Dissertation

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NIGERIA NSUKKA.

Economics of cocoyam production by small-holder farmers in ihite/uboma local government area of Imo state, Nigeria

OCTOBER, 1991

ECONOMICS OF COCOYAM PRODUCTION BY SMALLHOLDER FARMERS IN IHITTE/UBOMA LOCAL GOVERNMENT AREA OF IMO STATE, NIGERIA.

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A PROJECT REPORT IN THE DEPARTMENT OF AGRICULTURAL ECONOMICS SUBMITTED TO THE FACULTY OF AGRICULTURE IN PARTIAL FULFILMENT OF THE REQUIREMENTS FOR THE AWARD OF THE DEGREE OF MASTERS OF SCIENCE (M.Sc.) UNIVERSITY OF NIGERIA, NSUKKA SPONSORED BY CODESRIA- DAKAR- SENEGAL.

OCTOBER, 1991.

CERTIFICATION

Eze, Christopher Chiedozie a Postgraduate Student of the Department of Agricultural Economics and with Registration number PG/MSc/89/7897 has satisfactorily completed the requirements for the course and research work for the degree of master of science (M.Sc) in Agricultural Economics. The work embodied in this project report is original and has not been submitted in part or full for any other diploma or degree of this or any other university.

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Date: 28/10/91

Date: Nov 11, 1991

DEDICATION

Dedicated to Nigerian Women especially my Mother, Mrs Christiana Egoigwe Eze, who toils day and night for the sustenance of the family.

ACKNOWLEDGEMENT

This work got to the present stage through the help, encouragement, guidance, criticisms and persuasion of many. Upper most is my supervisor Dr. E.C. Okorji who took the pain to read through several manuscripts of this work and made suggestions.

My mother's understanding and inspiration as well as cooperation during this study will continue to guard me.

I am indebted to council for the Development of Economic and Social Research in Africa (CODESRIA) for funding the research project.

I am also grateful to chief and Lolo F.I. Anamekwe, Mr and Mrs Chris Okafor, Hon. and Mrs J.O. Ukaegbu, Mr and Mrs H.O. Okwu, Oby Ukaegbu, Chike Igwe, Emma Arrah, Mr and Mrs Cletus Iwu, Chika Keke, Mr and Mrs Fidelis Ogbuehi and Mrs Ijeoma Okorji for their encouragement.

I would not forget the immense contributions of lecturers in Agricultural Economics during proposal stage. I appreciate the work done by my typists Cordelia Onah and Cordelia Ike.

I acknowledge the help rendered by those whose names were not mentioned. I thank the Almighty God for everything.

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ABSTRACT

This study arose from the need for further investigation into the economics of cocoyam production, its profitability, rate of adoption of improved technologies and problems of growing the crop bearing in mind its place in the study area as a staple food, source of income and planting material.

Six communities and sixty respondents were randomly selected. Cocoyam field size and yield from individual farms surveyed were measured. Two sets of questionnaire were used to collect the relevant information. Means, percentages, gross margin, benefit - cost ratios, regression and correlation analyses were employed in data analysis.

Research results showed that cocoyam was cultivated on 0.45ha out of 1.89ha cultivated by the surveyed farmers during the study. Women contributed 66% of the labour input used in cocoyam production.

Only 13% of the respondents used cocoyam minisett technique to source planting material while 58% used fertilizer in cocoyam production, though the target crop in a cocoyam based crop mixture was cassava. None of the respondents used pesticides, herbicides and improved cocoyam cultivar. The non-adoption of these technologies was attributed to their non-availability, and farmers' belief that they are deviations from normal practice and therefore could not take the risk.

Cocoyam was ranked third in the diet of the respondents after cassava and yam. There was a significant difference in the gross margin of the improved (₦5078.75) and local (₦1604.49) technologies. Benefit – cost ratio of improved technology was greater than that of local technologies by forty-six kobo. Its net return per hectare gave a monthly renumeration of ₦420.32 and this compares favourably with returns from non-agricultural sectors in Nigeria.

Decay/rot, pests and diseases were identified as the major obstacles in increasing cocoyam production in the study area.

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CHAPTER ONE

INTRODUCTION

1.1 Background Information

Cocoyam is grown in the tropical and subtropical regions of the world particularly Africa, where it is cultivated for food (F.A.O, 1966; Maduewesi and Onyeike, 1981). Two genera are particularly important and extensively cultivated. They are Colocasia esculenta and Xanthosoma sagittifolium (Onwueme, 1978).

Colocasia originated in South East Asia and was introduced to Africa through Egypt where it has been known for over 2,500 years. It then spread along the east coast of Africa and across the continent to West Africa (Plucknett, 1970). Xanthosoma originated in tropical America and was introduced to West Africa by Indian Missionaries (Purseglove 1972; Doku, 1981).

Nigeria was one of the countries that embraced the cultivation of this crop and presently is the largest producer in the world. Nigeria accounts for about 40% of the world production and is grown on about 281,000 hectares of land out of the total arable land of 27,900,000 hectares (Knipscheer and Wilson, 1981;

Onwueme, 1978; Udealor, *et al*, 1987). The national annual production is estimated at 1.6 million tonnes valued at about ₦600 million (Chinaka and Arene, 1987; Onwueme, 1987). Most of the Nigerian cocoyam is grown in the Southeastern part of the country (Olayide, *et al*, 1972; Arene and Ene, 1987; Udealor *et al*, 1987). In Nigeria, Imo State is the largest producer followed by Anambra and Ondo States (Odurukwe and Enyinnaya, 1987; Knipscheer and Wilson, 1981; I.I.T.A., 1980; 1986).

Prior to the oil boom of the 1970's, there was an increase in both land area cultivated, output and productivity of cocoyam, but the oil boom and other factors such as use of poor cultural practices by the smallholder farmers, inability to adopt new farming technologies, pests and diseases, social and cultural belief systems as well as economic constraints have reduced production. Federal office of Statistics (1978) reported a steady decline in the country's production since 1974. Onyenwaku and Ezeh (1987) also showed that cocoyam production has been characterised by a negative trend since the 1970's. This was attributed to decrease in cropped area; while Onwueme (1978) attributed it to neglect because cocoyam is not a foreign exchange earner.

F.A.O. (1988) reported a rapid growth of population in the last two decades while the per caput production of starchy staples in most developing countries has been declining. This made importation of cereals imperative to meet the increased need for food leading to increased spending of foreign exchange to the detriment of national development plans. It is, therefore, important that the quality and quantity of these crops which the people already consume is improved, hectarages under cultivation increased and new production techniques deviced so as to help meet the farmers' needs and consumers' demands for stable supply of acceptable foods at affordable prices.

International Institute for Tropical Agriculture (1980) reported that the nutritional value, taste and labour requirement in food preparation and market value gave cocoyam an economic edge over cassava. For instance, 40% of farmers surveyed in eastern Nigeria grow cocoyam for economic reasons and prices of fresh cocoyam are generally higher than those of cassava (Federal Ministry of Finance and Economic Development, 1979).

Colocasia can be grown in hydromorphic soils or under flooded conditions. Xanthosoma thrives on hydromorphic soils and tolerates upland conditions with an annual rainfall as low as 1000mm and a wide range of soils from those with high aluminum content to those composed mostly of coral rock (Lyonga and Nzietchueng, 1987). It can also be harvested without critical attention to time thus lending itself as an insurance crop to smallholder farmers. Its yield, though low, is reliable considering the risks and uncertainties involved in smallholder farming system. However, yields of between 3-10t/ha is achievable in Nigerian farms (I.I.T.A. 1973; Onwueme, 1987; Arene and Ene, 1987; Chinaka and Arene, 1987).

In Southeastern Nigeria, apart from cocoyam/maize and cocoyam/cassava mixtures where cocoyam population is high, cocoyam is grown in a few staggered stands in the other crop mixtures. The most common combinations include yam/cocoyam/vegetables, plantain/cocoyam, yam/cassava/cocoyam, cassava/cocoyam/maize and yam/maize/cassava/cocoyam and so on (Eluagu, et al, 1987; Nwagbo, et al, 1987; Ezulike, et al, 1987; Odurukwe, et al, 1986).

Cocoyam ranks third in importance as a staple food after cassava and yam in Imo State including Ihitte/Uboma Area. And given the labour input required for its production, adaptability to different soil's and harvesting seasons, it is expected that its production would be embraced by all households. However, an average of 44% of the households in the state cultivate cocoyam mainly as an insurance crop as well as to meet their food needs particularly during the months of May - August, a period usually regarded as hunger season (ISADAP, 1983). Odurukwe and Enyinnaya (1987), however, reported higher percentage cultivation in some areas in Imo State, namely, Etiti 80%, Orlu 80%, Mbano 83%. Eluagu, et al (1987) reported the presence of cocoyam in almost all farms surveyed in Imo State during the 1983 planting season.

In Imo State, very little improvement has taken place with regard to cocoyam production methods. Production technologies are still mainly on subsistence level despite new innovations and technological packages introduced by national and international research institutes and the use of extension personnel for dissemination. The slow rate of adoption of new techniques by farmers over the years has been attributed to the marginal cost of these improved technological packages, their availability, the level of education of the farmers (Akoroda et al, 1987; Ezeh and Unamma, 1987) in addition to customs and traditions of the people. Therefore, to improve output of cocoyam in Imo State, there is the need to introduce improved technologies that will improve the farmers' yield and hence the net income from the cocoyam enterprise. These new and improved technologies will complement or supplement the traditional methods of cocoyam production.

1.2 Statement of Problem

Cocoyam is one of the staple foods in Imo State. Traditionally, cocoyam is cultivated using hoes matchets, axes, household waste and animal droppings. It is mulched using palm fronds, and grasses. Most operations are carried out manually hence it is labour-intensive and costly.

Presently, very few farmers in the study area use such modern inputs as fertilizers, improved seeds, pesticides, insecticides and cocoyam minisett technique in their farming practices. It is assumed that the introduction of new technologies both biological and mechanical, may increase rural income and employment through increased cropping intensity, expanded crop area, increased yields, reduced costs and a shift to higher valued crops (Byerlee and Eicher 1972). These would, therefore, improve the profit potential under favourable price conditions of the farmers that adopt new technologies.

Cocoyam, being one of the staple foods in the study area, could have received equal attention like other crops in input allocation. But studies showed that cocoyams are produced by smallholder farmers with limited resources on farms less than two hectares. This, in addition to low soil fertility, short fallow periods, diseases and pests, bias against such roots and tubers as cocoyam in research development and resource allocation, has resulted in low yields and therefore, low returns in cocoyam production.

Given the importance of cocoyam to smallholder farmers in the study area, the rising population and resultant rise in prices of foodstuff as well as conducive soil conditions and new innovations with their attendant advantages, further investigation is necessary in the area of the profitability of cocoyam enterprise, problems inhibiting increased production of the crop as well as the reason for preferring old practices to modern ones. Low adoption of new technologies and continued preference to old system could be related to cost/returns of the adoption of the new innovation. Hence, this study focuses on the economics of cocoyam production by smallholder farmers in Ihitte/Uboma Local Government Area of Imo State, Nigeria.

1.3 Objectives of the Study

The broad objective of the study is to examine the economics of cocoyam production by smallholder farmers in Ihitte/Uboma Local Government Area of Imo State.

The specific objectives include;

1. to discuss the cocoyam based cropping systems and the importance of cocoyam in the smallholder farmers' economy.
2. to ascertain the level of adoption of improved technologies by the farmers in cocoyam production.
3. to compare output of cocoyam as well as costs and returns of cocoyam enterprise under improved and traditional technologies or practices.
4. to identify problems militating against increased production of cocoyam in the study area.
5. to make recommendations based on the research findings.

1.4 Hypotheses of the Study

The null hypotheses tested in the study are:

1. output of cocoyam from improved methods are not different from that of traditional methods;
2. Farmers donot adopt improved methods of cocoyam production; and
3. There are no differences in costs and returns in cocoyam production under traditional and improved technologies.

1.5 Significance of the Study

In view of the importance of cocoyam as an indigenous staple food stuff for man, animal feed and its potential industrial purposes, as well as its ability to be produced on marginal agricultural lands, the need for this research arises. Also information on cocoyam especially agronomic abound, but there is little or nothing about the economics of cocoyam production by smallholder farmers probably because of its image as "poor people's crop" or "woman's crops" as well as that it reflects a primitive agriculture. However, cocoyam is one of the low cost calorific starch sources with sufficient potentials to warrant more attention especially as it concerns the economics of its production in the study area.

This work is also significant because of its potential usefulness to researchers and policy makes especially those involved in root and tuber crops as well as rural development studies. It will also help to fill the vaccum created as regards the role of cocoyam within the West African Sub-region since it is one of the "poorly documented crops".

1.6 Limitations of the Study

This study was limited to one local government area in Imo State because of time and resource constraint The sample size was limited to sixty respondents because of the type of data being sort for. Information on farm yield, farmers' characteristics, income, farm size, land holdings, etc, were investigated.

Most of the information provided by the farmers were memory recalls. These respondents lack the ability to keep farm records. Hence a lot of persuasion was used to obtain as much of these information as possible. However, these limitations do not, in any way, impair the reliability of the findings and could therefore be taken to represent the situation in the study area.

1.7 Plan of the Report

The report of this study is presented in five chapters. The first chapter, the introduction, gives the background information and statement of problem, objectives and hypotheses as well as the limitations of this study. Chapter two deals with a review of related literature, while chapter three discusses the methodology used for collection of data for this study.

In the fourth chapter, the results and discussions are presented under which we have the cocoyam cropping systems in the study area, output, cost-returns analysis of the cocoyam enterprise using the improved and local technologies, analysis of the impact of these technologies on yield as well as problems inhibiting the increased production of cocoyam in the study area.

Finally, chapter five presents the summary, conclusion and recommendations.

CHAPTER TWO

LITERATURE REVIEW

This chapter deals with the relevant literature on cocoyam production technologies, post-harvest technologies and constraints.

2.1 Cocoyam Production Techniques

Efforts of research institutes, both national and international, over the years towards improving cocoyam production in Africa is commendable. In Nigeria, research institutes like National Root Crop Research Institute (NRCRI) Umudike and International Institute of Tropical Agriculture (I.I.T.A.) Ibadan have introduced different improved cocoyam production techniques which now exist along side the indigenous methods of production. It is common to observe traditional and improved agricultural practices going on side by side in Ihitte/Uboma Local Government Area and other localities in Imo State. These practices include methods of land preparation, time of planting and harvesting, planting materials, plant population and weed control as well as fertilization of the soil.

2.1.1 Land Preparation

Land preparation is basically the same for most arable crops in Imo State. Land is cleared by slashing and burning using hoe and matchet. Areas with little or no woody shrubs are cleared by burning alone.

Cocoyam can be grown under flooded or unflooded fields depending on variety. The flooded culture involves clearing, ploughing, harrowing and puddling while in upland or unflooded culture, land preparation requires clearing, ploughing and harrowing. Though cocoyam can be planted on mounds or ridges, its mounds are usually smaller than that of yams. They are sometimes planted in holes in unploughed fields (Onwueme, 1978). No tillage and minimum tillage methods are hardly practised despite the advantages (I.I.T.A., 1981). However, Okigbo (1979) and Onwueme (1978) noted that there was no effect of these forms of land preparation on root yield.

2.1.2 Planting Date

Nwagbo, et al (1987) observed that cocoyam cultivation was staggered to fall in when there was no major activity going on in yam enterprise. Anthonio and Ijere (1973) noted that cocoyam and cassava could be planted anytime of the year. However, Onwueme (1978) stated that availability of moisture determined time of planting. Generally, cocoyams (Colocasia and Xanthosoma) are planted in the study area anytime between March and July when the rain has become regular.

2.1.3 Planting Materials

Propagules of cocoyam are either from large cormels or heads of Small Corms (Bates, 1963; Njoku and Obiefuna, 1987). Stem cuttings consisting of the apical portion of the corm and the lower 15-25cm of the petioles may be used (Onwueme, 1978). Setts from corms normally give higher yield than those from cormels; while stem cuttings give a higher yield than even setts from corms. This is attributed to its ability to produce greater number of roots and total leaf weight than corms and cormels (Moursi, 1954; Onwueme, 1978; NRCRI, 1987). Use of disease free and resistant setts are recommended (Ibe and Iwueke, 1984).

2.1.4 Plant Population

A spacing of 60cm X 60cm is recommended for sole cropping of cocoyam, giving a plant population of 27,800 stands per hectare (Onwueme, 1987). Udealor et al (1987) in a survey showed that cocoyams were planted 1-2 stands per mound depending on size of mound and number of crops in the mixture, and this gave a plant population of between 8,000 and 10,000 stands per hectare. Close spacing increases the corm yield per hectare and the shoot yield per hectare but it decreases the corm yield per plant, the contribution of sucker corms to the yield, and the leaf area per plant. Weed incidence in the field also decreases when closer spacings are employed (Ezumah and Plucknett, 1973; Onwueme, 1978 and NRCRI, 1987). However, in traditional farming, spacing is irregular.

2.1.5 Fertilization

Fertilizers are not in common use in traditional farming, however, compound farms may be fertilized with household waste and animal droppings (NAFPP, 1980; I.I.T.A., 1981). Farms located at far distances from the homestead are less favoured in terms of fertilization (Ezumah and Okigbo, 1980). Onwueme (1978) reported that cocoyam requires a lot of potassium and is therefore well suited to traditional farming which rely on bush burning. Cocoyam planted immediately after bush burning will benefit from the ash that is rich in potassium.

Research results from National Root Crops Research Institute (N.R.C.R.I) Umudike showed that fertilization of a cocoyam farm with potassium not only enriches the soil but also reduces the severity of cocoyam declining disease and increases corm yield as well as efficient water use by the plant; Nitrogen fertilizer enriches the protein content of cocoyam corms (NRCRI, 1987).

Economically, studies showed that farmer's use of fertilizer is determined by anticipated yield responses, expected prices of the output, cost of fertilizer, availability of credit as well as the degree of risk and uncertainty involved in using the chemical for increased farm output (Falusi and Adubifa, 1975; Falusi, 1973; Ogunfowora, 1987). However, Nweke et al (1988) and Manfred (1989) independently reported that fertilizer application on per hectare basis needed 9.14 mandays and 17 mandays.

2.1.6 Mulching

In traditional farming mulch materials include dead leaves, wood shavings and grasses as well as palm fronds. These serve to conserve soil moisture, reduce soil temperature near the setts, control weeds, increase soil organic matter content and enhance the productivity of cocoyam (Onwueme, 1978; Ibe and Iwueke, 1984; Chinaka and Arene, 1987). In Japan, Polyethene sheets are used as mulch. Arene, *et al* (1987) showed that mulching could significantly enhance sprouting in *Colocasia esculenta*, but not as much in *Xanthosoma sagittifolium*. As the study area is a rural setting, traditionally, mulching is done using grasses and palm fronds.

2.1.7 Weed Control

Traditionally, weeding in cocoyam production or any other crop is labour intensive with the use of simple farm tools such as hoes and matchets or by hand pulling. It is important to control weeds during the early vegetative growth and the period of starch accumulation and maturation using either manual methods or chemical methods or an integration of both (Onwueme, 1978; Orkwor and Nwoko, 1987). Weeds can also be controlled by mulching and inter cropping methods by small farmers. Gurnah (1986) observed that lateness in weed control results in corms that are small. Chinaka, et al, (1987) recommended two hoe weeding at three and eight weeks after planting.

Chinaka, et al, (1987) recommended the use of Alachlor 2kg active ingredient (ai) per hectare as a pre-emergence herbicide in a cocoyam crop mixture. Also Alachlor 1kg ai/ha and Chloramben 2kg ai/ha have been successfully used in a cocoyam crop mixture a day after planting. Orkwor and Nwoko (1987) recommended primextra at 6kg ai/ha, Cotoran at 4kg ai/ha on *Colocasia esculenta*; and Emetryne and paraquat at 4-5kg ai/ha and 1kg ai/ha respectively as a pre-emergence herbicide in a *Xanthosoma sagittifolium* field. The application of herbicides reduces early weed interference within the first 45-50 days. Experience has shown that efficient weed control could be achieved using these chemicals and if properly applied will lead to increased yield and therefore a source of profit to the small farmer (Ene, et al, 1978).

On the other hand, hand weeding is expensive and difficult. Chinaka and Eluagu (1982) observed that herbicides help to conserve energy and stabilize the soil structure unlike the hoe weeding that disturbs the soil structure. This leads to soil loss by erosion as well as injury to the crop. Unamma, et al, (1985) and Ene, et al, (1978) observed the non-use of herbicides in Southeastern Nigeria and attributed this to ignorance of farmers, non-availability of herbicides, cost of the herbicides and lack of hard wares such as herbicide applicators. Training of farmers on the use of herbicides percautions and safety regulations seems necessary if chemical weed control is to gain ready acceptance by those farmers who grow root crops including cocoyam in Nigeria.

2.1.8 Harvesting

Cocoyam is harvested by pulling or using hand tools after yams have been taken into the barns in January - March and carried home in baskets (Nwagbo, et al, 1987). This takes place after about five to fifteen months from planting (Bates, 1963; Onwueme, 1978). It however, depends on variety of cocoyam and cropping system used as well as the ecological and nutritional conditions. According to Coursey (1984), though multiple harvesting can take place in cocoyam, farmers usually harvest the crop at their convenience with no serious deterioration on the crop. However, if harvesting of cocoyam corms is delayed into the dry season (November - February), such corms are tunnelled and eaten by termites; the termite tunnels are lined with hard dark faecal deposits of the termites. Severely infested corms when harvested are worthless. Also the cookability of the corms and cormels are reduced by the scorching heat of the sun (Atu and Nwufor, 1987; Anazonwu-Bello, 1976).

2.2 Post Harvest Technologies in Cocoyam Production

Post harvest technologies involve all the activities performed between the harvesting of the crop in the field to its eventual consumption. It includes storage, transportation, processing, marketing and utilization of the crop.

2.2.1 Storage Techniques

Cocoyam storage methods both, traditional and improved, are geared towards limiting the deterioration of the corms and cormels and keeping them in conditions that make them retain their nutritional value. Losses amounting to 30-50% have been recorded when cocoyam is stored for 3-4 months (Nwana and Onochie, 1979).

2.2.1.1 Traditional storage technique

A survey on traditional storage practices of cocoyam in Nigeria showed three main systems. These include storage in heaps loosely covered with leaves under shade of forest or plantain trees, storage in compound barns constructed with palm fronds in such a way as to allow free air circulation and storage in cylindrical pits covered with dried banana leaves and then sealed with a mixture of mashed banana stem and clay (NRCRI, 1979). Though the third method records least attack by rot organisms, it is very labour intensive and expensive. Onwueme (1978) and Agboola (1987) independently showed that cocoyam could be stored in the field by being left unharvested in the soil until needed. This type of storage according to Atu and Nwufor (1987) and Ezedinma, et al, (1981) leads to attack by termites, rodents and nematodes thereby reducing the nutritional value of the crop.

2.2.2 Transportation and Marketing

Okereke and Umearokwu (1983) observed that the type and means of transportation available to farmers affected the quantity of goods that flow within the marketing system. According to them, if large quantities of goods can be moved cheaply and quickly to markets and if buyers have access to such markets, their absorptive capacity will be strengthened. Furthermore, in most rural communities, farmers convey their farm products to the homes and markets with porters, bicycles, wheel barrows etc and this is a constraint to the distribution of farmers produce. Nwufor and Atu (1987) recommended the use of cartons and boxes in transporting cocoyam so as to reduce mechanical damages and hence market value of the crop.

In Nigeria, the marketing and transportation of agricultural products are far from being efficient due to the unpredictable fluctuations in prices of produce, lack of access roads, and high transportation costs. The situation is such that the consumers of agricultural products pay exhorbitant prices while the producers receive relatively low prices; a situation attributed to the role of middlemen involved in the distribution and sale of agricultural products including cocoyam (Eluagu, *et al*. 1987).

2.2.3 Processing Techniques and Utilization of Cocoyam

In Nigeria, cocoyam is processed mainly by traditional techniques and used as boiled, cooked, chipped, fried, fufu and Achicha forms. Studies by Obiechina and Ajala (1987) in Nsukka agricultural zone showed that Achicha has a long shelf life and not only provides food all the year round especially during the lean planting season but also serves as a cost-saving device since households can purchase and process cocoyam during the harvest period at low prices and consume later when prices are higher. However, this processing method cannot carry consumption overtime and space given the high degree of storage loss (Chandra, 1979; Nweke, 1981; Plucknett, 1979; Ezeh, 1983; Okorie, 1981; Eze, 1987).

Though traditional processing methods maintain the organoleptic quality demands of consumers, researches on alternative processing methods have been and are still being developed with the aim of improving output of farmers; minimising post harvest sanitary quality and utilization conditions (Chinsman and Fiagan, 1987) as well as increasing farm income or industrial profits.

Other forms in which cocoyam is utilized in Nigerian homes have been identified. They include roasting or baking, steaming and use as soup thickener as well as traditional medicine for embrocation of sprained and swollen parts using its scrappings as plaster (Anazonwu-Bello, 1976; Anthonio and Isoun, 1982; Nwana and Onochie, 1979). In Malaysia, Plucknett, et al, (1970) and Ghani (1981) reported cocoyam as being used for religious festivals, contact poison, mild laxative, treatment of wounds and snake bites as well as in the reduction of body temperature in a feverish patient.

Cocoyam starch is easily digestable and therefore can find its use in manufacture of infant and invalid meals, Anaemic patients, Convalescing patients, Peptic ulcer patients, patients with pancreatic chronic liver problems, inflammatory bowel and gall bladder diseases; cocoyam meal reduces the pressure on the patient's metabolic process (Robinson, 1972; Anazonwu-Bello, 1976; Onwueme, 1978).

Wang and Steinke (1979) reported high protein malnutrition among children of pacific Islanders due to the replacement of cocoyam by cassava which provides more energy and less protein in their diet.

Cocoyam is a better alternative to protein source for peptic ulcer patients than other carbohydrates. Colocasia leaves have been reported as good sources of Vitamin C, folic acid, riboflavin and Vitamin A (Onwueme, 1978; Moi, et al, 1979).

Akomas, et al (1987) and Ejimofor (1987) independently reported the potential of cocoyam being commercialized, for instance, cocoyam could be processed into flour, chips, cakes, beverage powder, frozen and canned products, dried flakes, cooked slices as well as alcohol with carbon dioxide as by-product. It can also be included in manufactured goods like noodles, biscuits and bread. Aguiyi (1982) reported a partial replacement of wheat by 10% cocoyam starch in bread production. Also its protein and vitamin contents have made the crop a good cereal substitute in the manufacture of livestock feed and human food.

2.2.4 Cocoyam Production and Utilization Problems

The major cocoyam production and utilization constraints stem mainly from biological, economic and socio-cultural factors. However, there are problems associated with inadequate research and extension services as well as low rate of adoption of innovations by farmers.

2.2.4.1 Biological constraints

The biological constraints in crop production are generally pests and diseases.

In cocoyam production, the important pests are insects (Colocasia leaf hopper and Xanthosoma bettles), termites and weeds as well as human and animal pests. The most serious diseases of cocoyam are leaf blight caused by Phytophthora Colocasia, soft rot complex caused by Phythium, and root knot nematodes. Xanthosoma species are more prone to rot disease attack than Colocasia. However, the intensity of pests and diseases attack differ in different parts of the World. It may range from 10% - 100% both in the field and in storage. In the store, mealy bugs attack corms reducing their weight and viability. Dusting with Lindane or Aldrin dust is recommended (Hahn, 1987; S.P.C., 1987; F.A.O, 1988; I.I.T.A, 1986; Onwueme, 1978, Aziwe, 1988).

2.2.4.2 Economic constraints

These concern the ways the farmers use, source and allocate scarce resources to the cocoyam enterprise. However, these depend on the farmers' production goals.

In Nigeria, smallholder farms are common whereby the main owner of the farm, usually the family head, puts in personal or borrowed capital, assumes all risks in addition to carrying out the organisation and supervision of the farm.

The labour in use are mainly family members; occasionally labour is hired. Farm size is on the average under two hectares and often scattered in small plots; and this has serious implication for innovations, innovativeness, adoption and extension education (Chidebelu, 1980; Mellor, 1966). They independently stated that there are low levels of resource utilization, and capital investment but there is usually a relatively high level of efficiency in resource allocation in enterprise combination within the context of multiple cropping. However, smallholder farming is characterised by full utilization of available capital assets, but there is no full exploitation of the potential for capital formation. The result is low return to capital as well as labour and hence productivity. For instance, Eluagu, et al (1987) reported that cocoyam contributed an average of 7.4% of the total farm income of farmers in Imo State. This may not be sufficient to cover cost of production and still leave some margin as profit. Okorji (1988) estimated the credit requirement of smallholder farmers in Anambra State for production of major food crop enterprises of yam based crop mixture (YBCM), cassava based crop mixture (CBCM) and rice as ₦1149.67, ₦487.46 and ₦1229.44 per hectare respectively while Nweke and Winch (1980) stated that smallholder farmers need an average of ₦342.00 per farmer. This credit requirement, however, depend on the farmers age, area cultivated and income.

Cost of cocoyam production is low in relation to other root and tuber crops like yam, potato and cassava. The range is estimated to be between ₦420 - ₦760 per hectare (Njoku and Obiefuna, 1987; Ajala and Obiechina, 1987) while cassava, yam and sweet potato have respectively ₦700 - ₦1,400, ₦770 - ₦1540 and ₦935 - ₦1870 as cost per hectare (Okorji and Obiechina, 1985; Horton, et al, 1984). Economically, it is expected that resource inputs that are limited should be allocated to the enterprise with the highest returns per input. Incidently, studies in Imo and Anambra States have shown that in general resource allocation to crop enterprises by smallholder farmers is often based largely on socio-cultural significance of particular crops (Okorji and Obiechina, 1985). This probably explains why resource allocation to cocoyam which has relatively low socio-cultural significance among the people of Southeastern Nigeria, is significantly low when compared to such highly revered crop as yam (Arua, 1981; Okorji and Obiechina, 1985).

Cocoyam competes for labour with yam and cassava. Since yam and cassava have priority over cocoyam production, invariably labour availability for cocoyam production is made worse than it normally should have been (Njoku and Obiefuna, 1987). This problem is compounded in the rural areas by rural - urban migration of the most energetic and innovative members of the labour force. This has resulted also to high labour cost (F.A.O, 1988).

Okorji and Okereke (1988) reported that in Abakiliki area of Anambra State, smallholder farmer's resource allocation for yam based crop mixture in 1981/82 far out weighed that of cassava based crop mixture. In 1983/84 planting season while there was increase in the resource allocation for yam and rice enterprises, those of cassava and cocoyam and other arable crops were on the decline. Nweke and Winch (1980) attributed this trend to cultural value attached to yam by farmers rather than nutritional or economic.

In most areas of Southeastern Nigeria, yam is considered a "man's crop" whereas cassava, and cocoyam are "woman's crop", all production, marketing and consumption decisions with respect to yam are made by the male head of the household. Similar, decisions with respect to cassava and cocoyam are made by female members of the household (Nweke and Winch, 1980; Okorji, 1988). This tends to affect cocoyam production negatively especially as men control most household resources.

2.2.4.3 Socio-cultural constraints

Roots and tubers suffer bias in research, extension, resource allocation and even consumption and utilization because they are regarded as poor peoples crops (Okigbo, 1987). Olorunda (1979) observed that though *Xanthosoma* was inferior to yam, it played a significant role particularly at some periods of the year when people cannot afford to buy yams. But many, especially men, would not eat cocoyam because of fear of being looked down upon as weak, lazy and unfortified. It is also believed that cocoyam neutralizes certain metaphysical power acquired through African traditions and customs. Olorunda, (1979) also reported that production and eating of cocoyam is left in the hands of women and weaklings who are not able to face the challenges of producing the royal crop, yam.

2.2.4.4 Problem of planting materials

The use of cocoyam corms and cormels as food and planting materials have resulted in their being expensive and insufficiently available for farmers use (Ibe and Iwueke, 1984). Unamma, et al (1985) reported the non-availability of improved planting materials for cocoyam and yam unlike other root and tuber crops. Research reports at National Root Crops Research Institute Umudike, recommended the use of "seed" produced by minisett technique (NRCRI, 1979, 1986, 1987). According to the reports, the minisett technique will reduce cost of planting materials by 40% and when the "seed" is produced, storage losses are reduced by 80% as smaller cormels have 3-4 months shelf life under farmgate storage technique. Also a 25gm minisett "seed" cultivated with the recommended agronomic input will yield as much as a standard planting sett of 90-100gm, a saving of over 75% in planting material outlay. However, most farmers cannot adopt this "seed" method because it is a deviation from normal practices (Okorji and Nwagbo, 1990).

2.2.4.5 Inadequate research and extension services

Research on cocoyam has trailed behind that of other staples both in Nigeria and the larger world. Ezedinma (1987) showed that the totality of published scientific work on cocoyam is insignificant when compared with those of rice, maize or cowpea as well as cassava and yam.

Knipscheer and Wilson (1981) stated that cocoyam is a poorly documented crop and basic information about its role within West African Farming system is scarce. Nweke (1987) attributed this condition to the lack of interest shown by the high income countries in the crop both for consumption and other purposes. Even locally, market is limited because of low income. These have gone a long way in affecting cocoyam production and productivity in Nigeria. Some of the available research findings on cocoyam cannot be adopted because they are beyond the farmers environment. However, ecologically based and economically viable innovations based on indigenous resources could be adopted by smallholder farmers of Imo State.

Extension services are inadequate because of shortage of the right personnel and logistic support for them to make any meaningful impact on the farmers production

(Eze, 1986; Gani, 1987). This has gone a long way in inhibiting adoption of modern technique of crop production including cocoyam.

2.2.4.6 Problems of adopting innovations

Adoption is the act of accepting an innovation. Jones (1963), in a study, considered farm size, income of adopters, age, education and socio-economic status as factors affecting adoption. Basu (1969), in a study in Western Nigeria, attributed illiterate farmers' adoption of new practices on the farmers' understanding of the importance of such innovation, the agroclimatic conditions of the area, advantages of the new practices over an existing one as well as the availability of resources needed for implementing the practices and ready market for the produce. Johnston (1958) stated that farmers would adopt new technology only when they themselves perceived it to be in their own socio-economic interests and capacities to do so. Furthermore, adoption or non-adoption of an innovation by smallholder farmers to improve the quantity and quality of their crops, depends to a large extent, on the profitability of the innovations on the farmer's fields. This in turn depends on the output and marketability of the crops concerned. Consequently, a knowledge of the degree of commercialization helps predict potentials for adoption of new technologies especially those technologies that require purchased inputs.

Olayide and Heady (1982) stated that biological innovations of new capital forms such as fertilizer, feed additives, new crop varieties, improved breeds, insecticides, herbicides and others, increased output per animal or per hectare as well as causing less labour to be required per unit of output. Also Ruttan (1982) stated that new technologies had the potential to increase production through higher yields per unit of land and in some cases, through the expansion of area under cultivation. It was also reported that a benefit-cost ratio of 2:1 or more are usually needed to encourage farmers to adopt and use fertilizer even with risk. Ajala and Obiechina (1987) noted that the use of fertilizer in cocoyam farms was still on a small scale contrary to the large scale adoption of fertilizer on maize and cassava. They, therefore, suggested the use of extension agents to demonstrate the use of fertilizers to farmers.

However, innovations proposed by agricultural researchers for extension were, rather often, simply not adopted or were adopted only in a partial or modified form by farmers. Smallholder farmers are economically rational but not necessarily profit maximising; they therefore approach innovations cautiously because it may be costly and risky however profitable (Johnston, 1958).

Bishop and Toussaint, (1958) observed that non-adoption of innovations resulted from inability of the project to either educate the farmers on the importance of the input or supply the commodity to the consumers at sites of demand. Ukoje and Baba (1983) observed lack of finance and cost of the input constituted a hinderance to adoption in a smallholder farm.

The present food crisis in Nigeria then calls for more attention to the growing of food crops that cannot only feed the small farmer's household but also increase his income and hence standard of living. The constraints of cocoyam production not withstanding, there is need to accord better attention to this crop because of its promising economic value. This could, however, be attained by the smallholder farmers' adoption of improved production methods instead of sticking to their traditional unproductive technologies.

CHAPTER THREE

METHODOLOGY

3.1 Selection of the Study Area

This study was conducted in Ihitte/Uboma. The location was purposively chosen because a good number of the smallholder farmers in the area grow cocoyam in addition to other crops (Imo State Ministry of Agriculture, 1987).

The study area is located in the rain forest belt between longitude 7°19' and 7°23'30" E and 5°30' and 5°45' N. It is bounded in the West by Ehime-Mbano and East by Ikwuano-Umuahia. While, Obowu and Ahiazu-Mbaise bounded it in the north and southwest respectively (Imo State, 1990).

The population of the local government Area was projected from 1963 census to be 293,891 in 1991. This was estimated from a growth rate of 2.5 percent per annum. The land area is 132.40 squared kms.

The area is drained by the Imo River and Lake Abadaba. There are little existing primary forests around the banks of the Imo River. The topography varies with the hilly land forms around the Western and Southern parts of the Local Government Area, while the lowest portion lie along the Imo River with some flooded plains in the eastern and northern areas (Figure 1).

There are ten major communities in the local government area out of which a random sample of six was made for the study.

3.2 Selection of Respondents

The sampling frame consisted of farmers who cultivated cocoyam during the 1989/90 planting season. From such list, a random sample of ten farmers was taken from each selected community to give a total sample size of sixty respondents.

3.3 Data Collection

Data for the study were collected from both primary and secondary sources.

The primary data were collected using two sets of questionnaires. The first set of questionnaire was used to collect information on household characteristics including household size and composition, age, level of education and farming experience. Information were also collected on current land holdings, types, sources and use of resource inputs such as labour, credit facilities, agrochemicals including pesticides, fertilizers and herbicides , improved cocoyam varieties in use, improved technologies in use as well as availability of storage,

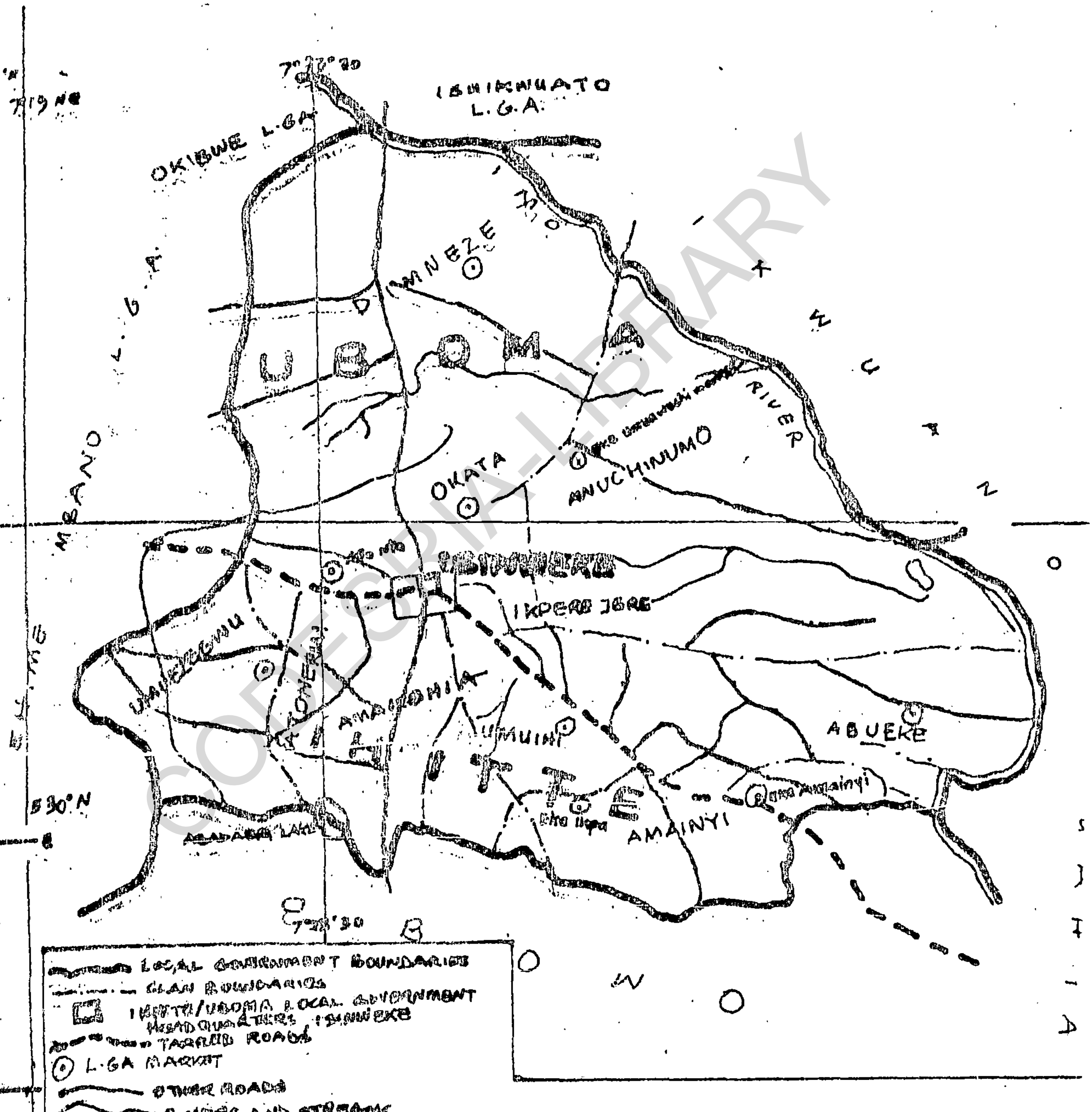

Fig. 1, Showing Map of IHITTE/UBOMA Local Govt. Area processing and marketing facilities and transportation systems in the study area. Information on field size, cropping patterns, plant population and calendar of farm operations for cocoyam production were also collected. Data were also collected on utilization of cocoyam as well as problems inhibiting increased cocoyam production.

The second set of questionnaire was used to collect information on yield of cocoyam at different ages of harvest. A weighing scale was used to determine output of cocoyam from sample plots, and such output value was then extrapolated to obtain yield of cocoyam per hectare.

The secondary data were collected from annual reports of the State Ministry of Agriculture, Owerri, National Root Crops Research Institute, Umudike and Ihitte/Uboma Local Government Area Headquarters. Journals, Conference/Seminar papers as well as other related texts and publications were also consulted for relevant information.

3.4 Analysis of Data

To analyse data on cocoyam based cropping systems and importance of the crop in the study area, descriptive statistics such as means, frequencies and bar charts were used.

Percentages were used to show the level of adoption of improved cocoyam production technologies.

Students t-test was used to test for statistical difference between means of the yield from cocoyam under improved and local technologies.

The costs and returns involved in the production of cocoyam using improved and local technologies were computed and profits determined. Benefit-cost ratio and gross margin were used to compare profitability.

A further analysis was done to find the impact of the technologies such as fertilizer use, labour input frequency of weeding, average plant population, age of cocoyam at harvest and minisett technique used on yield. Multiple regression analyses were used. The implicit function of the models are given as

$Yi = f(X_j)$.

Model 1. $Y1 = f(X_1, X_2, X_3, X_4, X_5, X_6, U)$.

where $Y1$ = Output/ha (Improved technologies)

X_1 = Quantity of fertilizer used in kg

X_2 = Labour employed in mandays.

X_3 = Frequency of Weeding

X_4 = Average plant population/ha

X_5 = Age of cocoyam at harvest

X_6 = Minisett technique (dummy)

U = Stochastic Error term.

odel 2

$YL = f(X_2, X_3, X_4, X_5, U)$

here YL = Output/ha (local technologies),

$X_2, X_3, X_4,$ and X_5 are as defined in model 1 above.

A third model was employed to use pooled data for mproved and local varieties. The implicit function is iven as $Y = f(X_1, X_2, X_3, X_4, X_5, X_6, U)$

here Y = output/ha of cocoyam (pooled) and X_j's are s defined above. The a priori expectation is that the ndependent variables would positively affect yield in he study area.

Three functional forms were tested and the one with he best fit was chosen. The functional forms employed nclude the linear, semi-logarithmic and double ogarithmic forms.

The average yield/ha was computed from the measured ocoyam corms and cormels per $40m^2$ obtained from the rmer's fields by extrapolation or simple proportion in hich the result obtained is multiplied by the ecommended plant population of 10,000 plants per hectare, nd then divided by 1000kg to give the yield in tonnes er hectare (Hahn, 1979; Ezumah and Okigbo, 1980). Thus the yield per tonne was obtained using the formula

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

A similar extrapolation was done to obtain the plant population per hectare.

$$\text{Plant population/ha} = \frac{\text{Observed Plant Population}}{40m^2} \times \frac{10,000m^2}{1}$$

Finally, the problems inhibiting increased cocoyam production was descriptively analysed.

3.5 Theoretical Framework

The growth and yield of a plant is a function of its genetic make up, the complex interactions between the crop and several factors and conditions in the environment, the crop production and management practices as well as the existence and application of scarce resources (Ezedinma, 1986; Kay, 1986). The control of these factors and conditions in the environment that affect crop growth and yield is essential. Hence, the establishment of such research Institutes as National Root Crops Research Institute, Umudike, and others aims at selection and improvement of the crops' resistance to these factors especially the biological factors.

The production techniques in use which include land preparation, time of planting, plant population, variety planted, cropping practices, weed management, fertilization, harvesting and storage may add or substract from the yielding ability of any crop in any environment. For instance, weed control under integrated weed management showed a higher output than one without good weed management strategy (Akobundu, 1981; Chinaka, et al, 1987). At Umudike, National Root Crops Research Institute, gross margins of ₦6,362.00 and ₦6,685.00 were realised for integrated weed management in cocoyam/maize/groundnut and cocoyam/maize/sweet potato respectively compared to a gross margin of ₦4,100.00 for sole cocoyam weeded twice.

In terms of actual yield, cocoyam sole out yielded the others with intercrops. Cocoyam sole yielded 9.6t/ha, cocoyam under cocoyam/maize/groundnut intercrop gave 9.01t/ha and cocoyam/maize/sweet potato intercrop gave 8.9t/ha (Chinaka, et al, 1987). This supports the observation that competition exists more often than not in mixed than sole cropping enterprises for most crops thereby reducing yield. However, complementary relationships exist, and are known to increase yields.

Variations in yields also results from differences in varieties, which have different levels of adaptability to physical and other environmental factors in the area of production. This could be specially applicable to cocoyam. Yield is also known to vary with age of crop at harvest. For most root and tuber crops, yield tends to increase with age though with some limitations (Gurnah, 1986). Furthermore, Castro (1979), Akobundu (1981) and Caesar (1980) observed that competition for food and light, frequency of weeding, time of planting and weather conditions as well as soil fertility and P^H give rise to differences in cocoyam yield.

Multicollinearity was used to test if the independent variables (technologies) were harmfully correlated. According to Koutsoyiannis (1987) multicollinearity means the presence of linear relationships (or near linear relationships) among the explanatory (independent) variables. If there occurs a perfect linear correlation between variables (i.e. if $rij = 1$), the parameters become indeterminate. On the other hand, if the explanatory variables are not intercorrelated ($rij = 0$), it means that the problem of multicollinearity does not arise or exist. In practice neither of the above extreme cases is often met. She further notes that in most cases there is some degree of intercorrelation among the explanatory variables, due to the interdependence of many economic factors overtime. In this event, the simple correlation (rij) for each pair of the explanatory variables will have a value between zero and unity and the multicollinearity problems may impair the accuracy and stability of the parameter estimates, but the exact effects of collinearity have not as yet been theoretically established. However, Klein (1981) stated that in a model with two explanatory variables, if the overall multiple correlation of the relationship $R^2Y.X_1, X_2, \ldots, X_k \geq r^2X_iX_j$ between any two explanatory variables then there is no problem of multicollinearity in the model but if $R^2y.X_1, X_2, \ldots, X_k$ is less than or equal to ($r^2X_iX_j$) simple correlation coefficient squared between any two explanatory variables, then there is a problem of multicollinearity; the latter method was adopted in this study.

CHAPTER FOUR

RESULTS AND DISCUSSIONS

4.1 Cocoyam Cropping Systems in Ihitte/Uboma

4.1.1 Farmers Characteristics

A household comprises all persons who generally live under the same roof and eat from the same pot (F.O.S, 1985). Lipsey (1986), on the other hand, stated that a household included all people who lived under one roof and made or were subject to others making for them, joint financial decisions. But in a rural setting, such as the study area, a household includes the household head, the wife or wives, children and other dependents which may include nephews, nieces, brothers and sisters to the household head or his wife/wives, other extended relations or house helps.

Thirty two percent of the respondents were males while 68% were females. The age range of the surveyed farmers was 22 years to 64 years with a mean of 51 years.

Each household had a wife. The number of children in each household ranged from one to fifteen with a mean of six children per household. The average number of dependents was three, with a range of one to eleven. On the average, the household size ranged from three to twenty-one persons per household with a mean of ten persons. The percentage distribution of household size in the study area is shown in Table 1.

Table 1: Percentage distribution of household size in the study area 1989/90

Household size	Frequency of Respondents	Percentage
≤5	4	6.67
5-10	26	43.32
11-15	25	41.67
16-20	4	6.67
21-25	1	1.67
Total	60	100.00

Source: Field survey, 1989/90.

The farming experience of the respondents ranged from three years to forty eight with an average of twenty eight years. This was acquired through the farmers' involvement in household farming operations.

Table 2 shows distribution of respondents according to number of years spent at school.

Table 2: Distribution of respondents according to number of years spent at school

No. of years spent at school	Frequency of Respondents	Percentage
0	28	46.67
1 - 6	25	41.67
7 -11	5	8.33
12 and above	2	3.33
Total	60	100.00

Source: Field survey, 1989/90.

The level of literacy of the respondents was relatively low as only about 12% of them spent beyond six years in formal school. Low level of literacy could be negatively related to farmers' access to material inputs, extension advice and adoption of new technologies in the study area.

Table 3 shows occupational distribution of respondents in the study area.

Table 3: Occupational distribution of respondents

Occupations	Rank of Occupations			
	Primary		Secondary	
	Frequency of Respondents	%	Frequency of Respondents	%
Farming	50	83	-	-
Trading	-	-	39	65.00
Manson/bricklayer	-	-	5	8.33
Fashion design/ Tailoring	-	-	6	10.00
Teaching/civil Servant	10	17	-	-
Hair plating/ Salon	-	-	3	5.00
Housewife	-	-	2	3.34
No other secondary Occupation	-	-	5	8.33
Total	60	100	60	100.00

Source: Field survey, 1989/90

About 83% of the farmers were fully engaged in farming as a primary occupation while 17% were involved in teaching/civil service work. In addition to primary occupation, the farmers were also engaged in such other activities as trading, fashion design/tailoring, etc as secondary occupations. The farmers engaged in these secondary occupations mostly during the off-season, when relatively less work was done on the farm.

4.1.2 Land Ownership

Ninety eight percent of the farmers acquired some of their farm lands by inheritance, eighteen percent by communal method, thirty percent by outright purchase and twenty three percent by lease. Others acquired theirs by pledging (12%) while two percent acquired theirs as gifts. In the case of land lease, thirty five naira, a bottle of schnapp and three kolanuts were offered to the lessor for Igbaju-ala or Iheokpaevu - a form of sacrifice to the gods of land and fertility to appease them for good yield. Those who acquired land through gifts are newly married women whose mother or father-in-law gave out a portion of her/his land to her/his daughter-in-law as a token of acceptance. The average number of farm fields and farm sizes owned by each household according to communities is shown in Table 4.

Table 4: Average number of farm fields and farm sizes owned by the survey households

Community	Average No. of Fields	Average Farm Size (ha)
Amakohia*	3.3	0.56
Awuchinumuo	8.6	3.69
Amainyi*	4.6	0.73
Atonaerim*	5.1	1.24
Abueke	9.9	4.32
Dimneze	7.7	3.81

*Communities near the Local Government Area Headquarters.

Source: Field Survey, 1989/90.

Diehl (1982) referred to a field as a piece of land under the control of a farmer. The average number of fields owned by each household was 6.5 fields while the farm size was 2.39 hectares/household. The range was 3.3 to 5.1 fields for communities nearer the Local Government Area Headquarters and 7.7 to 9.9 fields for the communities farther away. Also the farm size range was 0.56 to 1.24 ha for communities close to the Local Government Area headquarters. Communities farther away had a farm size range of 3.69 to 4.32ha. The implication is that farmers in Atonaerim, Amakohia and Amainyi had problem of acquisition of farm land while those farther away (Awuchinumuo, Abueke and Dimneze) had abundant farm lands. This may be related to the use of the available lands for development purposes especially building houses and other structures around the local government headquarters. This means, therefore, that the available land will be intensively used by the communities concerned.

Seventy percent of the respondents used compound/ neighbourhood farms for the cultivation of cocoyam, , twenty three percent distant farms and seven percent used swampy farms. The reasons for using a particular farm for growing cocoyam in the study area are shown in Table 5.

Table 5: Distribution of farmers according to reasons for using a particular farm land for growing cocoyam.

Reasons	a	b	c
Land is more suitable/fertile	52	17	4
Reduction in transport cost	34	2	-
Easy access to crops as need arises	23	8	2
Removed from home to avoid theft	2	12	2
For effective and efficient supervision	39	19	3

a = Respondents reasons for using compound/neighbourhoo farms.

b = Respondents reasons for using distant farms.

c = Respondents reasons for using swampy farms.

Source: Field survey, 1989/90.

Farmers' use of farm land depended on the suitabilit and fertility of the land, and opportunity the location of the farm offered them to effectively and efficiently supervised and manage the farm as well as reduced cost oi transportation. Other reasons given by the farmers were easy accessibility to the farm which enabled them to harvest the crop as the need arose, shadiness of the farm land and an expected better harvest if the farm was far from home. For instance, cocoyam was grown mostly on compound farm because of greater fertility of such land and the opportunity for effective supervision.

Compound farms could take crops ranging from cocoyams, yams, cassava, maize, pepper, fluted pumpkin, pumpkin, to tree crops including mango, oil palm and oranges. The most important crop mixture in the study area during the survey was cocoyam/yam/maize/vegetable/cassava. Others were cocoyam/cassava/maize, cocoyam/cassava, cocoyam/maize/yam/melon/vegetable/cassava.

Table 6 shows the percentage distribution of respondents according to the crop mixtures they cultivated during the survey.

Table 6: Percentage distribution of respondents according to crop mixtures grown in the survey year

Crop Mixture	Frequency of Respondents	%
Cy/Y/Ma/Veg/Ca	56	34.38
Cy/Ca/Ma	43	26.71
Cy/Ca	16	9.94
Cy/Ma/Veg	12	7.45
Cy/Y/Ma/Me/Veg/Ca	18	11.18
Cy/Ma/Me/Ca	11	6.83
Cy/Veg/Ca	3	1.86
Cy/Me/Pe/Ca	2	1.24
	161*	

*Multiple responses were recorded

Cy = Cocoyam
Y = Yam
Ca = Cassava
Pe = Pepper
Ma = Maize
Me = Melon
Veg = Vegetable

Source: Field survey, 1989/90.

Cocoyam/yam/maize/vegetable/cassava crop mixture was the commonest followed by Cy/Ca/Ma, while Cy/Me/Pe/Ca was the least favoured crop mixture in the area. Crop mixtures in some plots had as many as six crops growing at the same time. This may be related to land scarcity being experienced in some communities as discussed earlier.

4.2 Resource Allocation

4.2.1 Labour Allocation

All the farmers used family labour. In addition, 43% of the respondents used hired labour, 30% used exchange labour while 25% used cooperative labour. Most respondents indicated that labour was in greatest need during weeding and mound making. Specifically, this occurred during the months of March and June for most crops. Upton (1987) regarded March through June as work peak periods since critical tasks such as planting, weeding and harvesting must be completed within this limited time band. Also during this study, it was observed that the work peaks in the farm concided with the period of "Abar" when farmers harvested their palm fruits in the study area. Labour had to be released for the harvesting, packing and processing the palm fruits.

Eze (1986) observed that labour allocation among crop enterprises depended on labour requirement of the enterprise as well as the size of farm. Oluwasanmi, et al (1966) observed that in Uboma farmers spent an average of 2.91 hours per day on the farm while men and women respectively spent 3.35 hours per day and 2.51 hours/day. Johnson (1982), however reported that 1 woman day = 0.75 manday and 1 child day = 0.5 manday. This study, however showed that between 1988 and 1990, the farmers in the study area used an average of 493.83 mandays in their cocoyam farm, 814.18 mandays in yam, and 544.50 mandays in cassava farm. The labourers included men, women and children working at different rates and areas where they were most efficient. Table 7 shows household allocation of labour (mandays) per hectare to the major staple crops during the past three years (1988 - 1990).

Table 7: Household allocation of labour (mandays) per hectare to the major staple crops enterprises in the past three years (1988-1990)

Crop Enterprise	1990	1989	1988
Cocoyam	146.79	169.20	177.84
Yam	237.80	279.36	297.02
Cassava	170.75	179.63	194.12

Source: Field survey, 1989/90.

The trend in labour use/allocation by the surveyed households showed a steady decline in the past three years. This could be attributed to increasing labour scarcity resulting from existence of better jobs outside the sector, education, cost of labour and old age of the group that constituted the bulk of the labour force. Oluwasanmi, et al (1966) and Upton (1987) observed that labour force in rural areas could be depleted by rural-urban migration for better and more paying jobs in the towns. Of the total labour input of 1852.51 mandays allocated to the three enterprises, yam had 44%, cassava 29% and cocoyam was allocated 27%. The labour allocation preference of the farmers during the study is presented in Table 8. The table indicates that preference was given to yam, cassava, then cocoyam and maize. Research studies by Okorji (1985), Nweke and Winch (1980), Okorji and Obiechina (1985) and Okorji and Okereke (1988) showed that resource allocation by smallholder farmers for yam far out weighed that of cassava, cocoyam and maize - the women's crops. This allocation is based more on cultural values than economic and nutritional values of the crops.

Table 8: Labour allocation preferences by the households in descending order of preference

Crops	Ranks			
	1	2	3	4
Yam	31	12	15	2
Cocoyam	13	23	21	3
Cassava	14	25	18	3
Maize	2	-	6	52

Source: Field survey, 1989/90.

Yam enterprise is the most favoured in terms of labour allocation by the farmers, mainly due to its sociocultural values. Furthermore, most decisions concerning resource allocation were entrusted on the household heads and this affected the amount of resources allocated to the other stereotyped women's crops.

Table 9: Labour allocation (mandays/ ha) to different farm operations in a cocoyam based crop mixture

Operation	Males (Mandays)	Females (Mandays)	Children (Mandays)	Total	%
Land clearing	7.20	2.82	0.62	10.64	7.3
Mounding/ Ridging	18.67	3.78	1.48	23.93	16.42
Planting	2.24	9.98	1.58	13.80	9.47
Weeding	0.53	61.85	13.85	76.73	52.32
Fertilizer Application	0.32	3.93	0.70	5.95	3.40
Harvesting	1.10	13.78	1.28	16.16	11.09
Total	31.06	96.14	19.51	146.71	100
%	21.32	65.53	13.39		100

Source: Field survey, 1989/90.

In cocoyam production, it was observed that most of the labour input were contibuted by women. The total amount of labour required or used for a hectare of cocoyam was estimated at 146.71 mandays/ha. Out of this amount, 65.53% was contributed by women, men 21% and children 13%. In the case of farm operations, men contributed about 78% of the labour input/ha for mound making while women contributed 81% in weeding. Another area where men's labour input/ha showed higher percentage than that of women in the production of cocoyam was in land clearing. Men supplied 68% of the labour needed. In other operations, women dominated. Weeding took the highest of the available labour in the cultivation of cocoyam, followed by mounding harvesting, planting and land clearing. The operation with the least labour need was fertilizer application.

It was observed that some farming operations were predominantly carried out by men, whilst others were done by women. Generally, the men are responsible for mound making and clearing the bush while the women are concerned with the remaining operations in an arable farm. However, there are cases of overlap in carrying out the farm responsibilities. For instance, men and women take part in clearing, burning and cultivation of the land, although the bulk of the work is done by women. This tallies with the view point of Okorji (1985), who observed that the total labour input provided by women was higher than that of the men except in men's yam based crop mixture.

In the study, it was found that the type of operation, sex and age of labourer, determined the amount payable for hired labour. Men charged an average of ₦22.50 per day for the operation they were most efficient - mounding; women ₦15.50 per day for weeding and children were paid an average of ₦7.00 per day. Sometimes, the labourers were served meals and drinks. When cooperative or exchange labour was used, the labourers were served two meals in addition to drinks.

4.2.2 Land Allocation

A total of 113.23ha of farm land was put into use by the respondents with a mean of 1.89ha per farmer during the 1989/90 cropping season. Cocoyam was cultivated on 27.18ha with an average of 0.45ha per farmer. The average number of fields under cocoyam during the study was 4.05 fields per farmer with cocoyam having an average of 1.22 fields/farmer. This result agreed with the findings of Mellor (1966), Njoku and Obiefuna (1987) and Diehl (1982). They independently reported farm size range of 0.4 to 2ha. Njoku and Obiefuna (1987), however, reported in a study at Ideator and Ahiazu that cocoyam was planted on 0.95ha of farm land.

4.2.3 Capital Allocation

All the respondents' sourced the capital for production from their past savings. Other sources are moneylenders (10%), Banks (15%) friends and relations (28%) and Isusu/meeting Umunne (33%).

A total of ₦4347.93 was borrowed per farmer from the several sources available to them in the study area. Interest paid was ₦882.32 per farmer. Not all the loans were used in cocoyam production. Further analysis showed that borrowers from friends and relations never paid interest, borrowers from moneylenders and banks paid 35½% and 19½% interest respectively while borrowers from meetings(Umunne/ Isusu clubs) paid about 9%.

Table 10 shows the average amount borrowed from different sources and interest paid.

Table 10: Amount of loan from different sources and interest paid per household.

Source of Loan	Amount borrowed	Amount of interest paid	Interest in %
Private Moneylenders	650	230.8	35½
Banks	3,222.22	637.33	19½
Friends/Relations	310.71	-	-
Isusu/Meeting Umunne	165.0	14.19	9

Source: Field survey, 1989/90.

This means that it is advisable to borrow from established financial institutions. This would help the farmers obtain enough loan for their agricultural investment purposes. However, most farmers cannot take advantage of this because of the stringent lending conditions such as requiring farmers to keep accounts with the prospective banks, and provision of acceptable security. Other conditions were the demand for certificate of occupancy, insurance policy and the non-acceptance of agricultural lands as bankable security as well as the paper work involved in obtaining the loans (Chidebelu, 1983; Orakwe, 1982). With the exception of the banks, loans obtained from the other sources were not adequate to finance a large-scale farmer who needed a large amount of capital to be in business. For instance, only 10.94% of the total loan was obtained from friends/relations and meetings (Umunne/Isusu clubs).

Average capital (cash) allocation to different crop enterprises by the respondents are shown in Table 11.

Table 11: Capital (Cash) allocation to different crops by the respondents

Crop Enterprise	Amount Allocated	Percentage
Cocoyam	230.17	22.4
Yam	382.30	37.2
Cassava	269.67	26.2
Maize	21.00	2.1
Rice	125.00	12.2
Total	1028.14	100.00

Source: Field survey, 1989/90

The table shows that yam enterprise was allocated more fund (37%) than either cassava or cocoyam. This allocation is in consonnance with the findings of Okorji (1985), and Okorji and Obiechina (1985). They indicated that the preference in allocating more resources to yam was related to the socio-cultural role of the crop in the study area.

4.3 Adoption of Improved Technologies in Cocoyam Production

Cocoyam, as any other crop, needs modern inputs to realise its full genetic potential. These include fertilizer, pesticide and herbicide or even the use of minisett cocoyam as planting material. Adoption of recommended plant population, number/frequency of weeding and harvesting at the appropriate age by the farmers would improve yield of cocoyam.

There was no evidence of the use of improved cocoyam cultivar in the study area. Even the farmers who used cocoyam minisett technique to source their planting material did so with the local unimproved cultivars/varieties of cocoyam. Only thirteen percent of the respondents used minisett technique to source their planting material. The farmers learnt how to prepare this minisett cocoyam seed through the extension division of the state Ministry of Agriculture or ADP (Agricultural Development Project) at Isinweke.

Fifty eight percent of the respondents indicated having used fertilizer on their several crop fields. The quantity used ranged from less than 50kg to 1200kg. The farmers indicated that the fertilizer used in cocoyam farms were not directly aimed at cocoyam. However, it was applied on the same mound or ridge carrying cocoyam and cassava. The cocoyam, by extension, benefitted from the fertilizer since the input was not selective in the release and supply of plant nutrients. The farmers agreed having observed marked differences in the yield of their cocoyam planted with cassava treated with fertilizer.

The channel of distributing fertilizer might have contributed to the high usage of this input in the study area. In the study area, fertilizers were distributed by government through the community heads. They were then distributed through the clan and kindred heads to the farmers. The input was then shared among the women who mostly cultivated cassava, cocoyam, vegetables and maize. Also women associations, for instance, meeting Umunne - a thrift and savings union of women born and married within an area - got fertilizers from Better Life for Rural Women branch of the local government at reduced prices.

The minisett technique could not be adopted by most farmers in the study area. This is attributable to the farmers' belief that the plantable setts are so small that all efforts geared towards growing them would end up being wasted. Okorji and Nwagbo (1990) attributed the non-adoption of minisett technique as a method of sourcing planting materials by farmers to the farmers belief that the practice is a deviation from normal practice.

The non-availability of improved cocoyam cultivars in the study are is in agreement with earlier studies by Ajala and Obiechina (1987) in Nsukka agricultural zone and Eluagu, et al (1987) in Imo State. However Ajala and Obiechina (1987) reported the existence of improved cultivars of cocoyam at research institutes at I.I.T.A., NRCRI and National Institute for Horticulture. Udealor, et al (1987) attributed the non-availability of improved cocoyam cultivar to non flowering habit of cocoyam which makes hybridization difficult.

Information about innovations in agriculture got to the farmers in the study area through friends and relations (43.9%), radio sets (29%), agricultural extension agents (27%) while none got information through television sets.

Farmers in the study area purchased inputs (fertilizer) from the Ministry of Agriculture, open market or through their cooperative unions. Table 12 shows the average quantity of fertilizer bought from the different sources.

Table 12: Quantity of fertilizer (kg) purchased from different sources per household

Source	Qty. of Purchase (Kg)	%
Ministry of Agriculture/ ADP	325.83	83.91
Open Market	55.83	14.38
Cooperative Union/ Women Association	6.67	1.72
Total	388.33	100.00

Source: Field survey, 1989/90.

The bulk of the fertilizer used during the survey period was bought from the Ministry of Agriculture/ADP at Isinweke. It was related to the lower rate at which the input was sold. Though a good proportion of the farmers indicated having used fertilizer during the study, the quantity applied was insufficient to meet the demand of the crops.

4.4 Transportation, Marketing, Processing, Storage and Utilisation of Cocoyam in Ihitte/Uboma

Head portrage was commonly used in conveying farm products including cocoyam in the study area from the farm to the home. Other means were the use of wheel barrows and bicycles, motor cycle and very few used motor vehicles. The implication is that most farm products cannot be easily conveyed from the point of production to the point of need or sale. The distribution of respondents according to transport means used is shown in Table 13.

Table 13: The distribution of respondents according to transport means used

Transport Means Used	Frequency of Respondents	Percentage
Head porterage	48	80.0
Bicycle/Wheel Barrow	21	35.0
Motor Cycle	7	11.7
Motor Vehicle	3	5.0

Source: Field survey, 1989/90

A large proportion (80%) of the respondents used head porterage in conveying their farm products either to the home or market. This is largely due to the non-existence of all season motorable roads in the study area.

Farm products including cocoyams have four points of sale in the study area. These are the farm, homestead, rural markets and urban markets. The quantities of cocoyam sold at the different location is shown in Table 14.

Table 14: Quantity of cocoyam marketed and amount realised in each market by the household

Markets Markets	Quantity Sold (Kg)	Amount Realised (₦)	Unit Price/ Kg
Farm/homestead	158.18	139.33	0.88
Rural daily markets	71.0	97.35	1.37
Rural weekly markets	106.67	222.63	2.10
Urban Markets	1.67	5.50	3.30
Mean	337.52	644.66	1.91

Source: Field survey, 1989/90

The nearby rural weekly markets are Afornta Isinweke, Ekeikpa, Ekeamainyi, Eke-Umuawuchi and Orieagu (Ehime Mbano L.G.A.). Most farmers sell their cocoyam in the farm/homestead and rural weekly markets. The average unit price of cocoyam per kilogram was estimated at ₦1.91/kg. Difference in price was observed in the different points of sale. The difference in price could be attributed to the marketing cost of the product and the sellers profit margin. Also the category of buyers influences the price of cocoyam in the markets. Itinerant traders from Umuahia, Okigwe, Mbaise, Mbano, etc. attend these markets, especially the weekly markets. Most often, they haggle and pay high prices thereby influencing the price of the farm products including cocoyam. A significant proportion of the respondents (87%) sold their cocoyam unprocessed and on wholesale basis in these markets.

Cocoyam could be processed into flour, Achicha and chips in the study area but the proportion was small when compared with result of studies at Nsukka by Obiechina and Ajala (1987). The field result showed that only 3%, 5% and 1.7% of respondents processed cocoyam into flour, Achicha, and chips respectively. The respondents attributed their inability to process cocoyam to lack of the appropriate technology considering the slimmy nature of the peeled corms/cormels as well as its irritating characteristics that affected handling of the corms and cormels. Researchers at NRCRI Umudike recommended flow charts for processing cocoyam into flour and chips (Charts 1 and 2).

Peel
↓
Slice
↓
Wash thoroughly to remove adhering mucilage
↓
Soak overnight in water
↓
Immerse in 0.25% Sulphorous acid for 3 hours
↓
Blanching (4-5 mins) in boiling water
↓
Dry (57^{oc}-60^{oc})
↓
Mill

Chart 1: Flow chart for producing cocoyam flour

(Adapted from Akomas, et al, 1987).

Peel
↓
Wash to remove adhering mucilage
↓
Soak in water (1hr)
↓
Slice (1mm thick)
↓
Separate Individual Slive (Salt)
↓
Allow to dry
↓
Deep Fry

Chart 2: Flow chart for producing cocoyam chip.

(Adapted from Akomas, et al, 1987).

Ejimofor (1987) showed that alcohol could be derived from cocoyam when processed with carbon dioxide as by-product through a process of fermentation, distillation, rectification and stillage industrially. Most farmers, however, have no knowledge of these cocoyam processing methods. However, they are aware that processed cocoyam stays longer without deterioration than unprocessed ones. Researchers at N.R.C.R.I also showed that processing cocoyam could help reduce storage losses up to 70% (Akomas, et al, 1987).

Sixty eight percent of the respondents stored their cocoyams in barns, seventeen percent in the house, thirteen percent in heaps under tree shade and two percent in dug pit. Storage in dug pit is very much on the decline because of the labour requirement for preparing the pit. Some of the farmers also indicated having stored their cocoyam in the soil unharvested. Cocoyam is stored in the study area for upwards of five months (3-6 months) before being either consumed, marketed or used as planting material.

Table 15 shows the distribution of respondents according to their ranking of staple food crops in descending order of importance.

Table 15: Distribution of respondents according to their ranking of staple food crops in descending order of importance

Crops	Ranking			
	1	2	3	4
Cocoyam	6	19	27	8
Cassava	43	10	5	3
Yam	11	31	9	9
Maize	-	-	19	40

Source: Field survey, 1989/90.

Cocoyam ranked third as a staple food in the study area after cassava and yam. It was observed that more cassava and cocoyam is consumed. This could be related to the farmer's income level and household size. The farmers indicated having preference for yam due to its better taste but since they could not afford the cost, their reliance on cassava and cocoyam was justified. This agrees with the findings of Oluwasanmi, et al (1966) who reported the consumption of cocoyams in larger quantities than yams in Uboma. This is further buttressed by the number of times these staple foods are taken in the homes. Most of the respondents indicated having eaten cassava prepared in various forms twice daily while cocoyam is eaten once a day or on daily bases when used as soup thickener while yam was eaten occasionally.

Cocoyam is also of economic value. The sales are meant to realise money in order to meet up other financial commitments. A significant proportion of cocoyam output is usually stored for use as planting materials. A similar situation occurs in yam, and these show the effect of poor storage techniques adopted by farmers in storage. The purpose is to ensure availability of adequate quantity for use as planting materials in subsequent cropping seasons. The introduction of good storage techniques for cocoyam would release substantial quantities for sale, and hence increase farmers' gross income.

Cocoyam is given out as gifts to friends and relations or even in the church during the annual harvest and thanksgiving services. Cocoyam also serves in traditional medicine and sacrifices to the gods. Medicinally, cocoyam is used to treat whitlow by wearing it as a ring around the infected finger. It also serves as antiwitch crafts in the study area, though this is not common.

4.5 Cocoyam Farming Practices

Cocoyam production, as any other crop, involves many agronomic activities. The first operation is land clearing. The land is cleared by slashing and burning or if the volume of debris is small, it is worked into the soil while preparing the mounds/ridges. Land clearing for cocoyam is done in the study area between January and June using matchets. In fields containing cocoyam as the main crop, small mounds are prepared using the hoe. Mechanised technology is not in use in the study area for land preparation.

Land clearing is followed by ridging or mounding operation. Sixty-two percent of the respondents planted on small mounds. Cocoyam mounds when compared with that of yam and cassava are by far smaller. Thirteen percent planted cocoyam around or beside big mounds while the crest contained crops like yam or cassava; at times, smaller mounds were made between the furrows of these big mounds for planting cocoyams. Twenty-four percent, however, planted on ridges. Ridging was observed in areas where there were incidences of water erosion. The practices of planting cocoyam on beds, minimum or no tillage were not observed during the survey.

Planting of cocoyam commences around March and ends in June. In cocoyam based mixtures, it is planted two setts on the crest while other crops are distributed singly around the mounds. Cocoyam in the study area is mostly planted by women and the planting distance adopted by them is irregular. Plant population ranged between 5,430 to 13,250 plants per hectare with an average of 9351 stands per hectare. This gave a distance of 1.07m² apart. There is no difference in the planting methods adopted for the different cocoyam varieties.

Table 17 shows the distribution of farmers according to the cocoyam cultivar planted during 1989/90 cropping season.

Table 17: Distribution of farmers according to cocoyam cultivar planted during the 1989/90 planting season

Cultivar (Local Name)	Frequency of Respondents*	%
Akashi	39	65
Cocondia	60	100
Nwanyiakpi	48	80
Ede-Uhie	36	60
Okoriko	19	32
Ede Ofe	28	47
Ede akwa okuko	16	27
Onouti enyenwa-ara	4	7

*Multiple responses were recorded

Source: Field survey, 1989/90

Generally, there were about eight cocoyam cultivars planted in the survey year. Cocondia was the most commonly cultivated cultivar in the study area. Nwanyi akpi, Akashi and Ede 'Jhie were next in order of importance. Majority of the farmers cultivated Cocondia because it was early maturing. Akashi and Ede 'Jhie are also important because of their taste when cooked; they are likened to yam. The production of Akashi is, however, on the decline. The farmers attributed this decline to cost of "seed" cocoyam, disease attack and the length of time it takes to mature.

Fertilization operation in cocoyam takes the forms of the use of farm yard manure and fertilizer. Farms close to the family house are fertilized using mostly farm yard manure (FYM). Ninety-seven percent of the farmers indicated having applied farm yard manure to their farms (both distant and compound farms). Farm yard manure, are left overs from the kitchen, goat/sheep fodder as well as poultry droppings and livestock dungs. Farm yard manures,according to the respondents, are cheap, and easy to apply. Fifty-eight percent of the farmers applied fertilizer in cocoyam fields, though the target crop was cassava. Cocoyam and other crops, however, derive nutrients essential to them from the fertilizer applied.

Mulching in cocoyam farms starts in April when the soil must have been adequately soaked and ends in July; but it has to be done as early as possible to prevent using the mulch materials to smother the germinating shoots of the crop. The prominent mulch material in the study area is the palm fronds; however, grasses or shrubs or left over fodder are also in use. There was no case of using polyethene or wood shavings as mulch material during the survey year.

Fifty-seven percent of the farmers mulched their cocoyam plots primarily to control weeds, thirty-one percent to conserve soil moisture while twenty eight percent and seven percent respectively did so to cool the soil temperature and enhance the early sprouting of the crop. Farmers in the study area indicated that mulch materials added nutrients to the soil when they decayed. Also, intercropping cassava with cocoyam enhances yield since cassava protects cocoyam from the direct rays of the sun and rain drops, cocoyam being a shade loving crop.

Weeding in cocoyam farms starts in May and terminates in October in the study area. The range of weedings in cocoyam is between two and three before harvest, the average being two in 1989/90 planting season. First weeding is done between the third and fifth week and the second is done at about the eighteenth week after planting. The last weeding, which very few farmers do, is during the harvesting period to help sustain the crop that is left in the field especially cassava. This last weeding is mainly by hand pulling of weeds or using matchet to cut some of the shrubs that are growing in the "now" cassava plot. It is important to weed early to encourage suckering and good yield (Gurnah, 1986; Chinaka, et al, 1987). All weeding operations in the study area were carried out by either hand pulling or using weeding hoes. Herbicides were not used by the survey farmers during the study. The number of weedings in cocoyam farms however, depends on weed growth rate and management practices adopted by the farmer.

Time of harvesting cocoyam in the study area ranged from the fifth month to the nineth month of planting. Colocasia (Cocondia) is harvested after five months of planting through a series of multiple harvesting till the final harvesting is done either in December or January through February and March of the following year. These series of multiple harvesting are also called "topping" in yam and could take place in cocoyam between July and October. This result is in consonnance with what Coursey (1984) reported. Few farmers leave their cocoyams in the ground till such a time they are ready to plant but will continue harvesting the crop at their convenience. The methods used in harvesting cocoyam include hand pulling, and use of digging sticks; harvesting of cocoyam is usually done after yam must have been taken into the barn. This agreed with the findings of Nwagbo, et al, (1987) in Nsukka agricultural zone.

The calendar of farm operations for the major staple food crops in the study area is shown in Chart 3. The bars indicate the commencement and termination of each of the farm operations according to months. Land clearing commenced for all the enterprises in January and terminated in October for cassava, June for cocoyam and May for yam.

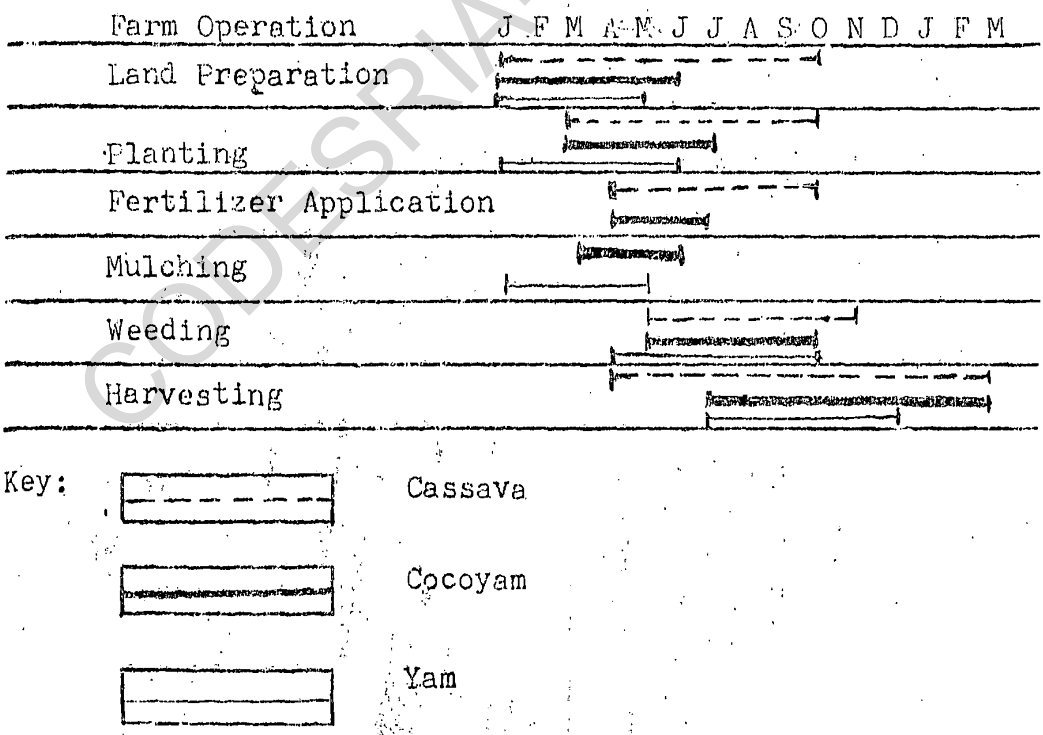

Chart 3: Calendar of farm operations for the major staple food crops in the study area

Source: Field survey, 1989/90.

The calendar of farm operations shows that most of operations were first carried out in yam fields before cassava and cocoyam. Okorji (1985) and Nweke and Winch (1980) independently related this to the importance of yam in the socio-cultural life of smallholder farmers rather than nutritional and economic. Hence, timing of performance of farm operations on cocoyam fields is influenced by duration/time of completion of similar operations on other crop fields, especially yam.

4.6 Comparisons of Yields of Cocoyam from the Use of Improved and Local Technologies

Yield differences in crops have been attributed to genetic factors, environmental, crop production and management practices as well as the existence and application of scarce resources (Kay, 1986; Ezedinma, 1986). In this study, farmers who used only the traditional methods without fertilizer and cocoyam minisett techniques were assumed to have applied local technologies in production. However, farmers that used fertilizer, cocoyam minisett technique, adopted the appropriate number of weeding, plant population density, number of labourers and harvested the crop at the right age, were assumed to have adopted improved practices and applied same on their cocoyam within the limit of their resources.

Thirty-five of such farmers were identified and used for analysis.

Table 18 shows the effect of technologies on the yield of cocoyam in the study area.

Table 18: Yield of cocoyam under improved and local technologies in the survey year.

Variable	Improved		Local		t-Value	Decision
	Mean	S.E.	Mean	S.E		
Yield (t/ha)	6.42	0.411	4.27	0.27	4.38	S
Quantity of Fertilizer (Kg)	585.71	86.74			6.75	S
Quantity of Labour (Mdys)	31.17	1.77	20.32	1.89	4.20	S
No. of Weedings	2.09	0.06	2.16	0.08	-0.76	NS
Plant Population/ha	9215.63	171.73	9539.28	355.26	-0.82	NS
Age at harvest	7.17	0.19	7.44	0.19	-0.99	NS
Minisett technique	0.51	0.86	-	-	6.0	S

S.E = Standard error, $t\alpha/2$ = 1.96

S = Significant at 5%,

NS = Not significant at 5%

T-Value = t-calculated.

Source: Computations based on data from field survey, 1989/90.

The results in Table 18 show that the use of improved technologies in the cultivation of cocoyam gave 6.42t/ha while that of local technologies gave 4.27t/ha as yield of cocoyam during the study. The t-test is significant at 5%, this implies that there is a significant difference in yield between the two technologies applied by the farmers.

There is a significant difference in labour used in mandays per hectare. This could be attributed to extra labour needed to apply fertilizer to the crop, weed the farm and/or to prepare the cocoyam minisett seed as a source of planting material. Fertilizer and cocoyam minisett use showed high levels of significance. The relatively high t-values shown by these technologies may imply the level of impact they have on the yield. Therefore, it may be assumed that the significant difference in cocoyam yield as indicated in Table 18 must have resulted from the use of fertilizer and minisett cocoyam seed. There is no significant difference between the two technologies in the number of plants per hectare, age of cocoyam at harvest and number of weedings. Environmental and soil factors were not considered in the analysis because they were assumed constant, since the fields were in the same location. Hence the effects of possible differences in these factors will be minimal.

hectare from food crop production that is comparable to returns from the non-agricultural sectors.

Tables 19 and 20 shows the gross margin analysis for cocoyam production.

Table 19: Gross margin analysis for cocoyam production under improved technologies

Item	Unit	Qty	Price/ Unit (₦)	Amount (₦)
Gross return	t/ha	6.42	1910	12,262.20
Total Revenue (TR)				12,262.20
Variable costs				
Cocoyam seeds	t/ha	2.10	1910	4,011.00
Land clearing	Mdys/ha	10.64	17.50	186.20
Mounding/Ridging	Mandays/ha	23.93	22.50	538.43
Planting & Mulching	Mandays/ha	19.80	15.50	306.90
Weeding Cost	"	76.23	17.50	1,334.03
Application of Fertilizer	"	5.95	10.50	62.48
Mulching Materials	Number	122.33	1.50	183.50
Fertilizer Cost	50kg	585.71	0.53	310.43
Harvesting	Mandays/ha	16.16	15.50	250.48
Total Variable Cost (TVC)				7,183.45

Gross Margin = TR - TVC

= ₦12,262.20-₦7183.45

= ₦5078.75.

Table 20: Gross margin analysis for cocoyam production under local technologies

Item	Unit	Qty	Price/ Unit (N)	Amount (₦)
Gross return	tonnes/ha	4.27	1910	8155.70
Total Revenue (TR)				8155.70
Variable Costs				
Cocoyam seeds	t/ha	2.10	1910	4011.00
Land clearing	Mandays/ha	10.64	17.50	186.20
Mounding/Ridging	"	23.93	22.50	538.43
Planting & Mulching	"	19.80	15.50	306.90
Mulching Materials	Number	122.33	1.50	183.50
Weeding cost	Mandays/ha	64.83	17.50	1134.53
Harvesting	"	12.30	15.50	190.65
Total Variable Cost (TVC)				6551.21

Gross Margin = TR - TVC

= ₦8155.70 - ₦6551.21

= ₦1604.49

Cocoyam produced under local technologies had a total revenue of ₦8155.70/ha arising from the sale of cocoyam corms and cormels. The total variable cost is ₦6551.21. The estimated gross margin is ₦1604.49 per hectare.

From these gross margin analyses, one could conclude that the use of improved technologies showed greater economic potential than the traditional technologies in the cultivation of cocoyam.

The benefit-cost ratio was computed after deducting the depreciated values of fixed production items such as weeding hoes, large hoes, cutlasses, basins and baskets. The depreciated values of these farm implements computed from a straight line method of depreciation with an assumed zero salvage value amounted to ₦34.91. This comprised of ₦2.40 for weeding hoe, ₦7.78 for large hoe, ₦8.18 for cutlass, while basin and basket had ₦13.33 and ₦3.22 respectively.

The benefit-cost ratio between total return (₦12,262.20) and total cost (₦7218.36) for cocoyam production under improved technologies is estimated at 1.70:1. This implies that for every one naira invested in cocoyam production resulted to seventy kobo profit.

On the other hand, farmers using local technologies had a benefit-cost ratio of 1.24:1 resulting from total revenue ₦8155.70 and total cost of ₦6586.13. The implication is every one naira spent on cocoyam enterprise using local technologies results in twenty-four kobo as benefit. Comparatively, therefore, the benefit-cost ratio of the farmers who used improved technologies in cocoyam production during the survey exceeded those of the farmers who applied local technologies by forty six kobo. The implication may be that resource inputs were better utilized by farmers who adopted improved technologies.

A distribution of net returns per hectare from the use of improved technologies on monthly basis gave ₦420.32/month. This compares favourably with returns from non-agricultural sectors while those of local technologies gave ₦130.80/month and do not compare favourably. This difference is attributable to the use of improved technologies in cocoyam production.

4.8 Impact of Technologies in use on Yield of Cocoyam in the Study Area

A multiple regression was conducted to determine the impact of technologies on output of cocoyam. Three functional forms namely linear, semi logarithm, and double logarithm were run. The linear equation was chosen for the improved technology data and pooled data while double log was used for the local technology data. The *a priori* expectation is that the independent variables would positively affect yield of cocoyam. The choice of the functional forms was also based on the magnitudes of coefficient of multiple determination R^2 and F-ratio.

4.8.1 Results of Pooling Data Obtained for Use of Improved and Local Technologies in Cocoyam Production

In pooling this data, it is assumed that the respondents used the same management practices and that the farming communities were homogenous in the study area. This analysis would enable us indicate the impact of the technologies used in cocoyam production on yield.

The estimated regression equation for the pooled data is as follows. Equation I

$$Y = 1.953 + \underset{(0.0007)}{0.0020X_1^{*}} - \underset{(0.0291)}{0.0034X_2} + \underset{(0.625)}{1.171X_3^{**}} - \underset{(0.0002)}{0.00002X_4} + \underset{(0.226)}{0.025X_5} + \underset{(0.746)}{1.687X_6^{*}}$$

$R^2 = 0.52$, F cal = 9.63, $t\alpha/2(5\%) = 2.01$,
F tab = 2.30, n = 60, $t\alpha/2(10\%) = 1.67$

* Coefficients significant at 5%

** Coefficients significant at 10%

figures in parentheses are standard errors of the coefficients

Where, Y = Yield of cocoyam t/ha (pooled)

X_1 = Fertilizer used in kg

X_2 = Labour input (Mandays)

X_3 = Frequency of weedings

X_4 = Plant population/ha

X_5 = Age of cocoyam at harvest

X_6 = Minisett technique.

The regression equation showed that improved technologies such as fertilizer (X_1), and minisett technique (X_6) were found to be significant at five percent and are positively related to output. Frequency of weeding X_3 is also positive but significant at 10% level of probability. Age of cocoyam at harvest is not significant but is positively related to output. The implication in increased cocoyam production is that if these technologies are applied in the cocoyam the use of fertilizer, recommended plant population per hectare, frequency of weeding, number of labourers (mandays), harvesting at the appropriate time and use cocoyam minisett technique to source planting materials in the production of cocoyam. However, high yield would be expected if researchers could produce improved cocoyam varieties that are adapted to fertilizer use by improving the agronomic potentials of the crop. By so doing, cocoyam could be in position to fulfil the prediction of the Nigerian Academy of Science (1975) that cocoyam is not a poor man's crop or woman's crop but a crop with promising economic value.

A correlation matrix was constructed for the pooled data and is shown in Table 21.

Table 21: Correlation matrix indicating the relationship between the dependent variable and the independent variables (X_1 - X_6) for pooled data

	Y	X_1	X_2	X_3	X_4	X_5	X_6
Y	1.00						
X_1	0.657*	1.00					
X_2	0.334*	0.465*	1.00				
X_3	0.195	0.015	-0.236*	1.00			
X_4	-0.055	-0.068	-0.488*	0.158	1.00		
X_5	-0.087	-0.130	0.150	0.087	-0.213**	1.00	
X_6	0.626*	0.705*	0.562*	-0.010	-0.145	-0.177	1.00

*Coefficients significant at 5%

**Coefficients significant at 10%

All the independent variables are positively correlated with cocoyam yield except plant population per ha and age of cocoyam at harvest. This means that an increase in their use would most probably lead to an increase in yield. However, the negative impact of plant population and age of cocoyam at harvest may mean the harmful impact of extremes of these variables on yield; or their impact is not appreciable in view of the very low values of their correlation coefficients.

4.8.2 Impact of Improved Technologies on Cocoyam Yield

A regression analysis was conducted for the yield arising from the use of improved technologies - fertilizer, plant density, labour use, number of weedings, age of cocoyam at harvest and minisett technique. The results of the model is shown in equation II.

$$Y_1 = -2.115 + \underset{(0.00075)}{0.0017X_1^{*}} - \underset{(0.043)}{0.025X_2} + \underset{(0.892)}{1.75X_3^{**}}$$

$$+ \underset{(0.0004)}{0.0002X_4} + \underset{(0.2952)}{0.253X_5} + \underset{(0.849)}{1.99X_6^{*}}$$

R^2 = 0.54; F-value = 5.50; F-ratio $\alpha/2(5\%)$ = 2.56

$t\alpha/2(5\%)$ = 2.05; $t\alpha/2(10\%)$ = 1.69

Figures in parentheses are standard errors

*Significant at 5%

**Coefficient Significant at 10%.

The empirical F-value for the improved technologies is 5.50. When evaluated against the theoretical F-ratio of 2.56, at 5% level of significance it established that the equation is significant. This means that the joint effect of the explanatory variables on cocoyam yield was statistically significant. The coefficient of multiple regression R^2 was 0.54 approximately. This implies that about 54% of the total variation in cocoyam output was explained by the estimated variables. However, the explanatory variables were not sufficient as to explain total yield. Other factors such as mulching material used, soil characteristics, farm size, environmental factors etc may also be important in determining cocoyam yield.

When the standard error test was conducted on each of the variables (using t-test statistic) only three of these were statistically significant at 5% and 10% probability levels. Thus, fertilizer used (X_1) and cocoyam minisett technique (X_6) were significant at 5% while frequency of weedings (X_3) was significant at 10% level of probability. Other variables such as plant density (X_4), and age of cocoyam at harvest (X_5) were not significant. With the exception of labour input (X_2) all other explanatory variables showed the a priori expected signs.

Fertilizer use (X_1), being positively related to yield was correctly signed. This confirms the obvious expectation that fertilizer use is associated with high yield especially when applied at the right time and quantity as well as the recommended method.

Labour input in mandays (X_2) had a non-significant impact and an inverse relationship with cocoyam yield. It did not conform with the a priori expectation. It may be related to the cost of hiring labour, rural-urban migration of the able bodied men and women and reduction in the available family labour due to children's attendance at school. The method of labour allocation which is skewed towards yam and cassava could have affected the availability of labour for cocoyam cultivation in the study area. This finding is in consonnance with F.A.O (1988) reports which showed that farmers gave priority to yam and cassava in labour allocation and that labour problems in rural areas were compounded by rural-urban migration which on its own gave rise to high labour cost.

Frequency of weedings (X_3) was positively related to cocoyam output. It conforms with the hypothesized expectation that normal weeding (2-3 weedings) could increase yield. This is, however, to an extent. Higher weeding rates using simple farm tools may lead to destruction of the planted crops and therefore lead to reduction in yield. The coefficient of the frequency of weeding (X_3) is significant at 10% level of probability. This result is not surprising since weeds compete with the cultivated crop for soil nutrients space and sunlight; so its elimination would enhance the performance of cocoyam. Unamma (1984) reported that a properly managed mixed crop vegetation would be more effective in reducing available niches for weed encroachment than a sole cropping system. He advocated intercropping of root crops with fast canopy forming crops to reduce weed competition.

Average plant population/ha (X_4) was positively related to output but not significant. This means that a hectare of land planted to its right density would give a reasonable yield; problem may arise if the carrying capacity of the farm land is exceeded. Competition for nutrients, space and sunlight among the cultivated crops may result to small corms and cormels that would not meet the marketing need of the producer. Though these have longer shelf life, a commercially oriented farmer would not benefit financially from producing such sizes. However, Ezumah and Plucknett (1973), Onwueme (1978) and N.C.R.C.I (1987) independently reported that close spacing (or increased plant density) increases corm yield per hectare but decreases corm yield per plant.

Age of cocoyam at harvest (X_5) was positively related to cocoyam yield though not significant. This non-significance may imply that cocoyam would yield better at maturity, but if left in the field longer than necessary, may lead to reduction in output per hectare; total crop failure may be experienced in some extreme cases. For instance, sprouting, rotting, pests and diseases may set in thereby reducing the harvestable yield. The economic implication is low income and avoidance of risk taking on the part of the farmers. Onwueme (1978) reported that late harvesting results to corms and cormels that are severely infested and therefore worthless.

The use of cocoyam minisett technique "seed" (X_6) showed a positive and significant impact on cocoyam yield; it conforms with the a priori expectation. The coefficient is significant at 5%; the significance may be related to the expected reduction in cost of planting material the users would enjoy. N.C.R.C.I (1986) reported a reduction of 40% in cost of planting material. This would go along way in improving the output of the crop in the study area.

A further analysis was conducted using correlation analysis method. This analysis is meant to indicate the relationship among the selected technologies used in growing the crop and between them and the cocoyam yield. This relationship is shown in the correlation matrix in Table 22.

Table 22: Correlation matrix of the relationship between Y_1 and $X_1 - X_6$ using improved technologies

	Y_1	X_1	X_2	X_3	X_4	X_5	X_6
Y_1	1.00						
X_1	0.5896*	1.00					
X_2	0.1520	0.3191**	1.00				
X_3	0.3821*	0.12167	-0.1547	1.00			
X_4	0.1369	0.00496	-0.5628*	0.3206**	1.00		
X_5	-0.0256	-0.08485	0.1703	-0.03602	-0.2017	1.00	
X_6	0.5522*	0.5603*	0.51056*	0.07099	-0.1735	-0.159	1.00

*Coefficient significant at 5%
**Coefficient significant at 10%

All the variables are positively correlated with the yield of cocoyam except average age of cocoyam at harvest (X_5) while fertilizer, average number of weedings (X_3) and cocoyam minisett techniques (X_6) are significant at 5%. Labour input (X_2), average plant population/ha (X_4) and age of cocoyam at harvest (X_5) are not significant. The implication is that an increase in the use of these technologies would most probably increase the yield of cocoyam. The implication of the negative correlation coefficients of age of cocoyam at harvest may not necessarily mean that harvesting early is preferred, rather it may imply that this technology could have adverse effect on yield if the crop is not harvested in time after maturity. Its coefficient is lower than others. From the analysis, it may be said that the use of improved technologies in the production of cocoyam could go a long way in increasing its yield.

4.8.3 Impact of Local Technologies on Cocoyam Yield

Another regression analysis was ran for the impact of local technologies on cocoyam yield in the study area. Thus we have the following regression result,

Equation III.

$$YL = 4.44 + \underset{(0.0230)}{0.0223X_2} + \underset{(0.607)}{0.675X_3} + \underset{(0.000443)}{0.000210X_4} - \underset{(0.0691)}{0.0683X_5}$$

$R^2 = 0.21$, F-cal = 2.57; F-ratio $\alpha/2(5\%) = 3.07$
$t\alpha/2(5\%) = 2.09$; $t\alpha/2(10\%) = 1.72$

The empirical F-value based on the regression equation was 2.57 while the theoretical F-ratio was 3.07. This shows that the equation is not significant and the effect of explanatory variables on cocoyam yield was not statistically significant.

The coefficient of multiple regression R^2 was 0.21. This means that about 21% of the total variation in cocoyam yield was explained by the estimated explanatory variables. The result means that the estimated variables are not sufficient as to explain the variation in cocoyam yield. This implies that there are other very important random variables that were not included in the model. Furthermore, the value of the t-test for the coefficients of the independent variables X_2 to X_5 were all less than t /2 at 5% and 10% and therefore not significant. Hence the researcher could confidently conclude that the use of local technologies do not have significant impact on yield of cocoyam. Yield therefore would have resulted from inherent soil fertility, and other biological capital other than the independent variables considered in the analysis. Among the independent variables, labour input (X_2), number of weedings (X_3) and average plant population (X_4) showed positive impact on yield while only age of cocoyam at harvest (X_5) was negatively related to yield.

In the case of farmers who applied improved technologies, labour input (X_2) had an inverse relationship to yield of cocoyam while it is positive in the case of those who used local technologies. This difference may be related to the size of operation and hence labour need. Weeding frequency maintained the same relationship in both technologies. This means that if the operation is carried out at the normal rate, yield increases would be experienced using either of the technologies. The coefficient of plant density (X_4) in equation III is positive, yet, it showed low and insignificant impact on cocoyam yield. This may be attributed to overcrowding which leads to survival of the fittest and hence poor output. However, the positive relationship between cocoyam seed planted and cocoyam yield showed that with good cropping practices and use of improved inputs, high yield could be obtained per hectare. Age of cocoyam at harvest (X_5) did not conform with a priori expectation in equation III as it did in equation II. This means that the farmers that used local technologies may not have harvested their crop at the right time. The crop yield was therefore below expectation both in quantity and quality. Generally, the result of equation III analysis indicate that though the explanatory variable estimates may be true of the population parameters, there are other vital random variables that influenced yield that were not included in the equation. This is a pointer for further research.

Further analysis was done by constructing a correlation matrix to show the correlation between yield and the independent variables, labour input mandays (X_2), frequency of weeding (X_3), plant population/ha (X_4) and age of cocoyam at harvest (X_5).

All the independent variables are negatively correlated to yield except labour input in mandays (X_2). This is unlike the result obtained for using improved technologies (table 22) where only age of cocoyam at harvest is negatively related to yield. This is shown in Table 23.

Table 23: Correlation matrix of the relationship between yield (YL) and the independent variables (X_2 - X_5) using local technologies

	YL	X_2	X_3	X_4	X_5
YL	1.00				
X_2	0.217	1.00			
X_3	-0.0848	-0.343**	1.00		
X_4	-0.0173	-0.412*	-0.0003	1.00	
X_5	-0.096	0.326	0.269	-0.326	1.00

* Coefficient significant at 5%

** Coefficient significant at 10%

None of the independent variables showed significant impact on yield but in the case of improved technology usage, frequency of weeding (X_3) showed significant impact on yield at 5% level probability. The implication of the results is that the use of only local technologies in growing cocoyam will continue to experience reduced output. However, adoption of improved technologies will lead to better yield. Consequently, the farmer's returns would be positively affected.

The general low correlation coefficients observed in all the correlation matrices may be related to the unpredictability of the weather condition and other management practices. The results showed that all the simple correlation coefficients squared were less than the coefficient of multiple determination. Therefore, the varying levels of multicollinearity are tolerable. Hence the correlation and regression results were used for analysis with a reasonable level of confidence in the accuracy and stability of the parameter estimates.

4.9. Problems Inhibiting Increased Production of Cocoyam in the Study Area

The problems militating against increased production of cocoyam in the study area is summarised in Table 24. Decay of cocoyam both in the field and store was identified by 88% of the farmers as the major problem in increasing the production of cocoyam in the study area. This response may be realiable considering that the study area is in the tropics where sun shine and high temperatures are prevalent during the later periods of the crop being in the field

<u>Table 24</u>: The percentage distribution of cocoyam farmers according to problems militating against increased cocoyam production in the study area

Production Problems	Frequency of Respondents*	Percentage
Lack of money to invest	41	68
High cost of labour	45	75
Inadequate/Non Availability of Agrochemical	38	63
Poor Transport Facilities	18	30
Diseases and pests attack	51	85
Ineffective extension services	47	78
Lack of ready market	8	13
Lack of mechanised Cocoyam planting systems	17	28
Lack of government support	32	53
Poor storage facilities	40	67
Lack of processing Facilities	47	78
Non-availability/ Insufficient planting materials	39	65
Scarcity of labour	46	77
Land tenure/land scarcity	36	60
Rotting/decay at storage/ Field	53	88

* Multiple Responses were recorded

or barns. Ajala and Obiechina (1987) recorded 30-40% loss through storage rotting of cocoyam kept in barns or buried in the soil. F.A.O (1988) reported mealy bug attack of corms which reduced its weight and viability. Diseases and pests were indicated by 85% of the respondents as an important factor inhibiting increased cocoyam production. Studies showed that soft rot disease, root knot nematodes, leaf blight, grass cutter, termites, etc., could reduce yield of cocoyam to an unbearable level (Hahn, 1987; I.I.T.A. 1986).

Ineffective extension services were reported by 78% of the respondents as a hinderance to cocoyam production; lack of adequate manpower and logistics hindered the work of the extension division in the study area. Hence innovations on growing crops, including cocoyam, could not be extended to the farmers. For instance, the cocoyam minisett technique for cocoyam "seed" multiplication and fertilizer use are yet to reach many farmers in the study area. Seventy eight percent of the respondents identified lack of processing facilities as a problem militating against cocoyam production. The crop could not be processed into forms that are attractive just like gari, yam and maize despite its high nutrient value. Eleje (1987) observed that cocoyams were rich in carbohydrate and protein for energy and body building. Ezeh and Mbanasor (1987) attributed the inability to process cocoyam into attractive forms to its low storability and bulkiness.

The amount of labour a family could contribute or hire during the farming period determines the family's farm size and level of farm activity for the year. Seventy-seven percent of the respondents, however, indicated labour scarcity as one of the problems hindering cocoyam production in the study area. This is indicative of the rural-urban migration, children attending school, discriminatory allocation of labour by family heads in favour of yam, in addition to high cost of hiring labour.

The problems of non-availability or insufficient planting materials could be as a result of the cocoyam corms and cormels serving as food and feed to man and animals. Plantable cormels and corms are therefore lost to consumption. The little available quantity are expensive for a smallholder farmer in the study area to buy.

Private savings are mainly used for investment. Since these are smallholder farmers, this source of funding was insufficient to increase or expand cocoyam production. This poor financial base may be attributed to low production and low saving ability by the farmers as well as fear of taking risk. The available storage facilities in the study area are traditional and not good enough for storing a crop meant for either future consumption or planting since sooner than later it could get rotten. About 63% of the respondents reported inability to get agrochemicals at the right time and quantity as a problem inhibiting increased cocoyam production. However, some of the farmers could not afford to purchase them even when available due to their limited capital base.

In Nigeria, Imo State is known as one of the states with land scarcity problem; this has been a hinderance in agricultural expansion in the study area. Sixty percent of the respondents indicated land scarcity and land tenure system as one of the major obstacles facing increased cocoyam production. Available land is, therefore, utilized to capacity. The number of intercrops per field reflects this problem in the study area. This study identified six crops growing on the same piece of land during the survey period.

Lack of government support or incentives was indicated by 53% of the respondents as a problem in increased cocoyam production in the study area. Cocoyam "seeds" were not supplied to the farmers as obtained in the case of cassava cuttings. Some of the farmers complained of having supplied the extension services division of Agricultural Development project at the local government area with corms and cormels with which they were taught how to prepare cocoyam seed. Considering the potentials of cocoyam, both as a food crop and industrial raw material, there is need for government to encourage the production of the "poor man's" or "woman's crop" either directly or indirectly.

The responses on transport facilities, mechanisation and availability of ready markets indicate that these are minor problems in the study area. In the case of transportation facilities, most farmers conveyed their produce from the farm to the home on head porterage except on weekly market days that were of far distance when they require transport to the market. Mechanised farming, a labour-saving device, could not be introduced readily because it was not economical in cocoyam production. The nature of the crop and the prevalent planting on mounds makes mechanised farming even more difficult. Marketing of cocoyam in the study area did not present any problems because of its location and channels of distribution open to the farmers from neighbouring villages and towns.

CHAPTER FIVE

SUMMARY, CONCLUSION AND RECOMMENDATIONS

5.1 Summary

This study arose from the need for further investigation into the economics of cocoyam production in Imo State of Nigeria and Ihitte/Uboma in particular. The study examined the cropping system and importance of the crop in the study area, output and profitability of cocoyam enterprise under improved and local technologies, level of adoption of improved cocoyam production techniques and the problems militating against its increased production in the study area.

Both primary and secondary data were used in the analysis. Primary data were collected using two sets of questionnaires. These were administered to sixty randomly selected cocoyam farmers. Cocoyam yield per hectare was extrapolated from yield measurements obtained from $40m^2$ of sampled plots. Secondary data were collected from national and international agricultural institutions and ministries of Agriculture as well as textbooks, journals, periodicals and other related publications. Statistical tools such as percentages, means, gross margin, benefit-cost ratios and regression analyses were used to analyse the data.

The findings showed that the surveyed farmers had been in farming business for 28 years. Forty-seven percent of them never attended formal school hence the problem of adoption of innovations. Apart from farming, the respondents were engaged in trading, teaching, tailoring, etc.

Land acquisition was by inheritance. There were 6.5 fields and 2.4ha of farm land owned per household studied. A total of 1.89ha was put into use during the survey period per household. Cocoyam was cultivated on 0.45ha. Seventy percent of the respondents used compound/neighbourhood farms in the cultivation of cocoyam due to their suitability and fertility content.

The most prominent cocoyam crop mixture was cocoyam/yam/maize/vegetables/cassava. The highest intercrop mixture observed was six.

The major source of labour used was the family. Forty three percent of total labour used was hired. Labour was in greatest need during weeding and mound making operations. Of the total amount of labour (1852.51 mandays) used for three planting seasons (1988-1990) in growing yam, cassava and cocoyam; yam had 44%, cassava 29% and cocoyam 27%. The labour allocation preference of the farmers was skewed towards yam and cassava. Labour allocation pattern to the different farm operations (1989/90) showed that weeding took 52% of the total labour (146.71 mandays/ha), followed by mounding/ridging, harvesting, land clearing, etc. Women contributed 66% of the total labour used, while men contributed 21%. Men contributed 78% and 68% respectively of the labour needed for mounding and land clearing, while women contributed 81% for weeding operations. Sex, age and type of operation determined the wage rate a hired labourer would receive.

The main source of capital for farming was private savings. In addition, farmers obtained loans from meeting Umunne/Isusu 33%, friends/relations 28%, banks 15% and moneylenders 10%. However, most of the borrowings were not used in cocoyam production. In spite of the high patronage received by meeting Umunne/Isusu, the amount borrowed from this source was the least (₦165.00) when compared with other sources. For instance the 15% who borrowed from banks obtained ₦3,222.22. While the banks charged interest rate of 19½%, moneylenders charged 35½% and meeting Umunne/Isusu charged 9%. Out of a total sum of ₦1,028.14 allocated to five arable crops, 37% went to yam cultivation, 26% to cassava, 22% to cocoyam etc. This indicates the preference yam enjoys relative to the other crop enterprises in the study area due to its socio-cultural importance.

There was no evidence of the use of improved cocoyam cultivar. Only thirteen percent used cocoyam minisett technique to source planting material. Fifty eight percent applied fertilizer during the study. No pesticides or herbicide and minimum tillage methods were used by the farmers in cocoyam production. Information about innovations in agriculture was received by farmers mainly through friends/relations 39% and radio 29% respectively. Eighty-three percent of the fertilizer used by farmers during the study were bought at the ADP/Ministry of Agriculture, Isinweke.

The production method for cocoyam is predominantly traditional. Land preparation, planting, weeding and harvesting were done manually with the use of simple farm tools. About 62% of the respondents planted cocoyam on small mounds while twenty-four percent planted on ridges. Planting period for cocoyam lasts from March to June. In cocoyam based mixture, two setts are planted on the mound crest. Plant population averaged 9351 stands per hectare. This implied planting at about 1.07m^2 apart. Eight local cultivars of cocoyam were identified. Multiple harvesting takes place in cocoyam farms from the fifth month of planting especially in colocasia species. Cocondia is popular followed by Nwanyiakpi, Akashi and Ede Uhie. However, Akashi and Ede Uhie are preferred because the cormels are likened to yam in taste. The commonest mulch material in use is palm frond. Generally, farm operations take place first in yam fields before cassava and cocoyam in Ihitte/Uboma.

Agricultural products cannot be conveniently conveyed from point of production to the point of great demand. This is because head porterage is the main conveyance method used by the farmers. Farm/homestead was the major point of sale of cocoyam in the study area, though this fetched the least amount. Average unit price of fresh cocoyam was ₦1.91 per kilogramme. Itinerant traders play a great role in the distribution of cocoyam in the study area. Cocoyams are sold mostly in an unprocessed form.

Only 5% processed their cocoyam into Achicha, 3% into flour and 1.7% into chips. Corms and cormels are stored in barns for 3-6 months before being used for consumption, source of income or planting material. Cocoyam is consumed in various forms such as boiling, soup thickening, roasted etc. Despite its nutritive value, it ranked third as a staple food in the study area after cassava and yam. Consumption is the most important use to which cocoyam is put.

Yield of cocoyam using improved technologies was 6.42t/ha; it was 4.27t/ha using local technologies. Difference in means test showed a significant difference in yield at 5% level of probability.

Gross margin from using improved techniques was ₦5,078.75 while it was ₦1604.49 per hectare for local technologies. The net return for using improved and local technologies was ₦5,043.84 and ₦1,569.58 per hectare respectively. The Benefit-cost ratio was 1.70:1 for improved technologies and 1.24:1 for local methods. The implication is that every one naira invested in using improved and local technologies in cocoyam production results to seventy kobo and twenty four kobo profit respectively. Also returns of ₦420.32/month from the use of improved technologies compares favourably with returns from non-agricultural sectors while those of local technologies gave ₦130.80/ month and do not compare favourably. These differences n returns must have resulted from the use of improved ractices in cocoyam production.

Application of improved technologies in cocoyam roduction showed a significant and positive impact n cocoyam yield in the study area. The policy mplication is that if farmers could adopt the use f improved techniques in the cultivation of cocoyam, here is the probability of enjoying higher returns.

Decay, pests, and diseases attack in storage or ield are the major handicaps in cocoyam production n the study area.

.2 Recommendations

There is the need for more research on the agronomic otentials of cocoyam especially in the area of adaptability f the local cultivars to fertilizer and other improved nputs. Also research into eliminating or reducing torage decay/rot should be encouraged by government nd its agencies.

Available research findings on the production, torage, processing and utilization methods of cocoyam hould be brought to the knowledge of farmers for their doption. There is also the need to enlighten people n the nutritive qualities of cocoyam as is currently eing done to soyabean, a protein-rich legume

Cocoyam farmers should be encouraged to form viable cooperatives to enable them benefit from the several government agencies in terms of input purchases at reduced costs.

Extension workers should be used in educating farmers on the use of available research findings stocked at the research stations. This means that they should be provided with the right personnel and logistics needed to cover as many farmers as possible.

Finally, further work is needed on the econometric influence of adoptable technologies on cocoyam yield.

5.3 Conclusion

Given the yield from improved techniques of 6.42t/ha and 4.27t/ha from local techniques as well as the gross margin of N5,078.75 and N1,604.49 for using improved and local technologies respectively, one is made to buy the idea of increasing cocoyam production by the application of improved techniques. But since the crop (local cultivars) is not yet fully adapted to the use of improved technologies, it would need some agronomic improvement before the crop could give its full potential yield.

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DEPARTMENT OF AGRICULTURAL ECONOMICS

UNIVERSITY OF NIGERIA, NSUKKA

Research Questionnaire

This research is on the "Economics of Cocoyam Production by Smallholder Farmers in Ihitte/Uboma Local Government Area of Imo State". You are required to mark (✓) where necessary. Short sentences can be used where necessary.

A. Farmer Characteristics

1. Sex: Male [ ] Female [ ]

2. Age: ....

3. Number of Wife/Wives ....

4. Number of Children ....

5. Number of Other dependents/relations ....

6. Number of Years in Farming ....

7. Number of Years Spent in School ....

8. Occupation outside farming

i) Trading [ ] (ii) Teaching/Civil Service [ ]

iii) Fashion Designing [ ]

iv) Hair plating/dressing [ ]

B. Types and Sources of Inputs

1. Land

i) How did you acquire land for cultivation?

(a) Heritance /__/ (b) Communal /__/
(c) Purchase /__/ (d) Lease /__/
(e) Gift /__/ (f) Pledge /__/

ii) How many farm fields do you own ....
iii) What is their total size ....
iv) Which land do you use most for growing Cocoyam? (a) Compound/Neighbourhood Farm /__/
(b) Distant Farm /__/ (c) Swampy Farm /__/

v) What are your reasons for using each

	Compound	Distant	Swampy Land
a) The land is more suitable and fertile			
b) Reduces cost of transportation			
c) Have easy access to the crops as need arises			
d) To remove it from the home to enable me have a better harvest			
e) For effective and efficient supervision			

vi) Name the crops you found in your compound farms.

....
....
....

vii) Mention the crop mixtures you planted this year (i.e. number of crops in a farm).

a) .... (b) ....

c) .... (d) ....

viii) How many fields and hectares did you crop this year

....

ix) How did you allocate them to yam ....

Cassava ....Cocoyam...........Rice...........

Maize ....

x) How did you allocate land to the following crops in the three years. (rank them 1 - 5)

	1990	1989	1988
Cocoyam	....	....	....
Rice	....	....	....
Yam	....	....	....
Cassava	....	....	....
Maize	....	....	....

2. <u>Labour</u>

i) What type of labour did you use this year

a) Family [ ] (b) Hired [ ]

c) Exchange [ ] (d) Cooperatives [ ]

ii) How many mandays did you use in

a) Cocoyam Farm .... (b) Yam farm ....

c) Cassava farm .... (d) Maize farm ....

in the past three years (1988-1990) including children.

	1990	1989	1988
Cocoyam	....	....	....
Yam	....	....	....
Cassava	....	....	....
Maize	....	....	....

iii) Rank the following crops according to how you allocate labour to them (1 is superior to 4)

	Rank
Yam	....
Cassava	....
Maize	....
Cocoyam	....

iv) How many labourers did you employ (mandays) in carrying out the following duties in your farm

Operation	Males	Females	Children
Land Clearing			
Mounding			
Planting			
Weeding			
Fertilizer applic application			
Harvesting			

3. Capital

i) What are your main sources of funding

a) Private Savings /___/ (b) Banks /___/
c) Moneylenders /___/ (d) Friends/relations /___/

ii) How much did you receive as loan from the following sources. State amount repaid too.

Friends/relations .... Bank ....
Moneylenders ....
Isusu/Meeting Umunne ....

iii) How much did you pay each male ....
female .... and child ....
for the operation carried out.

iv) Did you feed and pay the labourers? Yes /___/ No /___/

How many times ....

v) How do you pay exchange and cooperative labourers

a) Cash /___/ (b) Food & drinks /___/

c) Drinks only /___/ (d) Food only /___/

vi) Indicate the amount you allocated to the following crops this farming season.

Cocoyam .... Cassava ....

Maize .... Rice ....

vii) Which source of funding do you like most ....
Give reasons

a) ....

b) ....

c) ....

4. Adoption of Innovations

1. Which of the following have you used in your farm in the past two years.

	Yes	No
a) Pesticide	.....	....
b) Fertilizer	.....	....
c) Herbicide	.....	....
d) Improve Cocoyam	.....	....
e) Minisett Technique	.....	....
f) Use of Polyethene as mulch material	.....	....

ia) Did you use minisett cocoyam this year? Yes /__/ No /__/

ii) How did you know about the existence of adoptable innovations. Through

1) Friends/relations /__/ (2) TV /__/

3) Radio sett /__/ (4) Agric. Extension Agents /__/

iii) What quantity of fertilizer did you buy from the following sources this season.

a) Ministry of Agriculture ______

b) Market/Dealers ______

c) Isusu/meeting Umunne ______

iv) What quantity did you apply to cocoyam ....

5. Transportation, marketing, processing, storage and utilization of cocoyam.

i) What means do you use to convey your cocoyam to the home/market?

a) Head porterage /__/ (b) Bicycle/wheel barrow /__/

c) Motor cycle /__/ (d) Motor Vehicle /__/

ii) What quantity of cocoyam did you sell and how much was realised at the different points of sale.

Market	Qty Kg	Amount realised
Farm/homestead		
Rural Markets		
Urban Markets		

iii) In what forms did you market your cocoyam?

a) Corms/Cormels /___/ (b) Chips /___/ (c) Flour /___/

iv) Into what forms do you process cocoyam?

a) Achicha /___/ (b) Flour /___/ (c) Chip /___/

v) State what use(s) do you put your cocoyam? Indicate quantity too.

Uses	Quantity (Kg)
Consumption	....
Sold	....
Gift	....
Festivals	....
Stored	....
Medicine	....

vi) How long do you store your corms and cormels before consumption, marketing and planting ....

6. Harvesting

What are the harvest periods within the compound and distant farms.

Crop	Compound		Distant	
	Start	Finish	Start	Finish
Yam				
Cocoyam				
Cassava				
Maize				
Rice				

7. Cropping Pattern

i) How did you plant your cocoyam setts?

a) Cut surface placed faced upward and covered /__/

b) Cut surface placed down wards /__/

ii) What part of cocoyam do you use most as planting material (a) Corms /__/ (b) Cormels /__/
c) Stem cutting /__/

iii) Where did you store your cocoyam?

a) Barn /__/ (b) Heaps under tree shade /__/

c) Dug pits /__/ (d) Refrigerator /__/

e) Sprout inhibitors /__/

iv) How long did the crop stay in storage ....

v) What methods of land clearing did you use

a) Clearing using matchet /__/

b) Burning and Clearing /__/

c) Burning only /__/ (d) Use of herbicides /__/

e) Use of tractor /__/

vi) Indicate the implements you used

a) Hoe [ ] (b) Weeding hoe [ ]
c) Matchets/Cutlasses [ ] (d) Basin/Baskets [ ]

vii) How did you prepare the land for cocoyam?

a) Making small mounds [ ]

b) Big mounds [ ] (c) Ridges [ ]

d) Beds [ ] (e) No tillage [ ]

f) Minimum tillage [ ]

viii) What methods of weeding did you use.

a) Manual [ ] (b) Herbicide [ ]

c) Both [ ]

ix) Did you apply farm yard manure? Yes [ ] No [ ]

x) What periods of the year do you carry out the following operations in your cocoyam farm (Tick ✓ against the month).

	Operation	Jan-March	April-June	July - Sept.	Oct - Dec.
1.	Land clearing				
2.	Mounding/Ridging				
3.	Planting				
4.	Mulching				
5.	Weeding				
6.	Harvesting				
7.	Fertilizer application				

xi) What of yam (Tick √) against the month

Operation	Jan-March	April-June	July-Sept	Oct. - Dec.
Land clearing				
Mounding/Ridging				
Planting				
Mulching				
Weeding				
Harvesting				
Staking				
Fertilizer application				

xii) What of your cassava farm.

Operations	Jan-March	April - June	July - Sept	Oct. - Dec.
Land clearing				
Mounding/ Ridging				
Planting				
Weeding				
Harvesting				
Fertilizer application				

xiii) During which operation did you need most labour

....

xiv) What is the month? ....

xv) What mulching material did you use?

a) Palm fronds [ ] (b) Leaves [ ]

c) Polyethene materials [ ]

xvi) Why mulch your cocoyam

a) To enhance sprouting [ ]

b) Cool the soil [ ]

c) Conserve Soil moisture [ ]

d) Control weed [ ]

xvii) Did you use cocoyam minisett technique in your planting? Yes [ ] No [ ]

xviii) What of improved cocoyam cultivar? Yes [ ] No [ ]

xix) How many times did you weed your cocoyam farm before harvest ....

xx) What is the interval from .... to .... and from .... to ....

8. What do you think are the problems inhibiting the increased production of cocoyam in your area?

a) Lack of money to invest [ ]

b) High cost of labour [ ]

c) Inadequate/non availability of agrochemicals [ ]

d) Poor transportation facilities [ ]

e) Diseases and pests [ ]

f) Ineffective extension services [ ]

g) Lack of ready market for cocoyam [ ]

h) Lack of mechanised cocoyam planting systems [ ]

i) Lack of government support for growing the crop [ ]

j) Poor storage facilities and quality of cocoyam [ ]

k) Lack of processing facilities [ ]

l) Non-availability/insufficient planting materials [ ]

m) Scarcity of labour [ ]

n) Land tenure/land scarcity [ ]

o) Rotting/decay at storage/field [ ]

9. Mention all the cocoyam cultivars you planted this year ....

....

QUESTIONNAIRE SET 2

Yield Measurement of Sampled Farms ($40m^2$)

Field	Yield	Plant Population	Age at Harvest	Farm Size	Time Planted	Time Harvested
1						
2						
3						
4						

TEST FOR MULTICOLLINEARITY

a) Comparisons Between the r^2xij and $R^2_{y}.X_yX_2, \ldots, Xk$ for pooled data.

Pairs of Variables	$rxij$	r^2xij	$R^2_{y}.X_1, X_2, \ldots, Xk$
X_1X_2	0.4645	0.21573	< 0.52168
X_1X_3	0.41482	0.17208	< 0.52168
X_1X_4	-0.06760	0.00457	< 0.52168
X_1X_5	-0.13024	0.01696	< 0.52168
X_1X_6	0.70510	0.49717	< 0.52168
X_2X_3	-0.23546	0.055441	< 0.52168
X_2X_4	-0.48818	0.23832	< 0.52168
X_2X_5	0.14983	0.02245	< 0.52168
X_2X_6	0.56167	0.31547	< 0.52168
X_3X_4	0.15819	0.0250	< 0.52168
X_3X_5	0.08667	0.00751	< 0.52168
X_3X_6	-0.00985	0.000097	< 0.52168
X_4X_5	-0.21273	0.04525	< 0.52168
X_4X_6	-0.14530	0.021112	< 0.52168
X_5X_6	-0.17661	0.03119	< 0.52168

b) Comparisons between the r^2Xij and $R^2_{y}.X_1, X_2, \ldots, Xk$ for improved technologies use

Pairs of Variables	$rXij$	r^2Xij	$R^2_y X_1, X_2, \ldots, Xk$
X_1X_2	0.31912	0.10184	< 0.54105
X_1X_3	0.12167	0.014804	< 0.54105
X_1X_4	0.00496	0.000025	< 0.54105
X_1X_5	-0.08495	0.0072	< 0.54105
X_1X_6	0.5603	0.31394	< 0.54105
X_2X_3	-0.15471	0.02394	< 0.54105
X_2X_4	-0.56284	0.316789	< 0.54105
X_2X_5	0.17030	0.0290	< 0.54105
X_2X_6	0.51056	0.26067	< 0.54105
X_3X_4	0.32060	0.102784	< 0.54105
X_3X_5	-0.03602	0.00130	< 0.54105
X_3X_6	0.07099	0.00504	< 0.54105
X_4X_5	-0.20170	0.0407	< 0.54105
X_4X_6	-0.17351	0.03011	< 0.54105
X_5X_6	-0.15920	0.02534	< 0.54105

c) Comparison between $r^2_x ij$ and $R^2_y X_1, X_2, \ldots, Xk$ for local technologies use.

Pairs of Variables	$r_x ij$	$r^2_x ij$	$R^2_y X_1, X_2, \ldots, Xk$
X_2X_3	-0.3425	0.11731	<0.2103
X_2X_4	-0.41225	0.1700	<0.2103
X_2X_5	0.32634	0.1065	<0.2103
X_3X_4	-0.00034	0.000	<0.2103
X_3X_5	0.26898	0.07235	<0.2103
X_4X_5	-0.32612	0.1064	<0.2103

APPENDIX 3

MULTIPLE REGRESSION RESULTS

Type of Equation	Constant	X_1	X_2	X_3	X_4	X_5	X_6	R^2	Fcal	$t\alpha/2$
Linear	1.953	+ 0.002^{s} (0.00065)	− 0.003^{Ns} (0.0291)	+ 1.171^{Ns} (0.5246)	− 0.00002^{Ns} (0.00019)	+ 0.025^{Ns} (0.2261)	1.657^{s} (0.7460)	0.522	9.634	
tcal		3.09	0.12	1.88	0.11	0.11	2.26			1.96
Semi-log	2.4277	+ 0.3632^{s} (0.10065)	+ 0.7872^{Ns} (0.7523)	+ 3.764^{s} (1.559)	− 0.1006^{Ns} (1.88291)	1.2847^{Ns} (1.8357)	—	0.372	6.400	
tcal		3.61	1.10	2.41	0.05	0.70				
Double log	0.9413	+ 0.0556^{s} (0.0202)	+ 0.21978^{Ns} (0.15075)	+ 0.5156^{Ns} (0.3123)	+ 0.29103^{Ns} (0.3773)	− 0.4365^{Ns} (0.3679)	—	0.312	4.89	
tcal		2.75	1.46	1.65	0.056	1.19		Pooled	Data	
Linear	−2.116	+ 0.0017^{s} (0.00075)	− 0.0254^{Ns} (0.0432)	+ 1.75^{Ns} (0.892)	+ 0.00020^{Ns} (0.0004)	0.253^{Ns} (0.295)	1.991^{s} (0.8493)	0.54	5.50	
tcal		2.33	0.588	1.96	0.497	0.856	2.34			2.05
Semi log	−4.592	+ 1.60^{s} (0.48)	− 0.1008^{Ns} (1.257)	+ 4.203^{Ns} (2.030)	− 0.102^{Ns} (4.26)	− 0.202^{Ns} (2.34)	−	0.41	4.05	
tcal		3.37	0.080	2.07	0.024	0.086				
Double log	−2.24	+ 0.235^{s} (0.088)	+ 0.086^{Ns} (0.232)	0.5603^{Ns} (0.375)	0.2603^{Ns} (0.786)	0.2367^{Ns} (0.4319)	−	0.33	2.91	
tcal		2.68	0.37	1.5	0.33	0.55				
								Improved Techn.	Data	

Type of Equation	Constant	X_2	X_3	X_4	X_5	R^2	F	t /2
Linear	6.128	+ 0.0235[Ns] (0.0415)	+ 0.5174[Ns] (0.914)	- 0.00014[Ns] (0.00019)	- 0.287[Ns] (0.363)	0.127	2.397	0.05
tcal		0.57	0.57	0.73	0.791			2.09
Semi-log	20.975	+ 0.554[Ns] (0.8485)	+ 1.423[Ns] (2.25)	+ 1.61[Ns] (1.64)	+ 2.365[Ns] (2.555)	0.1699	2.547	
tcal		0.652	0.63	1.01	0.93			
Double log	4.443	+ 0.0223[Ns] (0.0229)	+ 0.6751[Ns] (0.6074)	+ 0.00017[Ns] (0.00044)	- 0.0553[Ns] (0.069)	0.210	2.558	
tcal		0.97	1.1	0.386	0.99			

Local technologies Data

N.S = Not Significant Coefficient

S = Significant Coefficient at 5% level of probability

Figures in Parentheses are standard errors of the coefficients