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UNIVERSITY OF IBADAN

A GENDER ANALYSIS OF ECONOMIC EFFICIENCY IN CASSAVA-BASED FARM HOLDINGS IN SOUTH-WESTERN NIGERIA

MARCH,2000

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ABSTRACT

The study undertook a gender analysis of economic efficiency of cassava based farm holdings with a view to enhance productivity gains through efficient intra-household allocation of resources.

Primary data were collected through well structured questionnaire administered to characterize the production, processing and consumption of the respondents. A combination of analytical techniques were used to analyse cross-sectional data from 149 male respondents and 138 female respondents selected through a two-stage stratified random sampling of villages and households as well as purposive sampling of ultimate farmers in Oyo and Osun States of Nigeria.

The study employed a stochastic frontier production function and duality model of a translog cost functional form to measure technical, allocative and economic efficiency of small scale cassava producers. Multivariate discriminant analysis was also used to predict whether or not an individual cassava based farmer was viable hence likely to be sustainable. The non-parametric approach adopted was that of Kendall coefficient of concordance to test the significance of agreement among the respondents to their common problems.

The results indicated that, average overall productive efficiency in the sample was 79.61 percent implying that small scale cassava farmers in the sample could

reduce total variable cost by 20.39 per cent if they reduce labour, fertilizer, land and capital application to levels observed in the changing input mix (technical efficiency) and then obtain optimal input mix for the given input prices and technology (allocative effeciency). The average technical efficiency and allocative efficiency indexes for the sample were 82.7 per cent and 96 per cent respectively. Also, evidence from empirical analysis of data from the male respondents show that the average economic, technical and allocative efficiency indexes for the sample were 82.7 per cent and 96 per cent respectively. Also, evidence from empirical analysis of data from the male respondents showed that the average and economic, technical allocative efficiency indexes were 78.29per cent, 87.4 per cent and 89.58 per cent respectively while the same computed for the female sample were 72.53 per cent 95.0 per cent and 76.35 per cent respectively. Efficiency enhancing factors were found to include farm size, labour, crop diversification, education, capital, fertilizer and quantity of output while extension contact, experience and age were not. Labour was the most limiting factor in cassava production suggesting that the technologies that enhance the productivity of labour are likely to achieve significant positive effects on cassava production.

In order that modern technology can spread uniformily over a region, eradicating rather than creating economic and social imbalance and in order that every sector of the rural population can be given an opportunity to become integrated in the development efforts, the female factor with its variations must be understood, analyzed and finally employed. Again, technical inefficiency constituted a more serious problem than allocative inefficiency thus, most cost savings will accrue to improvement in technical efficiency.

DEDICATION

TO MY WIFE AND CHILDREN

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CERTIFICATION

I certify that Mr. Awoyemi Taiwo Timothy carried out this work in the Department of Agricultural Economics, University of Ibadan, Ibadan.

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CHAPTER ONE

INTRODUCTION

1.1 STATE OF NIGERIAN AGRICULTURE

Given the fact that Nigeria is blessed so much with total land mass of about 92.4 million hectares, of which about 65 million hectares are cultivable and over 60% of the population deriving their livelihood from agriculture and allied occupation, it is clear that Nigerian agriculture has considerable potential. Although historically agriculture has been an important sector of Nigeria's economy, its overall performance during the last decades as judged by several indicators has shown steady decline. Statistics show that the agricultural sector contributed about 64.1% of the Gross Domestic Product in 1960 compared with 1.2% from mining and 48% from manufacturing sector. From the peak of the 1960 the share of agriculture to total production dropped to 22% in 1985 while those of other sectors, particularly the crude oil gained rapidly. Although the increase in 1997 of agriculture contributes up to 40.36% of the total production its contribution is still low when compared with other sectors.

This is due to callous neglect of the rural areas and the low level of agricultural production practices, which is still largely on trial - and - error basis.

Within the context of Nigerian economy, which is predominantly rural in settlement, the problem of economic growth and development hinges largely on raising the productivity and therefore the real income of this sector. Basic economics and experience suggest that by providing food, labour and investible surplus, the rural areas help to generate urban incomes and employment. They also help to stabilise, if not reduce production costs for industries and cost of living for workers generally. Raising rural incomes and productivity thus are seen as a prerequisite for growth, particularly to keep the poorest strata of the population above poverty line, because of scarcity of resources. Again, for reasons of equity and justice, people may desire to live in a society with a certain distribution of income and welfare.

These reasons notwithstanding, rural dwellers continue to fight daily battle against hunger, disease and have to contend with their narrow horizons of possibility: low status in the community, lack of influence, uncertain or irregular sources of income.

What then should we do to enhance the image and productivity of agriculture as a profession and business? In the light of the above discussion, the vital thing would be to improve the purchasing power and dignity of the rural dwellers, majority of whom are silent producers - small holder farmers. Afterall Nigeria is still a country of smallholdings. Approximately 9 million farm households throughout the country have an average farm size of about 2.5 hectare (2 hectare in the south and 3 hectare in the north), (World Bank 1995).

This group of farmers is characterised by over-dependence on rainfed crops, inadequate investment, poor incentives, and inadequate extension service and technology. This has resulted in low levels of productivity, low aggregate farm output and hence low income. Also sub-optimal combination of farm enterprises, resulting in skewed involvement in farm and non-farm activities. Furthermore, this static hoe-cutlass technique of farming is low in capitalisation of operations and lacks optimal integration of production and distribution operations.

1.2 GOVERNMENT AGRICULTURAL POLICIES AND STRATEGIES

From the foregoing, we can deduce that where there is still poverty, policies are not enough. Nonetheless, over the years the Nigerian Government has designed agricultural policies and strategies aimed at achieving some goals which include the following: increased agricultural production to meet food requirements of a growing population and the raw material needs of agro-based industries, higher production of export crops, creation of more employment opportunities in rural areas and evolution of an appropriate institutional and administrative apparatus to facilitate an integrated development of the agricultural potential of the country as a whole. While these objectives have remained unchanged over the years, the choice of instruments and strategies have varied from time to time.

In the Golden years of 1950s and 60s, the Federal Government, for constitutional and functional reasons played a limited role in agriculture confining mostly to the area of research. The regional governments on the other hand were primarily responsible for a wide spectrum of agricultural operations, ranging from farm level to the market and formulated appropriate policies in this regard. The three main policy instruments used aimed at:

1. Spreading new technologies and improved inputs to peasants through extension services and appropriate incentives.
2. Setting up large-scale capital intensive plantations operated by Development Corporations to promote tree-crops especially in the Eastern and Western Regions and
3. Introduction of farm settlement programmes also in these two regions through infusion of highly skilled labour and training of new settlers in the use of improved techniques and inputs. Meanwhile, the Development programme did not make much headway because of high cost, inadequate response and the inability of even the few settlers to play the anticipated role of change agents.

In the 1970s, Federal Government took more active and leading role by devising agricultural policies and programmes within the framework of the long-term policy objectives mentioned earlier. It initially adopted the strategy of direct large-scale participation, using modern inputs, but it did not account for the bulk of output. The strategy has therefore been changed in favour of the small farmers.

While the main instrument of policy is the provision of modern technology and inputs to the small farmers, this is sought to be implemented through a variety of special institutions and programmes. More important among them are: National

Accelerated Food Production Programme of 1962; the Integrated Agriculture Development Projects of 1976, Operation Feed the Nation of 1976, Green Revolution launched in 1980; the River Basin Development Authorities (1976) and National Seed Service (NSS) (1976). More recent additions are Directorate of Food, Road and Rural and National Agriculture Land Development Authority (NALDA) albeit recently scrapped.

Among these strategies, Agricultural Development Programme (ADP) is one of the most successful efforts. The main objectives of the ADPs have been to increase production of food and fibre as well as producer income through extension activities.

Clearly, the above represents the various efforts of the Federal Government to develop agriculture or bring it back to its old glory of 1950 to 1960. Be that as it may, an important observation is that women were not adequately represented and involved in the planning and implementation phases of these programmes. By and large the language of these policies appears to be gender neutral, no specific mention was made of gender or of the sexual division of labour. This apparent gender-neutrality hides a deep gender bias in the analysis and policy - formulation. This apparent gender blindness can make the policies sterile and the economic contribution of women to the household can be distrupted and disadvantaged by the introduction of well intentioned technological changes, particularly when biased towards male heads of household.

Moreover, it has to be noted that, success of these programmes in transforming agriculture depends, among other things on technical and allocative efficiency of the individual farms. Thus a study of farm-level efficiency would be a useful guide to policy makers in ascertaining which farms are operating efficiently and therefore which ones will survive in the long run without subsidies.

In Africa smallholder agriculture is the main source of employment for the majority of the rural population (Nana-Sinkam, 1971), thus success of food security in Nigeria hinges largely on the productive activities of smallholder farmers. In fact there is a considerable agreement with the notion that an effective economic development strategy depends critically on promoting productivity and output growth in the agricultural sector, particularly among small-scale producers.

1.3 GENDER ASYMMETRY IN THE ALLOCATION OF RESOURCES

Africa has a female farming par excellence Staudt (1982). However, in spite of their significant contributions to agricultural production and rural household, generally they still have to contend with discrimination in form of unequal access to productivity augmenting opportunities such as schooling, agricultural credit, land, health facilities, agricultural co-operatives, extension contact, food and housing (Jiggins, 1984, Palmer, 1991).

1.3.1 Education

There is in general positive correlation between level of education and efficiency, effectiveness, ability to think through a problem and managerial capability. Until recently, the bias rooted in traditional sex roles limited the access of girls to formal education, especially beyond the primary level.

In theory, girls are faced with the same education as boys. In practice however, socio-cultural constraints still inhibit the education of girls beyond a certain level in various parts of the region and notably in Muslim areas. Preference for male child as the ultimate inheritors of farms among most cultures in Nigeria often make farmers to loose sight of adequate caring for the female child. They feel female child will only profit her marital family. So, in many societies parents have a strong preference for male children because they are more likely to bring economic returns and security to the family (Pinstrup, 1984).

1.3.2 Access to Agricultural Credit

Women's need for cash income has been rising because of the high inflationary trend, which increases the cost of household goods and services and farm, inputs as well. Thus in order to satisfy their essential expenditures, women need to source for help outside the family. But, in most cases, if a woman wishes to raise a loan she may need to persuade her husband who then puts up a guarantee in the form of a title deed, thereby making the wife financially dependent on her husband. When women do not have access to credit, the effect on household and individual well-being is striking. Borrowing by women is likely to increase holdings of non-land assets, and leads to improvement on the health.

But Agricultural Credit policies are the least adapted of all policies to the reality of feminization of smallholder agriculture. This is partly due to the fact that in many countries, credit policies do not favour smallholders at all, men or women.

1.3.3 Land

In Nigeria, as in most part of Africa, land is obtained in three ways: by inheritance, by purchase, and by application to government relevant ministry. Women are usually excluded from the first and by far the most common access to land. Men alone usually inherit land. Women obtain land for agricultural uses through their brothers and other male relatives in their natal families and their husbands in their marital families. This severely limited their production base, their income levels and loan raising ability (Adekanye 1993). Independent access to land is associated with greater investments by women in land conservation (World Bank, 1995).

1.3.4 Health and Food

Research has often shown that in some cultures, female children are fed only when the males have been properly fed. As family resources become scarcer so discrimination against girls in nutrition, health and educational expenditure increases (Palmer, 1991). The danger in this practice is that female children are then at the risk of starvation when there is food shortage. This again can have negative influence on the productivity of rural women.

1.3.5 Training and Extension Contact

As pointed out earlier, agricultural policies in Nigeria have generally been made by men and run for them. Women have remained largely marginalized and little affected by them. They have even been occasionally disadvantaged by some of these policies (Nelson 1981). A study (FAO 1992) showed that in Africa women make up eighty per cent of food producers but receive only two to ten per cent of extension contacts. This is partly because most extension agents are men. Even in countries that have created a separate women's extension unit, women farmers are served by small number of women extension workers since governments cannot afford to finance a women's unit of adequate size (Safilos - Ruthsehild, 1990). Extension services have therefore had little impact on women.

Many of these women are small-scale farmers at or near the subsistence level and, at this level, neither men nor women are adequately reached by extension. However, women, whether in cash crop production or the production of food for home consumption have less access to extension information than men. Since women form a large segment of the agricultural work force as such they deserve increased attention from agricultural extension services in every developing nation. There is a need for a blue print, an action oriented plan, for reaching the thousands of women in agriculture who fill the bread baskets of the third world and contribute to their exports.

In summary, there is a common theme in the literature and that is the asymmetry of obligations and reciprocities, in the allocation of household level resources between women and men and this like urban bias is seen as a source of distortion and inefficiency (Adepoju and Oppong 1994).

1.4 CASSAVA AND FOOD SECURITY IN NIGERIA

Increasing the productivity of small farmers can lessen chronic food insecurity arising from rural poverty and a shortage of food supplies. Cassava, Manihot esculenta Crantz (Euphorbeacea) perennial shrub is often characterised as women crop (Adekanye, 1983), because women are often the principal grower of food. Women do 70 to 80 per cent of the planting, weeding, and harvesting and 100 per cent of the processing of cassava, a root crop critical in times of food scarcity (Martin, 1987). It is widely distributed throughout the tropical world. It is a hardy, high yielding crop, that is adapted to a wide range of growing conditions. Cassava's adaptability to relatively marginal soils and erratic rainfall conditions, its high productivity per unit of land and labour, the certainty of a yield even under the worst conditions, and the possibility of maintaining a continuous supply year round make this crop a basic component of the farming system in most areas of sub-Saharan Africa (Nweke, 1996). Famine is rare in areas where cassava is widely grown, since it provides a stable base to the food production system and has the potential for bridging the food gap. Cassava is usually the cheapest source of food energy available especially, the processed forms. Table (1) below shows the comparative nutritive composition of cassava and some starch, roots.

Table 1.1 Food Composition of Five Roots Crops per 100gms Edible Portion

ITEM	UNIT	CASSAVA	POTATOES	SWEET POTATOES	YAM	TARO
Food Energy	Calories	140.0	82.0	117.0	105.0	104.0
Water	gms	62.5	78.0	70.0	72.4	72.5
Carbohy-drates	gms	34.7	18.9	27.3	24.1	24.2
Protein	gms	1.2	0.1	1.3	2.4	1.9
Fat	gms	0.3	0.1	0.4	0.2	0.2
Calcium	mgs	3.3	8.0	34	22	23
Iron	mgs	0.7	0.7	0.1	0.8	1.1
Vitamin A	I.U	trace	trace	500	trace	trace
Thiamine B1	mgs	0.06	0.10	0.10	0.09	0.15
Ribofla-vine B2	mgs	0.03	0.03	0.05	0.03	0.03
Niacin	mgs	0.06	1.4	0.6	0.5	0.9
Vitamin C	mgs	36	10	23	10	5

Source: FAO Food Composition Tables Minerals and Vitamins for International use (March 1954) pp 30-31 Cited in: NISER Monograph Series No. 11 1981.

It is evident from the table that cassava has very high carbohydrates content of 34.7gms and gives food energy of 140 calories per 100gms of edible portion. Cassava can be fortified with vitamins and minerals like "Soy-ogi". It supplies 70 per cent of the daily calories intake of over 50 million Nigerian (Ugwu et al. 1989).

1.5 FOOD CRISIS: A CALL FOR GENDER-AWARE APPROACH

Within the framework of government goal of ensuring widespread improvement in the well-being of households and individuals, better employment of human resources is an important intermediate objectives and a key means to other important ends, such as aggregate economic growth, more equitable distribution of wealth and income, increased labour productivity, alleviation of material poverty and political stability. In the light of the aforementioned reasons men and women should be recognised as important agents of development and the realization that women's labour and talents represent a vast under-utilized resource for development. This has become more imperative in a country like Nigeria where the communities are predominantly agricultural. Keen attention on both men and women and sustainable agriculture is the only way out of our present food crisis.

Accentuating this is the critical role of women in food production. Even, some historians of agriculture believe that it was women who first domesticated crop plants and thereby initiated the art and science of farming. While men went out hunting in search of food, women started gathering seeds from the native flora and began cultivating those of interest, from the point of view of food, feed, fodder, fibre and fuel (Swamithan, 1983). This view is strengthened by the fact that women have been traditionally seed selectors. Even today, this has continued in many parts of the developing world, as for example in Ifuago rice culture in the Phillipines and locust bean collection by Yoruba women in Nigeria.

Additionally, the following five basic categories of production, which taken together, embrace the output of the farm women, well again emphasize the pivotal role of women in rural agricultural communities in Nigeria.

(1) The non-wage agricultural production, which refers to output of crop and livestock, intended for home consumption or market sale;

(2) The household production, which encompasses goods and services, produced within the household for home consumption or market sale:

(3) Human capital production refers to child bearing, child care and the transmission of skills and knowledge;

(4) Self-employment in the informal market sector which includes off-farm production activities such as marketing and personal services and;

(5) The wage labour, which refers to, paid employment.

However, in spite of the central position occupied by women in agricultural production in the farm household, they have not been adequately integrated into the development system. Their efforts have been grossly under-utilized and relegated to the background. They are less of pressure group because of their strong attachment to traditional norms, influence of urbanization and glaring discrimination of government agricultural policies.

In general, in traditional African societies, men were evaluated more highly than women on most of the measures commonly used today to measure status. Women are oppressed through ideological and cultural mechanisms that make them feel inferior and passive and that isolate and privatize them within the family. In a way, it will be a dangerous illusion to believe that rural productivity can rapidly and radically increase without squarely facing up to the fact that in most African countries, women do the bulk of the farming that feeds the family and that their area of endeavour has up to the present, been relegated by governments and agricultural agencies to a low productivity.

From the foregoing, the underlying assumptions of this study include the following:

1. Failure to develop women's resources and skills undermines development as a whole.
2. Lack of women's access to funds with which to invest in agriculture is a major constraint in their efforts to purchase inputs, to hire labour or to invest in labour-saving technology. As a result plots controlled by women are farmed much less intensively than similar plots simultaneously planted to the same crop, but controlled by men.

3. The origins of women's poverty and inequality with men are attributable to their lack of access to productivity, augmenting opportunities like education, extension contact, land, capital and credit.

4. Factors, which influence women's economic efficiency, include women's differential access to agricultural inputs, household technologies, education and rural labour market.

5. Gender blindness could lead to errant policies and inappropriate identification of farms most in need of extension programmes. Thus, identification of the inefficient producers is very important, especially for government policy designed to promote efficient allocation of resources.

In the light of the above assumptions, Bailey et al (1987) noted that management ability, inventories, asset portfolio and outside resources may all contribute to a farmer's ability to succeed financially, grow, or be efficient.

Against this background, the high potential of cassava as both cash and food crop induced Nigerians to intensify its production through the programmes of the National Seed Service (NSS) which was established in 1986. By the end of 1990, the programme had made available to the Agricultural Development Projects (ADPs) enough improved cassava planting materials to plant 9130 hectares at the rate of 10,000 sets per hectare and provide support to the various ADPs in conducting 283,420 small adoption demonstration plots of the improved cassava growing areas of Nigeria (Nweke, 1995).

Additionally, it is becoming clearer in the recent time that persistent inequality between men and women constrains a society's productivity and ultimately slows down its rate of economic growth. For instance, Udele (1981) remarked that in Isoko Local Government Area of Bendel State, 14.28 per cent of the women who planted cassava in their husbands' farm did not have access to the income later realised from the product. But then, they might have used their labour and probably their money to tend the crop to maturity. The economy pays for this inequality in reduced labour productivity today and diminished national output tomorrow. Thus, more than ever before, there is an urgent need to assess the state of gender inequalities in Nigerian agriculture with the view to improving efficiency of resource use and allocation.

1.6 JUSTIFICATION FOR THE STUDY

Raising agricultural productivity holds the key to encouraging a stable rate of transition to an industrialized economy, improving income distribution and reducing the propensity to consume imported goods, in other words, stimulating growth and development. Thus in recent years, there has been a growing concern for farm efficiency and the question of how to measure it. Reasons for this are not far-fetched.

1. Measuring efficiency is important because this is the first step in a process that leads to substantial resource savings, with its implicit implications for both policy formulation and farm management (Boris et al 1991).

2. For individual farms, gains in efficiency are particularly important in periods of financial stress similar to what an average farmer is experiencing as a result of economic downturn in Nigeria.

3. Efficient farms are more likely to generate higher income and thus stand a better chance of surviving and prospering.

4. The upsurge in research along this line has been motivated in large part by an attempt to identify the factors influencing the efficiency of resource allocation in agriculture. More importantly in this era of structural adjustment programme, efficiency is a key determinant of smallholder farm survival.

5. Efficiency could be helpful in determining the cost of several poverty focused programmes being established by the government. Further, it should be possible to compare the attributes of the farms operating near the frontier with those of farms operating far from the frontiers.

Moreover, an underlying premise behind much of this work is that if farmers are not making efficient use of existing technology, then efforts designed to improve efficiency would be more cost-effective than introducing new technologies as a means of increasing agricultural output (Belbase and Grabowski, 1985). If this is the case, then empirical measures of efficiency are necessary in order to determine the magnitude of the gains that could be obtained by improving perfomance in agricultural production with a given technology (Bravo-Ureta and Pinheiro, 1997).

Be that as it may, in Africa rural women contribute about 80% of the labour force, in Asia about 70% and in Latin America about 45%. Additionally, on average they work about 10-15 hours each day and produce more than 50% of the needed food but two out of three adults in poverty are women (George, 1978). In other words, there is high tendency for feminization of poverty (Synder 1990). The worrying questions to ask are:

1. Why is it that so little substantive attention has been paid to the contribution potentials and needs of women in development relative to those of men?
2. Why have no really serious efforts been made until now, to strengthen women on going production activities and to broaden their opportunities to realize their full potentials?
3. Why is it that planners and programmers generally see women's concerns as welfare, rather than development matters or as narrow sideline elements of development, rather than one of the central perspectives for the whole development process?

Whatever the reasons, what is known about women is ignored or undervalued, but at the same time, lack of attention to women in development programme is attributed to paucity of information about them. It is the philosophy of this study, that if a man is maximising his utility by washing his face with one of his hands tied to his back, it will be cheaper to untie this hand than buy him a sponge. In other words, women should be given opportunity to exercise their full potential and seen as comrades in all development efforts.

1.7 CASSAVA AND PRICE OF GENDER BLINDNESS

In spite of government efforts, and high potential of cassava as a famine relief crop, chronic food insecurity and food gap still persist. Reason for this can be partly explained by the concept of strategic gender need which are related to economic and societal inequalities which can in turn affect the practical needs and constraints faced by women and men in cassava business. One way of analyzing these needs is to consider what control men and women have over resources and benefits from these resources at both the community level and within their households. Women's practical needs and the constraints they face are often related to their overall low-income status.

This relative disadvantage comes about through a combination of factors, particularly their lower levels of literacy, formal education and skill training. These barriers faced by women in terms of their overall economic status can obviously have an effect on their ability to purchase inputs such as fertilizer as well as their access to credit. Women's low-income status also means that they cannot afford to hire labour to help them in their farm business. So, labour constraints as well as time, access to land and lower extension contacts represent major constraints, for women to realise optimum output in cassava business.

Other problems include inability of extension agents to adequately understand the linkages between incentives and sex role differentials within the farm households. They might not have adequate insight into the responsibilities and constraints of individual members involved in agriculture. Too often they forget that both women and men are involved and needed to be considered in the technology development process. Perhaps they could be overwhelmed by the general belief that technology alone will solve the problem and is neutral to socio-economic differences among users. They may fail to understand who does what and with what in the production process.

Thus, there could be high tendency for misguided efforts, regarding to whom to direct their package of technologies. Also it seems appropriateness of a particular innovation to specific users has not been fully ascertained. All these are necessary for the design and introduction of appropriate gender sensitive techniques and tools to be used on the farm. In a way, they often fail to reach the people who are actually involved in the various activities of cassava business. Supports and intervention to enhance the particular stages of cassava business can be most effective only if they are designed with specific users of needed inputs and beneficiaries of returns in mind. So, the problems of male and female roles, constraints, opportunities and incentives need to be adequately understood since diversion of incentives can undermine any poverty-focused project.

Moreover, the absence of a gender perspective and sensitivity in the cassava production programme offered by the ADPs, perpetuate the invisibility, of women as a client group for ADP technology which amounts to a tragic waste of resources. Gender is a useful socio-economic variable to analyse this with the view of enhancing efficiency of resource utilization.

So, improved collection of data for differentiated analysis of women's and men's work and re-examination and interpretation of concepts and theories relating to their involvement, productivity, income differential and division of labour in development is imperative. Moreover, addressing gender issues will lay a sound foundation that will support any poverty focused project design, implementation and evaluation. It will also systemize the inclusion of gender concerns into development project documentation, not only for equity reasons, but also for the sake of efficiency. The target beneficiaries of the research are the small-scale farmers. Overall, enhancement of resource allocation efficiency in cassava production will improve the general well being of small-scale farmers and ensure long term food security goals. Also, it will increase income and job opportunities in the rural areas and help stem the tide of the rural-urban migration, which contribute to rising urban unemployment and crime rates. Hence, the study will strive to uncover an aspect of farming business which though, far reaching in its implications, has been neglected by most Agricultural Economists. Additionally, the results of this study will serve as an added source of information for further research works on gender concerns hence the need for this study.

1.8 OBJECTIVE OF THE STUDY

The general objective of this study is to assess the possibilities of enhancing productivity gains by improving the efficiency of small-scale agriculture, through gender-responsive intra-household allocation of resources in South-Western Nigeria. The specific objectives of the study are to:

1. Examine the degree of gender differential in access to productive resources in cassava based farm holdings with the view to evaluate and compare the economic efficiency of male and female cassava producers as users of resources.
2. Identify socio-economic factors which influence gender role and productivity differential in cassava smallholdings.
3. Analyze the incentive structure within the household and its relationship with the interdependence of men and women's roles in small-scale cassava based farms.
4. Estimate empirically the percentage of output lost due to the apparent misallocation of resources across cassava farms controlled by men and women.

5. Identify the constraints that impede cassava production among male and female farmers in the study area.
6. Based on the result of data analysis, make recommendations on operational policy options on how best to foster gender adaptation and improve productivity in cassava smallholdings.

1.9 THE STUDY HYPOTHESES

Given the underlying assumption that none of the cassava business involved is gender bound, and in the light of the objective stated, some of the key research hypotheses behind our test procedure include the following:

1. H_0: Socio-economic and physical factors are not the main determinants of gender asymmetry and inefficiency in cassava smallholdings.

   H_1: Socio-economic and physical factors are the main determinants of gender asymmetry and inefficiency in cassava smallholdings

2. H_0: Producer's control over the means of production and impact of development are unrelated hence has no influence on the economic efficiency.

   H_1: Producer's control over the means of production and effect of development have impact on development and hence on influence on economic efficiency.

3. H_0: Intra-household allocations of resources are Pareto efficient.

   H_1: Intra-household allocations of resources are not Pareto efficient.

1.10 THESIS FORMAT

Chapter two of the thesis deals with literature review and some theoretical frameworks underlying the study. Chapter three presents the research methodology and examines the key variables to be analysed in the study. Chapter four examines and discusses the socio-economic characteristics of the sampled farmers as they relate to their level of productivity. Further, chapter five discusses the results of empirical analysis stemming from stochastic production/cost frontier as well as translog functional forms and canonical discriminant analysis. Chapter six considers empirical analysis of problems impeding productivity growth of our respondents. And finally, chapter seven summarises the major findings of the study and presents the policy recommendations arising from the findings.

1.11 PROBLEMS AND LIMITATION OF DATA

The author believes that the method employed for the collection of data for this study is open to criticism. However it must be realized that collection of data of this nature in Oyo and Osun States where majority of the farmers are illiterates would not be an easy task. The research will touch a very sensitive aspect of the farm women's and men's life, for instance their annual income. Apart from memory bias, one could not rule out the possibility of the false information from their activities and their financial position. Again, given the current political and economic situation in the country, there is high likelihood of tension, fear and a lot of suspicion built up on the farmers. This may affect the reliability of the information given by some of the respondents.

However, in spite of the above, the researcher feels the information supplied are sufficiently reliable for this study.

CHAPTER TWO

LITERATURE REVIEW AND THEORETICAL FRAMEWORK

2.1 GENDER ISSUES

In the recent past, there has been increasing awareness of gender inequalities in developing countries. There is now greater knowledge and wider understanding of the importance of gender in development policy and practice. In the 1980s, there has been a growing trend towards seeing women as agents and beneficiaries in all sectors and at all levels of the development process. It is partly through an understanding of gender roles that this trend has emerged (Pietla, 1985). Gender has proven to be the most useful category to disaggregate the farms household and analyze intra-household behaviour (Cloud, 1987).

But disparities persist between men's and women's status and access to resources, control of assets and decision-making powers, which undermine sustainable and equitable development (World Bank, 1993). This was again exemplified in another report that persistent inequality between women and men constraints society productivity and ultimately slow its rate of economic growth. It was noted that evidence on the need for corrective action is more compelling today than ever (World Bank, 1995). In a 1989 International Development Research Center Study, Stamp observed that over the past two decades there has been an emerging moral and scientific commitment to the truth that women are half of humanity and that gender relations are as fundamental a shaping force in society as are economic relations or political structure. Indeed, there is no political economy that is gender neutral in development discourse; women are no longer entirely invisible, even if they still get far from equal time (Stamp, 1987).

In the light of the above, several scholars of women and development share the view of George, (1978) that in every development situation there are, indeed states of fact that can be identified as the contributions, potential and needs of women and that can be adequately understood, addressed and integrated into development undertakings. Exemplifying this and the need to pay more attention to women is the World Bank view, which may be grouped under six headings:

1. Women are disproportionately represented among the poor.
2. Economic changes have altered the traditional division of labour.
3. Women are responsible for preparing children for life; the quality of the future labour force depends on the health and education of mothers.
4. Rapid population growth rates are threatening development gains; one of the most effective ways to reduce birth rates is to educate women.
5. The survival of the new-born is associated directly with mother's nutritional status.
6. Leaving women out of development activities leads to inefficiency in resource use (Jiggins, 1984).

In fact, the state of world population points to some of the costs of ignoring the needs of women: uncontrolled population growth, ineffective agriculture, a deteriorating environment, a generally divided society and a poorer quality of life for all (Sadik 1989).

In 1995, World Bank reported that in modern agriculture, each additional year of education for women brings return of 2 to 15 per cent (comparable to those for men), evidence of the long-term effect of education on women's productivity. And that, bringing the physical and human capital of women farmers up to the level of men farmers would increase agricultural yields significantly.

This has become more imperative in Africa where communities are largely rural in settlement. And a number of investigators have substantiated the fact that women in sub-Saharan African have a predominant role in agricultural production. One of the pioneering efforts at synthesis of the information is contained in Boserup's book - "Women's Role in Economic Development" Boserup (1970) reviewed studies which have been made in African villages and found that in general more, women were usually working more hours per week in agriculture than the men. As a result, in almost all the cases, women were found to do around 70 per cent and in one case nearly 80 per cent of the total. A study of male-female differences and involvement in Nigerian agriculture indicate that the rural women work for longer hours and have fewer hours of leisure and rest than men, yet their status is generally lower than men (Adekanye, 1981). Average income levels for women are at least a third lower than the men's (Adekanye, 1983 and 1993). The report of a rural agricultural survey by the Federal Office of Statistics in 1984 on farm practice in Nigeria indicated that in Anambra, Benue and Imo States, over 80 per cent of women are involved in agricultural activities, women out-numbered the men in the farming business.

Paradoxically, women remained a highly marginalized group because they have little control over the major means of production (Dumor 1983). World wide, women face limited access to financial services, technology and infrastructure. They are locked into relatively low-productivity world (World Bank, 1995). Most agricultural development projects were planned and have been largely implemented by men. A fact that was rightly observed and substantiated by Nelson (1981) as she affirmed that development process have been run for and by men. And women have remained marginal to these processes, in some instances, have actually been disadvantaged by them. She described it as a tragic waste of human resources. While women are very much part of general development activity, they are not integrated into the development service network.

An investigator Staudt (1982) in her work alluded into a reason for this when she pointed out a statement from Kenya's (1929:3) Annual Report that illustrates an underlying assumption about female farmers in the evolution of agriculture. It quotes Lord Lugard whose words were dogma for many colonial policy makers "since men alone tend oxen in Africa, the result, as I have elsewhere said will be to replace female labour in the field to a large extent". Among the Christians some may argue that when the Lord spoke to Moses and said "when a man makes a special vow to the Lord which requires valuation of living persons, a male between twenty and sixty years old shall be valued at fifty silver Shekels, if it is a female, she shall be valued at thirty Shekels, (Leviticus 27:1-4). So in African agrarian societies, women have been passive and suppressed through ideological and psychological believes. In addition, Buvinic (1983) blamed the structure of power in third world societies as a major obstacle - productivity programs in general tend to be easily monopolized by the more powerful people in the community and the likelihood this may happen to programs for poor woman.

Just as in the industrialized countries, gender biased agricultural policies is a major determinant of women's poverty in the developing world. While considering the roles of women on farms Casson (1981) asserted that nearly all the women farmers interviewed had bitter experiences of discrimination directed against them for presuming to compete in a man's world. A ray of change was noticed by Nelson (1981) when she pointed out that the World Conference in Mexico City in 1975 marked the beginning of a global examination of women's roles in the economic, political and social life of their societies and a recognition of their right to participate fully and equally in all aspect of society.

Papanek (1979) supported that assertion when she argued that Women as members of families and households produce many goods and services that benefit other family members whether their work is paid or unpaid. However, understanding women's work and its worth is difficult. It is less visible, less clearly rewarded in concrete terms than the work of men, and it is more likely to be seen simply as a source of private comfort and welfare.

In Nigeria, where the settlements are predominantly agrarian, the role of men and women in different farming and livestock systems and off-farm employment should be brought to the focus for more scrutiny. Even, it has been asserted that research should move to more quantitative realm of rural household, including the role of women and men in different farming and livestock systems and off-farm employment and the role of women in household decision-making (Eicher and Baker, 1982). Its broader social and economic implications need to be brought out of hiding. A very significant fact (cited by Adepoju and Oppong 1994) to which Safilies - Rothschild calls attention and which needs to be more widely disseminated is that several studies have proved that when production conditions are equal, women farmers may be more productive than men.

2.2 Farm Efficiency Measurement

Farm efficiency and the question of how to measure it is an important subject in developing countries agriculture (Parikh et. al, 1995). However, the current interest in efficiency measurement began with the pioneering work of Farrell (1957). This has been motivated in large part by an attempt to identify the factors influencing the efficiency of resource allocation in agriculture. The analyses typically have centered on the technical, allocative and scale efficiency of farm production (Lau and Yotopoulos, (1973), Garcia et. al., (1982), Timmer, (1970), Havas and Aliber, (1993)). Economic or total efficiency is the product of technical and allocative efficiency (Boris and Rieger, 1991).

The analysis of efficiency has fallen into two broad categories. Parametric and non-parametric. The parametric approach relies on a parametric specification of the production function, cost function, or profit function, (e.g. Forsund, et. al., (1980) Bauer, (1990). Farrell's model, which is known as a deterministic non-parametric frontier (Fosund, et. al. 1980), attributes any deviation from the frontier to inefficiency and imposes no functional form on the data, (Boris and Reiger, 1991). A deficiency characterizing all deterministic frontier models is their sensitivity to extreme observation. Again, an important drawback of all the non-parametric measure is that they do not provide goodness of fit statistics for their estimates of productivity growth.

Hence we can not judge whether the differences observed are statistically significant (Mullen and Cox, 1976). Probably the most serious limitation relates to the fact that any deviation from the production frontier due to bad weather: measurement errors or merely statistical noise are lumped with actual technical inefficiencies (Kalaitzandonakes et. al, 1992). Aigner, et. al., (1977) and Meeusen and Broeck 1977 developed stochastic frontier model to ameliorate this problem. The stochastic frontier model assumes an error term with two additive components -

a symmetric component, which accounts for pure ramdom factors, and a one-sided component, which captures the effects of inefficiency relative to the stochastic frontier. Garcia et al (1993) remarked that for the parametric frontiers, the stochastic method results in much higher efficiency measure than the deterministic method, with approximately one-half of the farm inefficiencies found by the deterministic method being attributed to random occurrences by the Stochastic method. Here technical inefficiency could be measured separately from statistical noise (Kalaitzandonakes et al (1990). Work of Bravo - Ureta and Evenson (1994) among peasant farmers in eastern Paraguay using a stochastic efficiency decomposition methodology to derive technical, allocative and economic efficiency found an average economic efficiency of 40% for cotton and 52.3% for cassava. Implicit in their findings is the fact that there is a considerable room for productivity gains for the farms in the sample through better use of available resources given the state of technology.

The cost function approach is made possible by a 'dual' property of the Farrell efficiency indexes in which the measures are expressed either by terms of input vector norms (primal approach) or by variable costs (dual approach Akridge, 1989). In a number of applications, it is substantially easier to obtain good estimates of these functions than of the traditional production function and duality theory shows that any well-behaved cost or profit function, corresponds to a non-classical production function. Quiggin and Bui-lan (1984) and Parikh (1995) used a cost function approach to measure economic efficiency in Pakistan Agriculture. He concluded that 11.5% of the cost incurred could be avoided without any loss in total output. In the recent time, Mullen and Cox (1996) used translog cost function to estimate the extent and nature of productivity growth in Australian broad care agriculture.

2.3 FUNCTIONAL FORMS

Generally, in the literature, two groups of functional forms frequently occur: flexible and non-flexible. A functional form is flexible if it can provide a second order approximation to an arbitrary twice continuously differentiable function (which satisfies the appropriate regularity conditions). In the recent time, flexible functional forms are preferred to non-flexible functional form (NFFF).

Among widely used NFFF is Cobb-Douglas (1928) production function. The Cobb-Douglas model is also linear in parameter or hence its computation is relatively easy. These advantages not withstanding, it places restriction on some parameters of technological importance. Its disadvantages include assumptions of constant factor shares and unitary elasticity of substitution. Also it is not capable of generating a 'U' shaped cost curve.

Additionally, Arrow et al, (1961) introduced the constant elasticity of substitution (CES) production function which shared some of the characteristics of the Cobb-Douglas (C-D) production model. As its name suggests, it places *a priori* restrictions on elasticity of substitution, which though may assume any integer with the proviso that it is constant. Its other features include variable factor shares and increasing or decreasing returns to scale. In the limit CES functional form tends to C - D production function. Other NFFF models include Leontief and linear isoquant functional based model.

2.2.1 Flexible Functional Forms (FFF)

In the recent time, there has been an upsurge of interest in the use of flexible functional forms. Reasons for this include (1) application of duality theory in economics (2) a new awareness on the fact that there is usually more than two inputs and (3) advancement in computational facilities. Flexibility of functional forms is desirable because it allows the data to provide information about the parameters of interest without prescribing set of values for them. Thus, flexibility could be defined as the ability of the algebraic functional form to approximate arbitrary but theoretically consistent behaviour through an appropriate choice of parameters. Thus, the basic sets of constraints on flexible parameters of the functional forms (FFF) are based on theoretical or maintained hypothesis. Apart from these sets of constraints implied by maintained hypotheses, flexibility allows the functional form to take on any set of values.

Numerous flexible functional forms have been proposed, among them are (1) Transcendental logarithmic (translog or TL) functional form; Christensen, Jorgensen and Lau (1971, 1973) (2) Generalised Leontief (FL) functional form Diewert (1977)

(3) Generalised Cobb - Douglas (GCD) functional form: Diewert (1973) (4) Generalised Square Root Quadratic (GSRQ) functional form Diewert 1974 and (5) Generalised Box-Cox (GBC) functional form Berndt and Khaaled (1979). By far, the most widely used has been the translog function (Greene 1980). This is in part for being flexible and exhibit linearity in parameters. It also provides second order approximation to any arbitrary function.

We will concentrate on the stochastic frontier specifications proposed by (Aigner et al, 1977) in this study.

2.3 Choice of Functional Form

The major criteria commonly used:

2.3.1 ***Theoretical Consistency:*** Theoretically cost functions must be linearly homogeneous in factor input prices, non-decreasing in factor input prices, concave in factor input prices and non-decreasing in the quantity of output. Functional form must be selected to represent these desired properties. In addition such functional form must satisfy other desirable properties. For instance a consistent functional form may place *a priori* restrictions on some parameters (Greene, 1993).

2.3.2 Domain of Applicability: This concept has to do with the range of values within which the independent variables satisfy theoretical consistency requirements. Two types of domain of application are usually identified. These are global and local domains of applicability. Local domain of applicability implies that chosen functional form should satisfy theoretical consistency within the range of observed independent variables. Global domain of applicability on the other hand, required the chosen functional form to be theoretically consistent not only within the range of observed independent variables but also outside this range. This is usually desired but may not be practicable with most functional forms. Global domain of applicability enhances the robustness of the model. However, functional forms which satisfy theoretical consistency requirements locally are equally good especially when the model is not being used to forecast future trend (Ogunkola, 1991).

2.3.3 Flexibility: Flexibility implies ability of a model to represent arbitrary but theoretically consistent behaviour without placing strong restrictions on the parameters of interest. As pointed out by Lau (1986) in the case of cost functions, flexibility means that the function being used is capable of generating output supply and input demand functions whose own - and cross-price elasticity can assume arbitrary values subject only to the requirements of theoretical consistency at any arbitrary given set of prices.

2.3.4 Computational Facility: *Models* are designed to be solved at minimum cost. Hence some properties of chosen functional forms are necessary to facilitate its computation. These properties include:

(a) Linearity in Parameters: which postulate that parameters to be estimated are linear either directly or indirectly after necessary transformation of data might have been carried out.

(b) Parsimony in parameters: A functional form is parsimonious if it can provide the second - order approximation using a minimal number of parameters. This is another desirable properly aiding computational ease of a functional form. It requires that the chosen functional form should contain not more than the necessary parameters. This requirement will not only limit the problem of multi-colinearity but it will also conserve the degree of freedom and at the same time minimise the cost of computation. Other computational requirements ensure that the results, which are generated, are easy to interpret, explicitly representative and uniform.

(c) Factual Conformity: Lau (1986) identified other criterion for choosing among functional forms as the consistency of chosen functional form results with known relevant empirical facts. It worths noting that evidences abound in literature pointing to the fact that there is no Flexible Functions Form (FFF) which is always globally superior to all others. Be that as it may, in most empirical studies TL is preferred to any FFF. Thus selection of a FFF depends on (1) the type of data and structure of the system being modelled and (2) the purpose of the study in terms of parameters of interest (Ogunkola, 1991). Input costs were measured in terms of prices paid by each farmer for each input.

Further Udry et al (1995) used modified Cobb-Douglas and translogarithm methods to estimate the loss from the inefficient allocation, of inputs across plots within the household. Kumbhakar (1994) used flexible (translog) production function in estimating technical and allocative efficiencies using farm level data from West Bengal, India. The empirical results show that there is substantial scope for improving technical efficiency of these farms. The most efficient farm is about 14% below the production frontier.

In an effort to trace the sources of farm inefficiency, Parikh (1995) in Pakistan observed that at the aggregate level hired labour, fertilizer and manure were slightly underused while animal labour seemed to be significantly overused. He inferred that, providing rural education, extension services for expansion and propagation of modern techniques of production, and provision of credit, could reduce cost inefficiency. Bravo-Ureta and Pinheiro (1997) adopted a second step estimation method, where separate two-limit tobit equations for TE, EE and AE were estimated as a function of various attributes of the farms/farmers in the sample. He found positive correlation between EE and agrarian reform beneficiaries, farm size and formal education, but negative correlation with age and family size. We do not know of any gender disaggregated efficiency study among Nigerian peasants with such a rigorous analysis, but this piece of work.

2.4 CASSAVA

Be that as it may, the high potential of cassava as both cash and food crop compelled Nigerian to intensify its production through its programmes of the National Seed Service (NSS) which was established in 1986. By the end of 1900, the programme had made available to the Agricultural Development Projects (ADPs) enough improved cassava planting materials to plant 9130 hectares at the rate of 10,000 sets per hectare and provided support to the various cassava growing areas of Nigeria (Nweke, 1995). Prudencio and Hassan (1994) opined that the production of cassava for home consumption is guided by these objectives - short, medium and long term food security.The objectives are:

1. To bridge the food gap during hungry season (within - year security). After the stocks of preferred traditional staples such as maize, plantain, rice or millet has run down, cassava is used to supplement.
2. To have a food reserves on which to fall back so as to achieve between year conditions such as drought or pest invasions.
3. To maintain the per capita resource base, particularly land, declines in areas and quality, as a result of population growth or other factors.
4. To maximize profits where and when the demand for cassava and marketing possibilities are sufficient to generate profits.

With a lower resource cost (Hahn et. al, 1979; Ikpi et. al, 1986) cassava's virtue as a human food item is that it is a cheap land abundant source of energy (Ikpi et al, 1986). Okuneye and Igben (1981) agreed that the ability of cassava to provide the caloric requirement of Nigerian is indisputable and this will go a long way in providing food without which meaningful productive capacity needed for economic growth cannot be attracted. Wigg (1993) asserted that cassava represents the difference between hunger and sustenance. He called it the "Root of Life" across AFrica, Asia and Latin America, it supplies about 70 per cent of the daily caloric intake of over 50 million Nigerians (Nweke, 1995).

With the current trend of commercialization in farming business, cassava has become cash crop among the small holder's farmers. Sarma, (1987) argued that it is a source of subsistence and of cash income to poor farmers as well as a source of rural employment, particularly of women. Now that, the Federal Government of Nigeria has lifted ban on the exportation of food materials, cassava would favourably complement cocoa or rubber as foreign exchange earner. In 1982, the U.S. Agency for International Development (USAID) issued a Women in Development Policy Paper which emphasized efficiency considerations arguing that by delivering resources appropriately to both men and women project performance would improve (Cloud 1982).

In the same vein Akinwumi and Djato (1997) concluded that there is no economic rationale for biasing rice development strategies towards male farmers in

Côte d'Ivoire as female farmers when they have access to similar inputs have equal levels of economic efficiency. We argue in the same vein for cassava producers in Nigeria.

2.5 THEORETICAL FRAMEWORK

Farm household has offered to be an attractive unit of analysis for agricultural research purpose because of its uniqueness as unit of production, reproduction and consumption. In modern industrial society, the farm family enterprise is the focus of both production and reproduction. Within the context of Nigerian agriculture, which is predominantly rural in settlement, farm households produce most of the agricultural outputs. Each member of the household contributes to the production process. Atimes some members of the family may need to seek income from off-farm work to provide the cash resources necessary to sustain the farm enterprise. So family farm market and independent commodity production provide the vehicle through which husband, wife and children assume roles and acquire status in both the household and the larger community.

The foregoing paragraph points to the close relationship between the theory of household economics and the concepts of gender. By household economics we mean the concept of household production behaviour that has its basis in the new theory of consumer choice developed by Becker (1955), Lancaster (1966) and Muth (1966). This 'new' theory sees households as production-consumption units in which market goods and household resources (mainly time) are combined in a household technology to produce intermediate non-market goods "Z goods" which are then consumed in combinations that generated maximum utility (or satisfaction or welfare) for the households.

Traditional household models assume that a farm household function as single unit for productivity and consumption that a consensus exists among household members on the allocation of resources and benefits and that all-household member's interest and problems are identified (Cloud, 1987). The concept of gender describes the socially determined attributes of men and women, including male and female roles (Poats, 1991). It is how we define what it means to be feminine and what it means to be masculine in any society. Gender is not just another word for woman, but refers rather to the relationship of both men and women to the social and economic structure.

Contrary to the household economics, the concept of gender goes further to provide evidence for the fact that, adoption and productivity in the farm household is determined mainly be intra-household differences. Differences in the roles, incentives and constraints of men and women in the household. Household members are likely to have conflicting preferences in regard to the intra-household distribution of effort and reward.

In other words, recent evidence has challenged the underlying assumption of micro-economic analysis that the households interest can be aggregated into a single utility function, with its implicit corollary that the production and consumption objectives of individual family members are complementary rather than conflicting and that benefits and cost of changes will be distributed equitably. These assumptions are especially problematic in many societies where the division of obligations for family maintenance is highly gender-specific.

In these societies men and women allocate the resource under their control to activities that best enable them to fulfil their obligations rather than to activities that are most productive from an aggregate household perspective. A very clear example of this is the case of polygynous households in which household income generally is not pooled and each wife has clear and distinct responsibilities for herself and her children. In such cases, rather than viewing the household as single maximizing small firms, we should view it as a composite of small firms, with resources allocated according to separate utility functions. Further, to say that households behave as if they are single individuals is just a convenient and innocuous assumption in many contexts. In fact, it can be quite restrictive when investigating the cause and welfare consequences of gender differences in agriculture (Udry et. al, 1995). In his own view Chiappori (1992) claimed that such models of intra-household allocation assume only that Pareto efficiency is achieved. In a way, to assume that intra-household allocations of consumption are Pareto efficient is to say that the allocation of resources in production is allocatively efficient.

Going further, it implies that while the issues of gender and intra-household allocation may have distribution implications, they are unrelated to productive efficiency (Udry et. al, 1995). If we assume that households achieve Pareto efficiency, for example, we may argue that though discrimination against women in the allocation of credit might weaken the bargaining position of women, but any credit that reaches any member of a household will be allocated efficiently across the productive activities of all the members of the household. Looking at it from another perspective, suppose that in a given agricultural season a woman and a man are growing the same crop on their separate plots. If the two plots are identical in all respects except for the fact that one is controlled by the woman and the other by the man, then productive efficiency requires that yields, and input allocations be identical on the two plots. Udry vigorously argued that a necessary (but not sufficient) condition for Pareto efficiency within the household is that factors of production are allocated efficiently to the various productive activities of the household.

Going one step further, a necessary (but not sufficient) condition for the efficiency of the allocation of factors of production across the various activities of the household is that within any one agricultural activity (for example, cultivation of cassava) factors of production are allocated efficiently across the various plots on which it occurs. It is this final condition that is examined in this study. We are testing for first-best production efficiency, based on the null hypothesis that there is no information asymmetries or cultural constraints on the allocation of resources between men and women farmers.

Agricultural productivity by farm households in our area of study provides opportune environment in which to test this assumption. The opportunity is provided by the fact that, within many African households' agricultural production is simultaneously carried out on many plots controlled by different members of the household. In Nigeria, it is often the case that different members of this household simultaneously cultivate the same crop on different plots. Pareto efficiency in production implies that yields should be the same on all plots planted to the same crop within a household in a given year.

Analyzing incentive structure within the household helps to explain the abundant evidence of women's search for and protection of independent income sources as well as their preference for allocating their labour to activities where they control the product, for instance, to cassava processing for household consumption and sale rather than to the unpaid clearing of cassava fields that their husband control. Often, the practical and strategic needs related to the particular roles that women play in the gender division of labour in turn rise to specific constraints, which they face. The surest resource in a resource-poor farming family is often time. Pressures on use of family labour too can often result if men's and women's particular crops on their fields require attention at the same point of the agricultural production cycle.

Several decisions are made within the farm household which often reflect the size, structure and interaction of the family as a social unit. One aspect of these long-range planning decisions involves the generation of economic resource to support the family. Also operational decisions which focus exclusively, on the day-to-day running of the farm enterprise must be made, for instance, what to plant, where and when to plant. Furthermore, decisions on capital, which involves the allocation of economic resources between family or household needs and enterprise needs to be made. The gender mix of farm tasks and by extension, the configuration of on and off farm work roles reflects the relative importance of who takes what decision in the household. Studies on family decision making suggest that a sexual division of authority that exist in most families is better explained in terms of gender inequalities. World Bank (1995) under its collective household model opined that decisions on allocating resources reflect market rate of return, but they also mirror the relative bargaining power of household members within the collective. Bargaining power is a function of social and cultural norms as well as of such external factors as opportunities for paid work, laws governing inheritance and control over productive assets and property rights. These factors influence the terms governing household members access to resources and decisions about how those resources are used within the household. Thus an increase in household income may benefit some households but leave others unaffected or worse-off. The outcome depends on a member's ability to exercise control over resources both inside and outside the household, and it cannot be assumed that individual well-being increase as household income rises. In this study we shall attempt to quantitatively assess the above models via the use of stochastic production and cost frontiers. Theoretical frameworks of which are stated below.

The collective household model helps explain why gender inequalities persist even though household incomes increase over time. This study will adopt a collective household framework to explain how those inequalities exact cost in foregone productivity, reduced welfare for individuals and household and ultimately slower economic growth. Moreover, the choice of collective model matters, because certain types of interventions are effective, only under certain types of model regime. Also the efficacy of interventions might be heavily dependent on the type of intervention chosen.

2.5.1 Concept of Economic Efficiency and Duality Theory

In its simplest form a production function holds that it gives the maximum possible output which can be produced from a given bundle of inputs. In the same light, cost function gives the minimum level of cost, at which it is possible to produce some level of output, given input prices. Profit function gives the maximum profit that can be attained given output prices and input prices. Closely related to the above definitions are the concepts of maximality and minimality.Also, the word frontier is applicable because the function sets limit to the range of possible observations. So, the amounts by which a firm lies below its production and profit frontiers and the amount by which it lies above its cost frontier can be regarded as measures of inefficiency. Following Aigner,et.al, (1977).

Consider a firm employing **n** inputs $(X_1, \ldots\ldots, X_n)$, available at fixed prices $(W_1, \ldots\ldots W_n)^1 > 0$, to produce a single output Y that can be sold at fixed price $P > 0$. Efficient transformation of inputs into output is characterized by the production function f (x), which shows the maximum output obtainable from various input vectors. Given some regularity conditions an equivalent representation of efficient production technology is provided by the cost function $C(y, w) = \min_x (wx^1 / f(x) \quad y, x \geq 0)$, which show the minimum expenditure required to produce output y at input price w. Under certain regularity conditions a third equivalent representation of efficient production technology is provided by the profit function. $P(p, w) = \max y, x \ (py - w^1 x / f(x) \geq y, x \geq 0)$, which shows the maximum profit available at output price p and input price w. In econometric literature the functions f (x), c (y, w) and P (p, w) are typically referred to as optimizing behaviour on the part of an efficient producer and thus place limits on the possible values of the respective dependent variables.

Let us now suppose that the firm is observed at production plan (Y°, X°). Such a plan is said to be technically efficient if $Y^o = f(x^\circ)$ and technically inefficient if $Y^\circ < f(X^\circ)$. Note that $Y^\circ > f(X^\circ)$ is assumed to be impossible) One measure of the technical efficiency of this plan is provided by the ratio $0 \leq Y^\circ / f(X^\circ) \leq 1$.

Technical inefficiency is due to excessive input usage, which is costly, so $w^1 x^\circ \geq C (Y^\circ, W)$. Since cost is not minimized, profit is not maximized,and so $(PY^\circ - W^1X^\circ) \leq \Pi (p, w)$.

The plan (Y°, X°) is said to be allocatively efficient if $f_i (X^\circ) / f_j (X_0) = W_i/W_j$ and allocatively inefficient if $f_i (X^\circ)/f_j (x^\circ) \neq W_i/W_j$, assuming f to be differentiable. Allocative inefficiency results from employing inputs in the wrong proportions, which is costly and so $W^1 X^\circ \geq C (Y^\circ, W)$. Since cost is not minimized profit is not maximized, and so $(PY^\circ - w^1x^1 \leq \Pi (P, W)$.

It follows that observed expenditure w^1x° coincides with minimum cost $C (Y^\circ,W)$, if and only if, the firm is both technically and allocatively efficient. If $W^1X^\circ > C (Y^\circ, W)$, this difference may be due to technical inefficiency alone, allocative inefficiency alone, or some combination of the two. It also follows that observed input usage X° coincides with cost minimizing input demand $X (Y^\circ, W)$ if and only if the firm is both technically and allocatively efficient.

A combination of technical and allocative inefficiency cause $X_i^\circ > X_i (Y^\circ, W)$ for at least some inputs but may cause $X_j (Y^\circ, W)$ for some other inputs (Agner et. al, 1977).

(a) Econometric Models

Several efforts have been made to develop a framework that permits estimation of the various frontiers, and allows calculation of the magnitudes and cost of the various types of inefficiency relative to these frontiers.

Studies of frontier technology can be classified according to the way the frontier is specified and estimated. First, the frontier may be specified as a parametric function of inputs, or it may not. Second, an explicit statistical model of the relationship between observed output and the frontier may be specified or it may not. The frontier itself may be specified to be either deterministic or random.

(b) Deterministic non-parametric frontiers

The beginning point for any discussion of frontiers and efficiency measurement is the work of Farrell (1957), who provided definitions and a computational framework for both technical and allocative inefficiency. Consider a firm, using two inputs X_1 and X_2 and producing output Y, and assume that the firm's production function (frontier) is $Y = f(X_1, X_2)$. Assume that it is characterized by constant returns to scale, so that it may be written $1 = f(X_1/Y, X_2/Y)$. That is, frontier technology can be characterized by the unit isoquant. Let this unit isoquant be denoted UU^1 in Fig. 2.1.

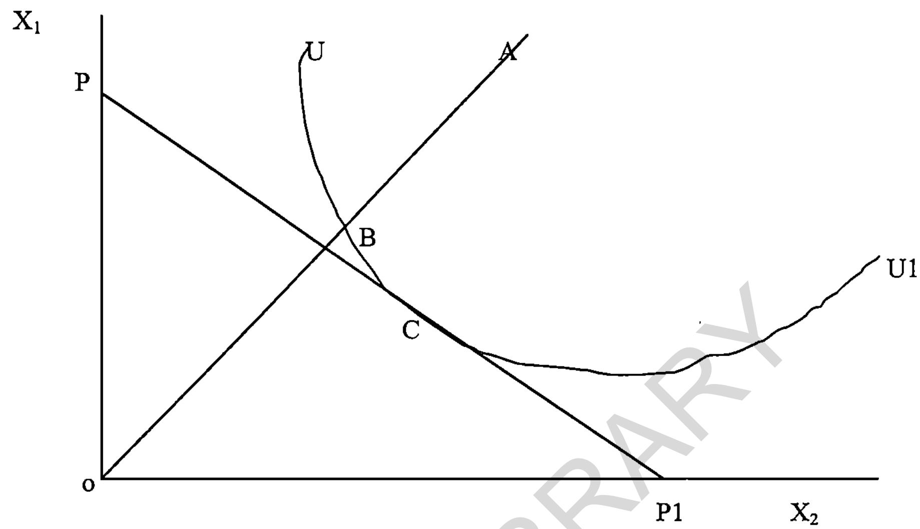


Fig. 2.1 Farrell's Frontier Production Function

In the figure above, values of X_s are plotted against the two inputs planes X_1 and X_2. Each point represents the input combination used by a particular farm to produce one unit of output. The resulting envelope of the observed points labelled UU_1 is Farrell's efficient unit isoquant. Farms represented by points inside the envelope curve can be said to be using whatever factor combination they do use less efficiently than they might, given current technology. With any given factor proportions – say that represented by the ray OA in the Fig. 2.1 above one unit of output can be produced from input levels at point B. Thus the amount of factor used by the farm from which we observed are larger than necessary. A measure of the degree of efficiency is the ratio OB/OA – the ratio between the input combination necessary to efficiently produce one unit with the given factor proportions and that actually observed. Farrell defines this ratio, as the technical efficiency (TE) rating of point A. Even a farm using a technically efficient input combination may not be producing optimally depending upon prevailing factor prices. Given factor prices as pp' line in Fig. 2.1 above, only a farm producing at point C is economically (technically and price) efficient for it is the least factor combination. The farm at point B is only technically efficient. The optimal factor combination given point C has the same total costs as point D that represents the same factor proportion as the farm at point A.

Thus the price efficiency (PE) of the input combination represented by the ray OA is given by OD/OB. In other words, the ratio between tow costs of producing one unit using actual factor proportions in a technically efficient manner and total costs of producing one unit using optimal factor proportions in a technically efficient manner.

Finally, the product of technical efficiency and price efficiency indices yields overall or economic efficiency (EE). This is intended to relate the costs per unit of output of the optimal input combination, to that of actual combination: algebraically.

$$
\begin{aligned}
EE &= (TE) \times (PE) \\
&= {}^{OB}/_{OA} \times {}^{OD}/_{OB} \\
&= \frac{OD}{OA}
\end{aligned}
$$

The efficient unit isoquant is of course not observable, it must be estimated from a sample of (possible inefficient) observations like A above. Farrell's approach is non-parametric in the sense that he simply construct and the free disposal convex hull of the observed input - output ratios by linear programming techniques, this is thus supported by a subset of the sample, with the rest of the sample points lying above it.

The principal advantage of the approach is that no functional form is imposed on the data. The principal disadvantage is that the assumption of constant returns to scale is restrictive, and its extension to non-constant returns to scale technologies is cumbersome. A second disadvantage of the approach is that the frontier is computed from a supporting subset of observations from the sample, and is therefore particularly susceptible to extreme observations and measurement error.

(c) Deterministic Parametric Frontiers

Later Farrell proposed computing a parametric convex hull of the observed input - output ratios. He recommended the Cobb-Douglas form, which was followed after about a decade by Aigner and Chu, (1968). They specified a homogeneous Cobb - Douglas production frontier, and required all observations to be on or beneath the frontier, their model is of the form.

$$\ln = \ln f(x) - u$$

$$= \alpha_0 + \sum_{i=1}^{n} \alpha_i \ln x_i - U \qquad U \geq 0 \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \quad (1)$$

Where the one-sided error term forces $Y < f(x)$.

The elements of the parameter vector $x = x_0, x_1 \ldots\ldots x_n)^1$ may be 'estimated' either by linear programming or by quadratic programming. The technical efficiency of each observation can be computed directly from the vector of residuals, since U represents technical inefficiency.

The main advantages of the parametric approach are:

1. The ability to characterize frontier technology in a simple mathematical form,
2. The ability to accommodate non-constant returns to scale.

However, the mathematical form may be too simple, the parametric approach imposes structure on the frontier that may be unwarranted. The parametric approach often imposes a limitation on the number of observations that can be technically efficient.

As in the non-parametric approach, the 'estimated' frontier is supported by a subset of the data and is therefore extremely sensitive to outliers. Another problem with this approach is that the estimates, which it produces, really have no statistical properties. That is, mathematical programming procedures produce 'estimates' without standard errors, t-ratio, etc.

Basically this is because no assumptions are made about the regressors or the disturbances in equation (1) and without some statistical assumptions inferential results cannot be obtained.

(d) Deterministic Statistical Frontiers

Few assumptions are made in order to make the above sections amenable to statistical analysis. For instance

$$\ln y = \ln x_{ij} + \sum \beta_j \ln x_{ij} - u_i \qquad (2)$$

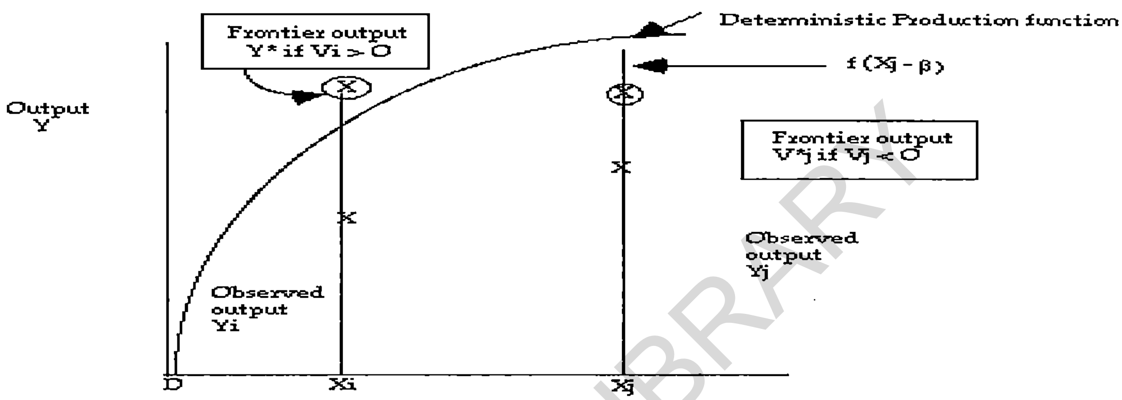
The assumptions are (1) the observation on U are independently and identically distributed (iid) and that X is exogenous (independent of u). This specification of a particular distribution for U allows equation (2) to be estimated through maximizing likelihood procedures (Kalaitzandonakes et. al, 1992). However, these estimation procedures are not independent of the distribution assumptions of U. It is relatively easy to estimate. However its limitation relates to the fact that any deviation from the production frontier is designated as technical inefficiency and is measured by U. Thus, deviations from the frontier due to bad weather, measurement errors, or merely statistical noise are lumped with actual technical inefficiencies. In addition, deterministic parametric frontiers are susceptible to outliers.

(e) Stochastic Parametric Frontiers

In the above section all frontiers are deterministic; what differentiate deterministic frontiers from stochastic frontiers is that within the specification of stochastic frontiers, firms may deviate from the production frontier not only because of technical inefficiency but also because of measurement error, statistical noise or other non-systematic influences. Within the framework of stochastic frontiers, this is accomplished by introducing in the estimation an error term that is composed of two part as Y = f (x) exp. (v-u). In the stochastic specification of the production frontier above, V is a symmetric error component that accounts for random effects and exogenous shocks, while exp. (-u), u > 0 a one-side error component that measures technical inefficiency.

This specification was first introduced by Aigner et al (1977) and Meeusen and Van den Broeck (1977) and has been extended by Jondrow et al (1982) to allow for estimation of the individual firm efficiency levels with cross-sectional data. Estimation of the frontier is then a statistical problem, and the usual types of statistical inference are possible (Schmidt and Lovell, 1979).

Following George and Battese (1992) the basic structure of the stochastic frontier model y = f (xi, β) exp. (Vi - Ui) i = 1, 2 .... N is depicted in Fig. 2.2 below in which the productive activities of two farms, represented by i and j, are considered. Farm i uses inputs with values given by (the vector) xi and obtains the output, yi, but the frontier output, yi exceeds the value on the deterministic production function, f (xi, β), because its productive activity is associated with favourable conditions for which the random error, Vi is positive. However, farm j uses inputs with values given by (the vector) Xj and obtains the output, Yj which has corresponding frontier output $Y^x{}_j$ which is less than the value on the deterministic production function, f (xj, β) because its productive capacity is associated with unfavourable conditions for which the random error, Vi is negative.



Stochastic Frontier Production Function

In both cases the observed production values are less than the corresponding frontier values, but the (unobservable) frontier production values would lie around the deterministic production function associated with the firms involved.

Although a stochastic production frontier is a useful construct, there is one serious limitation in the information it contains. A production process can be inefficient in two ways, only one of which can be detected by an estimated production frontier (Schimdt and Lovell, 1980). It can be technically inefficient, in the sense that it fails to produce maximum output from a given input bundle, technical inefficiency result in an equi-proportionate over-utilization of all inputs. It can also be allocatively inefficient in the sense that the marginal revenue product of an input might not be equal to the marginal cost of that input, allocative inefficiency results in utilization of inputs in the wrong proportions, given input prices. Since estimation of production frontiers is carried out with observations on output and input only, such an allocative inefficiency, and hence cannot be used to draw inference about total or economic inefficiency.

2.5.2 Cost Functions and Duality Theory

Duality between cost and production functions implies that cost functions which satisfy certain regularity conditions (and well behaved) corresponds to and yield an equally well behaved production function. The converse also holds. Application of duality theory has not only made studies of production functions via cost functions studies possible but has also relatively made them easier to estimate.

For instance, input demand functions are more easily derived from cost functions by applying Shephard's lemma and differentiating the cost functions with respect to corresponding input prices. Availability of data on prices of inputs and level of output as opposed to quantity of inputs has favoured cost function estimation.

However, a well behaved cost function must satisfy some minimum conditions. In general terms, the necessary restrictions for a cost function to be well behaved are: positivity or monotonicity, linear homogeneity in input prices (symmetry, equality and cost exhaustion restrictions) and concavity of the cost function in input prices.

Positivity (monotonicity) ensures that predicted cost share must be positive definite (non-negative) at each data point. Linear homogeneity in input prices (which is achieved through combinations of three restrictions, symmetry, cost exhaustion and equality restrictions) ensures that as the level of output is fixed and all prices are increased, the total cost also increases proportionately. In general terms, for a cost function C (p) to be well behaved the following conditions must be satisfied:

$C(P) > 0 \quad \forall P > 0$ .... Positivity

$C(\lambda P) = \lambda C(P) \; \forall \lambda > 0$ .... Linear homogeneity in input prices

$C(\lambda P_1 + (1 - \lambda) P_2) > \lambda C(P_1) + (1 - \lambda) C(P_2)$

$P_1 > 0, P_2 > 0$ and $0 < \lambda < 1$................ Concavity in input prices

Flexibility of duality theory enhances its wide applications in economic analysis. However, while duality theory suggests in general terms the theoretical requirements to be met by any dual functional form to correspond to its primal ability of different specifications or models to capture reality especially as relates to specific issues is a major factor in preferring one functional specification to others (Ogunkola, 1991).

For this study our minimum maintained hypothesis, is that the cost function is linearly homogeneous in input prices. This implies the following restrictions on the cost function.

$$\Sigma\ \alpha_i \quad = 1 \ldots\ldots\ldots\ldots\ldots\ldots\ldots \qquad (3)$$

$$\Sigma\ \alpha_{qj} \quad = O \ldots\ldots\ldots\ldots\ldots\ldots\ldots \qquad (4)$$

$$\Sigma\ \alpha_{ij} \quad = \Sigma\ \alpha_{ji} \quad = \Sigma\Sigma\ \alpha_{kj} \quad = \quad O \ldots\ldots\ldots\ldots\ldots\ldots\ldots \qquad (5)$$

Restriction (3) imply that total cost of production must be accounted for by all the factors of production. In order words, total cost must be exhausted by all the factors of production. Restrictions (4) which follow from restriction (3) imply that total factor costs are accounted for by the total output. Thus restrictions (3) together with restrictions (4) form cost exhaustion restrictions on the Translog (TL) cost function. Restriction (5) are known as symmetry restriction and they ensure that the second order partial derivatives are identically equal to each other not withstanding the order of differentiation.

While the three sets of restrictions jointly impose linear homogeneity in input prices Pi on the cost function, they do not directly eliminate any of the parameters; rather, their effects are on the magnitude and direction of the parameters in the model. Secondly, these restrictions enable some parameters to be generated from estimated parameters.

These restrictions are incorporated into the model prior to estimation by using cross-equation restrictions. Thus when n - coefficients are expected to sum up to zero or unity, we explicitly estimate any n-1 of the n-coefficients while the remaining coefficient is generated as residual. The implication of these cross-equation restrictions is that one of the equations become redundant and hence it is dropped from the system. In general, for an n-factor model, n equations from the model, which is, made up of the cost function and n-1 share equations. Given the nature of restrictions involved any of the share equations could be dropped without affecting parameters estimates significantly.

Linear homogeneity in input prices implies n+2 restrictions on the parameter estimates of the cost model. These restrictions are summarized in equations (3) - (5) above, therefore for the most aggregative model, there are $(n(n + 1) /2 + 2n + 3)$ parameters to be estimated. Other parameter $(N + 2)$ are calculated from the estimated ones given their relationships.

Two other basic restrictions, which are usually tested for, rather than imposed are monotonicity and concavity. The former ensures that a positive input generates at least non-negative outputs, and concavity in input prices ensures diminishing marginal rate of substitution between any two-factor input.

In our search for the technologies, which best describe cost/production structure of the small-scale cassava production in Nigeria models stated below were specified and estimated.

Thus following Greene (1993), we assume that the objective of the farm is to minimize cost subject to the production technology, viz.:

Min Px subject to Y = f (x).................. (6)

Where x is a vector of j inputs and P is the corresponding input price vector, Y is a scalar output, and f (.) is the production technology. An alternative to the primal approach is to start from a minimum cost function,C (p, Y) ....(7)

The solution to the problem of minimizing the cost of producing a specified output rate given a set of factor prices produced the cost minimizing set of factor demand, $X_m = X_m$ (Y, p)The total cost of production is given by the cost function

$$C = \sum_m P_m X_m (Y,P) = C(Y,P)$$

If there are constant returns to scale, it can be shown that

$$C = Y_c(P) \, or \, \frac{C}{Y} = C(P) \ldots\ldots\ldots\ldots\ldots (8)$$

Where c(p) is the unit or average cost function, the cost minimizing factor demands are obtained by supplying Shepards (1970) Lemma which states that if c (Y, P) gives the minimum total cost of production, then the cost minimizing set of factor demands is given by

$$X_m = \frac{\partial c(Y,P)}{\partial P_m} = \frac{Y \partial C(P)}{\partial p_m}$$

Alternatively, by differentiating logarithmically, we obtain the cost -minimizing factor cost shares:

$$S_m = \frac{\partial \ln c(Y,P)}{\partial \ln P_m}$$

$$= \frac{P_m X_m}{C}$$

With constant return to scale, ln C (Y, P)

$$= \ln Y + \ln C(p), \qquad \text{So}$$

$$S_m = \frac{\partial \ln c\,(p)}{\partial \ln p_m} \quad \text{...}(9)$$

In many empirical studies, the objects of estimation are elasticities of factors, substitution and the own price elasticities of demand. These are given by

$$\theta mn = \frac{C\,(\partial^2 C / \partial P_m \partial P_N)}{(\partial\ C/P_m\ )\,(\ \partial C/\ \partial P_n}$$

$$\eta_{mm} = S_m \quad \theta_{mm}$$

By suitably parameterizing the cost function (8) and the cost share (9) we obtain on M or M+l equation econometric model that can be used to estimate these quantities..The translog function is the most frequently used flexible functions in empirical work. By expanding c(p) in a second order Taylor - series about the point in p = o we obtain

$$\ln c = \beta_0 + \sum \left(\frac{\partial \ln c}{\partial P_m} \right) \ln P_m + \frac{1}{2} \sum_m \sum_n \left(\frac{\partial^2 \ln c}{\partial \ln P_m \partial \ln P_n} \right) \ln P_m \ln P_n$$

Where all derivative are evaluated at the expansion point. If we identify these derivatives as coefficient and impose the symmetry of the cross-price derivatives, the cost function becomes

$$\ln c = \beta_0 + \beta_1 \ln p_1 + \ldots\ldots\ldots\ldots\ldots\ldots\ldots \beta_m \ln p_m$$
$$+ \quad {}_{11}(\ln p_1)^2$$
$$\vdots \qquad\qquad \vdots$$
$$+ \delta_{12} (\ln p_1 \ln p_2 + \delta_{n2} \frac{(\ln p_n)^2}{2}$$
$$+ \ldots\ldots\ldots\ldots\ldots\ldots\ldots \frac{\delta MM (\ln p_M)^2}{2}$$

This is the transcendental logarithmic or translog, cost function. If dmn equals zero, it reduces to the Cobb - Douglas function. The cost share are given by

$$S_1 = \frac{\partial \ln c}{\partial \ln P_1} \beta_1 + \delta_{11} \ln p_1 + \delta_{12} \ln p_2 + \ldots\ldots\ldots\ldots\ldots\ldots\ldots + \delta_{1m} \ln p_m$$
$$S_2 = \frac{\partial \ln c}{\partial \ln p_1} \beta_2 + \delta_{12} \ln p_1 + \delta_{22} \ln p_2 + \ldots\ldots\ldots\ldots\ldots\ldots\ldots + \delta_{1m} \ln p_m$$
$$S_m = \frac{\partial \ln c}{\partial \ln p_1} \beta_2 + \delta_{12} \ln p_1 + \delta_{22} \ln p_2 + \ldots\ldots\ldots\ldots\ldots\ldots\ldots + \delta_{mm} \ln p_m$$

The cost shares must sum to 1, which requires in addition to the symmetry restrictions already imposed.

$$\beta_1 + \beta_2 + \ldots\ldots\ldots + \beta_m = 1$$
$$\sum_m \delta_{mn} = 0 \quad (column \;\; sums \; equal \; zero)$$
$$\sum_n \delta_{mn} = 0 \quad (culumn \;\; sums \; equal \; zero) \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (10)$$

The system of these equations provides a seemingly unrelated regressions model that can be used to estimate this parameters of the model. To make the model operational, we must impose the restriction in (10) above and solve the problem of singularity of the disturbance covariance matrix of the share equations. The first is accomplished by dividing the first M-1 prices by the Mth, thus eliminating the last term in each row and column of the parameter matrix. As in Cobb - Douglas model, we obtain a non-singular system by dropping the Mth share equation. We compare maximum likelihood estimates of the parameters in order to ensure invariance with respect to the choice of which share equation we drop. From the translog cost function the elasticities of substitution are particularly simple to compute once the parameters have been estimated.

$$\theta_{mn} = \frac{\partial_{mn} + S_m S_n}{S_m S_n}$$

$$\theta_{mm} = \frac{\partial_{mm} + S_m (S_m - 1}{S^2 m}$$

These will differ at every data point. It is common to compute them at some central point such as the means of the data.

CHAPTER THREE

METHODOLOGY

3.1 AREA OF STUDY

The study covered South-Western zone of Nigeria (Lagos, Oyo, Osun, Ogun, Ondo, Ekiti states).This area produces on the average 19.43 per cent of cassava output and engages more than 34.30 per cent of the labour force in cassava production in Nigeria (FOS, 1985).

Broadly, with its wide range of ecological and socio-economic conditions, Nigeria provides an important cassava zone in Africa. The country has estimated cassava production land of 415 thousand hectares, which represent 5.2 per cent of the total cassava production area in Africa. The study area is classified as lowland semi-hot isothermic climatic region with a mean daily growing season temperature 22°C with a range less than 10°C and less than four months of dry season (Carter and Jone 1989).

3.2 Criterion for viability

The concept of viability relates to situation where the particular economic unit under discussion is capable of sustaining itself. Here we consider a viable cassava farmer as one who is capable of at least maintaining the prevailing standard of living in a particular area and also able to pay off the total farm expenses. In other words, a farmer who is able to meet up with his expenses on cassava production and still have enough to take further risk of planting the subsequent year. A viable small farmer has been defined as one who has positive net income after meeting all the farm and family expenses. On the other hand, a small farmer who has negative net income is a non-viable small farmer. The farm business income includes income from crops and non-crops.

Results of data analysis from a series of Consumer Expenditure Surveys (CES) conducted by the Federal Office of Statistics (FOS) in 1980, 1985, 1992 and 1996/97 were used. Total Real per Capita Expenditure was used as a proxy for the standard of living of the households in the study area. This was worked out to be N4911.04 annually for a family of five to nine (FOS, 1999).

3.3 SAMPLING DESIGN AND COLLECTION OF DATA

The sample was spread over two states, (Oyo and Osun) which are geographically contiguous in Oyo and Osun states. A two-stage stratified random sampling of villages and households was effected. This was followed by the purposive sampling of the ultimate respondents. The list of villages as compiled by the Monitoring and Evaluation Units of Agricultural Development Programme in each state were used as sampling frame. In all, 149 men and 138 women small-scale cassava farmers were selected. Out of whom 132 respondents were classified as non-viable farmers and 155 classified as being viable. About 36 respondents in every zone of 8 except one, taken purposefully from 10 villages. Farm units, which cultivate 5 or more hectares, were excluded. The author administered well-structured questionnare to characterize farmer's production, processing, marketing and consumption unit administered well-structured questionnaires. The information was collected on single visit and collection methods include direct observation, field measurement and individualized interview. Yield estimation was made for planted plots, which were nine months old, and above. Input costs were measured in terms of prices paid by each farmer for each input.

The frontier total cost function contains six variables: total cost, prices of labour, capital, fertilizer, land and output. Total cost is equal to the sum of expenditures for labour, land, fertilizer and inputed expenditures for capital. Labour expenses include both wage payments for hired labour and farmer's unpaid labour (owner operator). Output was measured in physical units of weight harvested. The yield plot method was adopted in the measurement of the output variable. This consisted of marking out a portion of the farm and measuring the area so marked out. Farmers harvested the crops within the marked area in the presence of the author who weighed the output. With the output of the marked area known, the estimated total output of the entire farm was calculated.Other information obtained include, the farm inventory of tools and equipment - for instance, value and cost of cutlasses, knives, hoes, baskets, headpans etc. It worth noting that none of these farmers keep records.

3.4 ANALYTICAL TECHNIQUES

3.4.1. Multivariate Discriminant Analysis

One of the objectives of this study is to examine some of the socio-economic and physical factors influencing gender role and productivity differential in smallholder cassava. Here we employed the use of discriminant analysis to separate and distinguish the two groups of persons, the viable and non-viable cassava farmers. To this end, each respondent (male and female) was measured on eleven variables. We want to know whether or not the measurement we obtain on the eleven variables can be used as a means of discriminating between viable and non-viable cassava producers.

The discriminant function was used to predict whether or not a small-scale cassava producer is likely to be viable. It is to be noted that the choice of this technique is informed by the principal difference between the discriminant function and regression analysis. The former contains a qualitative dependent variable whereas the later has a quantitative variable (Singh and Pandey, 1981). These two authors further noted that Fisher (1950) has shown that the two methods virtually merge, if the qualitative dependent variable is quantified by assigning the dummy values. However, with the help of discriminant function analysis two social groups can be separated which is not possible in regression analysis.

Here, the discriminant function, also known as a classification criterion was determined by a measure of generalized squared distance (Rao, 1973). Facilities in SAS version 6 computer software were used for the analysis. Given the assumption that each class has a multivariate normal distribution, the classification criterion was based on the individual pooled covariance matrix information, and it also takes into account the prior probabilities of the groups. Each observation was placed in the class from which it has the smallest generalized squared distance. Essentially, we attempted to compute the posterior probability of an observation belonging to each class. Beyond this, we were able to estimate the number of male and female belonging to either viable or non-viable cassava farmers. To this end, each farmer was measured on eleven variables.

QQ = Total value of output of woman/man from small-scale cassava business.

QJ = Operated size of cassava holding in hectare

EDU = Literacy = (Years of schooling)

EXP = Experience - years in farming

QK = Capital stock - is the sum total of equipment, cutlass, hoes, knives and baskets used mainly for production activities (naira)

SEX = Sex of the respondent male or female

AGE	=	Age of the woman/man (Years)
EXT	=	Number of extension contacts
QM	=	Per hectare of fertilizer use in naira
QL	=	Annual hired and family labour utilization in work days
CDIV	=	Extent of crop diversification

3.4.2 Measures of Inefficiency: A Stochastic Production Frontier Model

We begin with a Cobb Douglas production function

$$Y = \alpha \Pi X_k^{\beta k} \ell^{\varepsilon i} \qquad k = 1............k \; ; \quad i = 1.............n \quad ....(11)$$

where Y is the output of the ith farm, Xki is a vector of k inputs of the ith farm; b is a vector of parameters, εi is a farm-specific error term. The stochastic frontier is called a composed error model because the error term is composed of two independent elements namely:

$$\varepsilon_i = Vi - Ui \qquad i = 1 .... n$$

The economic logic behind this specification is that the production process is subject to two economically distinguishable random disturbances with different characteristics, Aigner, et. al, (1977) stated that when the output of individual firms is not found lying on the production frontier, this deviation could consist of a systematic as well as a random component. The term Vi is the symmetric component and permits random variation in output due to factors outside the control of the farmer like weather, diseases, and statistical noise and measurement error. A one-sided component (Ui > O) reflects technical efficiency relative to stochastic frontier. It is the systematic component, which consists of technical inefficiencies associated with differences in management abilities (Bailey et al, 1987). If Ui = O production lies on the stochastic frontier. If Ui > O, production lies below the frontier and is inefficient. Advantages derivable from this analysis include:

(1) the analysis is not based on the notion of a representative farm as in some studies

(2) an estimate of technical inefficiency can be obtained for each farm without panel data (Bailey et. al, 1987). This is accomplished by treating U as a random variable. Here we shall define technical efficiency as Y/Ymax, where Ymax is the maximum possible output obtained by putting Ui = O in (11)

Technically efficient farms produce output that lies on the stochastic production frontier with some random fluctuations because of V . Deviations from the frontier can be explained as differences in management that leads to less than optimum output given the level of inputs (Mundlak, 1961). It is the view of this study that possible differences in the level of productivity between men and women might not be as a result of one being inherently less efficient than the other. But the differences might reflect differences in access to inputs and thus to the intensity with which inputs are applied on men's and women's plots. In other words, this may be partly explained by the intra-household allocation of resources that is not Pareto efficient which afford the use or none use of particular resources as a result of differences in assets portfolio.

A profit-maximizing farm is said to be economically efficient if it is technically, allocatively and scale efficient (Bailely et. al, 1987). Allocative inefficiency occurs if the ratio of the marginal physical products of two inputs do not equal to the ratio of their prices (e.g. fj/fi ≠ wj/wi where fi is the marginal physical product of xi and wi is the price of the input xi). This relationship can be written as

$$f_j / f_i \neq w_j / w_i \exp(u_j) \qquad j = 1 \ldots\ldots\ldots\ldots n \qquad (12)$$

Where Uj is a representation of allocation inefficiency. If Uj = O, no allocative inefficiency exists and the first-order conditions of cost minimization are met. Equation (12) can be rewritten as follows:

$$\frac{x_j}{x_i} \cdot \frac{x_j}{x_i} = \frac{w_j}{w_i} \exp(u_j) \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (13)$$

Taking logarithms of (12) and (13) yields

$$\ln Y = \ln \alpha + \sum \beta_k \ln X_k + \varepsilon_i$$
$$where \ \ \varepsilon_i = v_k - u_k$$
$$\ln(\alpha_i / \alpha_j) - \ln w_i + \ln w_j + u_j \qquad j = 1, \ldots\ldots\ldots n$$

3.4.3 Method of Estimation

Here we will be dealing with estimation of (a) the production function parameters and (b) technical inefficiency parameter. Application of the ordinary least squares to equations (12) and (13) will result in inconsistent estimates, since technical inefficiency affects input demand. This can be avoided by the maximum likelihood (ML) technique that uses all equations (12) and (13). Of course, some distributional assumptions are to be made on the error terms. The two components V and U are assumed to be independent of each other where V is the two sided, normally distributed random error [$V \sim N(O, \sigma_v^2)$], and U is the one-sided efficiency component with a half-normal distribution $U \sim |N(O, \sigma_u^2)|$.

Following Jondrow et al, technical inefficiency (TI) for each observation is calculated as the expected value of Ui conditional on $\varepsilon i = Vi - U_i$

$$TI = E(u/\varepsilon) = \frac{\sigma_u \sigma_v}{\sigma} \left[\frac{\frac{f(\varepsilon\lambda)}{\sigma}}{1 - F\frac{(\varepsilon\lambda)}{\sigma}} - \frac{(\varepsilon\lambda)}{\sigma} \right]$$

where E is the expectations operator, f (.) and F (.) are the standard normal density and distribution functions

$$\alpha = (\sigma_v^2 + \sigma_u^2)^{\frac{1}{2}} \quad , and \qquad \lambda = \frac{\sigma_u}{\sigma_v}$$

3.4.4. Estimating Gender Differential in Allocative Inefficiency from a Stochastic Translog Cost Model

As a result of the development of duality theory, cost functions and profit functions have been used in a number of studies of production (Schmidt and Lovell 1977). In a number of applications it is substantially easier to obtain good estimates of these functions than of the traditional production function. Duality theory shows that any well behaved cost or profit function corresponds to a neo-classical production function (Quiggin and Ah Bui Lau, 1984). There exist considerable literature pointing to the fact that even though the actual vectors of prices faced by male and female farmers are equal, the measured prices may not; because of gender biases in the distribution of resources. So, because of gender differential in access to factors of production, asymmetric gender role and obligation within the household, this study presumes that there is violation of competitive assumption in the agricultural input market. Within the context of this study, which is cross-sectional, differences in time are excluded. Thus, variation in the vector of actual prices faced by farms can come only from differences in location or from violations of the competitive assumptions. Here, we assume climatic experience to be the same across all farms. Moreover, the farmers are assumed to be price takers.

In the patrilineal family set up of our study area, men are given position of authority over women in the household. This might, in part explain why it is possible for men to receive input subsidies independent of their own action. For instance, this could be in form of easier access to credit and other productivity augmenting opportunities like education, extension contact and land (Adekanye and Awoyemi, 1995). Also, there may be variation in the opportunity cost of operator and family labour (Udry et al, 1995). In particular, for a farm on which hired labour is not used or is sparingly used, it is possible that the opportunity cost of operator and family labour at the margin is less than the market wage. In such a situation, the competitive assumption that the supply of all factors are in infinitely elastic at the farm current price in this case, the marginal opportunity cost is violated.

Another area of gender biases, which may lead to price variation between male and female farmers, is that of input quality, that may be heterogeneous. Staudt (1985) remarked that when women and men manage separately a given crop, women's yields are often lower than men's because women are allocated inferior land. The fact that women often get farmland through men in most African countries, there is high likelihood that best land might be reserved for men. The point to make is that, male and female farmers employ inputs of various quality levels in different proportions to undertake their farm activities. Hence, if the price paid by either male or female farmer is measured by dividing total payments to that factor by the aggregate of total services of each factor, without regard to quality differences, then the price and quality differences will be confounded. In other words, price differences across farms could exist for two reasons. First, the "law of one price" (Chavas and Aliber, 1993) may not hold, implying that different farmers face different prices due to transaction costs and/or market imperfections. Second, the commodities may not be of homogeneous quality. In this case, different farmers may face different prices because they purchase inputs or sell outputs of different quality.

Against this background, we follow the cost functions based on the composed error model by Aigner, et. al., (1977) Schmidt and Lovell (1989) Parikh et al (1995)

Mullen and Cox (1996) Greene 1993, Tan et al, (1994) and attempt to put the foregoing theoretical underpinnings in a statistical form. Parikh (1995) remarked that any error in the production decision translated into higher cost for the producer. At the same time, the stochastic nature of production implies that the theoretical cost function is stochastic. With this, we have set out to use the stochastic frontier approach in which translog cost function will be specified and estimated using share equations. The estimated cost inefficiencies will then be related to socio-economic, demographic and farm variables.Variables to be considered for the analysis include the following:

Variables	Measuring units
Age of household head (AGE)	Years
Education (EDU)	Years
Farm Assets (QK)	Naira/hectare
Extension contact (EXT)	Numbers
Farm size (QJ)	Hectare
Fertilizer price (PM)	Naira/hectare
Human labour price (PL)	Naira/day
Fertilizer (QM)	Kilogram/hectare
Human labour (QL)	Days/hectare
Land price (PJ)	Naira/hectare
Asset price (PK)	Naira

It must be noted that for the computation of stochastic frontier production function, the total values of the variables were used. Following this, a transcendental logarithmic function was applied due to its flexibility since the more flexible the parametric form, the closer it will envelop the data (Tan et al, 1994). The choice of estimating a cost frontier was based on the exogeneity assumption i.e. output is exogenous. Additionally, the inherent advantage of estimating a system of equations (i.e. cost and cost-share equations) over a single equation in deriving more asymptotically efficient estimates of the technology led us to employ this estimation. The cost systems can be expressed as:

$$In\ TC = \ln TC\ (P, Q) + W$$

$$W = V + U$$

$$Sj = Sj\ (P, Q) + \varepsilon j$$

$$j = L, M \text{ and } K$$

where TC is observed total cost; TC (.) is the deterministic minimum total cost frontier, Q is output; P is an input price vector; V is a two-sided disturbance as stated earlier (statistical noise) and U is a one-sided (inefficiency), Sj is the observed share of the jth input, Sj (.) is the efficient share of the jth input, ej is the disturbance (composed of statistical noise and inefficiency) on the jth input share equation and L, M, J and K are labour, fertilizer land and capital inputs respectively.

With respect to the disturbance terms, U is assumed to be distributed truncated normally with zero mode while V is assumed to be normally distributed and independent of U and ε_i is assumed multinormally distributed and dependent of U, (Tan et. al.,1994)

These assumptions can be illustrated as follows:

$$V \approx N(0, \sigma_v^2)$$

$$\begin{bmatrix} U \\ \varepsilon \end{bmatrix} \approx N(0, \Sigma)$$

where

$$\varepsilon^i = (\varepsilon_L, \varepsilon_M, \varepsilon_K)$$

$$\Sigma = \begin{bmatrix} \sigma_{UU} & \sigma_{UL} & \sigma_{UM} & \sigma_{UK} \\ \sigma_{UL} & \sigma_{LL} & \sigma_{LM} & \sigma_{LK} \\ \sigma_{UM} & \sigma_{LM} & \sigma_{MM} & \sigma_{MK} \\ \sigma_{UK} & \sigma_{LK} & \sigma_{MK} & \sigma_{KK} \end{bmatrix}$$

(Σ is the variance - covariance matrix of the inefficiency disturbances of the cost and cost-share, equations).

Following Tan et al, (1994) the likelihood function for this system can be written as

$$\ln L = \sum_i \ln \lambda (w_i, \varepsilon_i)$$

$$= -\frac{1}{2} \ln (1 + \sigma_v^2 \sigma^{UU})$$

$$+ \frac{N}{2} \left[\ln \sigma^{UU} + \ln \sigma^{LL}(U) + \ln \sigma^{MM}(L) + \ln \sigma^{KK}(M)\right] + \sum_i \sum_j \ln f^*(Z_{ji})$$

$$- \sum_i \ln \left[1 - F^*(Z_{ui})\right] + \sum_i \ln \left[1 - F^*(A_i)\right]$$

$$i = 1 \ldots\ldots\ldots\ldots N \qquad j = L, M, U, \text{ and } K,$$

where N is the number of observations; σ_{UU} , σ_{LL} , σ_{MM} and σ_{KK} are elements of Σ^{-1} matrix; and f^* and F* are standard normal and standard normal cumulative density functions. Estimates of this model were calculated using command for ML estimation of constrained seemingly unrelated regression model (SURE) systems of LIMDEP econometric software (Greene, 1994).

The inefficiency component can be estimated as follows:

$$EI = 1 - E\left[\exp(-u_i) \mid w_i , \varepsilon_i\right]$$

where

$$E\left[\exp\,(-u_i\,)\;|w_i\;\varepsilon_i\,)\right] = \frac{\exp\left[-u_i^* + \dfrac{(\sigma^*)^2}{2}\right] . \left[1 - F^*(\sigma^* - (\dfrac{u_i^*}{\sigma^*})\right]}{1 - F^{**}\left(\dfrac{u_i^*}{\sigma^*}\right)}$$

$$U_I^* = \frac{-w_i + \sigma_v^2\,(\sigma^{UL} . \varepsilon_{Li} + \sigma^{UM} . \varepsilon_{Mi} + \sigma^{UK} . \varepsilon_{ki})}{1 + \sigma_v^2 . \sigma^{uu}}$$

$$\sigma = \frac{\sigma_v}{\sqrt{1 + \sigma_v^2 . \sigma^{uu}}}$$

In the final analysis, the different determinants of inefficiency were estimated by methods of iterated SURE.

Here, the stochastic frontier total cost function employing a translog functional form was adopted. The specification is as follows:

$$\ln\frac{TC}{P_{mi}} = \alpha_0 + \alpha_1\ln\frac{P_{Li}}{P_{mi}} + \frac{1}{2}\alpha_{11}(\ln\frac{P_{Li}}{P_{mi}})^2 + \alpha_2\ln\frac{P_{ji}}{P_{mi}}$$
$$+ \frac{1}{2}\alpha_{22}(\ln\frac{P_{ji}}{P_{mi}})^2 + \alpha_3\ln\frac{P_{ki}}{P_{mi}} + \frac{1}{2}\alpha_{33}(\ln\frac{P_{ki}}{P_{mi}})^2$$
$$+ \alpha_Q\ln Q_{ii} + \frac{1}{2}\alpha_{QQ}(\ln Q_i)^2 + \alpha_{12}\ln\frac{P_{Li}}{P_{mi}}\ln\frac{Pji}{P_{mi}}$$
$$+ \alpha_{13}\ln\frac{P_{Li}}{P_{mi}}\ln\frac{P_{ki}}{P_{mi}} + \alpha_1 Q\ln\frac{P_{Li}}{P_{mi}}\ln PQ_i$$
$$+ \alpha_{23}\ln\frac{P_{ji}}{P_{mi}}\ln\frac{P_{ki}}{P_{mi}} + \alpha_2 Q\ln\frac{P_{ji}}{P_{mi}}\ln Q_i$$
$$+ \alpha_{3Q}\ln\frac{P_{ki}}{P_{mi}}\ln Q_i + w_i$$

where TCi is the total cost of the ith sample, PLi, Pji, Pmi and Pki are respectively the prices of labour, land, fertilizer, and capital of the ith sample; and Wi is the disturbance consisting of statistical noise Vi and inefficiency Ui. As shown, dividing TCi, PLi, Pji and Pmi by Pmi has imposed the linear homogeneity in prices.

The symmetry of parameters (αij = α ji and αiQ = aqi) was also imposed.

The associatde cost-share equations are as follows:

$$S_{Li} = \alpha_1 + \alpha_{11}\ln\frac{P_{Li}}{P_{mi}} + \alpha_{12}\ln\frac{P_{ji}}{P_{mi}} + \alpha_{13}\frac{P_{ki}}{P_{mi}}$$
$$+ \alpha_{1Q}\ln Q_1 + \varepsilon_{Li}$$
$$S_{ji} = \alpha_2 + \alpha_{22}\ln\frac{P_{ji}}{P_{mi}} + \alpha_{12}\ln\frac{P_{Li}}{P_{mi}} + \alpha_{23}\frac{P_{ki}}{P_{mi}}$$
$$+ \alpha_{2Q}\ln Q_i + \varepsilon_{ji}$$
$$S_{ki} = \alpha_3 + \alpha_{33}\ln\frac{P_{ji}}{P_{mi}} + \alpha_{13}\ln\frac{P_{Li}}{P_{mi}} + \alpha_{23}\frac{P_{ji}}{P_{mi}}$$
$$+ \alpha_{3Q}\ln Q_i + \varepsilon_{ki}$$

Furthermore, for policy purposes, it is useful to identify the sources of these inefficiencies, which can be done by investigating the relationship between farm/farmer characteristics and the computed TE and AE indices.To do this, we relate the weights of the estimated canonical discriminant function to the computed efficiency indices.

3.4.5 Farm task allocation

Questions were asked about the participation of men and women in the decision making process concerning some areas of cassava production, processing and marketing. For example, respondents were asked, "for household and for individually owned cassava farm, who takes the decisions to do the following": to plant; (b) to harvest; (c) to process; (d) to use at home; (e) to market; (f) to obtain credit; (g) to hire or use family labour and (h) to use inputs. To measure the extent of women's participation in this type of farm task, a decision scale was developed. The wife and husband (Male and female) in each household were asked who they perceived had the major decision making responsibility for each of the farm tasks or activities. The response categories will be (1) wife, (2) wife and husband (3) husband.

The assumption is that successive answer will reflect less responsibility for women, 2, 1 and 0 points will be allocated, respectively. A total score of (y) points (n x 2) (where n is the number of areas of activities and y is the total score) represent the maximum score and will indicate that the respondent perceived the wife as having complete responsibility for decision making for each of the n areas. A score of 0 would indicate the respondent perceives the husband to be totally responsible for making decisions about the farm household cassava production, processing or marketing. The scores of each sex group were reported in bar graphs. Descriptive statistics were used to analyse activities (like planting, weeding, land clearing, harvesting etc) access and control profile among the respondents.

3.5 Non-Parametric Approach

In this study, attempt was made to find the level of agreement among the small holder cassava farmers to their common problems. To this end, a non-parametric approach was considered. This test is used when a test does not involve making any stringent assumptions about the distribution of the population measures. It is known as a distribution free statistics because it does not make any assumption about the distribution of the different measures or variables with which one may be concerned. It makes possible the statistical analysis of data which may not be numerically precise, but which rather represent some ranking of the statements being analyzed. This is particularly useful in such analysis where subjective ranking as in the case of this study. Another advantage is that the technique is relatively simple to use.

The non-parametric technique to be used is the Kendal Coefficient of Concordance. This gives us a measure of association among K judges. It is valuable because it provides a single measure of agreement among several statements expressed as rankings. This may indicate inter judge reliability.

Here we attempt to find out some of the problem confronting or limiting the productivity of small holder cassava farmers in the area of study. In particular, those that may limit their capacity to secure optimum and continuous, flow of income. Sampled farmers were asked to rank seven identified problems limiting the production of cassava in order of importance.

Few sampled farmers responded to the questionnaire and detail of the summary and analysis are presented later in the study. However, the following mathematical notations were employed.

$$R_j = \text{Sum of ranks}$$

$$\Sigma R_j = \text{Total sum of ranks}$$

$$\frac{\Sigma R_j}{N} = \text{Mean of sum ranks}$$

$$R_j - \frac{\Sigma R_j}{N} = \text{Deviation from rank mean}$$

$$SS_R = \sum \left(R_j - \frac{\Sigma R_j}{N} \right)^2$$

$$W = \frac{12 SS_R}{K^2 \, (N^3 - N)} = \text{Coefficient of concordance}$$

$$N = \text{Number of statements}$$

$$K = \text{Number of respondents}$$

Kendall's W will take values from 0 to 1 corresponding to no association (no common ranking) to 1 for identical ranking for all sets.

Test of Significant for Kendall's W

Null Hypothesis: The K sets of ranks are dependent

Alternative Hypothesis: The K sets of ranks are not dependent

$$Test\ stastic: \quad K(N-1)\,W = \frac{12SS_R}{KN(N+1)}$$

Rejection region: Reject the null hypothesis if K (N-1) W is greater than the critical value of the chi-square with a = α , degree of freedom (d.f) = N - 1.

3.5.1 The chi-square (X^2) Test

The chi-square test is the general method used to determine the significance of difference between two independent groups (observed and expected) with frequencies in discrete categories. This would be employed in the appropriate places to the problem of testing the significance of the agreement among respondents using the Kendall coefficient of concordance (W).

CHAPTER FOUR

4.0 SOCIO-ECONOMIC CHARACTERISTICS OF THE RESPONDENTS

Nigeria is still predominantly rural in settlement. This rural sector is characterised by many deep-rooted socio-economic and physical factors, which influence their level of resource use efficiency. Their need to acquire new set of knowledge and skills that will enable them to move from barely subsistence level of production to a market-oriented production makes it imperative for them to make efficiency and effectiveness, the thrust of their cassava business.

An underlying assumption of this study is that the origins of rural poverty and inefficiency are in part attributable to gender differencial in access to productivity augmenting opportunities like education, extension contact, land and capital to mention the few. Additionally, the gender blindness could lead to sterile policies, misguided efforts and inappropriate identification of groups in dire need of government incentives. Arising from this, we attempt to examine the gender imbalance in socio-economic relations as they affect agricultural development and productivity growth.

4.1 AGE

It is evident from Table 4.1 that more females get involved in cassava business earlier than their male counterpart. The results indicate that while as early as 25 years of age, girls were already engaged in cassava production, their male counterpart could be busy with other productive venture. It is to be noted that girls are often socialized in believing that their major role in the household is to prepare and provide food for the members, while their male counterpart are regarded as the bread-winners. Further, cassava, one of the major food crops in our study area has been regarded as female crop produced for home consumption (Adekanye, 1993). Perhaps, this could suggest women's earlier involvement in its production. However, the implication of this in the family system in which women are primarily responsible for house-work, food production, often child care and men for financial support or other productive venture will be ill-suited for the goal of economic parity and resource use efficiency to be achieved.

Table 4.1. Distribution of the Respondents According to Age and Sex

SEX		16-25 Years	26-35 Years	36-45 Years	46-55 Years	>55 Years	Total
FREQ		0	31	43	45	28	147
	Pct	0.00	10.80	14.98	15.68	9.76	51.22
M	RPCt	0.00	21.09	29.25	30.61	19.05	
	CPCt	0.00	52.54	42.16	58.44	63.64	
	FREQ	5	28	59	32	16	140
F	PCt	1.74	9.76	20.56	11.15	5.57	48.78
	RPCt	3.57	20.00	42.14	22.86	11.43	
		100.07	47.46	57.84	41.56	36.36	
		5.00	59.00	102	77	44	287
		1.74	20.56	35.54	26.83	15.33	100

FREQ = Frequency; RPCt = Row per cent; M = Male; F = Female; PCt = Per cent; CPCt = Column percent
Source: Field Survey 1998

4.2 FARM SIZE

Farmers in Nigeria are predominantly smallholders with average farm size between 1-2 ha. However, for this study we only considered cassava farm size of each respondent. Table 4.2 shows that average cassava farm size of our respondents was about 0.5179 hectare. Male cassava producer cultivates on the average 0.5518 ha while their female counterparts cultivate 0.429 ha. One possible explanation for the difference is conspicuous gender differences in access to and control over the land, with men dominating and dictating the use of this resource. Generally, men cultivate larger farms than their female counterparts. However, common to them is a small unit of production, which may not encourage modern agricultural techniques.

Table 4.2. Descriptive statistics of variables used in the study (Means and Standard Deviations)

	All Respondent			Male Respondent		Female Respondent	
Names	Measuring Units	Mean	Standard deviation	Mean	Standard deviation	Mean	Standard deviation
Quality of outputs	Kg/ha	6.180	5.297	7.130	5.434	5.376	4.051
Quantity of fertilizer	Kgs/ha	6	3	7	4	6	8
Farm size	Hectare	13.4087	12.6135	14.4763	13.4549	10.8165	9.5201
Farm assets	N/ha	0.5179	0.3370	.5518	0.3511	0.4298	0.2706
Labour	Manday	6.0628	4.2464	6.6672	4.2892	4.9639	3.6781
		23.7232	17.9912	25.7993	18.9008	18.6228	13.8322

Source: Field Survey 1998.

4.3 EDUCATION

Gradually, the country is growing up with more educated farmers who will not find it difficult to pick information relevant to the improvement of their management decisions from the literature. A well-educated farmer is likely to be more responsive to innovation than stack illiterate farmer. Human capital development in agriculture thus holds the key for highly productive and sustainable agriculture. The level of education of both male and female small-scale cassava producers was considered and the results are summarized in Table 4.3. The results indicate that 26.48 per cent of the farmers had no education at all. Only about 26.6 per cent had up to secondary education while a little below 1 per cent (0.7%) had higher education.

Table 4.3. Farmer's level of education

Level of Education	Percentage Respondents		
	Male	Female	Total
No education	15.65	37.86	26.48
Primary School	53.39	39.29	46.67
Secondary School	29.25	22.86	26.6
Others (Higher Education)	1.36	0	0.7
Total	147	140	287

Source: Field survey 1998.

Further, it is evident from Table 4.3 that there are more educated men in cassava cultivation than women. Up to 53.37 per cent male had primary school and 29.25 per cent had secondary school education even a little above 1 per cent had higher education. Comparatively, 39.29 per cent of the female cassava cultivators had primary school education and 22.86 per cent of them had secondary education. None of them had higher education. These results perhaps are indicative of gender discrimination in terms of unequal access to education. Beyond this, Okojie (1978) noted that introduction of Western education and institutions created the notion of wife of leisure, so that to be a full-time house-wife became a mark of prestige. In other words, some educated women may prefer being a full house-wife or paid work to farming which they still consider full of drudgery.

4.4 EXTENSION CONTACTS

Generally, throughout the survey area, agricultural extension services are conspicuous by their inadequacy. Extension workers are seen as important agents of change in the campaign for the use of modern farm inputs. Table 4.4 shows the number of times that extension agents visited the farmers. It is evident that a good number, about 45.65 per cent of the farmers did not come into contact with extension agents in the past twelve months. About 24.74 per cent of them remembered they had one extension contact within the period. Lower percentage of 4.48 indicated up to four visits of extension agents. In general, more sampled male cassava producers had contacts with extension agents than small-scale female cultivators. Empirical results indicate that 54.29 per cent of the female respondents did not have contact with extension agents in the same vein, 37-42 per cent of the male farmers indicated that they had no contact. Up to 46.26 per cent of the male respondents indicated one or two visits of extension agents, while 41.43 female respondents indicated the same.

The inherent problems of extension units like inadequate personnel and materials coupled with poor access roads to villages could be partly responsible for these low extension contacts. Additionally, there are more men than women in extension units of the two states surveyed. This explains higher contacts with male farmers than female farmers. Again, the general notion that only women can serve as extension agent in Women In Agriculture (WIA) units of Agricultural Development projects could limit the number of workers in that unit. It is worth noting that women are not gender experts just because of their sex. Qualified men should be encouraged to serve in the WIA units of our ADPs to serve the interest of female farmers.

Table 4.4. Respondent's extension contacts

Extension Agents Visit/Year	Percentage of Farmers Visited		
	Male	Female	Total
No visit	37.42	54.29	45.65
Only one visit	22.45	27.14	24.74
Two visits	23.81	14.29	19.16
Three visits	10.88	2.86	6.97
Four visits	5.44	1.43	3.48
Total	100	100	
n	147	140	287

Source: Field survey 1998.

4.5 CROP DIVERSIFICATION

Along with other analyses, extent of crop diversification between male and female cassava producers was examined. Anosike and Coughenour (1990) argued that by diversifying, the farmer may use resources more efficiently and promote sustainability. Beyond this, diversification of farm enterprises has been known to be a risk reduction strategy used by farmers. More importantly, decision-making involved in diversification could be taken as indicative of a successful management ability because the selection of a certain combination of enterprises over others involves decisions which are inevitably rooted in social, cultural and economic factors. Also, the enterprises must be selected with respect to how well they complement existing enterprises and how agroecologically compatible they are. This places a premium on the farmer's decision-making ability. Results in Table 4.5 indicate the number of crops planted along with cassava in our respondent's plots. It is evident that monocropping is still unpopular among small-scale cassava producers. About 11 men and 5 women had sole cassava farm.

In general, female cassava cultivators had higher number of crops planted on the same plot than their male counterparts. This could be largely due to the higher subsistence needs of the women within the household as well as high risk coping strategies imposed on them by their life-style of multiple goals.

Table 4.5. Crop diversification among the respondents

	Percentage of Farmers		
	Male	Female	Total
One crop	7.42	2.14	4.88
Two crops	43.54	37.86	40.77
Three crops	38.1	44.29	41.12
Four crops	6.8	9.29	8.01
Five crops	2.72	3.57	3.14
Six crops	1.36	2.86	2.09

Source: Field survey 1998.

CHAPTER FIVE

A GENDER DISAGRETATED MEASUREMENT OF EFFICIENCY

5.1 TECHNICAL EFFICIENCY

The measurement of efficiency is an important area of research in Nigeria because of the meagre resources and dwindling opportunities for developing and adopting better technologies. So this chapter examines the extent to which it is possible to raise productivity with the existing resource base and available technology. However, at the onset we selected an econometric (stochastic) technique of estimating frontier and consequently inefficiency due to its ability to handle statistical noise. The novel approach adopted is gender aware. The later part examines some socio-economic - physical factors as they relate to productivity efficiency in our area of study.

As stated earlier, the concept of technical efficiency relates to the question of whether a firm uses the best available technology in its production process. Furthermore, it can be defined as the minimal proportion by which a vector of input x can be rescaled while still producing only y.

In general, $0 < TE < 1$, where $TE = 1$, implies that the farm is producing on the production frontier and is said to be technically efficient. In this case, $(1 - TE)$ is the largest proportional reduction in inputs x that can be achieved in the production of output y. Alternatively, (1 - TE) can be interpreted as the largest percentage cost saving that can be achieved by moving the farm toward the frontier - isoquant through a radial rescaling of all inputs X (Chavas and Aliber, 1993). Since output is treated as exogenous in a cost-minimizing framework, the appropriate measure of technical inefficiency is input-saving (Farrell, 1957) which gives the maximum rate at which use of all inputs can be reduced without reducing output (Kumbhakar, 1997).

Tables 5.1 and 5.2 show the maximum likelihood estimates of the stochastic frontier production function for small-scale male and small scale female cassava producers respectively. The ratio of the standard error of U to that of V, λ, exceeds one in value,8.2909 for male farmers and 4.2972 for female farmers. In both cases, λ is greater than one which implies that the one sided error term U dominates the symmetric error V; indicating a good fit and correctness of the specified distributional assumption (Tadesse and Moorthy 1997). Also λ was statistically different from zero at the 1% level.

Table 5.1. Maximum likelihood estimates of the stochastic frontier production function for small scale male cassava producers

Variables	Coefficients	Standard error	$z = b/S.e$
Constant	5.5521	1.2499	4.442*
LM	0.069376	0.054816	1.266*
LJ	0.075825	0.12847	0.59
LK	0.026215	0.067134	0.39
LL	0.17408	0.20223	0.866
$\sigma U / \sigma V$	2.6320	0.88790	2.964*
$\sigma^2 U + \sigma^2 V$	0.70657	0.062722	11.265*

Variance components: $\sigma^2 (V) = 0.6298$
$\sigma^2 (U) = 0.43627$
$\gamma = 0.874$

Log likelihood function = -93.47775
Iteration completed 13
* Significant at 1%

Source: Field Survey 1998.

Table 5.2. Maximum likelihood estimates of the stochastic frontier production function for small scale female cassava producers

Variables	Coefficients	Standard error	z = b/S.e
Constant	6.9850	1.2842	5.439*
LM	0.049152	0.085629	0.574
LJ	0.12349	0.13274	0.93
LK	0.052147	0.086871	0.60
LL	-0.16512	0.16791	-0.983
$\sigma U / \sigma V$	4.3450	2.4495	1.774*
$\sigma^2 V + \sigma^2 U$	0.78931	0.10515	7.506*
Function Coefficient	0.05967		

Variance components: $\sigma^2 (V) = 0.03134$

$\sigma^2 (U) = 0.59167$

$\gamma = 0.95$

Log likelihood function = -48.30230

Iteration completed 12

* Significant at 1%

Source: Field Survey 1998.

Table 5.3. Maximum likelihood estimates of the stochastic frontier production function for small scale male and female cassava producers

Variables	Coefficients	Standard error	z = b S.e
Constant	3.0646	1.2499	4.442*
LM	0.15464	0.054816	1.266*
LJ	0.28965	0.12847	0.59
LK	0.11827	0.067134	0.39
LL	0.44011	0.20223	0.866
$\sigma U / \sigma V$	2.1858	0.88790	2.964*
$\sigma^2 V + \sigma^2 U$	0.76347	0.062722	11.265*

Variance components: $\sigma^2 (V) = 0.10089$
$\sigma^2 (U) = 0.48200$
$\gamma = 0.827$

Log likelihood function = -225.0967
Iteration completed 3
* Significant at 1%

Source: Field Survey 1998.

As shown by Schmidt and Lin, (1984) rejection of the null hypothesis Ho:1=0 implies the existence of a stochastic frontier function. The discrepancy between observed production and frontier production is due to technical inefficiency.

Based on λ we can derive gamma (γ) which measures the effect of technical efficiency in the variation of observed output.

$$\gamma = \lambda^2 / [1 + \lambda^2] = \sigma_u^2 / \sigma_\varepsilon^2$$

Battese and Corra (1977) defined γ as the total variation of output from the frontier, which can be attributed to technical efficiency. In other words, it indicates the estimates of the stochastic frontier which show the best practice performance i.e. efficient use of the available technology. It is evident from tables 5.1 and 5.2 that the estimates γ for male is 0.874 and 0.95, for female small scale cassava producers. This implies that (1 - 0.874) = 0.126 or 12.6 per cent of the total variation in cassava output of male cassava farmers is due to technical inefficiency while (1-.950) = .05, which indicate 5 per cent of the total variation in cassava output of female cassava farmers is due to technical inefficiency. These results suggest that small-scale male cassava producers were over utilizing resources in a slightly less efficient manner than their female counterparts.

One possible explanation for this is their higher access and control over resources than their female counterpart within the household. The function coefficients, which measure the proportional change in this output when all inputs included in the model are changed in the same proportion, are also given as 0.3465 for male sample and 0.05967 for female sample. They indicate decreasing returns to these factors.

Gamma (γ) estimate for both male and female cassava farmers is 0.827 as shown in Table 5.3. This implies that (1-.827) or 17.3 per cent of the total variation in cassava output of small-scale cassava producers in area of study is due to technical inefficiency. Thus, on the average, the farmers are just realizing about 82.7 per cent of their potential output, which is feasible in their socio-economic and physical production environment. To put it differently, the observed output variability is mainly due to farm-specific performance and not just to statistical random variability and this needs attention from the point of view of policy. As expected, in respect of male small-scale cassava producers, all four inputs have positive signs and significant impact on output. However, labour has the largest coefficient (elasticity (0.17508). This indicates that the largest impacts on output on average would be experienced if additional labour was imputed on the farms. This is expected in a situation where the resource-poor small farmers depend largely on their family and hired labour for production. The production structure still characterized by low capital investment is reflected by its smallest coefficient (0.026215).

So, significant increases in production among the male small-scale cassava producers will likely best be accomplished by increasing labour input in technical sense. Additionally, empirical results show that for the female small-scale cassava producers, the input with the highest coefficient is land (0.12049). This implies that the largest impacts on female cassava output would be experienced if they have access to more farm land.

However, against *a priori* expectation, labour input has negative sign (0.16512) suggesting possible use of excess labour on small area of land at the expense of other factors. This is possible because of women smaller farm holdings and their access to the labour of their children, those below the ages of 15 years in particular, who form their major asset.

Considering the whole respondents the results suggest that labour is still the principal resource in cassava production. It has the highest coefficient (0.44011) while capital input has the smallest coefficient (0.11827) suggesting that the use of capital as input in the production of cassava in our study area is still minimal.

5.2 A SURVEY OF EFFICIENCY INDEXES

To provide a basis of comparison for the efficiency measures just discussed; Table 5.4 presents average efficiency indices reported in other studies that have estimated stochastic production frontiers using farm data from developing countries. As the data show, the 82.7 per cent average TE found in this study is in line with the findings reported by others. Table 5.4 also shows the few estimates of AE and EE that have been reported in the literature. Although we hardly know of any study that has come up with the estimated AE in Nigeria, our result of 96.26 per cent is very close to the figure reported by Bravo - Ureta and Evenson (1994) for a sample of cassava farmers in Paraguay.

Table 5.4. Empirical Estimates of Efficiency from Stochastic Production Frontiers

Author	Country	Product	TE	AE	EE
This study	Nigeria	Cassava	82.7	96.26	79.61
A. Parikh and M. Kalan Shan (1995)	Pakistani	Crops	88.7	-	88.5
Bravo-Ureta and E. Pinheiro (1997)	Dominican Republic	Crops	70	44	31
Bagi (1982)	India	Rice	93	-	-
Bravo-Ureta and Evenson (1994)	Paraguay	Cotton Cassava	58 59	70 88	40 52
Huang and Bagi (1984)		India	Whole farm	89	--
Hussain (1989)	Pakistan	Crops	69	43	29
Kalirajan (1981)	India	Rice	67	-	-
Kalirajan (1984)	Philippines	Rice	63	-	-
Kalirajan and Flinn (1983)	Philippines	Rice	80	-	-
Kalirajan and Flinn (1983)	Philippines	Rice	50	-	-
Kalirajan and Shand	Malaysia	Rice	67	-	-
Phillips and Marble (1986)	Cruatemala	Maize	75	-	-
Rawlins (1985)	Jamaica	Crops	73	-	-
Taylor and Shonkwiler (1986)	Brazil	Whole farm	71	-	-

Source: Updated table from Bravo-Ureta and Pinheiro (1997).

5.3 ALLOCATIVE EFFICIENCY

The concept of allocative efficiency is related to the ability of the farm to choose its inputs in a cost minimizing way. It reflects whether a techically efficient firm produces at the lowest possible cost. In general, O < AE < 1, where AE = 1 corresponds to cost minimizing behaviour where the farm is said to be allocatively efficient. Alternatively, AE ≤ 1 implies allocative inefficiency. In this case, (1-AE) measures the maximal proportion of cost the technically efficient firm can save by behaving in a cost minimizing way. Note that the two indexes technical efficiency (TE) and AE can be combined into an economic efficiency index defined to be the product of the two indexes.

Here, translog cost function is specified and estimated using cost share equations with all cross equation restrictions. Command for ML estimation of constrained iterated seemingly unrelated regression (SURE) systems of LIMDEP verson 7 (Greene, 1994) was used to estimate the parameters.

The four factors involved were capital (K), Labour (L), land (J) and fertilizer (M) Quantities are denoted 'Q' while price indices are denoted 'P'. The output quantity is denoted 'Y' in the model below. For convenience, denote by K, L, and J. The logs of the normalized prices as in

$$K = \ln (PK/PM)$$

$$L = \ln (PL/PM)$$

Table 5.5. Three Share Equations for Male Small Scale Cassava Producers with Constraints Imposed

Name of the Variables	Parameters	Coeffcients	z = b/S.E
Capital (BK) (K)	βK	0.05945 (0.028216)	2.107*
Labour (BL) (L)	βL	0.82668 (0.046556)	17.757*
Land (BJ)	βJ	0.00025187 (0.00011778)	2.138*
Capital x Capital (CKK)	ϒKK	0.0097517 (0.0031123)	3.133
Capital x Labour (CKL)	ϒKL	-0.013403 (0.0084658)	-1.583
Capital x Land	ϒKJ	-0.00066414 (0.0021152)	-0.0314
Labour x Labour (CLL)	ϒLL	0.038676 (0.013969)	2.759*
Labour x Land (CLJ)	ϒLJ	-0.0076988 (0.0034901)	-2.206
Land x Land (CJJ)	ϒJJ	0.00007003 (0.0000088297)	7.931
Capital x Cost (DKY)	δKY	0.0018431 (0.0015672)	1.176
Labour x Cost (DLY)	δLY	-0.0020219 (0.0025859)	-0.782
Land x Cost (DJY)	δJY	0.000017827 (0.0000065422)	-2.725*
Labour x Capital (CLK)	ϒLK	-0.017156 (0.0051352)	-3.341
Land x Labour (CJL)	ϒJL	-0.000039814 (0.00035339)	-1.127
Land x Capital $\Sigma = 0.8958$	ϒJK	0.0000046211 (0.000012992)	0.356

Source: Field Survey 1998

Table 5.6. Three Share Equations for Female Small Scale Cassava Producers with Constraints Imposed

Name of the Variables	Parameters	Coeffcients	z = b/S.E
Capital (BK) (K)	βK	0.23725 (0.11501)	2.063*
Labour (BL) (L)	βL	0.46719 (0.34766)	1.344
Land (BJ)	βJ	0.00091286 (0.00050664)	1.802
Capital x Capital (CKK)	γKK	0.088512 (0.021879)	4.045*
Capital x Labour (CKL)	γKL	-0.054949 (0.018231)	-3.014
Labour x Labour (CLL)	γLL	0.22305 (0.055107)	4.048*
Labour x Land (CLJ)	γLJ	-0.07698 (0.041411)	-1.859
Land x Land (CJJ)	γJJ	0.00044322 (0.000060348)	7.344*
Capital x Cost (DKY)	δKY	0.014567 (0.010830)	1.345
Labour x Cost (DLY)	δLY	-0.04614 (0.032736)	-1.410
Land x Cost (DJY)	δJY	0.000077834 (0.000047706)	1.632
Labour x Capital (CLK)	γLK	-0.077252 (0.066136)	-1.168
Land x Labour (CJL)	γJL	-0.00022035 (0.000080308)	-2.744
Land x Capital Σ = (.7635)	γJK	-0.00006449	-0.671
(0.000096380)			

Source: Field Survey 1998

Table 5.7. Three Share Equations for Male and Female Small Scale Cassava Producers with Constraints Imposed

Name of the Variables	Parameters	Coeffcients	z = b/S.E
Capital (BK) (K)	βK	0.51504 (0.2307)	2.232
Labour (BL) (L)	βL	0.43175 (0.23172)	1.863
Land (J)	βJ	0.00014576 (0.000063139)	2.309
Capital x Capital (CKK)	KK	0.062201 (0.0040396)	15.398
Capital x Labour (CKL)	γKL	-0.14693 (0.089858)	-.635
Capital x Land (CKJ)	γKJ	-0.0007197 (0.089858)	-0.036
Labour x Labour (CLL)	γLL	0.16502 (0.090226)	1.829
Labour x Land (CLJ)	γLJ	-0.0030279 (0.019899)	-0.152
Land x Land (CJJ)	γJJ	0.000051272 (0.0000054221)	9.456
Capital x Cost	δKY (DKY)	0.0010383	0.071 (0.01482)
Labour x Cost	δLY (DLY)	-0.0014717	-0.101 (0.014642)
Land x Cost	δJY (DJY) (0.0000039896)	0.000014051	3.522
Labour x Capital (CLK)	γLK	-0.060487 (0.0040562)	-14.912
Land x Labour (CJL)	γJL	-0.000026790 (0.000024585)	-1.090
Land x Capital Σ = (0.96258846)	γJK	-0.0000094363 (0.0000011052)	-8.538

Source: Field Survey 1998.

J = ln (PJ/PM) and so on.

Let Y denote In Y, C denote . In (Total Cost /PM) and Si denote the cost shares. The equations of the full models are:

$$
\begin{aligned}
C = \; & \alpha + \beta_k K + \beta_l L + \beta_J J \\
& + \beta_y Y + \theta_{yy} Y^{1/2} + \delta_k K_Y + \delta_L LY \\
& + \delta_j JY + \gamma_{kk} K^{1/2} + \gamma_{KL} KL \\
& + \gamma_{kj} KJ + \gamma_{LL} L^{1/2} + \gamma_{LJ} LJ + \gamma_{JJ} J^{1/2} \\
& + \varepsilon \\
SK = \; & \beta K + \gamma_{KK} K + \gamma_{KL} L + \gamma_{KJ} J + \delta_K Y + \varepsilon_K \\
SL = \; & \beta L + \gamma_{KL} K + \gamma_{LL} L + \gamma_{LJ} J + \delta_L Y + \varepsilon_L \\
SJ = \; & \beta_J + \gamma_{KJ} K + \gamma_{LJ} L + \gamma_{JJ} J + \delta_J Y + \varepsilon_J
\end{aligned}
$$

....................................(10)

There are a total of 30 parameters in the model, but 15 constraints leaving only 15 free parameters to be estimated. The maximum likelihood (ML) estimates of the cost share equations are reported in Tables 5.5, 5.6 and 5.7 for small scale male cassava producers, small scale female cassava producers and both male and female small scale cassava producers respectively.

5.4 THEORETICAL CONSISTENCY

The frontier translog variable cost function and three input cost share equations defined in equation (10) for male, female and all respondents were estimated using the ML procedure. The 15 estimated parameters are presented in

Tables 5.5, 5.6 and 5.7 The estimated cost function is monotonic in input prices at the geometric mean because all first order input terms are positive. In addition, the estimated K, L, and J are all positive; implying the cost function is monotonically increasing in input prices. Homogeneity and symmetry restrictions were already imposed.

Greene, (1980) argued that it is appropriate to interpret the deviation of the observed cost shares from the theoretical optimum as the effect of allocative inefficiency. In particular if the production is homothetic as the input ratios and factor cost shares are independent of output. Thus, allocative inefficiency can be represented in this manner for this study in which linear homogeneity has been assumed and imposed.

Allocative efficiency estimates computed from the estimated parameters of cost share equations in Tables 5.5 and 5.6 for male and female small scale cassava producers are 0.8958 and 0.7635 respectively. The results indicate that both male and female cassava producers were producing off their least cost expansion path. The average value of allocative inefficiency for male small-scale cassava producer (1-0.8958) is 0.1042, which indicates that through allocative inefficiency they have raised their cost by additional 10.42%. For their female counterpart allocative inefficiency has raised the cost by an additional 23.65%. It is evident that though female cassava producers seem to be slightly more technically efficient than their male counterpart they prove to be less allocatively efficient.

This seems to reinforce our initial assertion that in agricultural system because of gender asymmetry in access to factor inputs the law of one price may be grossly violated, thus women's technical efficiency is not effectively translated to allocative efficiency.

Further, the results underscore the fact that improving allocative efficiency can help reduce production cost of many farmers. The three share equations for both male and female small-scale cassava producers (Tables 5-7) show an allocative efficiency of 0.96259 or 96.26%. These resource poor small farmers were slightly allocatively efficient because they operate with relatively scarce inputs, also they practice agricultural systems mainly established by trial and error over a long period. Additionally, either the mix of inputs employed by the sampled farmers is reasonably consistent with cost minimization or variable inputs are close substitutes, making the input mix relatively unimportant from a cost perspective.

5.5 ECONOMIC EFFICIENCY

Arising from the foregoing analysis is economic efficiency (EE) index which is the product of the two indexes, technical efficiency (TE) and allocative efficiency (AE) where $O < (TE - AE) < 1$. Then $(TE . AE) = 1$ implies that the firm is both technically and allocatively efficient. Altenatively, $(TE. AE) < 1$ indicates that the firm is not efficient $(1 - [TE . AE])$ measuring the proportional reduction in cost that the firm can achieve by becoming both technically and allocatively efficient.

Empirical results in Table 5.8 shows that EE of male small scale cassava producers is 0.7829 which indicates that if an average male cassava producer in the sample was to reach the EE level of his most efficient counterpart, then he could experience a cost savings of (1 - .7829) = 21.71 per cent. On the other hand, if an average female small scale cassava producer in the sample was to achieve the EE level of her most efficient counterpart, then she could realize (1 - 0 .7253) or 27.4 per cent cost saving. However, in general, for both male and female small scale cassava producers in our sample the estimated EE is (1 - .7960) = .204 which indicates that if the average farmer in the sample were to reach the EE level of his/her most efficient counterpart then the average farmer could experience a cost savings of 20.40 per cent.

Table 5.8. Empirical Estimates of Technical Efficiency, Allocative Efficient and Economic Efficiency of Sampled Farmers from Stochastic production Frontier and Translog Cost-share Equations

	TE	AE	EE
Male	87.4	89.58	78.29
Female	95	76.35	72.53
All	82.7	96.26	79.60

Source: Field Survey 1998.

In sum, it is evident from these results that EE could be improved substantially and that technical inefficiency constitutes a more serious problem than allocative inefficiency. Thus, most cost savings will accrue to improvement in TE.

5.6 RESOURCE-POOR SMALL SCALE CASSAVA PRODUCERS AND SOURCES OF INEFFICIENCY

Various factors could be responsible for the observed inefficiency amongst small-scale cassava producers. One important feature in Nigeria is the prevalence of subsistence needs amongst the rural poor farmers. And when farmers produce subsistence crops like cassava, they may be prevented from reaching the efficiency frontier. This is because scarce inputs may be allocated to various uses on the basis of their marginal shadow values (Parikh et. al., 1995). Marginal shadow values and marginal value productivities can differ for each of the inputs so that inefficiency may result. The higher percentage of inefficiency amongst the female farmers may be indicative of higher subsistence needs of women within the household. Women are natural nurturants they care for the old and the young within the household and higher tendency to harvest their cassava earlier than their male counterpart. Moreover, the overall empirical results show that there is sustantial scope for improving technical efficiency of these farmers.

5.7 ADDITIONAL INTERPRETATION

Although measuring production inefficiencies is of interest by itself, it would be helpful to identify the sources of such inefficiencies. In an attempt to do so, we propose to relate the coefficients of the given socio-economic physical variables, estimated through canonical discriminant function to productive efficiency.

5.7.1 Discriminant Analysis

Our aim here is to explain and predict the group membership of our sampled cassava farmers into viable and non-viable group on the basis of measurement of the earlier stated socio-economic and physical variables. Analysis concerns estimation of the coefficients (ai, i = 1, 2........... K) in the discriminant functions for an appropriate set of variables (xi, i = 1, 2 ..... K) which best discriminate between viable small-scale cassava producer's and non-viable cassava producers. In the first instance, we shall attempt to estimate the percentage of female and male farmers who would be classified into the two groups, and determine which variables best discriminate the two groups. We propose that those variables which best classify our farmers into viable farmers will enhance their productive efficiency. Since efficiency indexes can be taken as indicative of effective and efficient management, thus viability.`

Our estimation procedure will employ canonical correlation to derive the appropriate number of functions in descending hierarchical order such that the first function discriminates most and last function discriminates least. However, with two groups a maximum of one discriminant function is required. The null hypothesis is that the information is not significant. Thus the derivation of a particular function is justified if the null hypothesis is rejected at the chosen level of significance.

The estimated model provides for identification of the relative importance and direction of influence of the explanatory variables on the basis of magnitude and sign. Having established the explanation of group membership the following stage involves an evaluation of the classification performance of the function.

For this purpose, group and individual scores were calculated from the unstandardized function. The group scores are obtained from group average values on the explanatory variables whilst individual scores are obtained from the observations on each individuals. The classification procedure compares the individual scores with the group scores and classifies the individual as a member of the nearest group. Classification provides a group membership, which can be compared, to actual membership. A cross-classification of actual and predicted groupings is used to derive a summary measure of performance, which calculates the percentage of cases correctly classified.

Additionally, cross-validation results using linear discriminant function based on posterior probability of male and female cassava small-holder membership in either viable or non-viable group is presented as a test of the efficiency power of our viability criteria. Posterior probability estimates, also, yield information about each unit in addition to that of indicating predicted population membership.

Our survey covered 287 small-scale cassava producers who were measured on their response to 11 variables. At the onset we had 155 viable cassava producers and 132 non-viable cassava producers.Table 5.9 below shows the class level information.

Table 5.9 Distribution of farmers according to their viability

V1	Frequency	Weight	Proportion	Prior Probability
NV	132	132	0.45993	0.5
V	155	155	0.54007	0.5

VI = Viability; NV = Non viable; V = Viable

Following the above, we used the posterior probability to predict the farmers membership in either group Table 5.10 below summarizes the number of observations and their distributions.

Table 5.10. Number of observations and per cent classified based on their viability

	NV	V	Total
NV	127	5	132
	(96.21)	(3.79)	(100)
V	45	110	155
	(29.03)	(70.97)	(100)
Total percent	172	115	287
	(59.93)	(40.07)	(100)
Priors	0.50	0.50	

Source: Field Survey 1998.

Table 5.11. Error Count Estimates Based on Viability

	NV	V	Total
Rate	0.0379	0.2903	0.1641
Priors	0.5	0.5	
V = Viable			
NV = Non-viable			

Source: Field Survey 1998.

The result in tables (5.10) and (5.11) provide a predicted group membership, which can be compared, to actual membership. From this, 5 respondents 3.79% were misclassified as non-viable while 45 were misclassified as viable small-scale cassava producers. Thus, the overall misclassified respondents were 50 (16.41%)

On gender. basis our survey data covered 82 viable male cassava producers and 75 viable female cassava producer. However, based on posterior probability estimates it was predicted that 20 out of the 82 viable male respondents were non-viable and 28 out of the 75 viable female respondents were non-viable. In the same vein, we had in our sample, 130 non-viable farmers. Out of this 64 were female while 66 were male. Given the posterior probability estimates out of the 64 non-viable female cassava producers, 4 were predicted viable while 1 out of the 66 non-viable male farmers was predicted viable. The total count estimates based on viability was just 0.1641 ,which is rather low

Be that as it may, our goal here is to determine and estimate the magnitude of the efficiency - enhancing socio-economic - physical factors as suggested in this study. Towards this, we examined the result of our canonical discriminant analysis as stated in the table 5.12 below.

Table 5.12. Canonical Discriminant Function Weights

Variables	Discriminant function weights, Wij
QJ	0.208005
QL	0.210357
SEX	0.025416
CDIV	0.123877
EDU	0.063890
EXP	-0.070627
EXT	-0.007266
AGE	-0.090436
QQ	0.568242
QK	0.376679
QM	0.697571

Source: Field Survey 1998.

The canonical discriminant analysis yields values for the coefficients or weights for each variable on the discriminant function. A computer programme SAS V.6 produced these weights. The estimated discriminant function seems to make reasonable and intuitive sense. Further, on the null hypothesis that there is no significant variation between the two groups for the function to explain, the model's F score with 11 and 275 degree of freedom was 19.6281 which is significant beyond the 99% confidence level.

The magnitude and signs on the discriminant function Coefficients indicate the degree of influence and the direction of influence of each variable. Larger coefficients indicate greater importance. Thus, it is evident that (QM = 0.677571) quantity of fertilizer is the most important variable which discriminates the two groups. Quantity of the output (QQ = 0.568242) is the second most important followed by farm assets (QK = 0.376679), Labour (QL = 0.210357), Land (QJ = 0.208005), Crop diversification (CDIV = 0.123895), Education EDU (0.063690) and Sex (0.025416) which contribute the least. The negative sign on experience (EXP = -0.070637), Extension contact (Ext = -0.007266) and age (-0.090436) implies that as these variables increase, the value of the discriminant function decreases. In other words, given the present situation, lower levels of experience, extension contact and age would contribute the lower variable value (weight) and thereby placing the small farmers into the non-viable group.

Beyond this, several authors have investigated the relationship between efficiency and various socio-economic variables using two alternative approaches. One approach is to compute correlation coefficients or to conduct other simple non-parametric analysis. The second way usually referred to, as a two-step procedure is to first measure farm level efficiency and then to estimate a regression model where efficiency is expressed as a function of socio-economic attributes. These analysis have been criticised by some who argue that the socio-economic variables should be incorporated directly in the production cost frontier model because such variables may have a direct impact on efficiency (Battese and Coelli and Colby, 1989). Despite the controversy just mentioned, we still believe that it is useful to examine the possible relationship between efficiency and socio-economic characteristics. For this purpose, our approach will be to relate the coefficients of estimated cononical function to the efficiency measure, since viability can be taken as indicative of efficiency.

Empirical results in Table 5.15 indicate that lower levels of extension contact (EXT), experience (EXP) and age (AGE) would contribute the lower weight and thereby placing the small farmer into non-viable group. Thus, within the context of this study, they are not efficiency - enhancing factors. However, higher levels of farm size (QJ), labour (QL), crop diversification (CDIV), education (EDU), capital (QK) fertilizer (QM) and quantity of output (QQ) would contribute the higher weight and thereby placing the small farmers into viable - group, thus constitute vital efficiency - enhancing socio-economic - physical factors.

Coefficient of sex (0.025416) implies that being a male could contribute higher weight to discriminant function thereby placing a small-scale farmer in viable group. The point to make is that, soil-augmenting resource will enhance efficiency, as any crop in good edaphic and climatic environment will produce uptimally. Further, it is becoming glaringly obvious that inadequate capital investment among resource poor small cassava farmers is a profound limiting factor to their productivity. In a way, infusion of science and technology holds the key to increasing productivity in agriculture. Additionally, efficiency in agricultural production is very much a human enterprise and not simply irrigation, seeds, fertilizer and pesticides.

Therefore human values that stimulate and guide its pursuit are central to the definition of the efficiency problem. In other words, the role of education toward improving farmer's efficiency cannot be overemphasized, in that it enables farmers to acquire and process relevant information more effectively. Extension education exposes farmers to improved techniques. However, education and extension services are not costless, but require investment. Because the cost function is unlikely to remain unchanged when costs are incurred, it would be difficult to conclude from this study that the gap between inefficient and efficient farms can be bridged without incurring any costs. Thus, lack of education and extension services might not be regarded as factors causing inefficiency. Only if they were costless activities could we say that they would contribute to improvement in efficiency.

5.8 INTERDEPENDENCE OF MEN AND WOMEN'S ROLE AND TASKS ALLOCATION IN CASSAVA PRODUCTION

It is to be noted that smallholder agriculture is the production system evolved by rural families living on the land to provide their basic human needs of food, clothing, shelter, and other family supports. It is a complex of interdependecies based upon a variety of contribution from family members _ physical strength, judgement and experience, intuition and imagination, light labour and heavy labour. In an attempt to investigate the scope and nature of interdependences, the respondents were asked how often they personally perform a set of tasks and could respond never, occasionally, regularly or not done on farm. Figure 5.1 is the graphical representation of the results.

There seems to be clear evidences that women perform the lighter farm activities of weeding, (95%) fertilizer application, (95%) transportation of inputs and products and harvesting (95%) while men perform the heavier tasks of farm clearing and ridging (100%). However, it must be noted that this division of labour is not that clear cut. Few women perform these activities themselves (80%). Processing is mainly in the women's domain almost all of them are involved in processing. Also, few men were also found in processing. Generally, all male respondents 100% are involved in land preparation, planting of cassava and weeding of cassava plots while all female respondents 100% do involve in harvesting and processing of cassava.

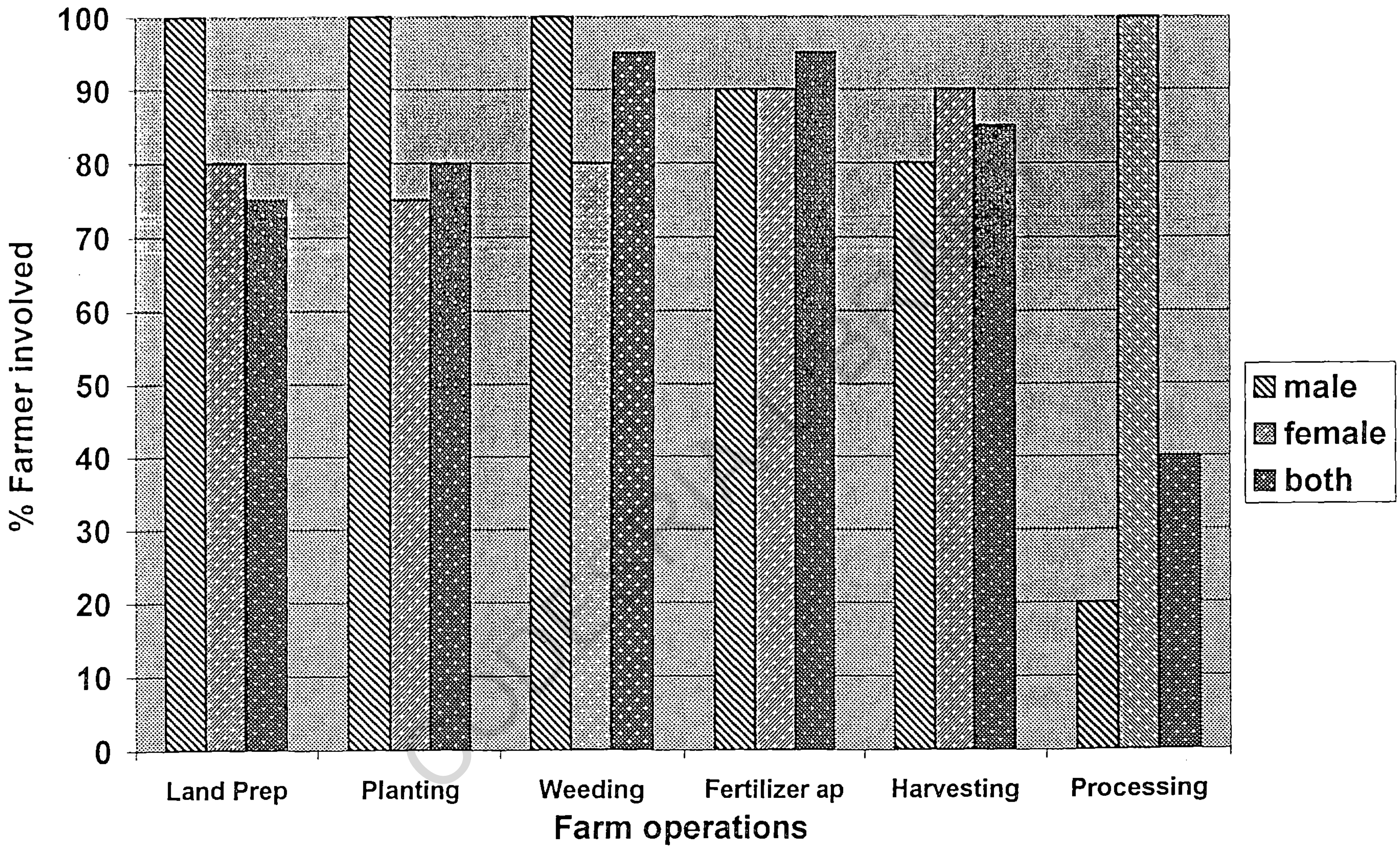


Figure 5.1: Gender roles in cassava production

CHAPTER SIX

6.0. EFFICIENCY INERTIA AMONG SMALL SCALE CASSAVA PRODUCERS

In addition to other relevant data collected for this study, we tried to find out some of the problems confronting small scale cassava producers especially those that are likely to influence their resource allocation decision and their level of resource use efficiency. Each respondent was asked to rank seven identified problems affecting their effectiveness and efficiency in order of importance.

The identified problems were as follows:

(a) Poor reads

(b) Poor health

(c) High cost of labour

(d) Insufficient capital

(e) Lack of good market outlet

(f) Lack of agriculture inputs and equipment

(g) Others e.g. drought or unfavourable weather conditions

About 105 respondent responded to the questionnaire and the results obtained are presented in the Appendix 1. However, in order to present a clearer picture of this ranking a summary of the ranking is essential, Table 6.1 present this summary. From this summary ranking, weighted scores were assigned to each rank with the highest rank being assigned one. A summary of these weighted scores was presented in Table 6.2. The summation of all the weighted scores gives the overall ranking associated with each factor of the problems. This is the cummulated-weighted scores presented in Table 6.3. It is evident from Table 6.3 that high cost of labour was ranked first while insufficient capital was ranked second. Other problems ranked third and fourth were lack of agricultural inputs and equipment and poor roads. See table 6.3 for further details.

As a further test of this ranking, the results were subjected to a non-parametric statistical analysis to determine the association among the rankings (See Appendix 1 for details). A non-parametric test is used when a test does not involve making any stringent assumption about the distribution of the population measures. It is known as a distribution-free statistic because it does not make any assumptions about the distributions of the different measures or variables with which one may be concerned. It makes possible the statistical analysis of data which may not be numerically precise but which rather represent some ranking of the statements being analysed. This is particularly useful in such analysis where subjective ranking as in the case of this study collected data. Another advantage is that the technique is relatively simple to use.

The non-parametric technique to be used is the Kendall co-efficient of concordance. This gives a measure of association among K judges. It is valuable because it provides a single measure of agreement among several statements, expressed as rankings This may indicate interjudge (farmer) reliability.

Table 6.1. Ranking of Agricultural Problems by the Respondents (Summary Rank)

	1st	2nd	3rd	4th	5th	6th	7th	Total
a. Poor roads				78	27			105
b. Poor health					10	73	22	105
c. High cost of labour	56	39	10					105
d. Insufficient capital	41	55	9					105
e. Lack of good market outlet					27	68	10	
f. Lack of agricultural inputs and equipment	8	11	86					
g. Others e.g. drought or unfavourable weather						22	83	105
	105	105	105	105	105	105	105	105

Source: Field survey 1998.

Table 6.2. Respondent Scores for Agricultural Problem Ranking

Agricultural Problems	1st	2nd	3rd	4th	5th	6th	7th	Total
a. Poor roads				312	81			393
b. Poor health					30	146	22	198
c. High cost of labour	392	234	50					676
d. Insufficient capital	287	330	45					662
e. Lack of good market outlet					108	204	20	332
f. Lack of agricultural inputs and equipment	56	66	430					552
g. Others e.g. drought or unfavourable weather						44	83	127

Source: Field survey 1998.

Table 6.3. Cumulated Weight Scores for Agricultural Problems Ranking

Agricultural Problems Weight Scores	Total Ranking	Overall
a. Poor roads	393	4th
b. Poor health	198	6th
c. High cost of labour	672	1st
d. Insufficient capital	662	2nd
e. Lack of good market outlet	332	5th
f. Lack of agricultural inputs and equipment	552	3rd
g. Others e.g. drought or Unfavourable weather	127	7th

Source: Field survey 1998.

Table 6.4. Analysis of Ranks Assigned to Seven Agricultural Problems by 105 Farmers

Statement	A	B	C	D	E	F	G
R_j	451	666	165	384	512	291	720
$R_j - \frac{\sum R_j}{N}$	-4.57	210.43	-290.57	-71.57	56.43	-16.57	264.43
$\left(R_j - \frac{\sum R_j}{N}\right)^2$	20.87	44280.79	84430.93	5122.27	3184.35	27083.29	69923.23

$$SS_R = \Sigma\left(R_j - \frac{\Sigma R_j}{N}\right)^2 = 234045.75$$

$$W = \frac{12 SS_R}{K^2(N^3 - N)} = \frac{12(234045 - 75)}{105^2(7^3 - 7)} = 0.758$$

Before interpreting the result of this analysis, the test of the significance of the calculated W was carried out. We may test the significance of any computed value of it by determining the probability associated with the occurrence under the null hypothesis (Ho) using the formular

$$X^2 = K(N - 1)W$$

distributed as chi-square with d.f. = N - 1

If the computed X^2 equals or exceed tabulated X^2 for a particular level of significance and a particular value of d.f. = N - 1, then the null bypothesis that the K rankings are unrelated may be rejected at that level of significance.

For this particular case, we found that W = .758. The significance of this relation was determined by applying the formular

$$X^2 = K(N - 1)W$$

$$= 105(7 - 1)0.758$$

$$= 477.54$$

At 1%, level of significance tabulated X^2, d.f. = 6 = 22.46.

Since calculated X^2 exceeds the tabulated value, the coefficient of concordance is statistically significant at one per cent level. Thus indicating that the ratings of agricultural problems are related to each other.

6.1 Interpretation of the Results

The implication of the result of such analysis, when W is significant can be obtained by observing the order of the various sums of ranks Rj. Results of the chi-square test indicate that the rankings by the sampled farmers are relatively uniform. Thus, the best estimate is provided by the order of the sum ranks.

In this particular case, the statement with the least sum of ranks is the high cost of labour considered as the most significant problem confronting the sampled farmers while the statement with the largest sum of ranks, the least important is that of unfavourable weather conditions. A possible explanation for this is the adaptability of cassava to poor agronomic conditions.

Therefore, the order of importance of the seven agricultural problems militating against the small-scale cassava farmers of our study area as indicated by the rankings of the sampled farmers is presented below:

(a) High cost of labour

(b) Insufficient capital

(c) Lack of agricultural inputs and equipment

(d) Poor roads

(e) Lack of good market outlet

(f) Poor health

(g) Unfavourable weather conditions

wastage and inefficient allocation of scarce resources. Thus, the study set to assess the possibilities of productivity gains by improving the efficiency of smallholders through gender-responsive intra-household allocation of resources, using data from western Nigeria.

Along with descriptive statistics, the study used deterministic stochastic frontier framework to analyze efficiency in small-scale cassava production. The methodology developed here yields efficiencies measures that are not distorted by statistical noise. In addition, the methodology makes it possible to calculate not only technical but also allocative and economic efficiencies relying solely on the econometric estimation of a production frontier. Since any errors in the production decision will translate into higher cost for the producer, we also used the stochastic frontier approach in which translog cost function was specified and estimated, using share equations. The cost share equations were estimated jointly with a cost equation incorporating all cross-equation restrictions.

It is evident from our empirical results that Nigeria is still a country of smallholdings. Overall average cassava farm size among our respondents was 0.5179 ha. On the average, male cassava farm size was 0.5518 ha while their female counterpart cultivate on average of 0.429 ha.

There is ample evidence now that more educated individuals are entering into agriculture though, considerable size up to 26.6 per cent had no education. Nonetheless, more educated men were found in cassava production than women.

Also men had more extension contact than women did. Considering crop diversification as a means of efficiency assessment, results indicate that female farmers had more crops planted on their cassava plots than men. Further, it is to be noted that female get into cassava production earlier in their age (< 25 years) than their male counterpart (> 25 years).

The hypothesis of small and inefficient has been developed in the Agricultural Economics literature as one possible explanation for the gradual disappearance of the small and medium-sized family farm in recent years. Be that as it may, results here indicate that both male and female small-scale cassava producers were not obtaining maximum possible output from the use of resources and technology available to them. Male and female small-scale cassava producers were producing 12.6 per cent and 5 per cent respectively below their maximum output as a result of technical inefficiency. But the overall average level of technical efficiency was 82.7 per cent. So, on the average the farmers were just realizing about 82.7 per cent of their potential output, which is feasible on their socio-economic and physical production environment. An assessment of the magnitude and resource use-pattern defines the characteristics of peasant agriculture with intensive labour use but minimal capital investment. Labour has the highest coefficient of 0.44 while capital has coefficient of 0.118. Land explains the highest variation (0.1235) in the output of the female cassava producers, which suggests that they depend mainly on land as a source of their input; for the production of cassava.

Results of the cost function approach indicate that 10.67 and 12.6 per cent of the cost incurred by male and female cassava producers respectively could be avoided without any loss in their output. But, in general for all sampled farmers up to 30.75 per cent of the cost incurred could be avoided. These results in part suggest that male cassava producers are slightly more cost effective; than their female counterparts. However, it is to be noted that, earlier in this study it was pointed out that though in theory, male and female farmers may face the same price vector, but in practical term, gender disparity may not allow it to hold. In other words, the law of one price may not hold. So, the gender differences in the amount of cost that could be saved among our respondents could not have resulted from inherent differencial in efficiencies, rather, it is an indication of gender disparity in price vectors faced by male and female farmers as pointed out earlier in this study. So, one possible explanation for differential cost saved among male and female cassava producers may be due to gender - caused price differential amongst the respondents.

In sum, on average, household within our study area could increase output of cassava by approximately 17.3 per cent by allocating variable factors of production evenly across the plots controlled by men and women and save up to 30.75 per cent of the cost incurred.

Beyond this, further results indicate that the farmers input mix-proportions were not consistent with cost minimization. In other words, they were using the inputs in the wrong proportions given their market prices. This apparent allocative inefficiency has raised the production cost by 10.42 per cent and 23.65 per cent for male and female cassava producers respectively. The overall results for all respondents indicate that they were slightly allocatively efficient - about 96 per cent allocatively efficient.

Arising from the foregoing is economic efficiency indexes. From empirical results, it is evident that small scale male cassava producers and small scale female cassava producers could save up to 21.71 per cent and 27.4 per cent cost respectively if they were to achieve economic level of their most efficient counterparts. Moreover, if an average small-scale cassava producer in our study area were to reach the EE level of his/her most efficient counterpart he would experience a cost saving of up to 20.40 per cent.

In general, we may infer from the foregoing results that EE could be improved substantially and that technical inefficiency constitutes more serious problem than allocative inefficiency, thus, most cost savings will accrue to improvement in TE.

The beauty of our further interpretation lies in the light they shed on the causes of these inefficiencies. Our investigations revealed that quantity of fertilizer, quantity of total output, labour, land, crop diversification, education and sex do contribute to the level of efficiency. However, in this study, extension contact, experience and age were not considered efficiency - enhancing.

7.2 POLICY RECOMMENDATIONS

It is to be noted that, attention to issues of intra-household allocation underscores the importance of improving factor-market efficiency and might help in designing such improvement. Here we note that any market imperfections are amplified by the fact that households do not allocate labour, fertilizer, land and capital they obtain with internal efficiency.

- Thus policies should be geared towards, improvement in input and credit markets to alleviate some of the internal allocation inefficiency, as individuals (in particular women) would then purchase inputs up to uptimal levels regardless of what levels men allocate to their own fields.

The results suggest that actual cassava output produced is less than cost minimizing level of output. Nevertheless, among other factors output and capital were found to be key efficient – enhancing factors.

- Policies should be designed to encourage efficiency as well as production. And this should be fashioned to a specific goal. For example, one policy goal might be to increase overall production while another might be to reduce inefficiency.

Otherwise, production expansion will be difficult from an economic viewpoint. Increasing efficiency will lower average total costs and may encourage increased capital investment in farming. Following this, the farmers may need to be educated in the value and use of some capital inputs.

- So, farm management education may increase efficiency if it teaches farmers to use capital inputs efficiently. This would have the effect on both increasing output and decreasing technical inefficiency.

Further, it is evident that high cost of labour constitutes the most significant constraint to the efficiency bid of our sampled farmers. This, again underscores the need for policies toward the design of gender - sensitive appropriate technology.

In sum, in order that modern technology can spread uniformly over a region eradicating rather than creating economic and social imbalance and in order that every sector of the rural population can be given an opportunity to become integrated in the development efforts, the female factor with all its variations will have to be understood, analyzed and finally redeemed.

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APPENDIX

Table 6.5. Ranking of Agricultural Problems Statement in order of importance

Respondent	A	B	C	D	E	F	G
1	4	6	1	2	5	3	7
2	4	6	1	2	5	3	7
3	5	6	2	1	5	3	7
4	5	6	1	2	4	3	7
5	4	6	1	3	5	2	7
6	4	7	2	1	5	3	6
7	5	6	3	2	4	1	7
8	4	6	1	2	5	3	7
9	4	7	1	2	5	3	6
10	4	7	1	2	5	3	6
11	4	6	1	2	5	3	7
12	5	6	2	1	4	3	6
13	4	7	1	2	5	3	6
14	4	7	1	2	5	3	6
15	4	5	1	3	5	2	7
16	5	6	3	2	4	1	7
17	4	6	1	3	5	2	7
18	4	6	1	2	5	3	7
19	4	6	1	2	5	3	7
20	4	7	2	1	5	3	6
21	5	6	2	1	4	3	7
22	4	6	1	2	5	3	7
23	4	5	1	2	5	3	7
24	4	6	1	2	5	3	7
25	4	6	3	2	5	1	7
26	5	6	1	2	4	3	7
27	5	7	2	1	4	3	6
28	4	6	1	2	5	3	7
29	4	5	2	1	6	3	7
30	4	6	1	2	5	3	7
31	4	6	1	2	5	3	7
32	4	6	2	1	5	3	7
33	5	7	1	2	4	3	6
34	5	6	1	2	4	3	7
35	4	6	1	3	5	2	7
36	4	6	1	2	5	3	7

37	4	7	1	2	5	3	6
38	4	7	2	3	5	1	6
39	4	7	2	1	5	3	6
40	4	6	1	2	5	3	7
41	4	6	1	2	5	3	7
42	4	6	3	1	5	2	7
43	5	6	2	1	4	3	7
44	5	6	2	1	4	3	7
45	5	6	2	1	4	3	7
46	5	6	1	3	4	2	7
47	4	6	1	3	5	2	7
48	4	6	1	2	5	3	7
49	4	6	1	2	5	3	7
50	4	6	3	2	5	1	7
51	4	7	1	2	4	3	7
52	4	6	2	1	5	3	6
53	4	6	1	2	5	3	7
54	4	6	1	2	5	3	7
55	4	6	1	2	5	3	7
56	4	6	1	2	5	3	7
57	4	6	1	2	5	3	7
58	4	6	1	2	5	3	7
59	4	6	1	2	5	3	7
60	4	6	1	2	5	3	7
61	5	7	2	1	4	3	6
62	4	6	1	3	5	2	7
63	4	6	1	2	5	3	7
64	4	6	3	2	5	1	7
65	4	6	3	2	5	1	7
66	4	7	1	2	5	3	6
67	4	6	2	1	5	3	7
68	4	6	2	1	5	3	7
69	4	6	1	2	5	3	7
70	4	7	1	2	5	3	6
71	4	7	3	2	5	1	6
72	4	6	1	2	5	3	7
73	5	6	1	3	4	2	7
74	5	6	2	1	4	3	7
75	5	6	2	1	4	3	7
76	4	6	2	1	5	3	7
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78	5	7	1	2	4	3	6

79	5	6	3	1	4	2	7
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82	4	6	1	2	5	3	7
83	5	6	1	2	4	3	7
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99	5	7	2	1	4	3	6
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102	4	6	2	1	5	3	7
103	4	5	2	1	6	3	7
104	4	5	2	1	6	3	7
105	4	5	2	1	6	2	7
106	4	5	2	1	6	3	7
107	4	5	2	1	6	3	7
108	4	5	2	1	6	3	7
Σ	451	666	165	384	512	291	720