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COST FUNCTIONAL ANALYSIS OF TRADITIONAL FARMING SYSTEMS IN RIVERS STATE OF NIGERIA

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DEDICATION.

This thesis is dedication to my father, (Rtd.) Ven. S.Y. Chukuigwe who insisted on education and my wife Orokwu and daughters Mgbechi and Okachi for their patience.

DECLARATION

I hereby declare that this thesis has been written by me and that it is a record of my own research work. It has not been presented in any previous application for a higher degree. All quotations are indicated and the sources of information are specifically acknowledged by means of references.

Date --------------------

Eleoke E.C. Chukuigwe

The above declaration is confirmed.

Date --------------------

Professor Q.B.O. Anthonio

Chairman, Supervisory Committee.

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ABSTRACT

The economics of traditional farming systems in the eastern half of Rivers State was studied using the cost-functional approach. The major objectives covered include the determination of factors influencing the farming systems level of income and profitability. Other objectives involved the determination of the input demand functions and the corresponding elasticities of input demand and subsitution. The efficiency of input use are discussed.

The research methodology employed a two-stage stratified sampling technique. 275 farmers distributed proportionately according to the population (1963 census) of the block constitute the sample size. Primary data on socio-economic variables were collected via cost-route at bi-weekly intervals on age, family size, farm size and other relevant socio-economic variables. Analytical framework used were the translogarithmic and Cobb-Douglas cost functions through the application of the Duality Theory.

Two distinct mixed-cropping farming systems were identified. Farming system I involve the planting of yams in mounds while in farming system II, yams are planted in "inverted mounds".

The analysis of the data show that farmers in the area are old with an average of 45 years. Two economic factors characterising the two systems were the conventional factors such as land and labour. Fertilizer and other agrochemicals, purchased planting materials, farm tools and credit play minor role. Results show that all the elasticities of input demand were negative and ranged from -0.15 for fertilizer to -0.90 for farm tools.

Significant elasticities of substitution exist between labour and fertilizer even though in the area under study, both fertilizer and farm labour were in short supply and expensive. Analysis of the profitability of the systems show that the gross margin per hectare were N1859.34 and N1843.09 for farming systems I and II respectively.

Also gross margin per farmer were N2462.78 and N2184.40 for farming systems I and II. While the capital appreciation value of 2.0 and 1.72 for systems I and II reflect a positive effort, it is not impressive under the current high inflationary regime. Comparatively System I was more profitable over system II where yams are planted in "inverted mounds".

Suggestions for improvement of the systems include the introduction of technologies that are specific to the identified cropping systems instead of the current commodity-based technologies and research. In particular, technologies that minimises the use of fertilizer such as alley-farming are advocated. The systems require the introduction of labour-saving tools that reduces the drudgery of farming because of the relative high demand for farm tools. Finally design and implementation of agricultural policies should be farmer-based.

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CHAPTER ONE

INTRODUCTION

1.1 Agricultural Development And Research In Nigeria

The problems militating against agricultural research in Nigeria can be realistically considered for the two distinct periods: the pre-and post-independence era. In the immediate pre-independence era, the Nigerian constitutions treated agriculture as a residual; therefore, Regional Governments-East, West and North and not Federal Government were left with the major decision making as regards agriculture. As a result, there were myriads of uncoordinated plans, projects and programmes. They included the Group Farms, Farm Settlement Schemes, Livestock Development Schemes, Production Development Boards, Agricultural Credit Corporations. These projects and programmes by and large contributed very little to agricultural progress and development in spite of heavy draw down on capital budget. More importantly, the programmes and projects lacked the involvement and support of the farming population.

At independence the "colonial mentality" pervaded the policy-making environment with the eclipse of the Federal Department Agriculture and the emphasis on accelerated growth rather than development. The consequence of the these strategies was that the growth rate of the Gross Domestic Product (GDP) was kept down because majority of Nigerian farmers were producing food for domestic consumption albeit with stagnant productivity, Anthonio (1967). This situation persists with majority of farmers still using the "hoe - cutlass" technology.

Another feature of the post-independence Nigeria was the promulgation of Development Plans. Analysis of these plans five to date show that these plans have not been very helpful because actual performance was almost always below budgeted expenditure and agricultural share of the budget declined relatively over the years. More seriously was the fall in agricultural production and productivity due to lack of responses from the farmers who had no participation or involvement in policy formulation and implementation.

This period also witnessed the rise of the bureaucracy and pressure groups except for the largest group the farmers, who were deliberately kept impotent as far as agricultural policy is concerned in spite of the fact that they produce over ninety per cent of Nigeria's farm products. This period was also a period of proliferation of expensive agricultural institutions and parastatals. The creation of the state Ministries of Agriculture had some merits such as large budgetary supply and collection of large number of expertise both national and international with full legal responsibility for initiating, executing and appraising activities that relate to agriculture.

Against the merits are the demerits such as the slowness of pace of action or inaction; large numbers of stages and persons through which instructions, advice and reports have to pass; the problem of bureaucratic red-tapism a direct and/or an overt act of power centralisation; the relative high cost involved in running the Ministries and parastatals and the questionable benefits level derived there from. The failure of the Ministries of Agriculture and their parastatals to effectively optimize resource use for the food and non-food sectors emphasize the need for improvement in the machinery of these institutions. Efficiency has to be raised, productivity increased and both official and non-official red tapes reduced to the minimum. For this process of rejuvenation to take root it, requires that the policy-makers are more aware of the environment in which they operate. This requires more investment in agricultural research.

Agricultural research progress in Nigeria is constrained by the twin problems of funding and personnel. The more serious problem is that of funds to acquire experimental farms, equipment and machines, maintain high calibre research staff, and a consistent research policy that will continue research to their logical conclusion. The other problems has to do with the quality of research personnel, with low remuneration for agricultural graduates compared to other graduates in gainful employment many quality research staff are lost to other more lucrative sectors.

Within the research establishment the philosophy of "publish or perish" reduces the effectiveness of research as researchers scramble for higher number of publications. However, the nature of agricultural research being of medium to long term in gestation makes it difficult for researchers to adjust the time-lag involved in both basic and applied research to this process of "publish or perish".

In addition there is the problem of duplication of research activities by researchers and institutions. The institutions lack effective research policy; they are defective in adequate research agenda, highly politicised ineffective management, unduly high capital and running costs and overshadowed by corruption. On their part, the researchers are more involved in privately funded research mainly from external donors as public sectors are scarce and unreliable.

The dilemma of declining agricultural productivity has persisted principally because of the lack of improvement in the farming systems. This dilemma is made more complex by a number of factors such as continued loss of soil fertility, declining labour productivity resulting from ageing farmers and too rapid urban pool of energetic rural youths; ineffective government policies, poor remuneration; inappropriate ad hoc research approach and poor programme planning. Given this situation of declining real output, rising prices, unemployment, high debt burden and a weakening naira, achievement of self-reliance and self sufficiency in agricultural production can only be achieved through a sustained effort in research particularly the farming systems.

1.2 Background And Basic Information

The realisation of the pivotal role of agriculture in Nigerian economic development is manifested in the dominance of agriculture in the country's five development plans since 1962. The importance is predicated on the reasoning that agriculture is needed to stimulate growth. Agriculture is needed to supply the surplus food, industrial raw materials, labour for industry, tax revenue and export that earn foreign exchange for the development of other sectors in addition to agriculture. With an estimate of food deficit at 6.8 million metric tonnes in grain equivalents and with the population growing at an annual average of 2.1 - 2.4%, the food output would need to grow at an annual rate of 17 percent to close the deficit, FMA (1987).

Prior to the oil boom era (1970 - 1974), agriculture played a dominant role in foreign exchange earnings and Nigeria could be said to be relatively self-sufficient in food. However with the advent of the oil boom and with a lot of petro-dollars for disposal then, the development of agriculture was relegated to the background. Nigeria became a net importer of food and many agricultural crops disappeared from the export list. The drop in oil price of 1981 spelt disaster. To allow for orderly growth of the domestic production, imports of beef, poultry, rice, wheat and maize were banned. Wheat imports have since been unbanned in 1992.

With the reduction of national income following the reduction of petroleum prices and the near collapse of the market in recent times efforts are being made both at the national and state levels to reactivate and invigorate the agricultural sector. These efforts resulted in programmes such as the "National Accelerated Food Production Programme", "Operation Feed the Nation", "Green Revolution", "Graduate Agricultural Employment Schemes" and the "School-To-Land Schemes". These efforts seem to have made only marginal impact and the problems of how to feed the teeming population and supply raw materials for the infant industries are still with us.

Several reasons can be adduced for this poor state of affairs with the Nigerian agriculture. These range from policy disorientation, lack of political will, low and unstable income, low productivity, declining soil fertility, social taboos, low level of human investment, non use of modern inputs, lack of infrastructures, drudgery of farming and poor management of farm resources. On the demand side, the burgeoning Nigerian urbanization rate has put additional pressure on food demand.

Efforts made to organize the farms and farmers for increased production have not been successful. It is believed that farms and farmers can be organized for increased efficient utilization of land, labour and capital through cooperatives and other farmers organizations, Olayide and Falusi, (1980). The cooperative have proved to be ineffective due to such factors as lack of effective leadership, lack of education and training, embezzlement of societies's funds, government creation and interference in cooperative societies, and illiteracy. To fulfill their mission, cooperatives also need bargaining advantage, which many don't have due - mainly to the large number and wide geographical dispersion of Nigerian farmers.

Until recently, research and extension arms of the Ministries of Agriculture and the Research Institutes in Nigeria had followed the colonial philosophy of "that's how it is done at home" to develop and recommend mono-crop based technological packages. But over the years, these packages have not significantly increased farm production and productivity. It is either that the technologies being recommended by the experimental stations were often inappropriate to the needs of the small farmer or the non adoption or partial adoption of some of the components of the technological packages was due to the fact that an improved technology involves a whole series of changes and costs to the current farming system that may be perceived by the decision maker (cultivator) as unsuitable.

Also until recently, efforts at developing Nigerian agriculture had always been largely a top - bottom approach. The planning machinery lacked strong grass root base and many development projects were introduced without sufficient understanding of the environment in which small farmers operate. Public investments in agricultural research have not always been spent on the needs of the small farmers, who should be the major customers of the results of such research. Instead allocation of funds often has been made on needs of more influential farmers who often hold non-agricultural jobs in the society. Research is based on those that will appeal to professional peer groups of the researchers and types of technologies that have been developed in the high income countries.

Therefore the link between the small farmers and the research organisation has tended to be weak. Traditionally, this interaction should have been facilitated by the extension worker, but for some reasons this has not often been the case. The possible reasons that can be given for this state of affairs are:

(a) Institutional and administrative barriers which prevent effective interaction between researchers, extension workers and farmers;

(b) Lack of farm-based farmer organisation;

(c) The Top-Down approach of the Bencratic systems;

(d) Location-specific factors such as climate, pests and diseases that limit the transfer of improved varieties; while local research and extension effort are undermined by poor facilities, low pay, lack of trained manpower, deteriorating economic climate, inadequate funding and poor research integration with existing farming practices and

(e) Production is still labour-intensive and technologies which increase peak labour requirements are often impractical and uneconomic to adopt.

Initiative on the small farmer focus has recently been given by the Department of Agricultural Economics, University of Ibadan and the International Institute of Tropical Agriculture (IITA) under the farming systems programme. The same could be said of the Federal Agricultural Coordinating Unit (FACU) and their Agricultural Development Project (ADP) interface that emphasize the farming systems approach. This approach was spearheaded by Schultz (1964) who remarking on the plight of traditional agriculture indicated the areas of action by posing the following pertinent questions. The issues are:

(a) How can total agricultural output and productivity be substantially increased in manner that will directly benefit the average farmer while providing sufficient food surplus to support the growing urban population?

(b) What is the process by which traditional low productivity subsistence farms are transformed into high productivity commercial enterprises?

(c) Do traditional farmers and peasant cultivators stubbornly resist change or are they acting rationally within the context of their particular environment?

(d) Are economic incentives sufficient to elicit output increases among peasant agriculturists or are institutional or structural changes in rural farming "Systems" also required?

Anthonio (1972) and Norman (1978) made a strong case for the adoption of the farming systems approach in agricultural research and development because of the repeated failure of strategies that were deemed successful in developed countries and research institutes of developing countries. Olayide et al. (1980) and Stifel (1980) have confirmed the preponderance of small-scale farmers in Nigerian agriculture. All indications are that the status-quo will continue in the foreseeable future. There is therefore the need to concentrate on the small farmers in shaping any meaningful strategy in the immediate future for agricultural development in Nigeria.

Schultz (1964) Anthonio (1967) and Atobatele (1986) have demonstrated the rationality of the small farmer in Nigeria and other developing economies, who have been shown to be resource-allocation-efficient and are able to maximise profit subject to their constraints although profit maximization may not necessarily be their soleobjective. However, the issue is not merely that of rational utilization of resources but the discovery of the constraints facing the small farmer, the removal of those constraints and advancing new technology and resources in the form most suitable to them. But before this can be done there is the need to have a good knowledge of the existing situation backed by reliable objective facts and figures.

Technical packages are based on the optimum combination of input quantities, and farmers are more likely to adjust quantities used to the cost constraints, they face, so that a cost function rather than production function is more appropriate to capture the farmers production environment. This is particularly so, because of the relatively low level of income available to the small farmers. The level of illiteracy and lack of standardization of technical units in farm environment make it difficult for technical packages to be always applied as recommended. Hence, the parameters from expenditure function are more apt to capture the farmers decision strategy for action than production function (Binswinger 1974).

1.3 Problems of Research In Mixed Cropping Farming Systems

Problems of mixed-cropping research exist because of the type of operators in the systems, namely the costs and time involved to study all the variations and complexity of the environment particularly the physical and ecological environment; the types and degrees of support services available to the operators, the policy framework under which the system is operating, and the nature of the institutional constraints within which the farmers have to operate.

1.3.1 The Small Farmer

A typical small farmer is made up of a family of one man with one to three wives, six to seven children, two to three other dependants, cultivating 0.5 to 1.5 hectares of several plots which are in variably scattered over many farm lands. Delivery of resources and access to him is expensive because he lives in the remote part of the country. He is invariably an illiterate, old, and conservative. These create serious bottlenecks for research policy formulation and implementation. To develop Nigerian agriculture implies the development of the Nigerian small farmer. There is the need to throw more light on the nature of the decision - making process and cost patterns of the peasant food producers in Nigeria. This was because of the serious bottlenecks in agricultural productivity and development caused by capacity limitation of the fixed factors of production and of structural inflexibility in farming in Nigeria, Schultz (1967), Antonio (1967). The need for the concentration of research on the small farmer is informed by the small size of farms which limits economies of size and scale; the complexity of the traditional farming systems, the hoe-cutlass technology, low capitalisation, low yield per hectare and the atomicity of producers and consumers.

1.3.2 Farmers Physical Environment

Environmental factors that pose problems to the farmers under the mixed-cropping system include low soil fertility that result in low yields argued, Ojanuga et al (1986). The small farmer is also beset with poor tenurial arrangements that lead to fractionalization and fragmentation of holdings. Accordingly, sub-optimal farm size result in inadequate input use. Additionally, the climatic factors enhance the proliferation of disease and pests and those location-specific factors limit the mass transfer of improved varieties of seeds and other planting materials (Ojanuga et al, 1986). The system is rain-fed which increases the risk of operation in case of drought because lack of capital precludes the installation of irrigation systems.

1.3.3 Poor Support Services

Problems of the mixed-croppings systems are exacerbated by poor support services. These are particularly in the areas of research, extension and poor marketing arrangements. Anthonio (1972) discussed at length some misconceptions in agricultural research in Nigeria. He notes that research was "exploitative" in the sense that it concentrated on export crops to the detriment of food crops. Priority was in "expanding" rather than improving the production of only those products that will sell in the world market. Consequently, the question of economics did not arise since buyers had virtual monopoly on the prices to be paid to the peasant producers. This is largely true today since socio-economics of agricultural production lags behind physical and biological considerations in agricultural research. He opined that the research agenda depended on the expediency and priority of the metropolitan powers. There is over-generalization of the farmers environment where it is assumed that labour is surplus, land is surplus but capital is scarce and labour management is conservative and inflexible.

Furthermore agricultural research organisations compartmentalize the disciplines when farmers problems cannot be separated as such. Some of these problems have been addressed by the research institutes with the introduction of socio-economic departments and the encouragement of multi-disciplinary research. However, more needs to be done.

In the area of marketing as it pertains to the small farmers, Adeyokunnu (1980), highlighted some of the major problems as:

(i) inadequate physical marketing facilities in storage, processing and transportation leading to technical inefficiencies and high costs;

(ii) lack of grades and standards for food;

(iii) inadequate market information resulting in pricing inefficiencies;

(iv) small scale of operation;

(v) pricing of middlemen, and,

(vi) high marketing margins.

In addition to all these problems is the policy environment in which the farmers operate. Agricultural policies are unstable and inherently disjointed and disoriented. There is lack of political will to follow through with policies that will enhance the productive capacity of the small farmers involved in the mixed-cropping system. There is therefore the need for more and better on-farm researches to persist in finding solutions to small farmers problems as a springboard for agricultural development in Nigeria.

1.4 Justification And Objectives Of The Study

1.4.1 Objectives of the Study

The general objectives of the study is to determine the economic parameters that characterize the mixed-cropping systems in the eastern zone of the Rivers State.

The specific objectives are to:

i. appraise the factors, economic and non-economic, influencing the adopted farming (cropping) system in different parts; of the eastern zone of the State;

ii. determine the level of income and profitability of the major cropping systems using farm Business Analysis methods;

iii. determine cost-share functions and the corresponding elasticities of input demand and substitution;

iv. determine the efficiency of input use in the cropping system, and,

v. make recommendations on how best to improve productivity of the mixed-cropping peasant farms in the eastern zone of Rivers State.

1.4.2 Justification

The justification for this study stem from the need to intensify agricultural research. As a result of poor funding, lack of incentives and poor remuneration among others, agricultural research is weak in this country. The non-adoption or partial adoption of new technological packages by small farmers represents a gap or lack of knowledge of existing farmer environment. Studies intended to enhance this knowledge will help in the transmission and utilization of improved technological packages to the farmers.

Poor adoption outcome of improved technological packages portrays serious weakness in the institutional set-up for the delivery of these new packages as well. Agricultural institutions are poorly understood, closed and have low impact tendency for change.

Several development strategies have been tried in Nigeria namely, export-oriented, import substitution, large-scale plantation agriculture and recently the structural adjustment programme with little practical results. The problem seem to be that of poor policy formulation and implementation. This is particularly true of the agricultural sector with little or no farmer participation. This study included active farmer participation, so that variables derived will be more relevant for policy formulation and implementation.

Justification for the concentration on the small farmer is the fact that they form the bulk of Nigeria's agricultural producers. With the fragile nature of tropical soil, population growing at an estimated 2.4 percent and with the shortening of the fallow period, there is the need to develop technologies which calls for a balance between the existing farming systems and high pay-off technology as well as the selection of which crops to emphasize.

Finally, there is paucity of data about the area under study. With the increasing activities, siting of heavy industries (e.g. the Fertilizer Company at Onne, the Petrochemical Complex at Eleme as well as the (Liquefied Natural Gas Plant) and extensive drilling activities with the consequent destruction of farm lands by the oil companies and their subsidiaries the mode of land-use intensification is going to be very important. It is therefore necessary to isolate the best combination of input so as to maximise output and minimize the negative impact of these industrial activities on agricultural/food production.

CHAPTER TWO

THEORETICAL CONCEPT, RESEARCH METHODOLOGY AND LITERATURE REVIEW

2.1 The Concept of Duality

A major portion of this study is sustained on the concept of duality between production functions and cost functions. For every operational production function with the requisite characteristics such as convexity (concavity), monotonicity and homogeneity (regularity conditions), there is a corresponding cost function and vice versa (Thompson, 1988). This implies that duality results preclude the need for self-dual functions. These has led to the development of the flexible forms (F.F.F.) which was driven by the search for flexible forms which imposed fewer maintained hypothesis. For example the Cobb-Bouglas which is commonly used in Nigeria implies an elasticity of substitution of one which need not be the case particularly in a developing agriculture such as ours. The notion of flexible functional forms (F.F.F.) was formalized by Diewert (1971) and has become available for empirical research after initial exposition by Stepherd (1970).

For this study, the cost function approach is adopted. Both the trans-log and the Cobb-Douglas functions are used. This is because subsistence agriculture is hedging against risk and uncertainty, Norman (1977), 1978) and Baker (1980). It is made even so be the fact that the survival of the family is at stake. In such circumstances the major objective of the peasant is the maximisation not only of income but rather his family's subsistence and survival. So a minimisation of cost rather than profit-maximisation strategy will be implicit. Moreover in our traditional environment cost variables or expenditure are easier to obtain.

Silberberg (1978) has noted that in the estimation of factor demand and cost functions, there are basically two ways. One is to estimate, by some procedure, the underlying production function and then calculate by inversion the implied first order relations, the factor demand curves (holding output constant). The cost function can then be calculated also. This is however a very arduous procedure. Production functions are largely unobservable. The data points will represent a sampling of input and output levels that will have taken place at different times as factor or output prices changed. And what is the use of the knowledge of production function itself? Largely, it is to derive implications regarding factor usage and cost considerations when various parameters such as factors and output-prices change.

It would make more sense to start with estimating the cost functions or the factor-demand curves directly. The criticism of this procedure is that the costs and demand functions are derived from fictitious and non-existent production process. However, the concept of duality assures that if a cost function satisfied some elementary properties such as linear homogeneity and concavity in factor prices then there is in fact some unique underlying production function.

Binswanger (1974) has noted some econometric advantages of the cost function especially the trans-log cost function (Christensen et al, 1971) over the neoclassical production function. They include the fact that it is not necessary to impose homogeneity of degree one on the production process to arrive at estimation equations. This is because cost functions are homogenous in prices regardless of the homogeneity properties of the production function. For example a doubling of all prices will double the cost but will not affect factor ratios. In general, the estimation equation have prices as independent variables rather than factor quantities which at the firm or industry level are not proper exogenous variables. Farmers, and indeed enterpreneurs make decisions on factor use according to exogenous prices, which make the factor levels endogenous decision variables. This particularly relevant for our situation where measurement of factor quantities by farmers are not standardized; and at best questionable and unreliable.

If production function procedure is used to derive estimates of elasticities of substitution or, of factor demand in the many-factor case, the matrix of estimates of the production function coefficients has to be inverted. This inversion inevitably exaggerates estimation errors. No inversion is necessary when a cost function is used. Again, efficiency differences among observational units can be conveniently handled by the trans-log cost function. Therefore these differences do not result in biased estimates of the production parameters. In the case of trans-log cost function (as well as for the trans-log production function) all estimation equation are linear logarithms.

Finally, in the production function estimation high multi-collinearity among input variables often causes problems. Since there is usually little multi-collinearity among factor prices, this problem does not arise in the cost function estimation.

2.2. The Study Area and Data Source

The study area is eastern zone of the upland area of Rivers State. The area encompasses the former five Local Government Area (LGA) of Bori, Ikwerre-Etche, Bonny, Okrika/Tai/Eleme and Port Harcourt. The area is subdivided into blocks and cells by the Ministry of Agriculture and the Agricultural Development Project (ADP) more for ease of administration than for any ecological or agronomic reasons. For the purpose of this study, the zone was subdivided into two, based on cultural practices. The two zones have basically yam-based farming system but in the eastern half of the study area, yam setts are planted in "inverted mounds" while the normal mounds prevail in the western half. The eastern half comprises of five blocks namely Bori, Gokhana, Nyokhana, Okrika, and Tai Eleme-Oyigbo. The western half is made up of Port Harcourt, Isiokpo/Eleme, Emohua and Okehi (see figure 2.1).

2.2.1 Location, Size and Population

The study area approximately 5,200 km2 or 40% of the total land area of the State. It roughly lies within the coordinates 4 20"N, 12'N, 6 40'E and 7 37'E. It is bounded in the south by the Bight of Bonny the north by Imo and Abia States; the west by former Degema and Ahoada Local Government Areas; and the east by Cross River State. Table 2.1 shows the size of each of the local government areas within the study areas.

Projections were made from the 1963 census figures. The 1963 census indicated that about 899,494 people were living in the study area with a marked concentration in Port Harcourt Local Government Area (26%). Population projection estimates based on the 1963 census figures are given in Table 2.1. The estimated

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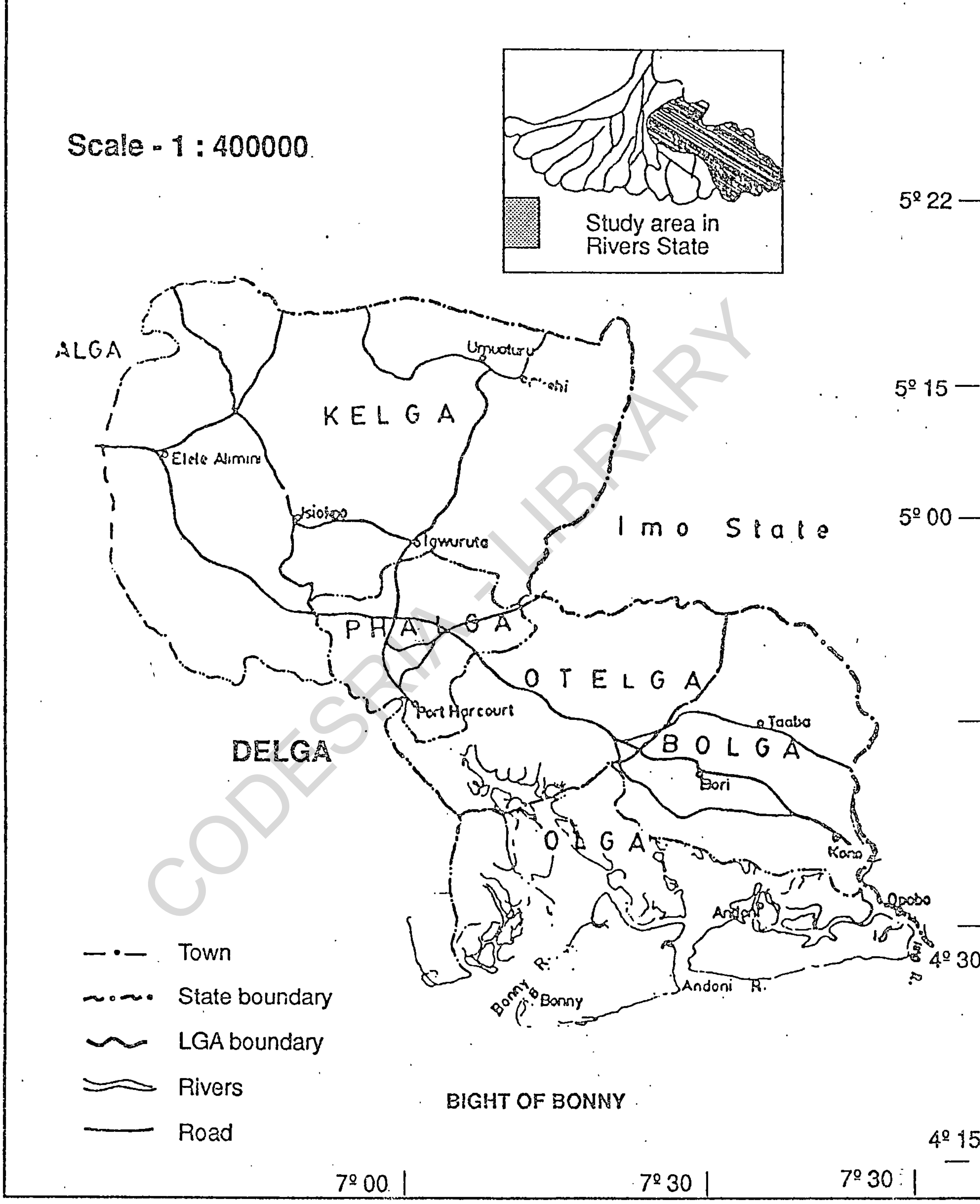
Fig. 2.1 The Study Area- Eastern Part of Rivers State



1985 population is about 1.78 million people for the study area, ranging from 223,300 for Bonny LGA. Port Harcourt Local Government Area which is mostly concentrated in Port Harcourt.

Estimated population density for the period ranged from 147 persons/km2 for Ikwerre-Etche to 1750 persons/km2 for Port Harcourt Local Areas. Port Harcourt Local Government is dominantly urban with a high concentration of industries while other LGAs are rural with agriculturally - based economy.

2.2.2 Accessibility

Moderate accessibility is provided by Federal and State roads except for the south eastern part of the area which falls within the riverine portion of the State. The State roads are not tarred and they are often difficult to traverse particularly during the rainy season. The south eastern part of the area is permeated by numerous creeks through which the various villages located within it are reached only by canoes. Accessibility in this part of the area is difficult and sometimes hazardous owing to lack of appropriate transportation facilities.

Table 2.1 SIZE, POPULATION AND POPULATION DENSITY OF THE STUDY AREA, 1985

LOCAL GOVERNMENT AREA	AREAS (KM^2)	POPULATION (X 1000)	POPULATION DENSITY (PERSONS/KM^2)
BORI	859	295.5	334
IKWERRE-ETCHE	2,380	349.9	147
BONNY	992	223.3	225
OKRIKA/TAI/ELEME	609	283.6	466
PORT HARCOURT	360	629.9	1,750
TOTAL	5,200	1,782.2	343

Rivers State Average Population Density = 169

Source: Rivers State Ministry of Finance and Planning, 1985.

2.2.3 Hydro-metreological Regime

The climate of the area, like that of the rest of Nigeria, is controlled by the Intertropical Convergence Zone (ITCZ) due to two opposing air masses, the southwesterly moisture-laden monsoon winds and the north-easterly dry and dusty (harmattan) winds. The front or zone where the two winds meet oscillates annually through the entire length of Nigeria. Rain often occurs south of the ITCZ. By January, it is located south of the country while by August it is located north of the country. Thus between January and December it creates a consistent seasonal rainfall pattern throughout Nigeria so far. A bimodal or unimodal wet season alternates with a dry season of varying duration. In the study area which is more southerly a bimodal wet season, peaking in June and September, alternates with a very short (about 2 months) dry season.

Rainfall:

Stations collecting meteorological data in the area are very few. Only Bonny, Borri, Rumuodamaya and Choba stations have rainfall data dating more than five years. The areas of study is characterized by a high rainfall which decreases from south to the north. (see Appendix 2.1). The mean annual rainfall from 1985 to 1990 is about 4698mm at Bonny, the most southerly station, and about 2396mm at Rumuodamaya, the most northerly station. The mean monthly rainfall ranges from 92mm to 871mm for the wet season (February-November). a slight diminution in rainfall in July is experienced in the area which gives the wet season its bimodal character. The mean monthly rainfall ranges from 3mm to 110mm in the short dry season (November and December). By definition (Pullan, 1962) there is no dry month in the area, as each month, including even the dry-season months, has more than 25cm of rain. Therefore what is referred to as the dry season in the area is a low rainfall period.

Temperature:

The temperature data for the area are very scanty, being available for Port Harcourt, Choba and Bonny only. The data for Port Harcourt dates back to 1951, while those for Choba and Bonny are more recent and incomplete. Appendix 2.2 summarizes the temperature regimes of the area. It clearly indicates the tropicality of the area. The range of the mean monthly temperature for each station is very narrow as for example 25.0 C to 27.2 C for Port Harcourt for a period of 15 years. The mean annual temperature is between 26°C and 27°C for the area. The difference between the wet season and dry season temperature is less than 5°C.

The southern part of the area commonly referred to as the riverine part is drained by New Calabar, Bonny, Opobo and Imo Rivers as well as the network of numerous creeks associated with them. These rivers and creeks carry salt water in their lower reaches which is moved by tides as far north as Port Harcourt. Not surprising surface water in the southern parts of the Phalga and Otelga and the whole of Olga are salty. Availability of potable water in these parts is a problem. Northward, the rivers gain fresh water so that the main channels and their tributaries provide good drinking water for the inhabitants. The western part of Kelga area is drained by the Sombreiro carrying fresh water. The central part of the Kelga and the northern part of Phalga are drained by the New Calabar river which also carried fresh water in those parts. The Imo river and its tributaries drain the eastern part of Kelga, northeastern part of Phalga, northern part of Otelga and all of Bolga. The river and its tributaries in those parts of the area also carry fresh water. The New Calabar, Bonny and Opobo rivers discharge negligible quantities of fresh water as they are not connected to substantial fresh water streams. They are blind tidal inlets mainly.

2.2.4 Vegetation and Land Use:

The original vegetation on the coastal plan terrace and the Sombreiro - Warri Terrace in Phalga, Kelga and Bolga is swamp forest - (Buchanan and Pugh, 1996). Swamp forest comprises the Mangrove and Coastal vegetation developed under brackish water conditions on the muddy banks and the fresh water swamp forest of the fresh water lagoons and estuaries. The rainforest consisting of a large variety of tall and low trees, oil palm and shrubs. However, the rainforest has been drastically exploited by past and present cultivation, resulting in the expansion of the secondary forest. In most places, the only tall vegetation are the oil palm trees and a few economic trees, which has led to the areas being described and mapped as oil palm bush (FDF, 1978). The cultivation intensity of between 10 and 50% is estimated for the land. The crops commonly grown are cassava, yam, maize, plantain, cocoa and rubber.

The upper Delta Flood plain in Olga, Phalga and Otelga is dominantly fresh-water swamp colonized by swamp trees which are the edaphic variants of the rain forest such as the Abura tree. Other typical vegetation include oil palm, raphia palm, shrubs, lianas, ferns, floating grasses and reeds. The flood plain is very little cultivated so that much of the natural vegetation is still preserved with lumbering and fishing as the main land use types. Crops grown on raised ground are plantain, cassava and cocoyam.

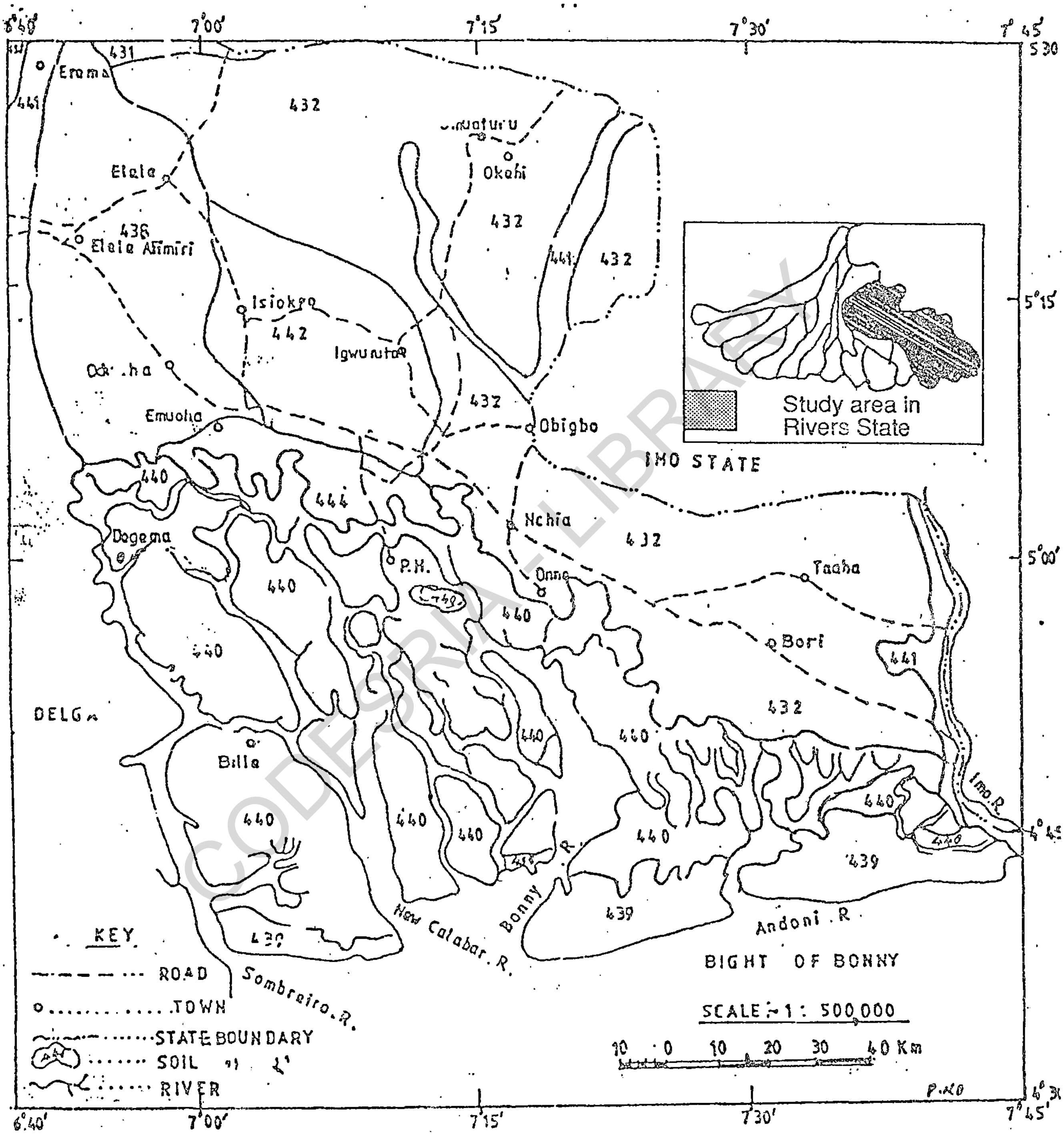
The salt-water tidal flats at Olga, Phalga and Otelga are mainly swamps vegetated by stilt-rooted mangrove (e.g. Rhizophora racemosa). The outliers of raised alluvial ground or coastal plain terrace are vegetated with tall forest tree species and oil palm, or where swampy, by freshwater stilrooted trees and palms. The salt water tidal swamps are used as fishing grounds whereas the raised outliers are cultivated sparsely to plantain and vegetables. The Beach Ridges in Olga is vegetated mainly by freshwater swamp trees, palms and shrubs, and sparsely cultivated to coconut, cassava and vegetables.

2.2.5 Soils

The distribution of the soils occurring in the study area is shown in fig. 2.2. The soil patterns separate according to the underlying geology. There are four main types, 'namely, the Soils Over Coastal Plain Sands, Soils Over Sombreiro-Warri; Delta Alluvium; and Soils Over Beach Ridge Sands. The Soils Over Coastal Plain Sands are made up of Egbeada - Ubomiri (soil unit 431, fig 2.2) and Omerelu - Bori (soil unit 432) soil associations. They are the dominant soils in the area (FDALR, 1951). They are deep, markedly leached, well-drained argillic soils. Typical subsoil colours are yellowish brown, reddish brown, red or strong brown with surface layer which is dark brown. Texture is sandy loam, sandy clay loam, loam or sandy clay in the subsoil and substratum, while it is sandy to sandy loam in the surface layer.

19A

Fig. 2.2 Soil Map of Eastern Part of Rivers State



The soils are very strongly acidic in reaction and highly deficient in bases (Ca, Mg, Na, K). They have moderate organic matter average nitrogen contents, and high available phosphorus. Low cation exchange capacity (CEC) and low base saturation.

Omoku-Elele association (438) dominate soils over Sombreiro-Warri Deposit. They have strongly acid reaction, moderate organic matter and total nitrogen content, low available phosphorus, moderate CEC and very low base saturation.

The soils over Delta alluvium occupy the fresh-water swamps of the upper Delta floodplain and the salt-water tidal flats of the lower Delta Floodplain. Soils of the upper Delta fresh-water swamps belong to Yenagoa - Mbiama association (443). The soils are very strongly acid in reaction. They possess moderate amounts of organic matter and total nitrogen contents, moderate amounts of available phosphorus and exchangeable base, low to moderate base saturation. Soils occupying the salt-water tidals flats are very extensive in the southern coastal part of the area. They belong to the Opobo-Degema association (440). They are largely organic tier derived from mangrove vegetation. The organic tier overlies a basal mineral stratum of stratified silt, sand and clay interspersed with plant debris. They are described as peats (locally called chikoko), mainly fribrists and hemists of sandy clay loam and loam texture. The peats are neutral or weekly alkaline but readily oxidize and become extremely acidic owing to their content of sulphidic materials. Their organic matter content is very high. Total nitrogen content is also very high and so are the exchangeable bases.

Soils other than peats occur on the tidal flats. They are mineral soils formed where the surficial organic tier is absent or where the ground is elevated above the tidal range. Of particular significance are the soils of the raised coastal plains and, outliers within the flats. These soils are well-drained to somewhat poorly drained similar to other upland analogues.

Soils over the Beach Ridge sands are minor soil fringing the coast, and formed in deep clean sands making up the beach ridges. They are well-drained to poorly drained soils with brown or strong brown or light gray subsoils and gray or grayish brown surface layer. Text is sand throughout the profile. They have very strongly acid reaction, very low to low organic matter and total nitrogen contents, low exchangeable bases, low CEC and low base saturation.

2.3 Data Sourcing and Sampling

Primarily data were collected on a bi-weekly basis for the duration of farming season which lasted nine to twelve months in most cases. The interviews were carried out by the researcher and a team of his ex-students working for the ADP, Shell and the Ministry of Agriculture. Individuals were already stationed in their areas of origin. This minimized both the language problem and farmer resistance which has become frequent in the area. Labour input was measured in man days and the value estimated by multiplying the man-days with the average daily labour rate.

Land and output were measured by the use of the yield plot technique in which a certain portion of the farm was targeted throughout the duration of the research (Spencer, 1972). This had the tendency of blowing up the output figures. Prices used were the average annual prices determined through the questionnaire. Secondary information were collected from libraries, Ministry of Agriculture and the Agricultural Development Project (ADP) with headquarters in Port Harcourt. Information were also gathered from Shell Agricultural Extension Department that has had extensive activity in the area for a considerable number of years.

The sample frame consist of 575 farms sampled in pretest or pilot survey of an on-farm adaptive research carried out by the Federal Agricultural Co-ordinating Unit, Ibadan, National Root Crops Research Institute, Umudike and Rivers State University of Science and Technology, Port Harcourt (Ojuanuga et al, 1986). The sampling method employed is a two-stage stratified proportional sampling whereby each zone was divided into blocks and between twenty to thirty-five farmers were randomly selected with respect to the population of each block. However, after a thorough review of the response, thirty farmers were dropped for a number of reasons including reliability of information leaving two hundred and forty-five farmers, giving eighty-nine percent response rate (see table 3.1).

2.4 Literature Review

Emphasizing the need to concentrate attention on the small farmer for any meaningful agricultural development, a considerable body of literature has emerged. Literature which deal on the structure and economics of mixed-cropping can be categorized into those that deal with the farmer, the agronomic potentials, socio-economic factors and the resource-use among the small farmers.

2.4.1 The Small farmer

The case for the concentration of agricultural development effort on the small farmers and especially the farming/cropping systems approach was made by Anthonio (1972) and Norman (1978). This was because of the repeated failure of strategies that were deemed successful in developing countries. There, the large size farms and huge financial investments were given preference over small farms but large size does not imply greater efficiency. Failure of large farms have been documented by recent sale of large farms - farm settlements - by multi-national corporations, (Ogbemudia/John Holt farms) and governments. Olayide et al (1980), have confirmed the preponderance of small-scale farmers in Nigeria and all indications are that the status-quo will continue in the foreseeable future. Therefore there is the need to concentrate on research and development on the small farmers and their environment. The rationality of the small farmer was demonstrated by Schultz (1964). In Nigeria, the rationality of the small farmer have been demonstrated by Anthonio (1967). Idachaba (1977), Ogunfowora (1984) and Atobatele (1986). These studies show the small farmers to be resource-allocation-efficient and to be able to maximize profit subject to their constraints although profit maximization may not necessarily be their only objective (Flinn et al (1980), Olayemi (1980). However, the issue is no more that of rational utilization of resources but the discovery of the constraints facing the small farmer, the removal of those constraints and the advancing of new technology and the provision of additional resources in the form most suitable to them.

Difficulties in dealing with the small farmer and his farm have been highlighted by Schultz (1964) and Olayide et al (1989). These difficulties include the scarcity of resources available to him. Labour, capital and management are limited. Land resources are fragmented and fractionalized by tenurial arrangement. Labour is seasonal, capital is limited by size while management is limited by education and technology. Previous research and extension activities have in the main focussed on mono-crop or agronomic and economic packages. The packages implies some agronomic and economic advantages of existing crop mixtures.

In the economic realm, Norman (1972) has shown that crop mixtures spread the labour demand and sequence of crop output more evenly throughout the year. Upton (1968), and Norman et al (1979) showed that growing crops in mixtures gave a more dependable return. This was due to the fact that different crop species are likely to respond differently to variations in weather, pests and disease attack. Therefore failure or partial failure of one crop can sometimes be counteracted by compensatory growth of another. Ogunfowora and Norman (1973) determined that mixed-cropping system not only alleviated the labour bottleneck in physical work but also paid off in terms of returns to the limited seasonal labour.

Socio-economically, the indigenous cropping systems with their emphasis on mixed-cropping appear to be well-attuned to the technical, social and economic environment of the area. Abalu and Da Silva (1980) documented the importance which farmers attach to diversification as a means of risk minimization, while Norman (1974) mentioned tradition as one of the reasons why inter-cropping is practiced in some parts of Nigeria. Attempts to change the rural farmer are frequently resisted both because existing traditional institutions and processes that serve the small farmer have proven more readily understood and dependable and because the various elements constitute something akin to an ecological unity in the human realm.

Agronomically, studies by Andrew (1972) and Banta (1972), Fisher (1972), Osiru and Wiley (1972) have shown that in the tropics and operating with low level technologies and capital, polyculture is more efficient than pure stands and better for overall ecology of the region, yield and resource use. Norman (1974) reported that with mixed-cropping, fields are better protected against soil erosion and that when fast-growing and slow-growing crops are combined the soil surface is covered with foliage for a greater part of the year. Wahua and Miler (1978) showed that maximum exploitation of light, water and soil nutrients from a given area occurred under mixed-cropping. Mixed-cropping promotes beneficial interactions between individual crop types with respect to disease and pest resistance as well as soil fertility, Norman (1972).

Low efficiency of resource use among the farmers under mixed-cropping systems are reported by Nwosu (1975), Adeyeye (1986) and Banwo (1986). They all used the production function analysis while this study used the cost functional analysis.

2.4.2 Resource Use

(a) Land:

Work by Adegboye (1967) and Famoriyo (1980) amplified, the geographical dispersion of the small farmers, the fragmentation of farm holdings (fractionalisation) and the sub-optimal farm size due to the traditional tenure system prevalent in Nigeria. Most of their recommendations concentrated on the consolidation of holdings and improved access to land use. This culminated in the Land Use decree which has been ineffective due to the conflict between Federal and State authorities in terms of hierarchy of authority over land matters; the bureaucracy involved which leads to long waiting period before the certificate of occupancy is issued; and the resistance from rural communities who are afraid of the permanent loss of their means of livelihood security and ancestral heritage.

Recently, (1991), an Agricultural Land Development Authority has been established to facilitate the acquisition of land for farming. However, the apparent conflict between large scale farming and the prevalent small-scale farming continue to exist. Efficiency of large scale farming has been questioned by Anthonio (1972), and Essang (1972), because they have not performed better than the small scale farms.

(b) Labour:

Recommendations on optimum utilization of farm labour by Essang (1972), Atobatele and Olayide (1980) involve the modernization of farm operations; new production technology conducive to higher labour productivity and efficiency; reorganisation of migrant labour, unionization or rural labour and comparable rural and farm wage structure. Implementation of these strategies may be difficult and costly hence the establishment of programmes like the School-To-Land and the Agricultural Components of the National Directorate of Employment (NDE) where young school leavers are given the necessary facilities to embark on various forms of agricultural production. However, these programmes do not address the geographical dispersion and peculiarities of the typical rural farmer situation.

(c) Fertilizer and Agrochemical:

Previous recommendations and programmes are summarized by Olayide and Falusi (1980). They border on the stimulation of effective demands for these farm inputs; creation of effective and more timely and readily available supplies. This involves the establishment of farm supply services such as the National Seed Service and Agro-service centres. National Fertilizer Companies have been established in Port Harcourt and Kaduna.

In spite of the implementation of some of these recommendations, fertilizer and agro-chemical supply and use are currently at less than desirable level. In many places these inputs are simply not available or only at considerable high cost. With the partial removal of subsidy and privatization of distribution, it is hoped that the situation may improve. Inflationary pressure occasioned by the Structural Adjustment Programme may however not actualize this hope in the short term.

CHAPTER THREE

THE MODEL AND FARMING SYSTEMS APPRAISAL

3.1 The Model

Corresponding to the following cost minimization problem

$$\text{Minimize } C = \sum_{i=1}^{n} XiPi; \ (i = 1,2, ..,n) \qquad (1)$$

Subject to

$$Y = f(X_1, X_2, ..., X_n) \qquad (2)$$

(where X_i = input levels, P_i = factor prices, Y = output),

there exists a dual minimum cost function

$$C^* = g(Y, P_1, P_2, ..., P_n) \quad ; \qquad (3)$$

while C is the cost of production under any feasible factor combination, but C* refers to the cost of production only when the cost minimizing input combination is used. Since the optimal input combination is a function of factor prices, the minimum cost is also a function of factor prices. C* assigns to every combination of input prices the minimum cost corresponding to the cost minimizing input levels X_i^*. C* is homogenous and of degree one in prices

By Shephard's lemma (Diewert, 1971)

$$\frac{dC^*}{dPi} = X_i \qquad (4);$$

The translog cost function is written as a logarithmic Taylor series expansion to the second term of a twice differentiable analytic cost function around variable levels of 1.

i.e. (Ln Y = 0, Ln P_i = 0 i = 1, ..., n); {Ln being logarithmic natural}:

If we rewrite (3) in natural logarithms then

$$\text{Ln } C^* = f(\text{LnY}, \text{LnP}_i, ..., \text{LnPn}) \qquad (5)$$

Now denote the first and second order derivatives at Ln(.) = O as follows

$$\text{LnC}^*\Big| = a_o \qquad \frac{d\text{LnC}^*}{d\text{LnY}}\Big| = a_y \quad \frac{d\text{LnC}^*}{d\text{LnP}_i}\Big| = a_i$$

$$\frac{d^2LnC^*}{dLnP_idLnP_j} \Bigg| = b_{ij} \; \frac{d^2LnC}{dLnP_idLnY} \Bigg| = b_{iy} \qquad (6)$$

The equality of the cross derivatives in (6) implies the symmetry constraint i.e. bij = bji. The Taylor series expansion is as follows:

$$LnC^* = a_o + a_yLnY + \sum_{i=1}^{n} a_iLnP_i + 1/2\sum_{ij}\sum b_{ij}LnP_iLnP_j$$

$$+ \sum b_{iy}LnP_iLnY + \text{remainder} \qquad (7)$$

This function is an approximation of an arbitrary analytic function and a functional form if the remainder is neglected and if we assume all the cross-derivatives to be constant. The latter constraint is imposed if the parameters are estimated in regression equations.

Homogeneity in prices is defined as

$Kg\ (Y, P_i, ..., Pn) = g(Y, KP_1, ... KPn).$

It implies $\sum a_i = 1 \quad \sum b_{ij} = 0, \sum b_{ji} = 0.$

Homogeneity of degree one in prices does not necessarily impose homogeneity of degree one on the production function. Furthermore, almost no constraints are imposed on elasticities of substitution or of factor demand which makes the function more general than other functional forms. The function can be estimated directly or in it's first derivative, which by Shepherd's lemma (4) are factor shares.

$$\text{i.e.} \quad \frac{dLnC^*}{dLnP_i} = Mi = Ai + \sum_{j=1}^{n} bijLnPj + biyLnY; \ (i = 1, ... n) \qquad (8)$$

where Mi are factor shares.

Both equations (7) and (8) can be estimated where

C^*	=	Total cost of production
P_i	=	rental value of land
P_2	=	wage rate
P_3	=	price of fertilizer/agrochemical
P_4	=	Planting material (cuttings, seeds etc)
P_5	=	price of tools (matchets, hoes etc).

Y = output in metric tonnes.

Uzawa (1962) has shown that elasticity of substitution, E_{rk} can be obtained directly from the parameters of a cost function because

$$Erk = \frac{\sum_{i=1}^{n} P_i X_i d^2 C^*}{X_k X_r dP_r dP_k}$$

Binswanger (1974) has also shown that the variable elasticities of substitution and of factor demand can be obtained as follows:

$$Eij = \frac{1}{MiMj} bij + 1 \text{ for all i,j } i \neq j \qquad (9)$$

where E = Elasticity of substitution

Mi, Mj = factor shares

$$Nij = \frac{bij}{Mi} + Nj \text{ for all i,j } i \neq j \qquad (10)$$

where Nij = cross price elasticity of factor demand and

$$Nii = \frac{bii}{Mi} + Mi = 1 \text{ for all i;} \qquad (11)$$

where Nii = own price elasticity of factor demand

It follows that all elasticities can be calculated from the estimation of the translog cost function.

Sets of the cost functions were estimated namely the translog function by the cost-share equations and the Cobb-Douglas for comparison. This procedure was carried out for the whole area and for the two identified farming systems [1] and [2] which were based on cultural factors. One share equation had to be dropped from the cost share model because only n-1 equations were linearly independent due to the homogeneity constraint (i.e. $\sum a_i = 1$ $\sum b_{ij} = \sum b_{ji} = 0$). If restrictions across equations ($b_{ij} = b_{ji}$) are imposed,the OLS estimates are no longer efficient and the seemingly unrelated regression problem applies. Moreover, there is the likelihood that the error terms across equations (for corresponding observations) are likely to be

(Zellner, 1962) is applied. Zellner (1962), suggests that efficiency in estimation can be gained if one views the system of seemingly unrelated equations as a single large equation to estimated. Estimation of this single (system) equation is accomplished efficiently through the use of generalised least squares. Zellner estimation achieves an improvement in efficiency by taking into explicit account the fact that cross-equation error correlations may not be zero.

3.2 Farm Business Analysis and Limitations

Farm Business Analysis which entails the identification of income and costs for each cropping system is used to measure resource productivity and allow for related comparisons. Productivity was investigated with respect to the productive inputs of land, labour, fertilizer/agrochemicals, planting materials (seeds, cuttings etc.) and tools (implements). Land productivity was measured in terms of net monetary returns with respect to the value of land per hectare. Labour productivity was determined by the total value of output per the amount of labour used. Fertilizer/Agrochemical productivity is measured by the value of output with respect to the value of fertilizer/agrochemical used. The same procedure is adopted for tools/farm implements.

Five factors normally affect a study of this nature. They are (1) cross-sectional problem; (2) the representativeness of the systems studied; (3) the reliability of the farmers responses; (4) the problem of estimating labour time; and (5) the problem of estimating quantities of outputs and inputs. The second , third, fourth and fifth problems were adequately handled by means of the collection procedure already discussed.

Due to the fact that only one season data were involved in the research, interpretation must be made accordingly. A longitudinal analysis where data are collected from the same observational unit at successive points in time would have been more desirable to enable us to take into consideration changes over time in the farmers' environment. For example, a change in the cost share with respect to a change in time would have helped to determine whether the current technology in use is neutral, factor-saving, of factor-using over a period of time.

3.3 Farming Systems and Resource Situation

3.3.1 Cropping and Livestock Enterprises:

Agriculture forms the major means of livelihood in the study area. Farming is traditional in nature with main emphasis on cultivation of crops and keeping of livestock. The use of animal power is non-existent, and heavy equipment use is minimal. The most common crop mixtures cultivated are shown in table 3.1, with yam and cassava as the major crops (Table 3.2). The intercrop combinations, sequences and stand geometry vary widely among localities. Tillage practices and seed-bed preparations as well as planting time also vary. Staking material and even yan varieties, and ecotypes differ from locality to locality. The farmlands near the homesteads are reserved for the production of food crops for family consumption as and when needed. Farmlands that are distant from the homsteads are planted with crops which are left to mature, bear frutis which could be sold or preserved and used as planting material for the next planting season. Crops such as plantain, yams, maize and vegetables are usually planted on farmlands nearby, while grain crops, seed yams, ware yams, cocoa, oil palm and other cash crops occupy distant farmlands.

The livestock that featured in the farming system of the area comprised goats, chicken, sheep, dog, pigs, native cow, cats, ducks and turkey. Poultry and goat are the most highly valued, while turkey and duck were least valued.
Two categories of fishermen were identified namely the artisenal fishermen and fish farmers. The artisenal fishermen fished along rivers and streams in the creeks and sometimes in the open sea. The farmers owned ponds either in brackish or fresh water environments or kept an aqua culture. Due to lack of equipment/capital, ventures into the open sea attracted the least number of fishermen (<5%) and so most of the artisenal fishing activities were carried out in the creeks (30-35%), particularly in Okrika (80%).

Table 3.1

CROPPING SYSTEMS AND THEIR DISTRIBUTIONIN THE EASTERN PART OF RIVERS STATE

Cropping System	A	B	C	D	E	F	G	H	I
1.Yam/telferia pepper/okra bitterball/egusi cassava			x	x	x	x			
2.Maize/okra Egusi/pepper/ Yam/ cassava/ Groundnut		-							x
3.Yam/maize aerial yam/ okra/pepper cassava	x	x	x			x	x	x	
4. Cassava Maize Egusi/okra	x	x			x	x	x		
5. Cocoyam/ trifoliate yam cassava	x		x					x	x
6.Yam/telferia pepper/garden egg/maize/ sugar cane okra/ egusi aerial yam cassava				x	x	x			

Legend

A = Port Harcourt
B = Okrika
C = Tai - Eleme
D = Bori
E = Gokana
F = Nyokhana
G = Isiokpo
H = Okehi
I = Emohua

Source: On Farm Adaptive Research Survey, NRCRI, Umudike; RSUST, Port Harcourt; and FACU, Ibadan 1986.

Table 3.2

MAJOR FOOD CROPS GROWN AND THEIR PRIORITY RATING BY FARMERS

IN THE EASTERN ZONE OF RIVERS STATE

Crop	A	B	C	D	E	F	G	H	I	ZR	PR
Yam	2	2	1	1	1	1	1	1	1	1	1
Cassava	1	1	2	2	2	2	2	2	2	2	2
Cocoyam	7	3	5	3	4	6	4	-	3	5	6
Sweet Potato	-	-	-	-	-	-	-	-	-	-	-
Maize	3	5	4	4	3	5	5	5	5	3	3
Rice	-	-	-	-	-	-	-	-	-		
Beans	-	-	-	-	-	-	-	-	-		
Plantain	5	6	3	5	5	4	3	4	4	4	5
Banana	6	6	3	5	5	4	3	4	4	4	4
Vegetables	4	4	6	6	6	7	6	6	6	6	7

Legend

A = Port Harcourt
B = Okrika
C = Tai - Eleme
D = Bori
E = Gokana
F = Nyokhana
G = Isiokpo
H = Okehi
I = Emohua
PR = Preference Ranking
ZR= Zone Rating

Source: On Farm Adaptive Research Survey, NRCRI, Umudike; RSUST, Port Harcourt; and FACU, Ibadan 1986.

3.3.2 Constraints in the Farming Systems

The production constraints are those conditions militating against increased production and whose total elimination would likely lead to increase agricultural productivity.

Family land is shared out to members in accordance with laid-down traditons. When a member acquired his portion, he has no right to dispose of it to a non-family member without the consent of the family head. However, a family member, who perhaps due to off-farm activities like trading or civil service finds it impossible to farm in any farming season, may rent his own portion of land on short-term basis usually. The family may as a group decide to rent or lease or mortgage some portions of land to realise fund for solving common family problems of paying off family inherited debts (e.g. lawyer briefs). Except in Port Harcourt blocks family land are rarely sold for fear of incuring discord from the younger members of the family at their adult ages.

There is still an abundance of thick forests in most parts of the study area except Port Harcourt and Okrika blocks from where yam stakes and other timber products are being derived. Trunks of trees cut from the forests are used in building boats and huts especially in the riverine areas. Some of the forests are sacred and some are cursed forests where dead bodies of ill-cursed people are thrown or buried. Mangrove swamps which serve as waste lands are found mainly in areas close to the sea or big rivers such as in Okrika, Gokhana and Nyokhana blocks. In these regions, the mangroves constitute about 90% of the total land area, and in Okrika blocks, most of the present land for housing is reclaimed from the marshy land of the mangroves. Water-logging of soils in these areas is a common feature. Another form of waste land found particularly in Gokhana is the land where wastes from shell operations are dumped . This constitutes a major constraint limiting farming in this block. The production constraints facing the farmers in the research area are similar to those encountered by other farmers in Nigeria. However, the priorities in the ranking of the major constraints as perceived by the farmers do vary. The major constraints in the area under survey were ranked from 1 to 17 with the lower numbers indicating higher priority. The ratings in Table 3.3 represent weighted rankings.

Land

Land availability for farming in the area is determined largely by the land tenure system. Farmlands are privately owned (purchased or inherited) by an individual, community or kindred group and the length of period of ownership depends on whether the farmland is leased, rented, purchased or inherited. Lease or rented tenancy are for short or long periods of time, while inherited and purchased land are for a lifetime. Farmlands for long-term tenancy may be for five to twenty hectare sizes and usually devoted to the production of cash crops such as rubber, cocoa, oil palm or for livestock rearing. These are found in Port Harcourt and parts of Gokhana and Bori blocks. Blocks such as Okrika, Isiokpo, Emohua and Okehi with large farming population practices short-term tenancy of 1 to 3 years after which the parcels of land revert to their original owners. In most of the blocks where land ownership is mainly by inheritance, a farmer, who has more land than he can farm may rent some parcels out to less endowed farmers.

3.3.3 Farming Calendar

Farming activities occupy at least 9 months of the year in most farming communities of the survey area. In areas such as Gokana, where farming is the major occupation and off-farm activities are relatively scarce, bush clearing and seed-bed preparation commence in September and planting is done almost immediately such that by March/April of the following year the first harvests are ready. Here, maize is usually the first crop harvested, followed by melon, okro and vegetable. Farmers often use this maize as food for hired labour for the late maturing crops like yam and cassava. Where the maize harvest is large, a part of it is sold for cash, used as labour wage and other necessities.

In other areas, usually from November all through to March is predominantly dry period and land clearing and bush burning take place between November and April of the succeeding year. In most of the blocks, seed planting is withheld until the

Table 3.3

Farm Production Constraints in the Area

S/No	Constraint	Mean Rank
1.	Scarcity and high cost of seed yams	2.1
2.	Scarcity and high cost of staking materials	6.5
3.	Insect pest and disease control	8.9
4.	High cost and low quality poultry feed	9.4
5.	Scarcity of other improved planting materials	10.0
6.	Weed (particularly carpet grass control)	10.3
7.	Inadequate storage facilities	10.3
8.	Declining soil fertility	11.3
9.	High cost of labour	12.8
10.	Soil and air pollution from gas flaring at drilling sites	14.5
11.	Scarcity of agrochemicals and high cost of fertilizer	17.0

Source: On Farm Adaptive Research Diagnostic Survey : NRCRI ,Umudike; RSUST, Port Harcourt and FACU, Ibadan 1986 first rains, and farmers are afraid of having their sown seed baked in the soil. After planting farmers visit their farms to check germination and survival of the crops and where necessary. Revisits and turn round times vary from crop to crop and from one block to another. Yams planted early in the season take longer before they are checked and the turn round period is on the average after 21 days in Gokana, Bori and Nyo-Khana blocks. In other blocks where late planting occurs, and checked for germination after a period of 7 to 14 days. Cassava which can be planted at any time of the year, and which takes longer to establish requires 14 to 21 days turn-round. In Port Harcourt, Tai/Eleme blocks, where cassava establishment is relatively more difficult, the revisiting time takes place after 28 days. (See Appendix 3.1)

Harvesting of yam is done at different times depending on the use of the harvest. Seed-yam usually stay longer in the field than others. They are left to harden in the soil and build up hard skins which can resist pest attack during storage. For ware yams, harvesting is usually done in two phases: in the first phase, known as "milking of yam", the tubers head are severed from the main tubers and the latter are removed for immediate consumption or for sale while the remaining portion is left to regenerate new mega tubers for next season planting. Such harvesting is done in July and August when the rains are still heavy and sprouting of tuber heads can be effective. The main harvesting of all yam takes places between December and January. Cassava on the other hand can be harvested at any time of the year and usually after 12 months from the planting time. Cocoyam is harvested between November and January, while maize can be harvested green in May, June and July or as dried cob in September. Second season maize is rare.

3.3.4 Labour Regime

The labour involved in farm activities comes from adult men and women of the extended family and hired labour mostly from within the communities and from neighbouring towns and villages. Okrika block is an exception because the source of labour is mainly hired labour from other towns. Sources of labour within the communities include extended families, tenants, co-operative community groupings and from labour exchange among farming families. Hired labour is predominant during land clearing and making heaps . Land clearing is usually the prerogative of men, while holing, planting and construction of mounds are performed mainly by women. Children are involved in planting, weeding, harvesting and headload transporting of harvested farm produce.

Everybody can however, participate in weeding and in the general maintenance of the farms. The average number of hours reported worked per day is 4 for children, and 8 for men and women. For the analysis of this report, man-days were used because of the difficulty in tracking the number of hours worked by each farmer. Moreover where hired labour was used, wage rate was paid per man-day. Except harvesting and transportation of farm produce which are usually carried out with family labour, all other farm activities from land clearing to weeding could be hired out and paid for, per man-day.

3.3.5 Capital Mobilisation and Utilization

The main sources of cash for farm operations in the survey area are from sales of previous years produce, loans from friends/relations. 'Isusu" contributions and social clubs: loans from government and cooperative banks are less significant. Funds so attracted are used principally for the purchase of farm inputs, labour wages and school fees. Interest rates range from zero (0.0%) for 'Isusu' loans using to 50% from private money lenders.

3.3.6 Soil fertility Management

Soil fertility management differs from block to block. The most important method of maintaining soil fertility is bush fallowing. The traditional bush fallow system that operates here involves the clearing and cultivation of land for one year or more and then leaving it to fallow for a varying number of years. Increasing population in several farming communities has led to a reduction of the fallow period, drastically to, near the point of continuous cutivation. The effect of both the industrial wage and population pressure is more pronounced in Port Harcourt and Bori Blocks.

Another method of soil fertility management is the application of organic manure in the form of household refuse. This is common for all compound farms. Compund farming system involves the continuous cropping of parcels of land surrounding the homestead.

A third type of soil fertility management is the use of "inverted mounds" instead of the "above-ground mounds" in yam production. With inverted mounds, holes are made to a depth of 0.75 metre and 0.50 metre wide. Yam is then planted at the bottom of the pit. The farmers reported that this practice reduced soil erosion, enabling the retention of organic component of the top soil and increased fertility. Others also reported that "inverted mounds" was culturally passed on from generation to generation.

3.4 Research and Development Situation in the Area

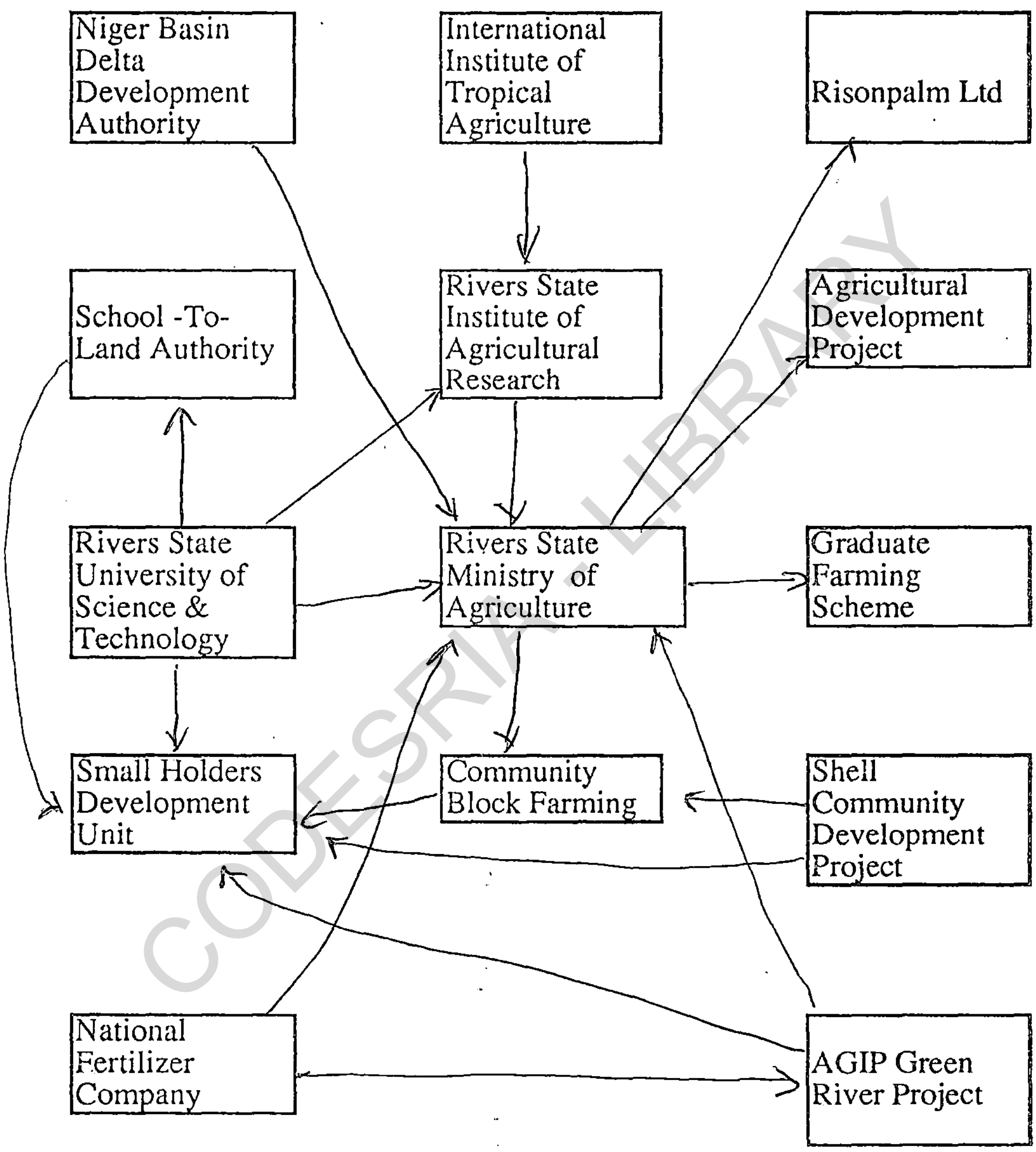
3.4.1 The Public and Private Sector Actitivites

Research and development in the area attracts the attention of both the public and private sector. The public sector component embraces the Ministries of Agriculture both at the Federal and State levels, the Agricultural Institutes and Universities, the Agricultural Development Project and state government agricultural parastatals. The private sector component on the other hand, is made up of the Shell Company Development Project, AGIP Green River Project, and Agricultural Projects of the ELF and Ashland Oil Companies. The private sector projects are targeted in areas of operation of the companies. The farmers in the area, of course, participate both directly and indirectly in the research and development exercise in their little ways.

Both the public and private sector agencies have stated research and development objectives for the state, Ojanuaga et al (1986). The general objectives are to ensure increased and stable farm productivity and income to small-scale farmers and to contribute to the overall improvement of living standards of the rural farmers in the state. Specifically, the objectives involve the evaluation of the productivities and compatibilities of the existing mixed-cropping, and the livestock

Fig. 3

Schematic Representation of the Research and Development Situation in the Survey Area



and fisheries management patterns in the Sate. It also include the development of more efficient technically feasible patterns and management practices that are acceptable to the rural farmers.

Objectives of research and developments the area are to be accomplished with the support of the farmers and research institutes serving the area (see figure 3.1). The research institutions are supplemented by several development programmes initiated by both the public and the private sectors. The major government programmes are:

(a) The School-To-Land Programme, aimed at mobilizing young school leavers for agricultural production;

(b) Community Block Farming Scheme aimed at assisting the peasant farmer to increase his farm holdings;

(c) The Graduate Farming Scheme, aims at converting University degree holders into practicing farmers and thus partially solving the problem of graduate unemployment;

(d) Niger Delta Basin Development Authority, established primarily to develop water resources of the Delta basin; and

(e) Risonpalm Limited, a company charged with the responsibility for oil palm development in the state.

The current private sector progammes are:

(i) The Shell Community Development Project;

(ii) The AGIP Green River Project; and

(iii) The National Fertilizer Company at Onne.

These projects are located mainly in the areas of operation of the companies. They are involved mainly in extension and to a leser extent credit and processing activities.

The extension programme in the state is carried out through the Agricultural Development Project. The universities are also involed in extension but poor funding for both research and extension limits their contribution.

3.4.2 The Agricultural Development Project (ADP)

The primary objectives of the state ADP are to increase food crop, livestock and fisheries production; and to raise the income of small-holder farmers and small-scale fishermen in Rivers State. Additionally, increased provision of better infrastructure in the farm of access roads and village water supplies will benefit all rural dwellers. The project has six development and four supporting components. The development components are:

- Crop Development (Extension, Adaptive Research and Seed Multiplication)
- On-farm/small scale agro-processing
- Livestock Development
- Fisheries Development
- Rural Infrastructure (Village water supplies and rural roads, and
- Commercial services (input supply and distribution, Agricultural Marketing and Credit). The supporting components include administration, finance, planning and manpower development.

The activities of the ADP are hampered by lack of and low rate of release of funds by both the State and Federal Government as well as the World Bank. The calibre of manpower engaged in their operations is still low as most of the workers were transfered from the Ministry of Agriculture to save costs. As a result while it is expected that the organisation would be more efficient, the ministry-mentality still prevails.

CHAPTER 4

SOCIO-ECONOMIC ANALYSIS OF THE RESPONDENTS

4.1 Family Size, Sex and Age Distribution

Table 4.1 shows the distribution of the sampled farmers by age, average family size and sex. The average ages were 43 and 46 years for the Farming Systems I and II respectively, while the overall average age for the zone was 45 years. The lowest age was 30 years while he highest was 66 years.

Table 4.1: Distribution of Farmers by Age, Family Size, and Sex

Zone	Respondents No.	%	Average Age(Years)	Average Family Size	Sex(%) M	F
Farming System I	110	43	43 [30-66]	12 [3-24]	59	41
Farming System II	135	45.1	46 30-66]	11[4-18]]	54	46
Farming System I &II Combined	245	100	45 [30-66]	12[3-24]	57	43

Source: Field survey, 1990

This age distribution indicates that we have farmers who are very poor and are fairly elderly majority of whom exhibit low productivity, high risk aversion, low initiative; and tend to be conservative, cynical and probably disgruntled if not frustrated. These facts are reinforced when we observe that 52% , over half, of the farmers cultivate less than one hectare compared with the low hectarage cultivated per farmer (see Table 4.2).

The average family size was about the same for the two systems: 12 and 11 persons respectively for Farming Systems I and II, while the average for all farmers was 12. This is relatively large when compared with the national average of 7. The distribution of the sexes was 59% male and 41% female for Farming System I, and 54% and 46% respectively for Farming System II. On the average, the area data indicate more males (57%) than females (43%), and no significant difference between the farming systems.

4.2 Farm Size and Tenure

Farmers in this area usually have several parcels of farmland located at different distances away from the homesteads. The farmlands close to the homesteads are for the production of food crops for family consumption as and when needed. Those further away are left to the final stage of maturity and dryness and are harvested to be sold or preserved as seeds for the next season's planting, and sometimes as gifts to friends and relations.

Table 4.2 Distribution of Farmers By Size of Farm

FARM SIZE (HA.)	NUMBER OF FARMERS	PERCENTAGE*
0.1 - 1.0	127	52
1.1 - 2.0	87	35
2.1 & >	31	13
Total	245	100

*Rounded to the nearest whole number

Source: Field Survey 1990.

Table 4.2 reflects that 87% of the surveyed farmers cultivate not more than 2.0 hectares, and only 13% cultivate over 2 hectares. The traditional standard of a farm unit is approximately 0.1 hectare and farmlands are rented, leased or hired out in multiples of this unit. Regenerated yam stakes and pacing are generally used to demarcate this unit area of land. Therefore, a farmer who cultivates 20 units of land lots actually cultivates effectively 2.0 hectares. This is also the most common rental unit except in areas close to Port Harcourt where plots are rented or sold in bigger units of 0.5 and 1.0 acre.

Farms are small or fragmented as a result of a number of factors including (a) inheritance which tries to ensure fairness by allocating a bit of good and bad soil to each member of the household; (b) technology; (c) population pressure; and (d) industrial utilisation (oil extraction) which is also chiefly responsible for ecological deterioration of soils resulting in poor yields.

The compounding effect of all these problems is manifested in the drastic reduction in the fallow period to the point of continuous cultivation. The current setting is risky with fragmented farmland, fractionalised farm holdings, increased population pressures and reduced or nearly non-existent fallow period. This scenario is bound to give rise to continuous periods of depressed crop yields, reduced output, consistent food shortages and a decline in the nutritional and economic situation of farmers and rural population in the area. In addition, the small size of the average farm of 1.1 hectares which seems sub-optimal for livelihood, supports the rationality of farmers' behaviour in restricting their farm size to resources which they can finance (Atobatele 1986). Consequently, the existence of off-farm activities is implicit.

The rental rate of farmland ranges from N130 per hectare to N600 per hectare in Port Harcourt Local Government Area and an overall average of N272.5 per hectare. This is not surprising as the price of land is expected to increase with unplanned accelerated urbanization. The land price escalation is exacerbated by the siting of many heavy industries in the survey area with the consequent pressure on farm land. Currently, expansion of farm land is constrained, if not irrevocably stagnated.

Table 4.3 reflects the various modes of increasing land holding for all farming activities irrespective of the farming system. Short term tenancy is the commonest whereby the land reverts to the original owner after every farming season. The most important source of land is the family land. This accounted for 80% of the land transfer. The next in importance is outright purchase which accounted for 27% while leasing accounted for 24%. Community land also accounted for 24% of land holdings while pledges accounted for 19%. In some areas (Tai-Eleme), individuals can acquire new parcels of land by clearing a primary forest nearby after obtaining permission from the local Council of Chiefs.

Table 4.3: Methods of Land Acquisition

METHOD OF ACQUISITION	NO. OF FARMERS RESPONDING YES	PERCENTAGE*
Family	196	80
Purchase	66	27
Lease	58	24
Pledge	58	24
Community	47	19

*Do not sum up to 100 because some respondents mentioned more than one method

Source: Field Survey, 1990.

Implication of the distribution of the modes of acquisition/disposal are that expansion of farmland will be difficult except through the family or by emigration. Farm size will continue to be smaller therefore increases in output will be by increasing yield namely by increased use of improved input and more efficient and economic management both of which will involve effort and the political will to fund research and development in a consistent manner.

4.3 Farm Inputs Used

4.3.1 Labour Supply

The labour used was made up mainly of male and female family and hired labour. Except for Okrika area where the source of labour is hired mainly from other towns because most the farmers are at off-farm work in Port Harcourt, in other parts of the survey area , the principal source of labour are the extended families, hired labour from neighbouring towns and states , tenants, community cooperative groupings and through labour exchange among the farming families. An average of 222.5 and 208.6 man -days/hectare per season were reported for Farming System I and Farming System II respectively while the overall combined average was 214 man-days per hectare. The average wage rate was N12 per day overall and N12 and N11.6 per day for Farming Systems I and II respectively. The difference though not significant reflects the proximity of most of the blocks in Farming System I to the cosmopolitan city of Port Harcourt.

Policies aimed at improving the systems must take cognisance of the role of women. Women participate in most farming operations and sometimes own their farms. Therefore, innovation to develop agriculture in the area must take cognisance of their support and participation. Labour is in short supply in the area. Availability (65%), cost (30%) and seasonality of labour (5%) were the major constraints encountered by the farmers. It is obvious that most of the available labour have been snapped up by oil-prospecting companies and the construction industry where remunerations are very high compared to what the small farmers are willing to pay.

4.3.2 Fertilizer and Agrochemicals

Fertilizer use in the area is very much limited. Less than 10% of the farmers applied fertilizer. The type of fertilizer used was the Nitrogen, Phosphorus and Potassium (N.P.K) compound and was sold at N20 per bag by the Agricultural Development Project (ADP). The partial removal of subsidy has led to a 100% increase in price to N40 per 50kg bag (1989/90).

Fertilizer is also in short supply in the area. Of the three most important problems associated with fertilizer use, availability (80%), ranked the highest, next was cost (15%) and other factors such as suspected altering of the yam taste was ranked lowest at 5%. Even when the fertilizer was available in central stores, transportation to the farmer's farms proved to be a formidable barrier to use. This is because of the poor road infrastructure, and the lack of transportation to the farms as well as lack of motorable roads to the farmers' farms. The use of motor cycle for fertilizer transportation proved to be uneconomic due to the distances of rough roads to be covered coupled with the small size of operation 1-2.0 hectares) under mixed crop production systems which further limits quantity used.

The farmers also reported they do not want fertilizer on their yams because of perceived or real effects on the taste and storage of yams. Yams produced with fertilizer tend to have a high water content and this, it is believed, reduces the rate of drying and therefore promotes decay and susceptibility to pest attack.

Agrochemical use is even less than that of fertilizer because 71% of the respondents did not use any agrochemical. Availability (64% of respondents) and cost (30% of respondents) ranked highest in the problems encountered in its use.

4.3.3 Seeds/Planting Material

Farmers in the area use seeds and other planting materials mainly from the previous harvests even though they were aware of the existence of improved seeds and planting material. As in the case of fertilizer, availability (92%) remains the major problem facing the farmers in the use of improved seeds and planting materials. However, improved cassava cuttings are making significant in-roads. Farmers (30%) reported using improved cuttings but their yields cannot be optimum without the use fertilizer and agrochemical application both of which remain scarce and expensive in the area.

4.3.4 Credit

Only 5% of the surveyed farmers report using formal credit. They got some loan from their cooperative societies (10%), while government loans (through the ADP) accounted for about 1% of the surveyed farmers. The figure would be higher than 5% if loans from farmers' relations were included as some of them do not consider money from their children or other relations as credit. Their major source of cash income was from the sale of their farm harvests. School fees dominated the use for which credit was acquired and interest rate ranged from 10% to 50%, depending on the source. Lack of credit for the small farmers strongly militates against increased agricultural investment in the area.

CHAPTER FIVE

ECONOMETRIC ANALYSIS AND DEDUCTIONS

5.1 Results of The Translog Cost Function

The translog cost functions for Farming Systems I, II and the combination of I and II were estimated with respect to land, labour, fertilizer, agrochemical and planting materials. Farm tools equation was dropped due to the homogeneity constraint. Appendices 5.1 through 5.3 give the results of these estimates.

For Farming System I, the F-ratios were all significant for the four equations while R^2 ranged from .70 to .84. Ten variables were statistically significant while each of the four factors was used as the dependent variable. With land as the dependent variable, land, planting materials and output were significant. With labour share as the dependent variable, the coefficients of labour, planting materials, fertilizer, agrochemicals and output were significant. The coefficient of output was negative. No coefficient was significant when fertilizer share was the dependent variable used. Planting materials and output were significant when planting materials was used as the dependent variable.

In the translog cost function estimation in Farming System II, all the F-ratios were significant for the four equations while R^2 values ranged from .55 to .75. The coefficients of twelve variables were significant. With share of land as the dependent variable, the coefficients of land, labour, farm tools, and output were all significant with labour having a negative sign. Similarly, with share of labour as the dependent variable, the coefficients of labour, fertilizer, agrochemicals, planting materials and output were all significant. With fertilizer as the dependent variable, the coefficients of fertilizer, agrochemicals and output were all significant while the coefficient of planting materials was significant when planting materials was used as the dependent variable.

For the combined systems I and II, all the F-ratios were significant while the R^2 values ranged from .52 to .75. Nine variables were statistically significant. With the cost share of land as the dependent variable, the coefficients of land and farm tools were all significant , while with the labour share equation, the coefficients of labour, fertilizer, agrochemicals and output were all significant. With the fertilizer share equation, the coefficients of fertilizer, agrochemicals and output were all significant , while with the planting materials share equation, the coefficients of farm tools and output were significant . The importance of these estimates can well be realised when they translate into the economic parameters namely the demand elasticities and the elasticities of substitution characterising the systems.

5.2 Factor Demand and Cross Demand Elasticities

a. Farming System I:

The estimates of factor demand and cross demand elasticities in Farming System I are given in Appendix 5.5. All the estimates have the right signs but low (i.e.<1). This may be the result of the low level and inefficient use of input in the system which is occasioned by high cost , unavailability,and the small size of farms.

The cost-shares of fertilizer and planting materials are 0.4 and 0.14 respectively for Farming System I . The demand for labour and farm tools are negative and relatively high at -0.73and -0.67. As earlier explained, there is high competition for labour with heavy industries and oil industries bidding very high for labour. Farm tools seem to be scare and expensive especially since the introduction of the Structural Adjustment Programme (SAP). Increases of over 100% are reported for knives, hoes, cutlasses, bags and baskets.

It is noteworthy that there is a high cross-demand elasticity between fertilizer and labour primarily because fertilizer application leads to higher labour demand. This strong correlation suggests that the efficiency of the system can be greatly improved only by the simulataneous increased intensity in the use of both factors. This calls for public policy intervention to increase the availability of and use of fertilizer and to improve the productivity of labour with labour enhancing facilities, equipment and machines.

b. Farming System II:

The estimates of factor demand and cross demand elasticities are given in Appendix 5.6. With Farming System II, the elasticities have the correct signs. with labour and planting material elastic (i.e. >1). Migrant labour availability is high especially from the neighbouring States. Availability of planting materials is higher than in Farming System I because of the nearness of the extension activities of Shell Development Division and Rivers State Institute of Agricultural Research, and the IITA Station at Onne. All these agencies are also involved in the distribution of planting materials in the area.

The demand for fertilizer is still low (-0.15) apparently because of the small size farms farmers' low purchasing power and unavailability due to a poor infrastructure and inadequate distribution network. However the demand for fertilizer is considerably higher than in Farming System I (-0.4). Farm tools still exhibit a relative high demand emphasising the need to develop labour augmenting technology that increase the marginal productivity of labour, and minimise the drudgery of manual labour.

c. Farming Systems I and II:

The estimates of the factor demand and cross demand elasticities for the combined systems I and II are in Appendix 5.7. The highest demand elasticity is exhibited by planting materials (-0.85). and farm tools (0.90). Therefore to accelerate agricultural production in the survey area, attention must be paid to the procurement and use of planting materials and tools. The farmers have also been sensitised to the use of modern planting materials but availability remains a bottleneck. The need to facilitate production with farm tools that reduce the drudgery of farming is also emphasised.

Fertilizer (demand elasticity [-0.15]) plays a relatively minor role in these two farming systems. This is due partly to poverty, scarcity, high price and a combination of other factors. Since the price of fertilizer is high for the poor farmers, and fertilizer is further scheduled for price increases as the subsidies are removed, one would conclude that an alternative farming technology that minimizes the use of chemical fertilizer be introduced in this area. For example, alley-farming technology that minimizes fertilizer use could be introduced. Simultaneously, planting materials that are resistant to pest and diseases should also be encouraged.

These conclusions are pertinent if the environment is not to be further degraded as it is already in a poor state due to the effluents and pollutants from the oil and heavy industries that abound in this area.

(d) Responses Determinate (Systems I and II):

Table 5.1 shows the comparative elasticity and cross elasticity coefficients for both Farming Systems I and II. For labour both Farming System I and Farming System II have similar results except that Farming System II is more labour responsive (-0.43) than Farming System I (-0.73) . Both of course use labour beyond diminishing returns owing to small plots and high cost of fertilizer. Labour response is quite effective in System I with useful responses to changes in the price of labour, land, fertilizer and tools. Labour in this area is very scarce indeed having to compete severely with the industrial sector (petroleum, fertilizer, liquefied natural gas, etc.)

The response of both farming systems to land is low principally due to marginal (fractionalised) size of farms (average 1.10 ha.) divided into several fragments.

Planting materials show relatively impressive response in Farming System II especially in relation to land, but no response to fertilizer. Many farmers argue that fertilizer is inimical to good storage of yams. Fertilizer, they further argue, leads to high water content (not substantiated) which results in poor fufu and pounded yam and also makes yams become readily susceptible to attacks from pests and diseases. Farm tools also show good response (-0.67, - 0.72 and -0.90). The drudgery of farming is vindicated in the high response in Farming Systems I and II. With respect to land, the response is 0.45, 1.01 and 0.70 respectively for Farming Systems I and II and the combined systems. The response of farm tools with respect to labour

Table 5.1: Factor Demand and Cross Demand Elasticities for Inputs

Factor	Farming System I	Farming System II	Farmings Systems I+II consolidated
Land /change in price of :			
Land	-0.37	-0.32	-0.34
Labour	0.27	0.16	0.26
Fert/Agrochem	0.04	0.05	0.30
Planting Material	0.05	0.13	0.12
Farm tools	0.09	0.09	0.14
Labour /change in price of :			
Labour	0.73	-1.43	-0.40
Land	0.45	0.36	0.43
Fert/Agrochem	0.84	0.26	-0.12
Planting Material	-0.04	0.10	0.20
Farm tools	0.46	0.05	0.17
Fertilizer /change in price of :			
Fertilizer	-0.04	-0.15	-0.15
Land	0.04	0.55	0.54
Labour	0.27	0.81	0.70
Planting Material	-0.14	0.10	0.15
Farm tools	0.09	0.05	0.10
Planting Material /change in price of :			
Planting Material	-0.21	-1.03	-0.85
Land	0.14	0.72	1.36
Labour	-0.46	0.25	0.10
Fert/Agrochem	0.04	0.05	0.05
Farm tools	-0.27	0.24	0.10
Farm tools/change in price of :			
Farm tools	-0.67	-0.72	-0.90
Land	0.45	0.01	1.70
Labour	0.67	0.25	0.10
Fert/Agrochem	0.04	0.05	0.05
Planting Material	-0.41	-0.48	0.15

<u>Source</u>: Calculated from Appendices 5.5 to 5.7

is also relatively high in Farming System II (0.67), while it is also responsive to planting materials at -0.48.

5.3 Elasticities of Substitution

(a) Farming System I:

Elasticities of substitution and cross-elasticities of demand are expected to be positive for factor substitutes and negative for complements. The elasticity of substitution for each and same factor has little economic significance except for verification that it obeys the constraint that factor shares weighted by the coefficients sum up to zero ($\Sigma M_j b_{ij}=0$). The estimates for Farming Systems I are given in Table 5.2. Labour and fertilizer, labour and planting materials, and planting materials and farm tools are complements. The labour-fertilizer complementarity has the highest estimate and this is important for policy making. The results show that if we want labour to be more productive in this system, we may need to put in more fertilizer. This reinforces the earlier fertilizer/labour relationship found in the demand elasticity estimates.

The other result that is noteworthy is the substitution possibilities between labour and farm tools and equipment. This conforms with the theoretical expectation where labour can be facilitated and made more productive with some tools and equipment. The policy implications for this result is that we should be pushing for farm tools and equipment to relieve the drudgery of farming especially among the resource-poor farmers. However, with the current poor economic climate, farmers may find it difficult to purchase these tools and equipment due to high cost. A solution would be for the government to encourage existing input agencies to intensify the production of farm tools and equipment that meet the farmers needs on the basis of usage and economics. Removal of restrictions on the importation of farm tools and equipment including import duties is also advocated. The private sector and cooperatives should be encouraged to administer tractor hiring services since government agencies manage these services poorly.

Table 5.2: Estimate of elasticities of substitution using the translog function (Farming System I)

	Land	Labour	Fertilizer/ Agrochem	Planting material	Farm Tools	Others*
Land	1.41	1.00	1.00	0.38	1.00	-1.07
Labour		1.00	-3.63	-1.20	3.14	-0.69
Fertilizer/Agrochem			26.00	1.00	1.00	-0.74
Planting material				8.65	-2.97	-0.83
Farm tools					3.72	-1.26

Source: Survey data. 1990.

Table 5.3: Estimate of elasticities of substitution using the translog function (Farming System II)

	Land	Labour	Fertilizer/ Agrochem	Planting material	Farm Tools	Others*
Land	1.24	0.66	1.00	1.31	1.84	-1.12
Labour		1.72	-3.24	1.00	1.00	0.78
Fertilizer/Agrochem			17.00	1.00	1.00	-0.74
Planting material				-12.00	-4.80	0.42
Farm tools					6.20	-1.14

Source: Survey data 1990.

Table 5.4: Estimate of elasticities of substitution using the translog function (Farming System I+II)

	Land	Labour	Fertilizer/ Agrochem	Planting material	Farm Tools	Others*
Land	1.08	0.83	1.10	1.23	1.50	1.18
Labour		2.00	-2.30	0.33	0.33	-0.98
Fertilizer/Agrochem			16.00	1.00	1.00	-0.91
Planting material				1.00	1.00	-1.014
Farm tools					1.00	1.149

Source: Survey data 1990.

(b) Farming System II:

The estimates of elasticities of substitution in this system are given in Table 5.3. In this system as in System I the labour/fertilizer elasticities (-3.24) and the planting materials/farm tools elasticities (-4.8) are complements, but labour and farm tools are not complements. The result reinforces the conclusions made for Farming System 1. The substitution possibilities are generally low.

(c) Farming Systems I and II:

The estimates of the translog function for the overall area are given on Table 5.4. Ignoring own elasticity of substitution, we find that the highest value is -2.3 for labour and fertilizer. It is also negative which implies complementarity. Unfortunately both fertilizer are expensive, therefore, we should probably encourage systems that minimise the use of chemical fertilizer but emphasize the use of organic fertilizer and mulching. Alley-farming which uses both organic and inorganic fertilizer in production is a feasible alternative.

Estimates of the Cobb-Douglas Function

Estimation of the Cobb-Douglas function was undertaken for the two farming systems and the consolidated data. The results of the estimation are given on Table 5.5. Of the fifteen parameter estimates, eleven were significant. This looks good but note that when the Cobb-Douglas restriction $\Sigma b_{ij} = 0$ was tested, only Farming System I was significant and only at 5%. The conclusion to be drawn is that the Cobb-Douglas is not the most suitable function to use for this type of analysis. In general, the economic parameters such as factor demand, cross demand and elasticities of substitution do not contradict the outcome using the translog function.

Appendix 5.5: Factor demand and cross demand elasticities implied in the estimated coefficients and their value in the Cobb-Douglas case (Farming System I)

	PRICE CHANGE OF				
	Land	Labour	Fertilizer	Planting material	Tools
Land	-0.37	0.27	0.04	0.05	0.09
Labour	0.45	-0.73	0.84	-0.04	0.46
Fertilizer	0.04	0.27	-0.04	0.14	0.09
Planting material	0.14	-0.46	0.04	-0.21	-0.27
Tools/Implements	0.45	0.67	0.04	-0.41	-0.67
Cobb-Douglas values for comparison					
Land	-0.55	0.27	0.04	0.14	0.09
Labour	0.45	-0.73	0.04	0.14	0.09
Fertilizer	0.45	0.27	-0.96	0.14	0.09
Planting material	0.45	0.27	0.04	-0.86	0.09
Tools/Implements	0.45	0.27	0.04	0.14	-0.91

Source: Survey data. 1990

Table 5.5

CHAPTER SIX

EFFICIENCY OF THE FARMING SYSTEMS

6.1 Output of the Farming Systems

In the absence of an efficiency index, the output variable was used as a proxy to measure the relative efficiency of the farming systems. In addition, the ratio of value of output per hectare to the cost of input per hectare was also used to determine the level of efficiency in the systems.

All the parameters of the output index were statistically significant except the planting material equation in Farming Systems II. Moreover, the parameters of output were virtually equal in all the share equations in both farming systems I and II. The result is a little surprising especially since the Shell Agricultural Extension workers have been more active in areas under system II compared with system I. It means that the rate of adoption of modern farming practices has been slow in farming systems II or it has spread to II and or not effective in both areas.

Of particular interest in the result is the fact that the output parameter in the labour equation in all the groups is negative and therefore these groups are labour - saving, (Binswinger, 1974). This indicates a labour - bottleneck in the survey area and the theory of surplus labour in a developing economy is not acceptable.

As a further measure of efficiency between the two systems studied the ratio of value of output per hectare to the cost of input per hectare was calculated. The results are shown in Table 6.2. Apart from the ratio with respect to planting material (19.0 against 11.59) where Farming Systems I clearly predominates Farming Systems II, there is no significant difference between Farming Systems I and II. This reinforces the conclusion derived from the translog analysis of efficiency. Return to fertilizer seem to be higher because of the low level of fertilizer used in the survey area.

The point is being reinforced that the extra cost of special yam setts needed for the "inverted mounds" (in Farming Systems II) is not justified by the insignificant extra yield. The study is only for one season and abstract deviations of this nature can only be tenable with caution. The long-run advantages might still be with Farming Systems II.

6.1.1 Average Farm Size Differences:

There is no significant difference (20%) in farm size between Farming Systems I (1.325 ha) and Farming Systems II (1.185 ha) (see Table 6.1). The small size of farm is caused by a combination of relatively high population and the presence of large-scale economic activities of the petroleum and fertilizer industries . The average population density for the study area is 584 compared to the state average of 169. Furthermore, the tenure system which ensures that every family member gets a piece of plot on every family land reduces the size of land per farmer.

6.1.2 Evaluation of Output (same price):

The average yield of yam is 8.975 tonnes per hectare in Farming Systems I when compared to 7.96 tonnes per hectare in Farming Systems II. However, the difference in total output is 5.3% in favour of system II but at a higher cost which may indicate that "Inverted Mounds" imposed higher cost on the system. Caution is needed in the interpretation of the results because there is the problem of pricing based on same average price for the area.

6.1.3 Cost Items:

The total cost difference is 17.6% higher in farming systems II due largely to cost of planting material (72.7%) higher for Farming Systems II. Scarcity of yam setts was reported as a major constraint in the farm output. Farmers in system II reported that the major market for yam seeds is at Elele which is located in the Farming Systems I area. The ADP is intensifying the yam minisett techniques that should help in the solution of the scarcity of yam seedling though the adoption rate seems to be slow.

Cost of tools also constitute a constraint to the farming systems in the study area (see Tables 6.1&6.2). Comparatively the cost of tools are higher in Farming Systems II (24.3%) than in Farming Systems I. Almost all the tools are purchased from the cosmopolitan city of Port Harcourt. The ADP and other development

Table 6.1: Profitability of the Farming Systems

Item/hectare	Farming System I	Farming System II	Farmings Systems I+II consolidated
Average Size	1.325	1.185	1.247
	₦	₦	₦
Value of output	2771.74	2916.33	2847.41
Cost of land	210.43	225.97	218.56
Cost of labour	310.42	324.97	318.04
Cost of fertilizer/agrochem	117.96	111.76	114.72
Cost of planting/ material	145.77	251.69	201.22
Cost of tools	127.82	158.85	144.06
Total cost	912.40	1073.24	996.60
Gross margin	1859.34	1843.09	1850.81
Gross margin/Cost	2.00	1.72	1.86
Gross margin per farmer	2462.78	2184.40	2309.36
Difference (I - II) %	11.30	-	-
No. of farmers	110	135	245

Source: Survey data 1990.

Table 6.2: Ratio of Value of Output/Ha. to Input/Ha.

Land	Farming System I	Farming System II
Land	13.17	12.90
Labour	8.93	8.97
Fertilizer/Agrochemicals	23.49	26.09
Planting material	19.01	11.59
Farm Tools	21.68	18.36

Source: Calculated from Table 6.1

agencies can facilitate agricultural development by investing in the design and fabrication of simple hand-held farm tools. However the ban on the importation of raw materials at the current structural adjustment regime the costs are expected to remain high.

Generally, there are no overall significant difference discernible between the farming systems particularly with respect to their factor substitutability and complementarity, (see table 6.3). Farming Systems II indicate a higher substitutability than Systems I with respect of land and farm tools (1.84). Obviously digging an "inverted mounds" for yams clearly calls for special tools beyond the average ubiquitous hoe and cutlass. Similarly the same substitutability in Farming Systems II is repeated with respect to land and planting materials, notably yams used for "inverted mounds" have a relatively higher value than those of Farming Systems I.

The complementarity of labour and fertilizer for both farming systems is not surprising. Operations such as fertilizer procurement, delivery, and application on the farm are labour-intensive. Farming Systems II used less fertilizer, probably having a better soil condition, which can only be determined if time series data were to be available.

Cost of labour was not significantly different at 4.7% higher for Farming Systems II. This is also true of land where the cost is relatively the same with a difference of 4.4% higher for Farming System II.

6.2 Profitability of the Farming Systems:

Aspects of the profitability of the Farming Systems are shown in Table 6.2. Gross margins are used as a measure of profitability because in peasant agriculture, according to Upton and Anthonio (1965) fixed costs are rarely observed and difficult to measure. This is because they are not only meagre, used universally besides farming, their receipts and costs are difficult for analytical comparison. The gross margin/farmer is a measure of return to family management or enterpreneurship.

Table 6.3: Elasticities of Substitution

Factor	Farming System I	Farming System II	Farmings Systems I+II consolidated
Land substituting for:			
Land	1.41	1.24	1.08
Labour	1.00	0.66	0.83
Fert/Agrochem	1.00	1.00	1.10
Planting Material	0.38	1.31	1.23
Farm tools	1.00	1.84	1.50
Labour substituting for:			
Labour	1.00	1.72	2.00
Fert/Agrochem	-3.63	13.24	-2.30
Planting Material	-1.20	1.00	0.33
Farm tools	3.14	1.00	0.33
Fertilizer substituting for:			
Fertilizer	26.00	17.00	16.00
Planting Material	1.00	1.00	1.00
Farm tools	1.00	1.00	1.00
Planting Material substituting for:			
Planting Material	8.65	-12.00	1.00
Farm tools	-2.97	-4.80	1.00

Source: Extrapolated from Tables 5.2 to 5.4

The results show that the farming systems in the study area are quite profitable with gross margins of N1,859.34 and N1,843.09 for Farming Systems I and II respectively. On the basis of gross margin alone it is safe to conclude that Farming Systems I is not in any way better than Farming Systems II nor is II better than I. The good performance of the systems however is confirmed by the gross margin per farmer of N 2,462.78 and N2.184.40 for Farming Systems I and II respectively.

Labour and land constitute the most expensive farm-firm input. The high cost of labour in Farming Systems II (N328/hectare) is explained by the cultural practice in yam production where "inverted mounds" are made. This practice is common traditionally because of the need for conformity in the area inspite of its high labour cost. It is a traditional culture which maintains a stagnant technology which tends to create solidarity among an ethnocentric group. However, this practice may have some soil regeneration and fertility effect which may be advantageous in the long-run. This practice does not seem to lead to higher yam yield because the average yield in Farming Systems I is 8.975 tonnes per hectare, while it is 7.96 tonnes per hectare in system II.

The relative high profitability of the Farming Systems is reflected in the capital appreciation ratio of 2.00 and 1.72 for Farming Systems I and II respectively. This is a measure of cost recovery and are both considerably greater than one. The performance of the systems is good even when considered under the present inflationary trend and high loan rate of 30%.

6.2.1 Measurement Problems :

Measurement and standardization problems constitute a drawback on effective analysis of traditional farming systems. This is because of the low level of education and general lack of awareness of the importance of measurement in agricultural production and research. Fixed cost items such as hoe and cutlass are used universally, home-made and when bought there are no receipts. Depreciation charges are assumed because of lack of records. These measurement problems informed the use of the concept of duality in this study.

6.2.2 Gross Margin:

(a) Total: The gross margin value of N1,851.00 for the season for the consolidated systems I and II works out to N154.3/month compared to the daily wage of labour of N350.00 in 1990. Obviously, this may lead to the exit of farm labour to the cities in search of urban employment though this might be tempered by the cost of urban living. This result, however, supports earlier results of labour bottleneck in the farming systems area.

(b) Difference between Farming Systems:

The difference in gross margin between the Farming Systems is less than 1% for Farming Systems I which is higher. The inclusion is that they are marginally the same.

(c) Per Farmer:

The difference gross margin per farmer is 13% higher in I which denotes a more successful farmer.

(d) Per Unit Cost:

The difference in per unit cost between system I and II is 16.3% in favour of I. This indicates a more profitable investment. If bank loan is put at 10%, then System I will meet the criteria for loan on the basis of balance sheet return compared to II.

6.3 Constraints to Efficiency and Limitations of Comparative Analysis:

6.3.1 Economic Information and Decision-Making:

Farmers in these farming systems are small size peasants at low level of agricultural development and practice multiple-cropping. While decision-making at the farm-firm level seem to be optimal given the available information, the farmers are constrained by lack of appropriate economic information in their decision-making process. This lack of information is manifested in the low level of modern input used as well as the low-level adoption of modern farming methods that should help to overcome the limited natural endowments. The cost of information could also be prohibitive as a result of low income and level of the small farmers operations.

The other problem in decision-making is the supply of home consumption from the farm; survival of the household feature prominently in the area. With rising costs of foods, home production predominates over cultivation for profit particularly with an average family size of 12 members. It is a significant aspect of agriculture in most developing countries. However, the essence of farm-firm decision-making must incorporate household-farm/farm approach so as to enable the farm family a rational overall use of all available resources. However, resource constraints continue as Schultz (1975) said, to be the bane of the peasant farmers.

6.3.2 Market Constraints

(i) Input Supply and Delivery:

The low level of modern input usage in these farming systems is symptomatic of poverty resulting in poor input supply and inefficient delivery network. Again, the low level of income and the fractionalized and scattered nature of the peasants farms and villages are such that it is uneconomic to have modern inputs such as improved seeds, planting materials, fertilizer and agrochemicals delivered to their farms. The network of roads and transportation are expensive and unattractive to move modern inputs to the small farmer. One answer to this handicap can be for farmers to participate in farmers multipurpose cooperatives. At this stage it is suggested that government should fill the void through agencies such as the River Basin Development Authorities and the Agricultural Development Projects (ADPs).

Another constraint with respect to the input supply is the lack of development of input supply market sector. The output of seeds and planting materials is still lagging behind demand levels resulting in the unavailability and very high cost of improved modern planting material.

(ii) Product Marketing and Transportation:

Product marketing and transportation constraints to efficiency of the farming systems include inadequate physical marketing facilities such handling, bagging, storage, processing packaging and transportation, leading to technical inefficiencies and high costs. The lack of grades and standards for food crops and inadequate market information further result in pricing inefficiencies. The small scale of operations is condusive to structural problems, consequently collusive behaviour and discriminatory pricing of middlemen and high marketing margins which are detrimental to the farmer particularly in the seasonal fluctuations in farmers returns. Policies aimed at market improvement would involve market information, physical facilities, pricing efficiency inducing, structural and infrastructural improvements at all levels.

6.3.3 Resource Availability, Prices and Resource Substitutability:

Further constraint to the efficiency of the Farming Systems is the lack of resource. Land, labour, fertilizer and planting materials usage in the system in low. The average farm size is 1.247 hectares. This seem to be what the farmers can handle with available financial and labour resources. As a result of this low level resource endowments, farm expansions to take advantage of economics of size and scale are limited. The high price of the resources excludes the farmers from formal financial markets where loan rates are in excess of 40%. The situation is further exacerbated by the low level of resource substitutability (as explained in chapter 5). Apart from fertilizer and labour, most of the pairs of the other resources are compliments. it becomes necessary for the government to expand the resource base by investments in agricultural research, extension and rural infrastructure.

6.3.4 Institutional Constraints:

It has to be mentioned that one area impinging on the more liberal use of improved inputs may be the efficiency and profitability of these modern inputs. For instance the general application of fertilizer recommended is not scientific in view of the fact that differences in soil fertility trend should clearly call for varying combinations and rates of application. Such details when lacking, may seriously affect profitability and investment.

An important constraint to the efficiency of the farming systems is the poor performance of the institutions serving agriculture both locally and nationally. These logical institutions were established on the need to bring together in a concerted way the technical, managerial and financial aspects of modern farming which individual farmers cannot afford. Unfortunately, these institutions have failed to achieve the desired objectives of increasing agricultural productivity at economic prices over a broad spectrum of agricultural enterprises, because of the following major defects, namely:

(i) inadequate research;

(ii) highly politicised decision-making;

(iii) ineffective management;

(iv) exorbitant cost;

(v) bureaucracy and

(vi) corruption.

Unfortunately, peasant farmers are not directly involved in policy and decision-making that effect the overall farmers' operations and their welfare. The farmers themselves do not have much input and they are not consulted in the decision process because of their weak lobby. There is the need to get the farmers to form groups that will coalesce farmers interest in the country's decision-making and help to accelerate the nations agricultural development through effective policies and relevant strategies.

CHAPTER S EVEN

SUMMARY OF FINDINGS AND RECOMMENDATIONS

7.1 Summary of Findings:

7.1.1 The Area and Model Used; Sources and Analysis of Data:

The study area is the eastern zone of the upland area of Rivers State. This area hitherto, constituted a major food producing area of Rivers State but has come under increased pressure from commercial and industrial activities of both oil and fertilizer producing companies. The farmers in this area are small farmers whose poor adoption outcome of improved technological packages portrays serious weakness in the institutional set-up for the delivery of these improved packages. With increasing activities, siting of heavy industries and extensive drilling activities with the consequent destruction of farmlands, it was necessary to isolate the best combination of inputs so as to maximize output and minimize the negative impact of these industrial activities on agricultural and food production.

The economics of the traditional farming systems in the survey area was analysed through the use of the cost function approach. The concept of Duality through the translog function as exposed by Sheppard (1970) and Binswinger (1974), in combination with Cobb-Douglas and the Gross Margin Analysis (Anthonio and Upton, (1965) were used to determine the relevant parameters. These models and analytical tools were selected because subsistence agriculture involves hedging against risk and uncertainty. It is made even so by the fact that the survival of the family is at stake. In such circumstances, the major objective of the peasant is the maximization not only of income but rather his family's subsistence and survival. So a minimization of cost rather than profit-maximization strategy will be implicit. Moreover, in our traditional environment cost variables or expenditure are easier to obtain. Econometrically the translog cost function fits this scenario and has some advantages over the neoclassical production function.

Primary data were collected on a bi-weekly basis for the duration of the farming season which lasted nine to twelve months in most cases. Interviews were conducted by the researcher and a team of his ex-students stationed in their areas of origin to minimize the communication problem and farmer resistance which has become frequent in the area. Labour input was measured in man days and the value estimated by multiplying the man-days with the average daily labour rate. Land and output were measured by the use of the yield plot technique, (Spencer, 1972). Prices were the average annual prices determined through the questionnaire. Secondary information from libraries and other depositories were also added.

7.1.2 Socio-Economic Data

Socio-economic analysis of the respondents in the survey area showed that age, traditions and land tenure were important factors in the traditional farming systems studied. The age distribution of the farmers were skewed with an average of 45 years which implies that labour may be limiting particularly with a farming system that relies heavily on household labour.

The tenure system is not different from most African traditional system and with population increase, holdings are considerably small and acquisition of more land is largely through the extended family inheritance (80%) and less through purchases, leases and pledges (25%). Though the average family size of twelve is high, family members did not seem to be readily available for farming activities, an indication of emmigration. Sex also plays a part in determination of the prevailing system as there are clear demarcation in farming activities on the basis of sex. While land clearing and holing were usually done by men, planting and construction of mounds, weeding and harvesting were done mainly by women who are sometimes assisted by older children.

7.1.3 Economics of The Two Farming Systems

Gross Margins were used to measure the profitability of the two farming systems. The results show that the two systems are profitable with a gross margin of N1,859.34 and N1,843.09 for farming systems I and II respectively. The relative high profitability of the systems was reflected in the capital appreciation ratio of 2.0 and 1.72 for farming systems I and II. While the value of output in farming system II (N2,916.33) was higher than in I (N2,771.74), total cost was also higher.

Labour and land constituted the most expensive farm-firm input. The high cost of labour in Farming Systems II (N328/hectare) is explained by the cultural practice in yam production where "Inverted Mounds" are made. The performance of the systems show that small-scale agriculture can be profitable, but that increasing profitability cannot be achieved with only limited attention to particular inputs. There was no significant difference in the profitability of the two systems.

7.1.4 Elasticities of Demand, Complementarity and Substitution of Resources Used

Economic parameters analysed influencing the farming systems are the conventional factors such as land and labour. the other factors such fertilizer, planting material, tools and credit play a minor role. This is normal for a developing agriculture with limited substitution possibilities. All elasticities of input demand are negative and in agreement with the postulate of rational behaviour assumed for the small farmers.

For land, the elasticity of land by the translog function is - 0.37 when compared with - 0.55 derived from the Cobb-Douglas function. While both of them are inelastic the smaller value by the translog depicts more accurately the elasticity of demand for land. The high cost of farm-land which ranged from N200.00 to N600.00 per hectare (near Port Harcourt) may explain this relatively low effective demand for farmland. In addition, the farmers purchasing power was low when compared with industrial demand for land in the survey area.

The elasticity of labour by both methods (-0.4) and (-0.4) was low. Labour though essential was limiting in the systems inspite of the high family size (12). The migrant labour phenomenon was common while landlords sold their labour to the industries. This is a rational behaviour in a high cost environment. The farmer meets the basic household consumption with the farm operations, but for his cash expenses he depends more and more on his earnings from non-farm labour offered to the industries nearby.

A great disparity exist between the estimates of translog (-0.15) and Cobb-Douglas (-0.95) in the demand for fertilizer. The translog is likely to be the right one because the cost share of fertilizer is very low (0.04-0.05). This low demand does not depict lack of awareness but lack of availability and cost. This situation is likely to be worse in the future with the removal of subsidy from fertilizer. As far as the farmers in this zone are concerned, removal of subsidy is not in their interest.

The demand elasticity for planting materials coincidentally has the same value for both functions though they differ for farming systems I and II. There seems to be a higher demand for planting materials and farm tools than fertilizer. Farmers are aware of improved seeds but again high cost and availability are problematic. Even seedlings, especially yam, were said to be a major constraint as farmers go outside the zone to purchase seed yams. Cassava cuttings used are the old traditional varieties, which indicates that extension activity in this area is still lagging behind and the rate of adoption is low. Farm tools are expensive since the beginning of the Structural Adjustment Programme which banned the importation of steel and iron into the country.

Significant elasticities of substitution exist between labour and fertilizer in all the groups, [(-3.63), (-3.24) and (-2.3) in I, II and I + II]. By the signs fertilizer and labour are compliments. This would have been good news for a developing economy with surplus labour. However in the survey area both fertilizer and farm labour seem to be short supply and are expensive. The systems are not separable and substitution is low; therefore we cannot provide fertilizer without appropriate planting material and tools to offset the increased labour requirement for fertilizer application. The model found that farmers in the area of study were labour-saving in their farm management practices; itself a result of labour shortage. Therefore the surplus labour theory in a developing economy is no longer valid and this is in consonance with Schultz (1964).

7.1.5 Limitations of Results

Five factors normally affect a study of this nature. They are:

(1) cross-sectional analysis problem;

(2) the representativeness of the systems studied;

(3) the reliability of the farmers responses;

(4) the problem of estimating quantities of outputs and inputs.

The second, third, fourth and fifth problems were adequately handled by the data collection procedure already discussed in the text.

However, due to the fact that only a seasonal data were involved in this research, interpretation must be made accordingly. A longitudinal (or time series) analysis where data are collected from the same observational unit at successive point in time would have been desirable to enable us to take into consideration changes over time in the farmers environment. For example, a change in the cost-share with respect to a change in time would have helped to determine when the current technology in use is neutral, factor-saving or factor-using over a period of time.

In the determination of the farming systems, factors other than economic are pertinent. for example, soil, temperature and socio-cultural factors are involved in the determination of prevailing farming systems. However, this study is concerned more with the economic factors.

7.2 Recommendations and Policy Implications:

7.2.1 Advantages of the Application of Duality; Cost Functions over Production Function

The study showed that it is possible to analyse the traditional farming systems which is common in Nigeria through the concept of duality. Since the concept allows for less restrictions on the function form, it's applicability is easier. The cost function specification is particularly important in a situation where there is mixed-cropping and input use cannot be specifically determined for each crop enterprise. It is therefore recommended that more studies be carried out on the use of the flexible functional form to confirm or refute the results of this study.

It is also recommended that studies in the area of mixed-cropping among the small farmers should be system-based instead of the current commodity-based approach. This recommendation assumes greater significance when we consider the low literacy level of our small farmers and the lack of standardisation of measurement in the agricultural sector of our economy.

Moreover, emphasis on the socio-economic analysis of mixed-cropping systems is recommended as socio-economic factors form important plank of the small-farmer agricultural systems. Research into traditional farming should be holistic, based on totality of systems inclusive of the non-economic factors.

7.2.2 Land and Labour Constraints in the Area:

The average size of land in systems is 1.247 hectares which is due to the combination of low income, type of tenure and low level of technology. Therefore, policies aimed at land consolidation for the purpose of ploughing may be advantageous. In spite of the negative aspects of the cooperatives, it is still advocated for mutual farming activities (i.e. multi-purpose cooperatives to be specific).

The study showed that labour was limiting thus negating the labour surplus theory. Migrant labour is often used but the labour is fairly an educated one in terms of awareness of new technologies. Therefore, the study calls for policies that would be labour-saving. There is the need to introduce tools that are more efficient to reduce the drudgery of farming and improve cultivation.

7.2.3 Use of Modern Inputs:

The demand for fertilizer in this study is low and it is not surprising for a developing economy, and fertilizer is labour demanding. Moreover, the problem of fertilizer use is not that of lack of knowledge, but availability and cost. This calls for improvement in the fertilizer distribution network and research into the specificity of fertilizer for mixed crops. The removal of subsidy may make it unattractive for loading and transportation out of the state in the long-run but in the short and long-run, cost will continue to be high. Therefore, sustainable systems, for example the alley-cropping technology, that minimizes fertilizer use, should be introduced.

Meanwhile there is the need for improved efficiency of available fertilizer use. Therefore, we need soil analysis for more localised use of fertilizer. The farmers reported some negative effects of fertilizer use in yams. This study was not able to anthenticate these claims but there is need for studies to determine the effects of fertilizer on taste, dry-matter content and perishability.

7.2.4 Planting Materials:

Planting materials demand elasticity is relatively high and seem to be a constraint in optimizing output. Four recommendations are made namely:

(a) Making the planting materials cheaper, for example the minisett technique in yam propagation;

(b) Improvement in the supply situation and this calls for the establishment of stores close to the farmers;

(c) The use of private sector distribution is advocated to improve the efficiency of distribution; and

(d) Further breeding and on-farm research to increase the availability and cheaper planting materials.

Therefore, the research component of the agricultural strategy in this area need to be strengthened. It should involve cooperative research effort between the Universities. The ADP and the Ministry of Agriculture as well as the private sector.

7.3 Concluding Remarks:

This study has contributed to the study of traditional farming systems by giving practical dimension to the concept of duality in a developing economy. It is particularly useful in our situation where data on input quantities are frequently not available but expenditure data are available. The models used were able to determine that production activities in this traditional farming system are not separable. It is hoped that more flexible functional forms will be developed and used to parametrize our economic environment and lead to sharper variables for appropriate policy prescriptions and evaluation.

Policy implications derived from the study involve the introduction of technologies that expand the availability of inputs in the traditional farming systems, optimize production activities in our agriculture. It also includes the need to understand our environment before the introduction of generalized macro-economic policies such as the introduction of the structural adjustment programme. Importantly, this study calls for the need to introduce technologies that take cognisance of the farmers environment, are sustainable and environment-friendly.

Finally, the study emphasized the fact that farming systems and tradition have ecological, socio-economic backgrounds that had to be understood.

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APPENDIX 0.1: SURVEY QUESTIONNAIRE FOR FARMERS

A. BACKGROUND INFORMATION Code No.---------

1. NAME..2. AGE .... 3. SEX ....

4. MARITAL STATUS ....5. VILLAGE ....

6. COMPOSITION OF HOUSEHOLD:

HEAD ....WIVES ....

CHILDREN ....OVER 10 ....UNDER 10...

DEPENDANTS/RELATIONS.................................... ...OTHERS (SPECIFY) ....

B. LAND OWNERSHIP, USE AND CROPPING PRACTICES

7. What is the land tenure of the farmers?..

8. How many plots do you have ....In how many locations.................

9. During the 1989/90 season state your cropping sequence?

(Put the letter corresponding to the crop).

CROP	NO OF HEAPS /AREA/HA	INTERCROP WITH	YIELD (KG)	TOTAL (BAGS)
A Yam				
B Cassava				
C Maize				
D Cocoyam				
E Telferia				
F Okra				
G Melon				
H Garden egg				
I Sugar cane				
J Groundnut				
K Pepper				
L Trifoliate Yam				
M Aerial Yam				
N Ukpo				
O Bitterball				
P Others				

10. What's the total size of land available for cultivation ....heaps?

11. What is the cost of renting a hectare (3,000 heaps) of land in your area?

(i) N......... for a year or (ii) a once-for-all payment of N.........

12. If you want to sell one hectare of your farm land today, how much would you sell it? N.........

13. What was the rental value of land/year in

1985 N.....; 1980 N......; 1975 N.....; 1970 N......;

14 Is there any change in your cropping pattern for this 1989/90 season? Yes/No

15. If Yes, list the reasons for change

Cost A	Availability B	Population pressure C	Others! D

C. INPUT USE

LABOUR

16. Which of these labour types do you use most often on your farm?

A Family Labour B Hired Labour C Communal D Labour E Others!

17. Complete the following for any labour (both family and hired) that you used on your farm during the last cropping seasons of 1989/90.

TYPE OF FARM OPERATION	MONTH OF OPERATION	TOTAL HECTARAGE COVERED	NO. OF DAYS OF OP..	HRS PER DAY
Land Preparation				
Planting				
Weeding				
Harvesting				
Transportation.				
Other Operation				
(specify)				
TOTAL				

TYPE OF FARM OPERATION	HIRED LABOUR		FAMILY LABOUR	
	MALES	FEMALES	MALES	FEMALES
	No.	No.	No.	No.
Land Preparation				
Planting				
Weeding				
Harvesting				
Transportation.				
Other Operation				
(specify)				
TOTAL				

18. Do you have problems obtaining labour for your farm operation? Yes/No

Tick off the problems

A Costl ....B Availability......... C Seasonality ....D Others.(Specify)................

19. MECHANICAL INPUT

TYPE OF FARM OPERATION	TYPE OF MACHINERY	HOURS USED PER DAY	NO. OF DAYS PER WEEK	HECTARAGE COVERED	TOTAL COST
Bush Clearing					
Ploughing					
Ridging					
Planting					
Weeding					
Fert. Application					
Harvesting					
Other operation					
(specify)					

CAPITAL

SEEDS/PLANTING MATERIAL

20(a) Where did you obtain the seeds/planting materials that youused on your farm?

(i) Last year's production from you

(ii) Purchased from agro-service centre

(iii) Purchased locally from other farmers

iv) From extension agent

(v) Other sources specify

20(b) Complete the following table for any seeds/planting materials used during the cropping season.

TYPE OF PLANTING MATERIAL	QUANTITY USED	TOTAL HA. COVERED	SOURCE OF MATERIAL	COST PER UNIT (N)	TOTAL COST (N)
Cuttings					
Cassava					
Sugar Cane					
Yams					
Cocoyams					
Others (Specify)					
Seeds					
Maize					
Okra					
Pepper					
Melon					
Others (specify)					
TOTAL					

F. FERTILIZER/HERBICIDES

21(a) Did you apply any of these chemicals to your crops during the last cropping season.

(1) Fertilizer Yes/no

(2) Herbicides Yes/No

3) Pesticides Yes/No

21(b) Complete the following table for any fertilizer/herbicides used during the last cropping season.

NAME OF AGRO-CHEMICAL	SOURCE OF CHEMICAL	QUANTITY USED (KG)	HECTARAGE COVERED	CROP APPLIED TO	COST (N)	
					Unit	Total
Fertilizer (specify)						
Herbicide(Specify)						
Pesticide (specify)						
TOTAL						

G. <u>OTHER ASSETS</u>

22. Complete the following table for any of these tools that you possess and which you use on your farm.

TOOL/ASSET/ EQUIPMENT	QUANTITY	YEAR PURCHASED	UNIT COST	REMARKS eg Terminal date of use
Cutlass				
Hoe				
Axe				
Tractor				
Plough				
Farm House				
Others (specify)				
TOTAL				

H. Credit

23(a) Did you borrow money for your farm operations in the1989/90 season? Yes/no

(b) If yes for what operation (i)-- clearing (ii) .... Land preparation (iii)....Weeding

(iv)... Harvesting (v)....Planting (vi) ...Others (specify).

(c) If No (a) what are your sources of capital

(i) Personal savings... (ii) Relatives/Friends...

(iii) Credit Associations......

(iv) Agricultural Finance Company/Banks ...

(v) Government Sources(specify)

(vi) Money Lenders ....

(vii) Other Sources (specify)....

(d) What are the terms of repayment? (i) In kind.... (ii) In cash...

(e What is the rate of interest (i) in kind (ii) in cashI. OUTPUT

24. Complete the following table for all crops harvested during the cropping season 1989/90.

Farm Location	Crop Harvested	Ha. Harvested	Quantity Harvested	Amount Sold	Output	Home Consumpt.	Yield /Hectare Good	Bad
TOTAL								

DATE..................................SIGNATURE OF STUDENT..

APPENDIX 0.2: THE DERIVATION OF SHEPHARD'S LEMMA

Assume the cost minimization problem is

Minimize $C = W_1X_1 + W_2X_2$..A1

Subject to $f(X_1X_2) = Y_0$..A2

Where C =total cost W_1, W_2 =prices of input X_1^* and X_2 respectively and

Yo = Output level. A3

The Langrangian is $L = W_1X_1 + W_2X_2.. + \lambda Yo\text{-}f(X_1,X_2)$

The envelope theorem says that

$$\frac{\delta C}{\delta W_1} = \frac{dL}{dW_1} \quad X_1 = X_1\,(W_1,W_2,Y_o)\text{...A4}$$

and similarly for X2.

Also $\frac{\delta L}{dyo} = \lambda(W_1,W_2,Y_o)$..A5

Equation A4 is referred to as shephard's lemma and is an important part of the duality theory of cost and production functions.

The envelope theorem is given by differentiating $C^* = W_1X_1^* + W_2X_2^*$ with respect to W_1, remembering the X_1^* and X_2^* are themselves functions of W_1,

$$\frac{\delta C^*}{\delta W_1} = X_1^* + \frac{W_1 dX_1^*}{\delta W_1} + \frac{W_2 dX_2^*}{\delta W_1} \text{ ....A6}$$

Using the first order conditions $W_1 = f1, W_2 = f2$ and factoring out, we have

$$\frac{\delta C^*}{\delta W_1} = X_1^* + \lambda^*(f1\,\frac{\delta X_1^*}{\delta W_1} + f2\,\frac{\delta X_2^*)}{\delta W_1} \text{ ....A7}$$

Consider now the constraint identity $f(X_1^*, Y_2^*) = Yo$

Differentiating this identity with respect to W_1 yields

$$F_1 \frac{\delta X_1^*}{\delta W_1} + f2 \frac{\delta X_2^*}{\delta W_1} \text{ ....} = O\text{..A8}$$

But A7, is precisely the expression in parenthesis in equation A6 hence as the envelop theorem indicated $dc^*/dw_1 = x_1^*\,(w_1, w_2, y_o)$ (same as equation A4).

APPENDIX 0.3: ABBREVIATIONS USED IN THE TEXT

ADP	Agricultural Development Project
Bolga	Bori Local Government Area.
Kelga	Ikwere-Etche Local Government Area
Olga	Bonny Local Government Area
Otelga	Okrika/Tail/Eleme Local Government Area
Phalga	Port Harcourt Local Government Area
FACU	Federal Agricultural Co-ordinating Unit
ITCZ	Inter Tropical Convergence Zone

APPENDIX 0.4: CROP YIELDS IN MIXED-CROPPING SYSTEMS IN THE SURVEY AREA.

(Yield is in tonnes /hectare).

Crop	A	B	C	D	E	F	G	H	I
Yam	9	8	9.5	8	6.3	8	8.6	9.4	8.5
Cassava	12.5	18.7	15.9	13	8.3	14	10	12.5	10
Maize	1.5	1.5	1.19	1.94	1.19	1.54	1.18	1.18	1.19
Telferia	1.2	1.3	1.4	1.5	1.5	1.5	1.3	1.5	1.4
Pepper	1.5	1.6	1.4	1.3	1.5	1.2	1.5	1.6	1.5
Okra	1.1	1.2	1.3	1.0	1.1	1.2	1.3	1.4	1.2
Melon	0.6	0.6	0.9	0.9	0.8	0.8	0.9	0.6	0.3
Trifoliate yam	4	3	5	4	6	4	5	6	6
Groundnut -	-	-	-	-	-	-	-	1.2	
Cocoyam	6.3	9.4	14	7.1	6 4.	3	5	9	4

Legend

A = Port Harcourt B = Okrika C = Tai - Eleme
D = Bori E = Gokana F = Nyokhana
G = Isiokpo H = Okehi I = Emohua

Source: Survey data 1990.

APPENDIX 0.5: FARM OUTPUT PRICES IN THE SURVEY AREA (Prices in N/Kg.)

Crop	A	B	C	D	E	F	G	H	I
Yam	1.68	4.58	2.15	3.06	2.18	3.94	4.07	3.14	4.12
Cassava	0.76	1.29	0.64	0.81	0.63	0.79	0.85	0.73	0.80
Maize	2.43	2.46	2.59	3.01	2.59	2.99	2.46	2.44	2.45
Telferia	1.89	2.10	1.66	1.16	1.66	1.24	1.37	1.58	1.37
Pepper	4.08	4.79	4.29	5.16	4.29	4.91	2.90	3.95	3.07
Okra	2.64	3.02	3.23	3.61	3.27	3.61	2.39	2.61	2.39
Melon	9.36	9.36	10.76	7.69	10.75	8.52	8.46	8.92	8.46
Trifoliate yam	1.68	4.58	2.15	3.06	2.18	3.94	4.07	3.14	4.12
Groundnut	-	-	-	-	-	-	-	4.80	
Cocoyam	3.43	3.94	2.26	2.38	2.22	2.25	2.83	3.39	2.83

<u>Legend</u>

A = Port Harcourt
B = Okrika
C = Tai - Eleme
D = Bori
E = Gokana
F = Nyokhana
G = Isiokpo
H = Okehi
I = Emohua

Source: Survey data 1990.

APPENDIX 2.1: MEAN ANNUAL RAINFALL IN SELECTED STATIONS IN THE STUDY AREA (mm)

	J	F	M	A	M	J	J	A	S	O	N	D	Annual
Bonny (6yrs)	155	157	192	325	321	871	480	575	676	605	301	110	**4698**
Bori (7yrs)	37	85	120	180	168	348	330	372	357	287	157	42	**2483**
Choba (7yrs)	33	92	137	225	205	275	273	299	366	285	108	65	**2363**
Port Harcourt 1 (7yrs)	32	102	136	225	181	279	253	314	409	269	128	33	**2361**
Port Harcourt 2 (10yrs)	40	119	130	183	202	367	345	389	443	387	153	47	**2805**
Rumuodomanya (7yrs)	34	96	129	215	156	259	278	343	396	325	115	49	**2396**

Source: Agrometereological Office , Ministry of Agriculture and Natural Resources, Port Harcourt

APPENDIX 2.2: MEAN MONTHLY TEMPERAURES IN SELECTED STATIONS IN RIVERS STATE

	J	F	M	A	M	J	J	A	S	O	N	D	Ave.
Bonny (1979)	28.2	28.0	27.7	00.0	27.2	26.1	25.7	25.1	25.9	26.2	28.5	28.0	27.0
Choba (1976)	27.4	27.8	28.5	27.8	28.0	26.0	25.0	25.7	26.3	226.0	829.0	28.0	26.9
Port Harcourt (1951 - 1965)	26.2	27.0	27.2	27.0	26.8	25.6	24.9	25.0	25.3	25.8	26.2	26.0	26.1

Source: Agrometereological Office , Ministry of Agriculture and Natural Resources, Port Harcourt

APPENDIX 4.1: METHODS OF ACQUISITION DISPOSAL OF LAND OWNED BY FARMERS IN THE EASTERN ZONE OF RIVERS STATE

Method	A	B	C	D	E	F	G	H	I
Inheritance	x	x	x	x	x	x	x	x	x
Purchase	x	x	x	x	x	x	-	x	x
Lease	x	-	-	-	-	1-	-	1-1.-	
Rent	x	-	x	x	x	x	x	x	x
Family	-	x	-	-	-	-	-	-	-

x indicates acquisition by the specified method
- indicates that land is never acquired by the method

Legend

A = Port Harcourt B = Okrika C = Tai - Eleme
D = Bori E = Gokana F = Nyokhana
G = Isiokpo H = Okehi I = Emohua

Source: Survey data 1990.

APPENDIX 4.3 : SOURCES OF LABOUR AND LENGTH OF WORK DAY IN THE EASTERN PART OF RIVERS STATE

Source	A	B	C	D	E	F	G	H	I
Family	x	-	x	x	x	x	x	x	x
Hire	x	-	x	x	x	x	x	x	x
Hire	x	x	x	x	x	x	x	x	x
Exchange	x	-	x	x	-	x	x	x	x
Tenant	x	-	x	x	x	x	-	x	x
Cooperative	x	-	x	x	x	-	x	x	x
Work Hours									
Adult	8	8	8	7	8	8	8	8-9	8
Children	4	-	-	7.	8	8	8	-	-

x indicates availability of labour through the specified source
- indicates non-availability through the specified source

Legend

A = Port Harcourt B = Okrika C = Tai - Eleme
D = Bori E = Gokana F = Nyokhana
G = Isiokpo H = Okehi I = Emohua

APPENDIX 4.4

SOURCES OF FUNDS IN THE EASTERN PART OF RIVERS STATE

Source	A	B	C	D	E	F	G	H	I
Prod.Sales &Savings	x	x	x	x	x	x	x	x	x
Govt. Loans	-	-	-	-	-	-	-	-	-
Loans from Rels/Friends	x	x	x	x	x	-	x	x	x
Social club Groups	-	-	-	-	-	-	x	x	x

Legend

A = Port Harcourt
B = Okrika
C = Tai - Eleme
D = Bori
E = Gokana
F = Nyokhana
G = Isiokpo
H = Okehi
I = Emohua