enhance members' production.

vi. Planting material should be made available to the farmers by government through extension agents . In other words, there is need for Government to provide adequate and timely farm inputs for farmers as this will enable the farmers to increase efficiency, output and income at large.

vii. Pests and diseases are severe constraints affecting cocoyam production. Government should provide high yielding and disease resistant variety of crops to the farmers through the extension agents in order to boost the productivity of the farmers. Farmers should be enlightened by extension agents on pests control and cropping systems like Crop rotation which helps control weeds, pests and diseases.

## REFERENCES


Adelekan B.A. (2011), "An Evaluation of the global potential of cocoyam (*colocasia* and *xanthosoma* species as an energy crop". British Journal of Applied Science and Technology 2(1):1-15,

Adepoju A.A and Awodunmuyila D.J (2008), "Economics of cocoyam production and Marketing in Ekiti East Local Government area, Ekiti State,Nigeria". Research Journal of applied Sciences 3(2):95-98

Adisa, B.O. and Okunede, E.O (2011)" Women in Agriculture and Rural Development in Madukwe M.C (ed) Agricultural Extension in Nigeria (2nd edition)" AESON Publication ARMTI, Ilorin, Nigeria Pp 90-100.

AgriInfo. (Agricultural information bank) (2011)," Farming Systems & Sustainable Agriculture".http://agriinfo.in/?page=topic&superid=1&topicid=643. Retrieved 30th April, 2015

Ajah J.and Nmadu J.N. (2012),"Socio-economic Factors Influencing the Output of Small-Scale Maize Farmers in Abuja, Nigeria". Crop Research Institute, Umudike.

Ajani, O.I.Y. (2000), "Resource productivity in food crop farming in the northern area of Oyo state, Nigeria". Unpublished PhD Thesis, Department of Agricultural Economics, University of Ibadan.

Ajijola, S. (2003),"Efficiency of resource use among cocoyam farmers in Owo Local Government Area of Ondo State, Nigeria". Moor Journal Agricultural Research, 4: 281-287

Akanni K.A and Dada A.O. (2012), "Analysis of Labour- Use Patterns among Small-Holder Cocoa Farmers in South Western Nigeria". Journal of Agricultural Science and Technology B 2 (2012) 107-113

Akinseinde (2006), "Nonfarm activity and production efficiency of farm household in Egbede local government of Oyo state, Nigeria". M.Sc project, Department of Agricultural Economics, University of Ibadan.

Akpan E.J. and Umoh .I.B. (2004)," Effect of heat and tetracycline treatment on the food. Quality and acidity factors in cocoyam(Xanthosoma Sagitti folium (L), Scoht"t. Pakistan Journal of nutrition 3 (4), 244 – 243.

Akoroda, M. (2012), " Better co-ordinated root crop systems for food and cash in Nigeria. In: Root and Tuber Crops Research for Food Security and Empowerment". Amadi, C.O. Ekwe, K.C, Chukwu, G.O, Olojede, A.O and Egesi, C.N. eds. NRCRI, Umudike, pp 3 -32

Alamu, S. and McDavid .C.R. ( 1978): Production of flowering in edible aroids by gibberelic acid.Journal of Trop. Agric., 55: 81-86

Amusa, T. A., A. A. Enete and U. E. Okon(2011), "Socioeconomic determinants of cocoyam production among small holder farmers in Ekiti state, Nigeria". International Journal of Agricultural Economics &Rural Development - 4 (2) Pp46-49

Anambra State Agricultural Development Programme (ASADEP,1992), "ASADEP Profile". Published by Communication media support unit ASADEP,Awka

Anderson .M. (2009),"World food supply". http\\www.m.microsoft. Retrieved 10th January 2014 by.4.25p.m.

Anne .E.S., Harrison G.H, Mohammed S.A. and Mohammed .A.S. (2012), " An efficient in Vitro Propagation Protocol of cocoyam (*Xanthosoma Sagittifolium l. Scholt)".* Scientific World Journal volume 3, Pp43-46

Anyanwu S. O. And Ezedinma C.I.(2006), "Comparative Analysis of Technical Efficiencies Between Compound and Non Compound Farms In Imo State, Nigeria." Journal of Agriculture and Social Research (Jasr) Vol. 6, No.2, Pp36-38

Arene C.J.and G.I.O.Mbata (2008),"Determinants of profitability and willingness to pay for Metropolitan Waste use in Urban Agriculture of the Federal Territory, Abuja Nigeria".Journal of.Tropical Agric.food,Environ Extension 7(1)Pp32-35

Ayichi, D. and Madukwe, M. C. (1996), "A comparative Analysis of Production Efficiency of Contact and Non-contact Farmers in Nigeria". Journal of Agriculture, Technology and Education Vol 1 (No. 2). pp 41- 45.

Azeez A.A and Madukwe D.M.( 2010), "Cocoyam production and Economic status of farming households in Abia state, South-East, Nigeria". Journal of Agriculture and Social sciences Vol 6., Pp 83-86

Babatunde, R.O., Omotesho O.A and Sholotan O.S., (2007)," Socio-economic characteristics and food security of farming households in Kwara State, North-Central Nigeria". Pakistan J. Nutrition, 6: 45–58

Baruwa O.I. and Oke J.T.O.(2012)," Analysis of the technical Efficiency of small-holder cocoyam farms in Ondo state,Nigeria". Tropicultura, vol 1.36-40

Bown, D. (2000)," Aroids. Plants of the Arum Family". 2nd Edition. Timber Press. Portland, Oregon, USA. 392 pp.

Bzugu, P.M., Gwary M.M. and Idrisa Y., (2005)," Impact of extension services on rural poverty alleviation among farmers in Askira Uba L. G. A., Borno State. Sahela Analyst". 7: 94–102

Chikaire.J. and Nnadi .F.N. (2011)," Agricultural Innovations Strategies for Sustainable food Security in Africa". International Journal of tropical and food system 5(*2):* 153-161.

Chinaka C.C. and Arene O.B.(1987)," The effect of Mulching on the Performance of Cocoyam in Cocoyams in Nigeria, Production, Storage, Processing and Utilization". First National workshop on Cocoyams, NRCRI Umudike. pp113-116

Chukwu G.O., Nwosu K.I, Mbanaso E.N.A., Onwubiloko .O. , Okoye B.C, Madu T.U. , Ogbony ,H. AND Nwoko S.U. (2009)," Development of Gocken multiplication Technology for cocoyam". MPRA (Munich Personal RePEc Archive) paper No 17441.

Chukwu G. O., Nwosu, P.O and Onyekwere I.N (2014)," Suitability Evaluation of land Resources zones of Nigeria for Cocoyam production". US Open Soil Science Journal Vol.1, No.1, pp. 1 -8

Chukwu G.O, Mbanaso E.N.A, Okoye. B.C, Onwubiko .O. and Nwosu .K.I. (2013), Advancement in cocoyam research in Nigeria". National Root and Crop Research Institute. www. Edible aroids. Org retrieved 21 February 2014

Debertin David,.L.(1986)," Agricultural production economics". Macmillan publishing company, New york

Dewett, K.K. and Adarsh Chand (1997)," Modern Economic Theory". Shyam Lal Charitable Trust, New Delhi.

Dixon, A.G.O., Ngeve, J.M. and Nukenine, E.N. (2002). Response of cassava genotypes to four biotic constraints in three agro- ecologies of Nigeria. African Crop Science Journal, Vol. 10(1) pp. 11-21.

Echebiri, R. N. (2004)," Socio-economic factors and resource allocation in cocoyam production in Abia State, Nigeria". Journal of Sustainable Tropical Agricultural Research, 9: 69-73

Effiong E.O., (2005) ‘’Efficiency of production in selected livestock enterprises in Akwa Ibom State, Nigeria". Ph.D. Dissertation. Dept of Agricultural Economics, Michael Okpara University of Agriculture, Umudike, Nigeria.

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

Ekwe, K.C, Nwosu, K.I, Ewe, C.C. and Nwachukwu, I. (2009)," Examining the underexploited values of cocoyams (*colocasia* and *xanthosoma* species) for enhanced household food security, nutrition and economy in Nigeria". International Symposium on Underutilized Plants for Food Security Nutrition, Income and Sustainable Development 806: 71-78

Eleazu C.O., Iroaganachi .M. and Eleazu.K .C. (2013)," Ameliorative potentials of cocoyam Esculenta and unripe plantain (*Musa Parasidiac*a) on the relative tissue weights of streptozotocin-Induced Diabetic Rats. Journal of Diabetes Research". volume 3 No.5 Pp45-48

Elena M. D.,(2013)," The Effect Of Intercropping On Crop Productivity and Yield Quality Of Oat (*Avena Sativa L.*)/ Grain Leguminous Species (*Pea–Pissum Sativum L., Lentil –Lens Culinaris L.)* Cultivated In Pure Stand and Mixtures, in the Organic Agriculture System". European Scientific Journal Vol.9,No.21 Pp 45-48

Enete, A. A,, and Okon, U. E. (2010)," Economics of water leaf production (*Talinum triangulare*) in Akwa Ibom State, Nigeria". Field Action Science Reports.vol. 6 Pp56-58

Englberg L., Schierle J., Kraemer K., Albersberng W. and Dolodolotawake U. (2008)," Carotenoid and mineral content of micronesian giant swamp taro (crytosperma) cultivars". Journal of Food Compos. Anal, 21:93-106.

Enwelu 1.A, Asogwa.N.P, Nwalieji it. U and Ezeano. C.1 (2014)," Assessment of cocoyam consumption in selected communities of Enugu State Nigeria ". International Journal of Research in Applied, Natural and Social Sciences Vol. 2, Issue 3, Pp31-40

Evbuomwan, G. O., Ikpi A. E., Okoruwa V. O. and Akinyosoye V. O. (2012)," Preferences of Micro, Small and Medium scale enterprises to financial products in Nigeria" . Journal of Agricultural Economics and Development, 1(4): 80- 98.

Eze.C.C., Amanze.B.,Nwankwo .O.(2010)," Resource Use Efficiency in Arable Crop Production Among Smallholder Farmers in Owerri Agricultural Zone of Imo State, Nigeria". Researcher 2(5).http://www.sciencepub.net/researcher Retrieved 15th November 2014

Eze C. C., Okonkwo S. O., Orebiyi J.S and Kadiri .F. A, (2011)," Land Tenure System, Farm size ,Innovation and Agricultural Productivity in South-East Nigeria". contributed Paper for the Agricultural Economics Society‘s 85th annual conference held at University of Warwick 18th -20th April,

Eze C.C. & Okorji E.C., (2003), "Cocoyam production by women farmers under improved and local technologies in Imo State, Nigeria". African Journal of Science, 5(1), 113-116

Eze C.C., (1991)," Economics of cocoyam production by small holder farmers in Ihitte/Uboma L.G.A. of Imo State, Nigeria". M.Sc thesis submitted to the department of Agric Economics University of Nigeria Nsukka .

Ezedinma C.I. (2000)," Farm Resource Allocation and Profitability of Arable Crop Enterprises in the Humid Forest Inland Valley Ecosystem: A case study of Ozu Abam in Southern Nigeria". UNISWA J. Agric., 9: 48-56.

Ezumah H.C and Okigbo B.N., (1980),"Cassava cultural practises": Webar E.J., Toro J.C. and Graham M.(eds ) proceedings of a workshop on cassava held in Salvador Bahia 18-21 March pp 44-49

Fabiyi, E.F., B.B Danladi, K.E, Akande and Y, Mahmood. (2007). Role of Women in Agricultural Development and Their Constraints: A Case Study of Biliri Local Government Area of Gombe State, Nigeria. Pakistan Journal of Nutrition 6 (6): 676 – 680.

FAO (Food and Agriculture Organization of the United Nations) (2005)," Framework for Farm Household Decision making". http://www.fao.org Retrieved July 10, 2014 from

FAO (2013)," Farming system" :A brief over view Corporate Document Repository and Database. Rome: Food and Agricultural Organization http://www.fao.org/docrep/013/am014e/am014e04.pdf Retrieved 10th February, 2014

FAO (2006)," Food crop and storage". Corporate Document Repository and Database. Rome: Food and Agricultural Organization http://www.fao.org/docrep/013/am014e/am014e04.pdf Retrieved 13th November, 2014

FAO (2013)," Properties of dry land cropping systems": A brief over view Corporate Document Repository and Database. Rome: Food and Agricultural Organization http://www.fao.org/docrep/013/am014e/am014e04.pdf Retrieved 17th May 2015

FAO (2011),"Women in Agriculture: Closing the gender gap for development". www.fao.org/docrep/013/i2050e/i2050e.pdf Retrieved 25th May 2015

Fasoranti, O. O. (2008)," The determinants of agricultural production and profitability in Akoko-land, Ondo State, Nigeria". Journal of Social Sciences, 4(1), 37-41

FAO (Food and Agriculture Organization of the United Nations). (1982),"The Estimation of Crop Areas and Yields in Agricultural Statistics". Economic and Social Development Paper No. 22. Rome, Italy.

Food and Agriculture Organization of the United Nations(FAO).(2012)," FAO Statistics data base". http://faostat3. fao.org/home/index.html. Retrieved April 8 2015

Fermont .A and Benson .T. (2011)," Estimating Yield of Food Crops Grown by Smallholder Farmers". A review in the Uganda Context. IFPRI (International Food Policy Research Institute) Discussion Paper 01097

Giacometti D.C and Leon (1994)," Tannia, Yatiua (*Xanthosoma Sagitfolium*). In Neglected Crops":1492,Plant Production and Protection Series No.26 FAO, Rome Italy pp 253-258

Guillermo .R.C. (2006)," Studies on Cocoyam (*xanthosoma spp*) in Nicoaragua, with emphasis on dasheen mosaic virus". Doctorial thesis Swedish University of Agricultural Sciences.

Hahn, S.K (1994)," Root Crops for Food Security in Sub-Saharan African in Akoroda", M.O (ed). Proceeding of the Fifth Triennial Symposium of the International Society for Tropical Root Crops. Uganda. Nov. 22-28:16-21

Hahn, S.K (1987)," Utilization, Production constraints and improvement potentials of tropical root crops" in Abstracts on Tropical Agriculture 12(8) p102

Hang D.T, Binh L.V, Preston and savage G.P ( 2011),"Oxalate content of different taro cultivar grown in central Viet Nam and the effect of simple processing methods on the oxalate". Livestock Research Journal for Rural Development 23(6)

Http://www.businessdictionary.com/definition/output. Retrieved July 13, 2014

Harsch, E. (2004)," Agriculture, Africa's Engine for Growth: Small Scale Farmer Holds the Keys": says NEPAD. Plan Africa Recovery . Volume 17, No 4

Ibekwe, U.C., Orebiyi J.S., Henri-Ukoha .A., Okorji .E.C., Nwagbo E.C., and Chidiebere-Mark M.N., (2012), "Resource Use Efficiency in cassava Production in Southern-Eastern Nigeria". Asia Journal of Agricultural Extension, Economics and Sociology,1(1):16-21

Idiong C.I., (2006,) ''Evaluation of technical, allocative and economic efficiencies in rice production system in cross river state, Nigeria'' Ph.D. Thesis. Dept. of Agricultural Economics, Michael Okpara University of Agriculture, Umudike, Nigeria.

Investopedia dictionary, http://www.investopedia.com/terms/c/crop-. yield. Retrieved March 10, 201

Ijere, M. O. (1998)," Agricultural Credit and Economic Development". In: Ijere MO; Okorie, A (eds) Readings in Agricultural finance, Longman, Lagos, pp 4–9.

Ikeorgu JEG (2000)," Root and tuber crops of Nigeria: production, challenges and future". In Akoroda MO (Ed.) Agronomy in Nigeria. 67-69

International Institute of Tropical Agriculture IITA (2007)," Growing Cocoyam in Nigeria": Commercial Production Guide Series. International Institute of Tropical Agriculture. Ibadan

International Institute of Tropical Agriculture IITA (1973)," Annual report for root and tuber improvement". Ibadan Nigeria. pp 73-74

Iwuoha, C. & Kalu, F (2000)," Processing cocoyam into flour". Department of food science and technology. Federal University of Technology, Owerri, Nigeria. Retrieved July 13, 2013. http://www.sciencedirect.com/science .

Jhingan, M.L.(1982)," Macro Economics Theory". Vikas Publishing House Pvt. Ltd., New Delhi.

Kadurumb .C. and Emerole C.O (2014)," Factors Influencing Transaction cost incurred by cocoyam selling Households in Abia State, Nigeria". Nigerian Journal of Farm management Vol. 15, N0 1 Pp35-38

Kareem, R.O, Bakare, H.A, Raheem, K.A, Ologunla, S.E, Alawode, O.O, Ademoyewa, G.R(2013)," Analysis of Factors Influencing Agricultural Output in Nigeria: Macro-economics Perspectives". American Journal of Business, Economics and Management . Vol. 1, No. 1, pp. 9-15.

Koutsoyiannis, A., (1979)," Modern Micro Economics", English Language Book Society/ Macmillian, London.

Kouyaté , Z., Krasova-Wade, T., Yattara, I., and Neyra, M., (2012)," Effects of Cropping System and Cowpea Variety on Symbiotic Potential and Yields of Cowpea (Vigna unguiculata L. Walp) and Pearl Millet (Pennisetum glaucum L.) in the Sudano-Sahelian Zone of Mali". International Journal of Agronomy Volume 2012 , PP 8

Laise Andrade (2012)," *Xanthosoma Sagittifolium* and Larportea aestuans species used to prevent Osteoporosis in Brazilian traditional medicine". Pharmacetical Biology, early online 1-3 informa health care. USA. Inc. www.academia.edu. Retrieved July 8 2013

Lenis Saweda, Liverpool-Tasie, oluyemisi Kulu, and Akeem Ajibola (2011): A Review of Literature on Agricultural Productivity, Social Capital and Security in Nigeria NSSP (Nigeria Strategy Program) Working Paper 21

Lumur and Katomgole C. (2011),"Comparative reduction of oxalates from New cocoyam (*Xanthosoma Sagittifolium*) leaves by four processing methods". Livestock Research journal for Rural Development, Volume 23.Pp 35-3

Maikasuwa M., A., and Ala, A.L,(2013)," Determination of profitability and resource-use efficiency of yam production by women in Bosso Local Government Area of Niger State, Nigeria". European Scientific Journal vol.9, No.16 Pp198

Manner 1.H. (2010)," Farm and Forestry production and marketing production and marketing profile for tannia (*xanthosoma spp*.)".Published by Permanent Agriculture Resources (PAR), Hōlualoa, Hawai‘i 96725, USA;

Manner I.H and Mary Taylor,(2010)," farm and forestry production and marketing production and marketing profile for taro (*colocasia esculenta*.)Published by Permanent Agriculture Resources (PAR), Hōlualoa, Hawai‘i 96725, USA

Matthews, P.J. (2000),"An introduction to the history of taro as a food". Pp 484-497 in Proceedings of the Twelfth Symposium of the International Society for Tropical Root Crops (ISTRC), Tsukuba, Japan

Mbouoda H.D., Bondjek.T, DJocgone P.F, Tsa fack T.J.J. and Omokolo .D.N.,(2007)," Morphological characterization and Agronomic Evaluation of cocoyam (*xanthosoma sagittifolium .L. schott*) Germplasm in Cameroon". Journal of Biological sciences, 7(1): 27-33.

Mwaniki, (2005). “ Achieving Food Security in Africa: Challenges and Issues”. Comell University Discussion Paper.

Mwenye . O.J, labuschagne. . M.T., Herselman and I.R.M Beries, (2011)," Mineral composition of Malawian Cocoyam (*Colocasia esculenta* and *Xanthosoma Sagittifolium*) ". Journal of Biological sciences II (A): Pp 331-335, .

National Data base (2003)," Fact sheet" http:// www .ntbg.org\plant_ details. Php? Plantid =3155.Retrieved January 12 2014.

National Root Crop Research Institute (NRCRI, 2003), "Annual report", National Root Crop Research Institute Umudike,

Nelson .S.C. (2008)," Dasheen mosaic of edible and ornamental aroids". Published by university of Hawaii. 9p.

Nkematu J.A.(2000),"Anambra State ADP extension service report for 1999 In : proc of the 14th annual farming system research and extension". In Nigeria 9-12 Nov pp 100-105

Nwakor F.N, Chukwu G.O, Asumugha G.N, Ekwe K.C, and Okoye B.C (2014)," Farmers Participation in Cocoyam Rapid Multiplication Technology in Imo State". Nigerian Journal of Farm Management Vol.15, No.1 Pp45-48

Nwaru, J.C. (2004)," Rural Credit markets and Arable Crop production in Imo State of Nigeria". Unpublished Ph.D Dissertation Michael Okpara University of Agriculture, Umudike, Nigeria.

Nyiira, Z.M. (1994),"Technological Change in Indigenous Root and Tuber Crop Production Systems in sub-Saharan African". In: Akoroda, M.O (ed). Root Crops for Foods Security in Africa Proceedings of the fifth Triennialsymposium of the International Society for Tropical Root Crops (ISTRC).Uganda. Nov. 22-28, Pp16- 21.

Obasi P. C, Henri-Ukoha .A, Ukewuihe I. S and Chidiebere-Mark N. M (2013)," Factors Affecting Agricultural Productivity among Arable Crop Farmers in Imo State, Nigeria". American Journal of Experimental Agriculture 3(2): 443- 454,

Obed John Mwenye (2009)," Genetic diversity analysis and nutritional assessment of cocoyam genotypes in Malawi" . M.SC Thesis retrieved 12th June 2014

Obiora C.J (2013),"Need Assessment: Overview from women farmers in Anambra state, Nigeria". Greener Journal of Agricultural Sciences vol 3(8), Pp. 618-622

Ogundele, O. O. and V. O. Okoruwa. (2006). Technical Efficiency Differentials in Rice Production Technologies in Nigeria. AERC Research Paper 154, Nairobi, Kenya. Retrieved june 10, 2015 from http://www.aecrafrica.org/documents/rp 154.pdf

Ogunniyi, L .T (2008),"Profit Efficiency among Cocoyam Producers in Osun State, Nigeria". International Journal of Agricultural Economics & Rural Development- vol. 1 Pp18-27

Ojinnaka.M.C., E.N.T Akobundu and M.O. Iwe (2009),"Cocoyam starch modification effects on functional sensory and cookies qualities". Pakistan Journal of nutrition vol.8 (5) Pp558-567, .

Ojonugwa A and Idoko .I.D (2013),"An Impact Assessment of Agricultural Credi on Rural Farmers in Nigeria" .Research Journal of Finance and Accounting vol 4, Pp18-25

Okojie, C. A. and Monye –Emina and K. Eghafona, and G. Osaghae and J. O. Ehiakhamen (2010),"Institutional Environment and Access to Microfinance by Self employed Women in the rural areas of Edo State". NSSP(Nigeria Strategy Support Programme) brief No. 14. Washington, D. C: International Food Policy Research Institute

Okoye B.C and Asumugha .G.N and Mbanaso E.N.A (2006),"Cost Return Analysis of Cocoyam Production at NRCRI (National Root Crops Research Institute,)". MPRA ( Munich Personal RePEc Archive)Paper No. 17363,

Okoye, B.C and Asumugha, G.N and Okezie, C.A and Tanko, L and Onyenweaku, C.E (2006)," Econometric Assessment Of The Trend In Cocoyam Production In Nigeria, 1960/61-2003/2006". MPRA( Munich Personal RePEc Archive)Paper No. 17460,

Okoye, B. C., Okorji, E. C and Asumugha, G. N (2004)," Outlook on Production Economics of Paddy Rice under Resource constraints in Ebonyi State". Proc. of the 38th annual conference of the Agric. Soc. Of Nig. (ASN), 17- 21 Oct. Lafia Nasarawa State. Pp 337-342

Okoye B.C. and Okoye A.C. and M.U. Pimenu and C.C. Agbaeze and O.W.Okoroafor and A.B. Amefula (2009)," Adoption scale analysis of improved yam production, production and storage Technologies, across gender in north agricultural zone of Enugu state" . MPRA paper No 17432

Okoye B.C ,. Onyenweaku C.F. and Agwu A.E..(2006)," Technical Efficiency of Small- Holder cocoyam farmers in Anambra state Nigeria : Implication for Agricultural Extension policy". MPRA (Munich Personal RePEc Archive) Paper No. 17564,

Okoye .B. C., C. E. Onyenweaku, O. O. Ukoha, G. N. Asumugha and O. C. Aniedu (2008)," Determinants of labour productivity on small-holder cocoyam farms in Anambra State". Nigeria Academic Journals Vol. 3, pp. 559-561

Olayemi J.K, (1998)," Distribution Problems Grains: Marketing, Storage and Transportation. Invited paper presented at a Seminar on the State of Grain production for food and industrial self sufficiency". Organised by the Agricultural and Allied Trade Group Ibadan Chamber of Commerce and Industries pp.25-27

Olayemi, J.K. (1994)," Policies and Programs in Nigeria Agriculture". A Publication of the Department of Agricultural Economics, University of Ibadan

Oluwafemi A.B.(2013),"Evaluation of weed management strategies in cocoyam (colocasia esculentus (L.) schott) production in Ado-Ekiti, Ekiti State Nigeria". *International* Research Journal of Agricultural Science and Soil Science Vol. 3(2) pp. 38-42

Oluyole, K.A.and Sanusi, R.A.(2009),"Socio-economic variables and cocoa production in cross river state, Nigeria". Journal of Human Ecology 25 *(1)* Pp5-8.

Oni.O., Nkonya E., Phillips D., Kato E. (2009)," Trends and Drivers of Nigeria Agricultural Productivity in Nigeria" . International Food Policy Research Institute Strategy Support Program (NSSP) Report 001

Onwubuya .E.A . and Ajani E.N (2012)," Strategies for improving production and processing of cocoyam among women farmers in Anambra state Nigeria". Universal Journal of Education and General studies vol(6)pp . 169-173.

Onyeka, J. (2014)," Status of Cocoyam (*Colocasia esculenta and Xanthosoma spp*) in West and Central Africa: Production, Household Importance and the Threat from Leaf Blight. Lima (Peru)". CGIAR Research, Program on Roots Tubers and Bananas (RTB)

Opara L.U.(2003)," Edible aroid post harvest operation". Food and Agricultural Organisation of the United Nations

Osagie, P.I (1998),"Transfer of root crop technology for alleviation of poverty: the contribution of shell, Nigeria". In: Akoroda, M.O. and Ekanayake, I.J. (eds). Proceedings of the Sixth triennial symposium of the international society for tropical Root crops. Oct 22-28, Malawi Pp 38-41.

Osundare, O.T. and Fajinmi, A. A.(2013),"Comparative Growth and Yield Performance of Different Planting Materials of Cocoyam (*Xanthosoma Mafafa)".* Australian Journal of Biology and Environment Research vol 2 Pp 56-61

Owusu-Darks P.G, . Paterso .A. and Omenyo.E.L.(2014),"Cocoyam (corns and comels)- An underexploited food and feed resource". *Journal of Agricultural chemistry and Environment* vol.3. No 1, Pp 22-29

Oyewo, I. O., & Fabiyi, Y. L. (2008)," Productivity of maize farmers in Surulere local government area of Oyo State, Nigeria". International Journal of Agricultural Economics and Rural Development,1(2), Pp1-10.

Passam, H.C. (1982)," Experiments on the storage of ed- does and tannia (*Colocasia and Xanthosoma spp*) under tropical ambient conditions". *Journal of Tropical Science*, vol.1 Pp 24-39.

Quaye .W, Adofo .K, Agyeman K.O, Nimoh .F (2010)," Socioeconomic survey of traditional commercial production of cocoyam and cocoyam leaf". *African Journal of Food Agriculture, Nutrition and Development*, Vol. 10, No. 9, pp. 4060-4078

Rodriguezylian, Irina Penicle, Presto .T.R. and Peters K (2009),"Nutritive value for pigs of new cocoyam (*xanthosom sagittifolium*); digestibility and nitrogen balance with different proportions of fresh leaves and soybean in a basal diet of sugarcane juice livestock". research for rural development vol.2 (1) Pp156-162

Sagoe .R. (2006)," Climate change and root crop production in Ghana". A report prepared for environmental protection Agency (EPA), Accra, Accra- Ghana.

Saweda Lenis, Liverpool-Tasie, Oluyemisi Kuku,and Akeem Ajibola (2011),"A Review of Literature on Agricultural Productivity, Social Capital and Food Security in Nigeria". NSSP( Nigeria Strategy Support Program) Working Paper 21

Scott G. J., Rosegrant M. W. and Ringler .C.(2000)," Roots and Tubers for the 21st Century Trends, Projections, and Policy Options". Food, Agriculture, and the Environment Discussion Paper 31

Shiyam, J.O., Obiefuna J.C, Ofoh M.C, Okoh B.F.O and Uko, A.E (2007)," Growth and corm yield response of upland cocoyam (*Xanthosoma Sagittifolium*) so sawdust Mulch and N.P.K 20:10:10 fertilizer rates in the humid forest zone of Nigeria". Continental Journal Agronomy vol.1, Pp 5-10 .

Sheng Y., Jackson T., Zhang D., and Zhao S. (2013)," Measuring Output, Input and Total Factor Productivity in Australian Agriculture: An Industry-level Analysis". Paper Prepared for the IARIW-UNSW Conference of Productivity: Measurement, Drivers and Trends .Sydney, Australia, November 26-27.

Shimelles Tenaw K.M. Zahidul Islam &Tuulikki Parviainen (2009)," Effects of land tenure and property rights on agricultural productivity in Ethiopia, Namibia and Bangladesh". University of Helsinki, Department of Economics and Management Discussion Papers No. 33

Sule A.M, Ogunwale, S.A and Atala, T.K (2002)," Factors affecting adoption of fishing innovation among fishing entrepreneurs in Jebba Lake community. In: Olowu, T.A (ed.)". Journal of Agricultural Extension , 6:48- 60.

Talwana, H.A.L., Serem, A.K., Ndabikunze, B.K., Nandi, J.O.M., Tumuhimbise, R., Kaweesi, T., Chumo, E.C. and Palapala, V. (2009)," Production Status and Prospects of Cocoyam (*Colocasia esculenta(L.) Schott.*) in East Africa". Journal of Root Crops 35(1): Pp 98-107.

Tambong T.J and Hofte.M.(2001), "Phenazines are involved in biocontrol of pythium myriotyhum on cocoyam by pse dulomonas aeruginosa PNAI". European Journal of plant pathology 107: Pp 511-521

Tewari, D.D. and Katar Singh., (1996)," Principles of Microeconomics". New Age International(P) Ltd., Pulishers, New Delhi

Tokula, M.H.(2003)," Adoption of cocoyam production and processing technology in Ikwuano LGA". Journal of Agric. Extension pp.36.

Ugbajah Mary (2013)," Enhancing income through cocoyam production, processing and consumption patterns in Dunurofia local Government Area of Anambra State Nigeria". *Greener Journal of Social Sciences* vol.3(6) pp-334-339.

Ugwu.S.D.(2006)," Crop production in compound farming system of south eastern Nigeria". Journal of Agricultural and social research. vol. 6, No.1 Pp 98-108

Ukoha O.O (2000)," Determinants of Labour Productivity on Small-Holder Sole Crop Farms: A Case of Waterleaf Enterprise (*talinum triangulare*)". Nigeria Journal of Agribusiness Rural Dev. vol.1: pp3

Umunna Nnaemeka Opara, (2010)," Personal and Socio-Economic Determinants of Agricultural Information Use by Farmers in the Agricultural Development". Information Science Federal Polytechnic, Nekede Owerri, Imo State, Nigeria

World Bank,(2010)," Global Strategy to Improve Agricultural and Rural Statistics". Report number 56719-GLB. Washington, DC: World Bank, United Nations, and Food and Agricultural Organization of the United Nations

www.nacd. gov.ng/ Anambra State Geographical_ location.htm.Retieved 12th January 2014

www.plant village .com. Retrieved 16th May 2014

www.zionsbank.com/pdfs/biz_resources_book-7.pdf. Retrieved 15th January 2014

Yahaya.I .J., vok.A.K. and J.J. Bornire (2013)," chemical studies of the peel of *xanthosoma sagittfolium* (tannia Cocoyam)". Pakistan Journal of nutrition vol. 12(1): Pp40-44 .

Yusuf ,O., Sanni S. A., Ojuekaiye E. O. and Ugbabe O.O.(2008) ,"Profitability of 'Egusi' Melon (*Citrulluslanatusthunb. Mansf)* Production Under Sole and Mixed Cropping Systems In Kogi State, Nigeria". Vol.3,No.2,Journal oF Agricultural and Biological Science