THE STRUCTURE AND EFFICIENCY IN RESOURCE USE IN MAIZE PRODUCTION IN THE ASAMANKESE DISTRICT OF GHANA

BY

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DEDICATION

I dedicate this work to my mum, dad and siblings.

DECLARATION

I, Charles Yaw Gyasi Amankwah, author of this project report do hereby declare that the work presented in this thesis

"THE STRUCTURE AND EFFICIENCY IN RESOURCE USE IN MAIZE PRODUCTION IN THE ASAMANKESE DISTRICT OF GHANA"

was done entirely by me in the Department of Agricultural Economy and Farm Management, University of Ghana.

This work has never been presented in whole or in part for any other degree of the University or elsewhere.

.....

Charles Yaw Gyasi Amankwah

This work has been submitted for examination with my approval as supervisor

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ABSTRACT

The study sets out to find out on one hand, the present structure of resources in agricultural production and secondly, to delve deeper into the controversy surrounding the comparative efficiency in resource use by sharecroppers and owner farmers in agricultural production.

The approaches used to assess the structure of the resources are frequency distributions, descriptive analyses and estimation of cost composition of individual resources. In assessing the comparative efficiency in the use of resources by sharecroppers and owner farmers, the gross margins method and the allocative efficiency method based on the profit maximizing assumption were used.

The findings of the study indicate that, there is limited use of fertilizers, weedicides and improved seeds. Cutlass is widely used. Mixed cropping is widely practiced, land areas cultivated to maize fall mostly below one hectare and the major source of labour on almost all the farms studied is the family. The study also found that there were no significant differences in the efficient use of land and labour by owner and sharecropping farmers.

It is therefore concluded that the traditional way of farming based on the structure of the resources has not changed in the study district. With the efficiency in the use of land and labour by sharecroppers and owner farmers, the conclusion is that both farmer groups use land and labour inefficiently.

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CHAPTER ONE

1.0 INTRODUCTION

1.1 Background Statement

Agricultural production requires the use of resources such as land, labor, capital, as well as managerial skills. These factors are however used in different proportions depending on available technologies.

The Structure of resources in an agricultural system refers to either (i) the proportion of each of the resource used in production or (ii) the composition of the resources. Composition of a resource refers to the make of the resource. For example the composition of land refers to the size of land cultivated, type of cropping pattern and the form of land tenure. Composition of labour refers to the size of labour (i.e. number of labour force), types of labour used on farms (i.e. family and hired), age and sex of labour of employment status (i.e. which type of labour does what). The composition of capital refers to the amounts and types of capital inputs employed by farmers in production or the equity-credit ratio of capital (Hill and Ray, 1987).

The structure of the resources used gives an idea of the structure of farms or the structure of agriculture in a given nation. The essence of studying the structure of resources is to know the strengths and weaknesses of agricultural production (Rourke, 1969).

Changes in economic conditions, population increases and changing agricultural technologies among other alters the structure of resources in farming which may have implications on output levels (Heady, 1961; OECD, 1975 and Hill and Ray, 1987). In Ghana, there have been changes in the economic environment especially relative prices, increase in the population and changes in agricultural technology which indirectly affect the structure of the resources used and hence output. But there has not been any recent study to document the structure of resources in agricultural production which could form the basis of reference if the above changes are to be examined on the structure of resource use in future.

In sub-Saharan Africa, due to rapid population growth and other demands on arable land, there is a strain on agricultural land. This has resulted in a significant reduction in the fallow period and the cultivation of marginal lands. In the absence of sound soil management practices or the economic use of fertilizers and other additives, declining fallow periods result in accelerated depletion of nutrients, increased weed populations, erosion and decreased moisture retention (Lal 1983, IITA, 1992). Consequently, soil fertility declines, adversely affecting crop yields, labour productivity and returns from farming. What then has been the structure of land in terms of sizes cultivated, the type of cropping pattern adopted and the tenurial arrangements among others all of which affect output levels?.

In Ghana, agricultural production is largely rainfed and therefore seasonal. There is a peak demand for labour for certain farm activities and because labour has competing uses with associated higher prices, the small scale farmer mainly depends on family members. However, due to the increasing monetization of the economy, decreasing family size, increasing rural-urban migration and increasing school attendance of children (GSS, 1995), the small holder farmers will have to rely more and more on hired labour which is getting more and more expensive. Thus, the availability of family labour during peak season is a crucial factor determining the level of farm output (Ewusi et al., 1983). Against this background, what has been the structure of agricultural labour?.

Capital inputs are required in the right proportions in combination with land and labour inputs to augment production. Due to the removal of agricultural input subsidies, the prices of productivity enhancing inputs such as fertilizers, weedicides and other improved inputs are relatively high. This situation, coupled with the high cost of agricultural labour which is beyond the pocket of most farmers and seasonal low output prices (NARP, 1983) call for the examination of the ways farmers allocate their available resources and the structure of capital inputs in terms of forms and amounts employed in agricultural production.

The second aspect of the study concerns the efficiency in the use of resources by small scale farmers. With the increasing costs of agricultural inputs such as labour, fertilizer, improved seeds and weedicides, it is important that small scale farmers use the

available resources at their disposal efficiently to increase yield. Special focus is placed on different groups of farmers by type of land tenure in the study of efficiency in the use of resources by small scale farmers. This is because many studies have indicated that the type of landholding affects the efficiency in the use of resources by small holder farmers (Dadson, 1969; Baumik, 1991; Junankar, 1976).

There has been some controversy over the efficiency in the use of resources by tenant (sharecroppers) and owner farmers. An owner farmer owns the land he cultivates and provides all resources (i.e. land, labour, capital and management). A tenant farmer (i.e. sharecropper) does not own land but as an agreement for the use of land for farming, he gives out a stated proportion of his total produce as rent to the landlord. One school of thought known as the "Marshallian view" associates inefficiencies with sharecropping systems due to insecurity of tenure (Feder and Ochan, 1987), while another school (the equal efficiency view), contends that sharecropping systems are not associated with inefficiency in the use of resources but do use resources as efficiently as owner-operator systems provided there is fair sharing of production cost between the landowner and the tenant farmer (Bishop and Toussaint, 1958). In Ghana, there is the belief that because sharecroppers bear all production costs, there is no incentive for the sharecropper to employ the required levels of inputs hence the sharecropper produces inefficiently or obtains lower outputs compared to owner farmers. This situation has led once to a call

for the abolishment of sharecropping systems and Ghana in replacing it with a cash tenancy system which is considered a better system in terms of efficiency in the use of resources (FAO, 1985). Dadson (1969) also notes that for developmental purposes, owner-operator systems and cash tenancy should be of priority. These recommendations for the replacement of sharecropping system in Ghana are not based on empirical evidence. There has not been any study in Ghana to substantiate quantitatively the comparative efficiency in the use of resources by sharecroppers and owner operators. A study carried out by Migot-Adholla et al., (1990) on "Land Tenure and agricultural productivity in Ghana" examined the insecurity of the use of farmland by tenant farmers in three districts of Ghana. They found that so far as security of tenure was concerned in the study districts, tenant farmers enjoy maximum security and that they found no evidence of tenure insecurity contributing to agricultural inefficiencies. This study still did not deal with the issue of efficiency in the use of resources by tenant and owner farmers. It should also be noted that due to differences in the social and traditional set up of different communities in Ghana, their findings which are based on only three districts in Ghana cannot be conclusive for Ghana. Against this background, what is the relative efficiency in the use of resources between owner and sharecropping farmers?.

The study focuses on the foodcrop subsector specifically maize. This is because the foodcrop subsector contributes the highest percentage of agricultural gross domestic product (MOFA,

1991) and the fact that foodcrops form the major source of our diets. This study limits itself to the maize foodcrop because statistics on average and achievable yields of major foodcrops from 1987 to 1990 indicated that maize had the highest yield gap percentage of 317% (MOFA, 1991).

1.2 Objectives of the Study

The primary objective of the study is to investigate the structure and efficiency in the use of resources in maize production.

The specific objectives of the study are:

(i) To document the present structure of resource use in maize production in the study area.

(ii) To determine the implications of thee existing land tenure systems on maize production in the study area.

(iii) To conduct a comparative assessment of the efficiency in the use of resources between sharecroppers and owner-operators in the study area.

(iv) To recommend measures to improve factor use efficiency.

1.3 Relevance of the Study

This study has food security implications because it concerns increased production by way of efficient use of resources. Food security is one of the specific objectives of the Medium Term Agricultural Development Programme meant to provide all Ghanaians

with food security through adequate and nutritionally balanced diets at affordable prices.

It is also a policy of the Eastern Region to improve agricultural productivity (through efficiency of production) to increase farmers' income, diets of people and raise the general standard of living of all engaged in agriculture (DED, 1990). This study could form the basis upon which the efficiency of maize production by farmers in the area could be further discussed.

Another relevance of the study is that, there is little work done in this area. Few related studies conducted by Atsu and Owusu (1971) and Atsu, Ewusi and Gyekye (1983) indicate how agricultural labour and land are utilized but have not touched on the efficient use of these resources. In addition, studies conducted on the impact of land tenure on agricultural production efficiency used a qualitative approach in explaining how tenancy affects agricultural production efficiency. This study adopts an econometric approach to determine the relative allocative efficiency of owner and sharecropping farmers.

Knowing the structure of resource use is important because it may help to understand the current structure of agriculture of which the effect of the changing economic policies, increasing population and agricultural technology could be studied in future and what policy directions to take in drawing up a programme for agricultural development for the country.

Finally, the study will add to the understanding of issues particularly on land tenure and agricultural production efficiency and will serve as a reference piece for further related studies.

1.4 Study Area

The study was conducted in the West-Akim district of the Eastern region of Ghana. Recent agricultural statistics on the region indicate that West-Akim, Kwawu North and Fanteakwa districts contribute the highest proportion of total maize production in the region. In the 1993 production year, the districts produced 12,700mt of maize each which was the highest in the region, (PPMED, 1993). The West-Akim district was selected for this study because of proximity to area of the author's residence and cost in terms of transportation and accommodation which are affordable in this area. Three sub-districts namely:- Adeiso, Osenase and Oworam were selected for the administration of the questionnaires. The selection of these sub-districts was based on information obtained from the District Extension Department that they are the main maize producing areas in the district. Within these sub-districts six villages were randomly selected from a list of villages. These selected villages are Asuofori, Akanteng, Ekoso, Pabi, Oworam and Kwametia. Figure 1 presents the map of the study area showing the locations of the study villages.

The vegetation of the study areas is mainly forest, characterized by high humidity and temperature. The rainfall is bimodal i.e., from April to July and from August to November. The

annual rainfall figure falls between 1500 and 200mm which is suitable for maize production.

The study area comes under the forest ochrosol type of soils (figure 2). Information on the nature of the soils in the study villages shows that the soils can be sub-divided into the Swedru, Nsaba and Akroso Series (Adu and Asiamah, 1992). The Swedru series is reported to consist of grey-brown clay loam on the topsoil while the Nsaba series comprises a brown less completely-drained associate of Swedru series. The Akroso soils are said to be associated with Swedru and Nsaba soils and are reported to be more silty and heavier in texture. These soil series are according to Adu and Asiamah (1992) very good soils for crops such as maize, cassava, plantain, cocoa among others.

The topography of the area is gently undulating. The population density of the study area is 93/km^2, (1984 population census). This shows that the area is densely populated. The major occupation of the people in the study villages is farming, specifically maize and cassava cultivation.

Infrastructural development in the study villages is low. There is no electricity and access roads are lacking. All the study villages use bore-holes as their sources of water supply. The health delivery system is mainly the unorthodox type but some of the people seek medical assistance from the district hospital. There are lack of schools and the few existing ones are inadequately equipped.

1.5 Limitation of the Study

The major limitation of the study was that the author was not able to adopt the recommended method of collecting field data on exact land areas cultivated by the farmers. Upton (1987) has recommended that, to obtain accurate data on land areas cultivated to a given crop, the researcher must visit individual farms and carry out field measurements. This was not possible because the data collection exercise was carried out months after the major growing period. Rather farmers were interviewed at their homes. Since with small scale farming, there is the possibility that some farmers may not have exact knowledge about the land areas they cultivate, they may overestimate or underestimate them. The expected errors of underestimation or overestimation of land areas cultivated by farmers were minimized by cross checking the data provided with help of Extension Officers. Because the Officers visit the farms of the sampled farmers, they have fair knowledge of the land areas cultivated to maize by these farmers.

1.6 Organization of the Study

The study is organised into five chapters. Chapter Two reviews the existing literature on the concept of structure of resources, how resource structure affects agricultural productivity, concept of efficiency of resource use and review on the comparative efficiency of sharecroppers and owner-operator systems. Chapter Three presents the study methodology. Presentation and discussion of results is in Chapter Four. In Chapter Five, the final chapter, is presented the summary, conclusions and recommendations from the study.

Fig 1 : MAP OF THE STUDY AREA IN THE WEST AKIM DISTRICT

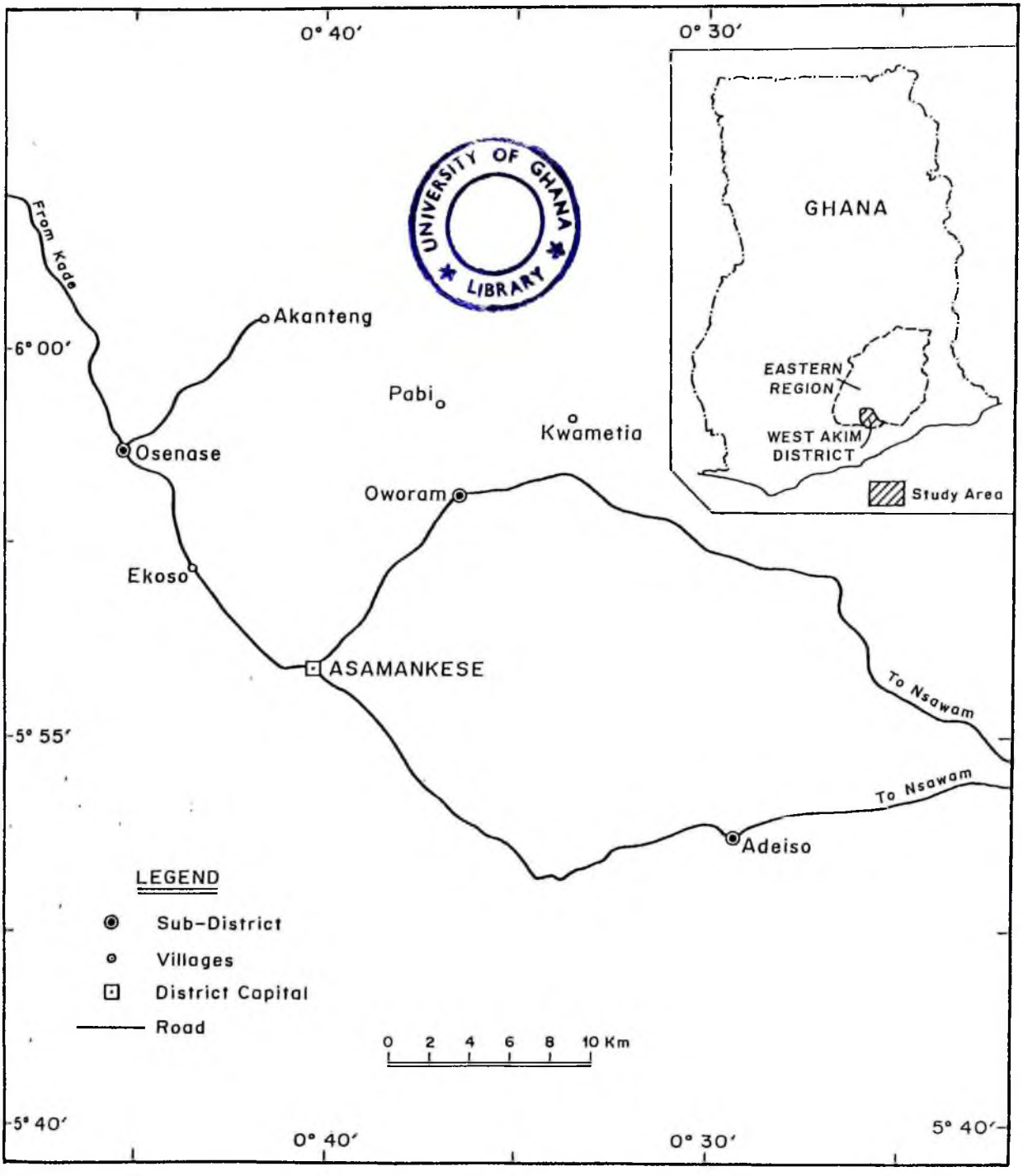
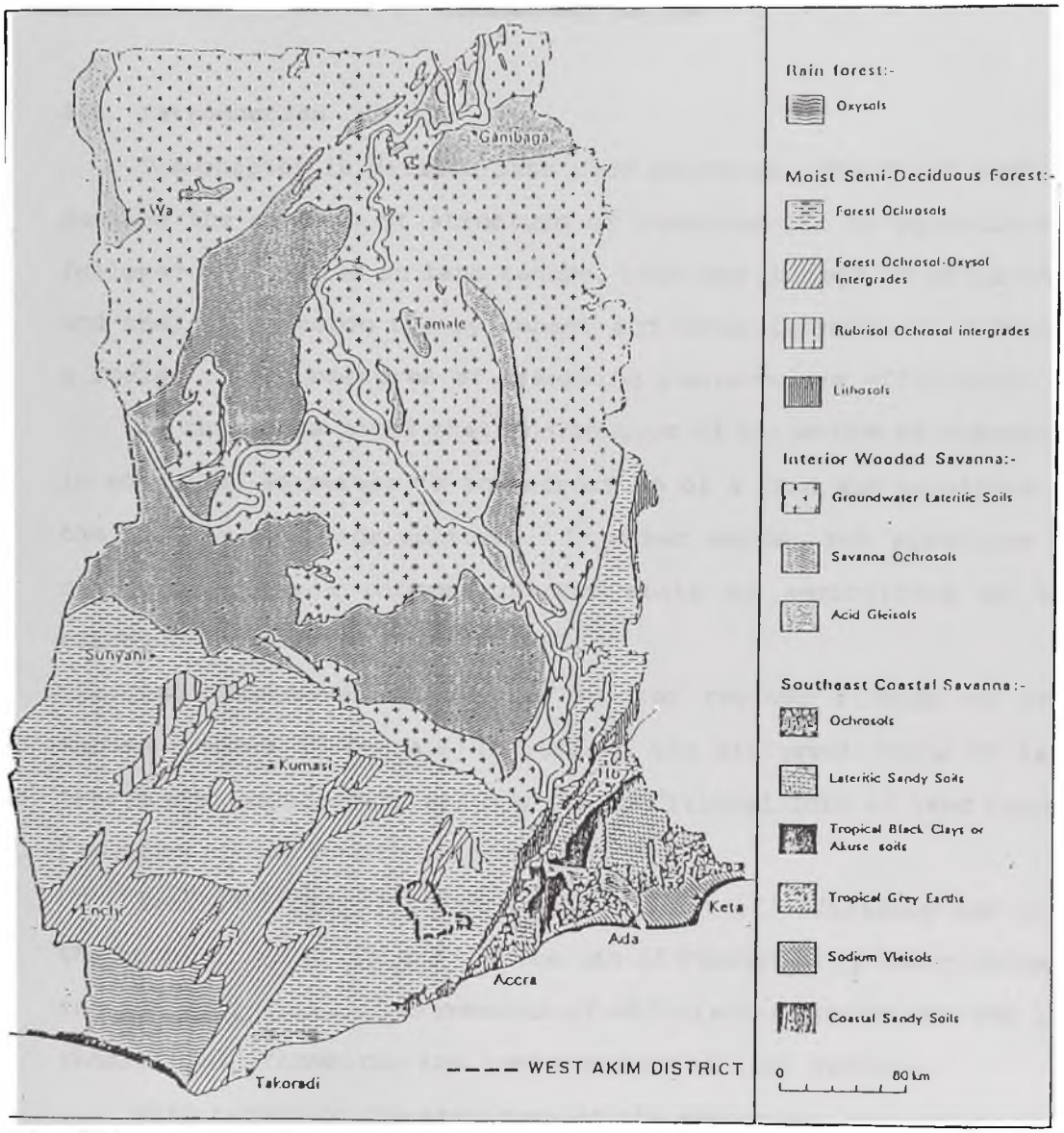


Fig. 2 MAP SHOWING THE MAJOR SOILS OF GHANA



Source: Dickson and Benneh.

CHAPTER TWO

2.0 LITERATURE REVIEW

2.1 Introduction

The chapter is divided into four sections. The first section reviews the concept of structure of resource use in agriculture, followed by a review on land tenure, then the concept of efficiency and that of resource use by tenant and owner farmers and finally, a review on the measures of assessing resource use efficiency.

It should be noted that the concept of structure of resources in some studies refers to the structure of a farm and in others as the structure of agriculture. In other words, the structure of resources gives a picture of the state of agriculture or the structure of a farm.

The second section of the chapter reviews studies on land tenure systems in Ghana. It reviews the different forms of land tenure systems in Ghana and how the traditional form of land tenure has transformed to other forms.

Section three reviews (i) the concept of efficiency and (ii) the comparative efficiency in the use of resources by owner farmers and sharecroppers. Measurements of efficient resource use and the theoretical frameworks are reviewed in the last section.

With regard to the structure of the resources, the review will come out with what the structure of the resources mean and how the structure is influenced by economic transformation and

technological changes. The review on the land tenure will help in knowing which types of land tenure arrangements exist and their terms of holding. This is important because it is hypothesized that the type and terms of agreement of landholding influence the type of farming technique and input usage adopted, (Junankar, 1976). The review on the comparative efficiency of resource use by owner and sharecropping farmers provides various arguments that have been put forward to support the efficiency in the use of resources by the two farmer groups. Finally, the review on the measures of efficient resource use will help to identify the best measure to use for the comparative assessment of efficiency in the use of resources.

2.2 Concept of Structure of Resources

A review of the literature reveals that the structure of resources are examined with two different perspectives. One view of structure is the composition of a particular resource, the other view is the proportions of resources to each other in any production.

Stabler (1975), refers to the structure of a farm as the proportion of each resource used. He further notes that generally, the structure of a resource in relation to other resources i.e. its combination with the other resources is also an indication of farm structure. Kwadzo (1995) in a Socio-economic study of small scale farm households on the Vertisols of the Accra Plains, looked at the proportions of resources used in terms of their production cost

structure. This was to find out the extent to which resources are utilised in the face of changing agricultural technologies and increasing cost of productivity enhancing inputs such as fertilizer, improved seeds, weedicides and tractor services. The method used to analyse the proportions of the resources in the study was to estimate the cost per hectare of each of the resources for each farmer. He found that for all farmers, labour input constituted the single highest cost of production (50-80%) which implies that less labour saving techniques were used.

Syndgrass and Wallace (1975) similarly examined the changes in the use of major United States farm inputs such as labour, machinery, fertilizer and seeds over a period of 44 years i.e. from 1929 to 1973 in a period of economic adjustments and changing agricultural technologies. They used the indices of prices of the major farm inputs to study the pattern of change in the use of the inputs. The findings were that, farm labour use continuously dropped and use of machinery/power, fertilizer and seed increased throughout the period. This finding indicates that over the period of study, labour saving techniques replaced farm labour which had positive implications on total production.

Harvey (1986) discusses the concept of structure in which he outlines the economic structure of agriculture in Europe and examines how this structure has been influenced by past economic and legislative circumstances. His concept of structure covers the number and sizes of farms; type and intensity of enterprise mix; land and labour use among farms. Hill and Ray (1987) defined

structure as a term referring to the inner composition of something. They used for example, the structure of a building to mean it's subordinate parts which make up the whole. They noted that the purpose of knowing the structure of something goes beyond simple curiosity. Such information gives insight into how the particular thing being referred to functions or works and even more importantly allows for possible explanations why certain things have happened in the past and enables future responses to be predicted. They looked at the change in the structure of an input like labour as being the reduction/increase in manpower it engages and the rise/decrease in use of machine. Hill and Ray (1987) examine the structure of United States' agriculture in the following way: They look at land structure in terms of size group of farms, type of farming and form of tenure. With regard to labour structure, parameters like the size of labour force, age, sex, employment status and family and hired labour composition. With capital, the amounts and types employed are examined.

Shawyer (1990) in studying farm structure and farm families of a Nottinghamshire field area used number of farms, size of the farms, capital such as mechanization and the use of chemicals, amount of labour employed to represent the farm structure. The study revealed the following changes over a period of 40 years: a reduction in the number of farms by half and an increase in the size of remaining farms; an increase in mechanization and in the use of chemicals; and a reduction in the amount of labour employed, all of which contributed to yield increases in the United Kingdom.

2.2.1 Labour Structure

In agriculture, labour is measured in man-hour or man-day of normal work by an individual for a specified period of time. One-man hour is the amount of work output per man hour. In much of rural Africa, access to labour, rather than land, is the basis of economic and political power (Upton, 1987). This reflects the relative sparseness of population and absence of labour saving machinery, as a result of which the labour available for critical tasks like planting and weeding is an effective constraint on production. The amount of labour used (actual labour input) over a given period on a particular farm, depends upon the family structure, the number of hours worked and the rate of working per hour (Kwadzo, 1995). A common trend in the traditional system is the extended or joint family unit, consisting of more than one married man plus dependents which is breaking up into nuclear family units, one married man plus dependents within the same household (Kwadzo, 1995). Labour used in agricultural production can be classified into various groups: family labour, comprising, male adults, female adults and children; hired labour made up of adult males and females and communal labour among others. Within the farm family, there is some form of division of labour. Many tasks are traditionally linked to age, sex, family or hired labour specific. Most domestic works like raising children in addition to planting, harvesting and processing are the responsibility of women. Men, generally, carry out heavier tasks such as land clearing, land preparation and weeding. Kwadzo (1995) and Adegeye

and Dittoh (1985) found that the major type of labour employed on small farms are family labour (adult male, adult female and children). Hired labour was found to be mostly used for land clearing and weeding. Norman (1972), Spencer (1976), Byerlee (1980) and Kwadzo (1995), have shown that the percentage of labour input supplied by hired labour is usually below 20 percent on small farms. Therefore, hired labour is not a critical factor in increasing agricultural productivity, (Ewusi et al., 1983).

Seasonal labour supply is a major constraint on expansion of production characterized by the use of traditional technologies. The availability of family labour during peak season is a crucial factor that determines the level of farm output and income, (Ewusi et al., 1983; Anthonio & Upton, 1965). Anthonio and Upton (1965) observe that although hired labour is often used to supplement the family labour, it has not played a major role in increasing the supply of labour and alleviating seasonal bottlenecks in sub-Saharan Africa.

In many areas, the supply of family labour is falling due to rural-urban drift and increasing number of children attending school. In many parts of the tropics, the area of land cultivated is decided by the amount of work the family can do. If the farmer could get more labour, he could cultivate more land. In such a case, the labour supply is limiting the size of farm.

Reviewing agricultural policies in the Organization for Economic Co-operation and Development (OECD) member countries, it was noted that the general image of agriculture has changed

considerably since 1950 in most countries (OECD, 1975). Infact, economic forces from 1950 to 1975 induced the application of labour saving techniques thus increasing land and labour productivity. These forces led to structural improvements and new forms of agricultural co-operation and made it easier for farmers to earn additional income outside agriculture. The adjustment process had been greatly determined by the special circumstances of individual farms, such as natural production conditions, possibilities for enlargement of cultivated area or intensification of production, financial position and the capacities of the farm operators as well as the family labour available and the desire of farmers or their heirs to stay in farming. The agricultural adjustment process makes agriculture more capital intensive with respect to both real and non-real estate investments. Moreover, adaptation to new conditions is unavoidable in that holdings of farmers, who neglect the exigencies of modern times and stick to their traditions, became inviable. Though they generally allow the operator a minimum income during his lifetime, such farms on the whole do not survive transfer between generations. This type of holding is often to be found in the small and medium size groups for which the financial implications of modernization are generally burdensome (OECD, 1975).

Sendaro and Forster (1992) examined the effect of technical stagnation and the changes in age structure of peasant producers in rural Tanzania. It was noted in the study that agricultural production has been progressively declining in recent years. The

explanations offered for this situation include factors such as environmental and climatic conditions, low producer prices, poor marketing facilities, poor infrastructure and transport facilities. However, Sendaro and Forster found that less attention has been given to the age structure as an important factor in explaining the decline in production. They indicated that the agricultural producing population has become old and as a result there has been no significant technical change. Evidence indicates that at any given time it is those aged 30 to 64 years and above who engage in agricultural production. The young people involve themselves in other economic activities until they have grown older and settle down to farm. This therefore implies that there will be more older people in farming which may have negative implications on yield because labour productivity may fall due to the ageing farming population. Ofori (1971) found that the problem of rural development in Nigeria has been accentuated as a result of rural migration. Young rural labour particularly those who have acquired some formal education, have continued to migrate to urban centres in search of wage price jobs. The consequence of this is that there is shortage of rural labour. This leaves agriculture in the hands of the older, non-literate rural population with consequent repercussions on managerial ability and productivity.

Majerova (1991), writing on the impact of privatization on the structure of agricultural labour, used age as an element of agricultural labour structure. He notes that the changing age

structure of the farming population i.e. towards old age has adverse implications for productivity.

Hill and Ray (1987) also found that due to a constant state of flux or adjustment in agriculture in the United Kingdom, the structure of its inputs has changed - notably the reduction in manpower it engages and the rise in use of machinery. Secondly, the number of small sized farms has fallen sharply and replaced by larger sized farms since the 40's. These changes have greatly influenced increases in outputs.

Writing on the changes in the Korean agriculture due to rapid economic development, Chung and Park (1991) found that as farming has changed from subsistence to commercial production, average farm size has increased. They also found that small farm size is one of the basic obstacles to increasing production. Improved technology, increased farm size, group farming and co-operative utilization of farm equipment are all ways of increasing output.

2.2.1.1 Pattern of Farm Labour Use in Ghana

In Ghana, the pattern of farm labour use differs significantly between the two southern and northern sectors. In the northern sector, characterized by prolonged dry season, all farm activities are concentrated in approximately one-half of the year and farm labour-use is distinctly seasonal. Here the farm household normally provides all the labour needed. Few children go to school;also wives and husbands tend to participate actively and jointly in the farm operations. Hired labour is occasionally

The foremost factor behind the existing pattern of allocating farm labour is food security. The small scale farmers in the southern sector, unlike their counterparts in the North, do not use farm manure or chemical fertilizers to enrich the soil (Atsu et al, 1980). Diminishing returns to labour thus quickly sets in as labour-use is intensified; rather than drive the marginal product of labour further down through a more intensive use on a piece of land, the farmer chooses to distribute his labour over a number of farms, since the land costs him little or nothing at all. This way, the farmer is assured of a greater total production from all the farms combined (Atsu et al., 1980).

2.2.2 Capital Structure

Capital is an important factor in production. Knowledge of the structure of capital in agricultural production may indicate whether agricultural production is subsistent or on commercial basis. In agriculture, capital is classified into two forms: fixed (investment capital) and variable capital (working capital). Fixed capital is the form of capital which does not vary with agricultural output while variable capital on the other varies with output levels. Working capital can also be classified by type of input i.e. seed (improved or local), chemical technology, mechanical technology and labour. The proportions of these capital types differ in usage in agricultural production depending upon whether the scale of operation is small or commercial. The structure of capital in agricultural production may have its

implications on agricultural output. For example, in small scale or traditional agricultural production, rudimentary capital inputs such as cutlasses and hoes are employed and there is also little use of output increasing inputs such as fertilizer and weedicide. The result of this is low agricultural outputs. The opposite is true for large scale production where there is investment in machinery and land, application of improved technologies on larger scale which ensure greater agricultural outputs.

Economic theory emphasis capital formation as the lever of development, (Phiri, 1991). Nurske (1953) believes that the route of escape from countries caught in the vicious circle of poverty lies in capital injection into their economies. Mellor (1962) points out that in order to increase output of traditional agriculture, there must be injection of capital. Similarly, Heady (1966) notes that the injection of capital is the ideal step in displacing human resources and increasing total production as well as raising productivity during farm modernization and economic development. This injection of capital could come in two ways. First, is the direct substitution of adaptive and/or new mechanical power for labour. This will enable each person to manage more hectares. Second, is the indirect substitution of biological and agro-chemical innovations for labour. These biological and agro-chemical innovations of new capital forms include fertilizer, feed additives, new crop varieties, improved seeds, insecticides, herbicides, fungicides and others which increase output per hectare while causing less labour to be required per unit of output per

while causing less labour to be required per unit of output per hectare.

Heady and Jensen (1954) reveal that many studies of production economics have shown that substantial potential exists for increasing the efficiency of resource utilization. Studies dealing with large aggregates and employing roughly defined variables, as well as micro level studies based on experimental and survey data, have convincingly attested to the existence of potentials under modernization based on injection of the two forms of capital (Heady and Jensen, 1954).

La-Anyane (1985), has observed that fertilizer, farm tractors and equipment and processing machinery will be the key inputs in the next twenty years from 1985. He further noted that as their costs have been increasing, it is important that they should be used efficiently so that the greatest number of farmers can have access to them for increasing food and agricultural production. In addition to efficient fertilizer use, improved seed and better husbandry practices should be adopted by the farmers.

A NARP (1993) report notes that, in order to sustain maize production at the current level of near self sufficiency, production growth rate should be at least 5% per annum. This rate according to the document can be achieved by farmers provided they adopt improved technology and inputs such as seed, fertilizer, other agro-chemicals and mechanization of operation.

2.2.2.1 Pattern of Capital Use in Agricultural Production in Ghana

In Ghana, the bulk of food is produced by small scale farmers. It is generally known that small-scale farmers adopt traditional way of farming i.e. the use of rudimentary tools like cutlass and hoe, mixed cropping and dependence on family labour for farming among others. Huge investments in capital equipment is absent in the Ghanaian agriculture. Though improved inputs such as fertilizer, weedicide, high yielding seeds, tractor services are employed in agricultural production in Ghana, they are employed on limited scale. The employment of these inputs may differ from one geographical region of the country to another. For example, soils in the Northern sector are relatively poor in organic matter and nutrients due to lack of vegetative cover. This situation compels farmers in the North to use fertilizer and other fertility enhancing chemicals more than their counterparts in the south where the soils are considered richer in nutrients (Atsu et al. 1980).

Quantitative estimates from crop budgets of the pattern of capital use on small farms in Asutuare and Somanya show that fixed capital inputs contribute only 5% of the total capital input cost, variable capital inputs contribute 27% and the remaining 68% come from labour (Kwadzo, 1995).

2.2.3 Structure of Land

Agricultural land tenure according to Dadson (1969), refers to the legal, political and socio-economic arrangements governing the ownership and management of agricultural land. He identifies three main forms of land tenure outside the communist system where farming is undertaken under state control:

(i) communal or group tenure

(ii) owner-operationship or owner-occupiership

(iii)tenancy.

The particular patterns of tenure in any given place depends on the customs and history of the area, the economic opportunities for land relative to its supply and the outcome of bilateral bargaining between the immediate landowner and the operator, (Dadson, 1969). As with other resources, the condition under which land is held influences the pattern and efficiency of use and the production of food, (Dadson, 1969; Karan et al, 1982).

Traditionally, in Ghana as in most parts of tropical Africa, land is generally owned communally by people having common descent or owing allegiance to a symbol of collective authority, for example, the 'stool' among the Akan of southern Ghana, (Bensti-Enchil, 1964; Ollenu, 1962; Parsons, 1971; Pogucki, 1962). Therefore the community or family constitutes the basic medium of access to land, (Gyasi, 1994). The individual members are supposed to enjoy free inheritable usufructuary rights over communal land on the basis of kinship (i.e., member of community without prejudice

to the communal ownership). Strangers or non-members may have access to communal land through the transfer of rights of use by the land-owning family usually through the leader, chief or occupant of the land. Another increasingly used medium to access land is the government, which may acquire land compulsorily from the original owners, through legislation for government's own use or by use of others, in so far as the acquisition is deemed to be in the interest of the public, (Gyasi, 1994).

One school of thought sees the traditional communal land tenure system as nebulous, inherently conservative, incapable of adapting fast enough to change and therefore a drag on development (La-Anyane, 1962; Migot-Adholla et al, 1990). It was for example observed that: "innovative and investment-oriented agricultural enterprise ... are inhibited" (King, 1973, P7). Other constraints on development have been associated with lack of clarity about the allocating authority and boundaries which may result in disputes. There is trespassing, inequitable tenancies, lack of security for tenants, especially alien or stranger farmers and inability to use communally owned land as collateral for loans. In addition to these factors, the customary system of inheritance, which in certain cases, excludes females, and entails the subdivision of land among succeeding generations with consequential fragmentation of holdings is also reported to be a constraint to development (Arhin, 1985; Johnson, 1962; Migot-Adholla et al., 1990; Ninson, 1989).

Though the communal system of land tenure was a bane to development, it was not static. The system in Ghana did not prevent extensive acquisition of land, even by strangers or migrants who do not belong to any of the land-holding groups in the locality, for cocoa farming especially from 1890s to about 1950 (Hill, 1963; Johnson, 1962), but also from 1950 onwards, (Arhin, 1985). Nor did it prevent the phenomenal post-1970 oil palm farming expansion, involving an over five fold increase in oil palm hectare in 20 years. This would seem to underscore the view that basically, the traditional system is a dynamic one, capable of adapting in good times to favourable economic opportunities, (Gyasi, 1994).

Individual ownership and tenancy appear to be the forms that emerge in development, (Dadson, 1969). Under owner-operatorship, the farmer owns the land he cultivates and provides all other resources (labour, capital and management). He has complete control over the farm. Under tenancy, there is a division of economic function between the landlord and the tenant. The landlord usually provides land only, and the tenant provides labour and capital in the production unit. The terms of the contract determine how the resources of the landlord and the tenant are to be combined and how the returns are to be distributed. It is this question of resource allocation and returns distribution that the economic problem of tenancy arises, (Dadson 1969).

There are two types of tenancies: cash and share tenancies. Under cash tenancy (or cash lease), a fixed sum is charged per hectare of farmland and payment is independent of production. Under share lease, the rent is a stated proportion of the total yield. There are two forms of the share lease namely 'ABUSA' system and Abunu system. Under the Abusa, one-third of the produce goes to the landlord and the remaining to tenant. 'ABUNU' tenancy is where the share is half each, (Dadson, 1969). Dadson, reported that the economics of the different forms of tenure may be examined or demonstrated with reference to their effects on the amount of various resources applied and the level of production induced, the size of farm business, the selection of enterprises ie, type of products; the horizon of investment; the length of lease; willingness to invest; the life of investment and arrangements regarding compensation for unexploited resources.

2.4 Comparative Efficiency of Tenancy (Sharecropping) and Owner-Operatorship Systems in Resource Use

A lot has been written and debated about the comparative efficiency of resource allocation in agriculture under alternative forms of land tenure in the economic literature related to land reform and agricultural development in less developed countries. According to Ip and Stahl (1978), a large body of economists and other social scientists concerned with underdevelopment contend that tenancy (especially sharecropping) results in an inefficient allocation of resources as well as a reduced incentive to improve

agricultural land. This school of thought also holds the opinion that the persistent poverty of the rural population of less developed countries is due to substantial variations of tenancies as forms of contractual arrangement. To this school of thought, land reform measures such as reduction in cash rental rate, abolition of sharecropping and minimum term leases are viewed as policy instruments that can improve development prospects.

Others, however, disagree with this view. Those of the "equal efficiency" school argue that the form of land tenure has no bearing on allocative efficiency and would attribute the poverty in the agricultural sector of less developed countries not to the prevailing land tenure arrangements but to their factor endowment which is a large body of unskilled labour relative to land and capital. This school also believes that arguments of land reform proponents' in support of reform are more often than not on normative welfare criteria rather than positive criterion of economic efficiency, (Ip and Stahl, 1978). An empirical dimension has been added to the debate in an attempt to resolve the controversy. Results have varied, but generally it has been found that tenancy is not necessarily less efficient than owner cultivation. According to Ip and Stahl (1978), the theoretical arguments of the equal efficiency school as well as the empirical studies purporting to support the equal efficiency school seem to be seriously misleading. The limitations of their analysis stem from their failure to take account of the interactions and linkages of the agricultural and other sectors throughout the development

process (Ip and Stahl, 1978). It is contended that the "efficiency" of alternative land tenure arrangements and associated land reform recommendations cannot be analysed out of context of these intersectorial linkages and interactions. Land reform, and the choice of an optimum land tenure system, has implications not only for the efficiency of resource allocation in the farm sector as a whole. In their conclusion, Ip and Stahl (1978) noted that when transaction costs, the role of entrepreneurship, and economic incentives are explicitly introduced and analysed in the framework of intersectoral interactions and linkages, land reform measures redistributing land to the peasants, substituting owner-cultivers for share tenants, tend to improve agricultural production efficiency, resource allocation between farm sector and other sectors, and contribute to economic development of less developed countries, contrary to conclusions reached by writers of "equal efficiency" school.

Bhaumik (1991) in his paper on "Tenancy and Resource Allocation" covering 224 tenant households in 12 villages in West Bengal of India, found that on the whole there seems to be a tendency on the part of farmers to use higher levels of inputs per acre and to achieve better yields on their owned land compared with land farmed by sharecroppers. This, according to Bhaumik illustrates the negative aspects of crop-sharing systems. Such a situation emerges due to the ineffective monitoring of tenants' activities by landlords. He further found that there is no significant difference in economic performance between the owner-

operator and fixed cash rent tenant households. It is shown that for the small marginal and landless rural people, sharecropping is a means for their survival, but it plays a negative role by discouraging agricultural investment and hindering agricultural productivity, (Momin, 1991).

Feder and Ochan (1987), hypothesised that the negative effects of sharecropping can be attributed to two related factors: (a) ownership insecurity: with ownership insecurity, investments in land improvements and equipment for land cultivation may be more lacking than under secured ownership. This is due to the uncertainty as to the length of tenancy which may affect a farm's long term planning. This situation will induce farmers to shift investment to activities not related to land cultivation or to invest less (and consume more), (b) Ownership insecurity does not allow land to be used as a collateral for loans. Lack of collateral limits the farmers' ability to borrow from institutional lenders because unsecured loans are more risky for such lenders. Constraints on credit limit the farmers' investment possibilities. Both factors imply that ownership insecurity reduces farm capital formation and land developments and hence productivity is affected.

Migot-Adholla et al (1990), while sharing the same views on tenancy systems limiting land improvements and access to institutional credit, debunk the notion that tenure insecurity is a source of agricultural resource use inefficiencies. In their study which was carried out in three districts in Ghana, they found that tenure security is high as measured by rights over land and

low incidence of dispute, except for migrant farmers from other regions. They further noted that, the issue is not gross inequality in land distribution as some writers claim, but the extent to which indigenous land rights may be a constraint on agricultural development.

Reynolds (1977) held the view that as the share tenant receives only a fraction of the output and only a portion of the marginal product of any tenant-supplied input, he would be encouraged to undersupply these inputs and thus produce inefficiently compared with fixed-rent and owner-operated contracts. Empirical work by Vernon (1971) tends to undermine the proposition that share tenancy is less efficient than fixed-rent and owner operated systems. He exemplifies the theoretical inefficiency of labour input by constructing hypothetical partial budgets for the use of fertilizer and insecticide on the assumption that the landlord shares in cost. He notes that "the analysis is consistent with the proposition that share tenancy does reduce the incentive for intensive use of labour inputs and for the use of output increasing inputs such as fertilizer and insecticides. However, in his study, it appears that share tenancy where landlord provided other inputs apart from land may actually encourage a more rapid rate of adoption of labour saving technologies than would occur under fixed rent holders or owner-operatorship system. This is expected since the farmer gets more for less labour input. He further notes that an empirical evidence collected in the Philippines tends to show that, on small farms, a higher output per

hectare was observed under share tenancy than under owner operation for the same size of farm growing the same crops; the converse was found for larger farms. Moreover output per man was lower on share tenancy again on small farms. In his conclusions, he notes that it is difficult to assess the statistical significance of his findings and as a result support from them for the traditional view of inefficiencies associated with share tenancy.

However, some studies have established that in terms of superiority in the efficient use of resources, land improvements and increased output levels, owner-operatorship and cash rent systems should be recommended, (Bhaumik, 1991 and Dadson, 1969).

Migot-Adhollar et al. (1990) study on "land tenure and agricultural productivity in Ghana" is the most recent study conducted with regard to land tenure and agricultural production. Their study covered selected communities and their conclusions were based on qualitative explanations of the data they collected. Therefore a study using a quantitative approach and conducted in a different geographical area could contribute to clearing the controversies surrounding tenancy and agricultural production efficiency.

2.5 Concept of Efficiency

Efficiency in general refers to a ratio of what is produced to input used, (Makeham and Malcolm, 1986). For example, Raleigh (1958), notes that land is said to be used efficiently when it yields optimum returns from a given enterprise. In the literature

on the concept of efficiency of resource use, the concepts of economic efficiency (ie. allocative or price efficiency) and technical efficiency are normally encountered. Technical efficiency refers to the ability to obtain the highest amount of output with given amounts of factor inputs and allocative efficiency is the concept of efficiency in which resources are allocated in the "Pareto" sense (optimum output) so that marginal value products of resources are equal to their unit prices, (Onyenwaku, 1991).

Heady and Jensen (1954), outlined a number of factors which affect labour efficiency. These include enterprise combination, replacement of labour with capital and equipment, the amount of capital combined with a given amount of labour and how labour is managed and supervised. As has already been noted, substituting capital and high capacity machinery for labour can also increase work output per man. Optimizing output results in economic efficiency. On many farms, substitution of capital for labour can greatly increase labour productivity and incomes if the displaced labour can be combined with more capital to expand output and size of operations. The efficient use and productivity of any single resource depends on the quantity of other resources it combines with (Heady and Jensen, 1954). According to them, the major reason why labour is used so inefficiently on many farms is that the farms are small and don't have enough resources to combine with labour on hand. A very large part of the labour inefficiency and low incomes on subsistence and sharecropper farms and even on many commercial

farms can be solved by adding more capital to the available labour supplies. Adding more capital on farms with limited funds requires the use of the opportunity cost principle so that capital is put into highest profit enterprises for maximum labour efficiency and income.

Land productivity relates to the ability of land to yield crops. There are a number of factors that determine the magnitude of crop yields. Among these factors are fertility of the soil, water supply, the availability and the relative proportions of capital and labour input and physical condition of the soil. Soil fertility, according to Acquaye (1969) refers to the capacity of the soil to supply nutrients both major and minor, in adequate and balanced amounts to plants. A soil may be fertile yet unproductive due to poor and unfavourable physical conditions. Conversely, a soil may be poor in fertility, yet by the use of fertilizers and irrigation, it may be made to produce high yields. Land per se is unproductive unless combined with capital and labour inputs. The proportions in which these resources are combined may determine how efficient land is used. In Africa for example, land productivity is considered low because of the mismatch between surplus land and limited labour and capital inputs, (Bishop and Toussaint, 1964). To improve upon productivity of land, factors such as crop and soil management should be of prior concern. Crop management entails first and foremost the selection of high yielding varieties adapted to local conditions. Secondly, the selected varieties should be resistant to local pests and diseases. Weed control measures,

irrigation and other requirements of the crop must be met.

Soil management in crop production is particularly concerned with soil water supply, soil fertility level and soil physical condition. Measures to improve soil fertility include green manuring, addition of organic matter to the soil, use of fertilizers and intercropping with leguminous crops.

2.5.1 Methods Of Measuring Resource Use Efficiency

The debate regarding the best method to measure farm performance and resource-use efficiency predates the subjects of farm management and agricultural economics as it is known today, (Phiri, 1991). Following the principles of production economics exemplified in the theory of the firm, maximizing profit has been regarded as the primary objective of the farm business. For example, Bernard and Nix (1979) stated that the objective of farm management is to arrive at the particular output that gives greater profit than any other level of output. Similarly, Drucker (1968) stated that management must, in every decision and action, always put economic performance first. The above statements are in line with the theory of the firm which implies that a farm is performing well if it organizes resources in such a way that it maximizes profit. However, the assumption of perfect competition that is implicit in this approach has been criticized by many economists. They argue that, because knowledge about the future is imperfect, agricultural production decision making takes place in an environment of uncertainty. Dillon (1979) notes that this is

especially true in under-developed agricultural systems where underdevelopment itself compounds the uncertainty, regardless of whether the decision maker is a subsistence owner, landlord or commercial producer. Economists argue that in the face of risk and uncertainty, smallholder farmers select crop combinations that facilitate sufficient food income for the family's needs. This situation is described by Simon (1955); Cyert and March (1963) as "satisficing" and by Lipton (1968) as a "Survival algorithm".

Where the profit maximizing and household objectives approaches have been applied to small-scale agriculture, the results have almost been at odds with each other (Phiri, 1991). Measures of farmer performance based on the profit maximization approach invariably lead to conclusions that small scale farmers allocate resources ineffienciently and that they are lazy and irrational decision makers. Measures based on the household objectives approach lead to conclusions that farmers allocate resources efficiently according to their subjective judgement of future outcome. Whether or not uncertainty is incorporated into the analysis, gross margins or linear programming method is helpful in comparisons and farm modelling especially in traditional agriculture (Phiri, 1991). Despite criticisms levelled against the profit maximizing approach of assessing resource use efficiency, many studies have used the approach. Kumbhakar (1994) applied the profit maximizing model using flexible production function to estimate efficiency in the use of resources. In his study, a translog production function is used to estimate the efficiency of

227 small-scale farms. Kumbhakar (1994) used the profit maximizing framework to estimate technical and allocative efficiencies of the farms. The empirical results show that so far as allocative efficiency is concerned, majority of the farms are found to be under-users of endogenous inputs such as fertilizer, human and bullock labour. Sankhayan (1993) used the Cobb-Douglas production function and the marginal value product and marginal cost techniques to respectively examine the resource productivity and allocation efficiency on a number of farms. The results of the study indicated that resources were inefficiently used or allocated. Matekwa and Mbata (1993) studied the resource use efficiency among small-scale farmers in selected areas of Western Kenya. A production function and the allocative efficiency of the resources are estimated. The results of the study indicate that farmers underutilized modern types of inputs such as fertilizer, pesticides and improved inputs but overutilized farm labour. Olomla (1991) compared capture fisheries with aquaculture (fish farming) in Ondo State, Nigeria to determine how efficient the systems were utilizing resources and how production could be economically increased. In determining the efficiency of resource use, factor productivity and returns to scale, production functions were estimated using the Cobb-Douglas production function. In his study, the marginal value product was compared with the input price to determine the resource use efficiency. Hopper (1965) made an attempt to study allocative efficiency on a sample farms by determining: first the production functions underlying the

traditional village production and secondly, the actual allocation of resources the farmers made among their production alternatives. The Cobb-Douglas production function was used for the estimation. In estimating or determining the allocative efficiency, Hoper (1965) notes that if a farmer has allocated his inputs among his production alternatives efficiently and if he is operating under conditions of competition in the product and factor markets, then the marginal value product of the input must equal to the input price. Other approach based on the profit maximizing assumption used extensively to determine resource use efficiency is the unit profit function approach. Dittoh (1988), Lau and Yotopoulos (1972), Sidhu (1974), Yotopoulos, Lau and Lin (1976) and Garcia et al (1977) have used the unit profit function approach in assessing resource use efficiency. The use of the unit profit function to determine resource use efficiency according to Dittoh (1988) has its limitations. Chard and Kaul (1986) outlined certain in built characteristics in the use of the unit profit function which make its use a bit complex. These characteristics are that (i) own price elasticity of factor demand is always elastic with Cobb-Douglas function (ii) all variable factors are complementary to each other and hence the substitutive relation is ruled out by this function (iii) cross-price elasticity of all factors with respect to price of any other factor is the same in magnitude and in sign (iv) the effects of change in any fixed factor is symmetric on all the variable inputs and (v) price elasticity of factor demand with respect to output price is always more than one (elastic). All

these factors must be satisfied if the unit profit function is to be applied. The unit profit function is most appropriate for determining relative efficiencies of large and small farms, of different technologies and of different scales of operation eg large and small scale irrigation schemes (Dittoh, 1988). As has been previously noted by (Phiri, 1991), gross margins analysis is more suitable for comparing resource-use efficiency among different groups of farmers producing especially on small-scale basis. This method is used to determine farm profitability which according to Garcia et al. (1977), is influenced by the enterprise mix and efficiency in input usage.

The Gross Margins is measured as the difference between the total value of output and the total variable cost of production. The gross margins method is used to study the financial performance of an enterprise, i.e. the productive components of a farm to obtain information about the enterprise's strengths and weaknesses in greater depth than can be derived by whole farm analysis (Buckett, 1981).

Taylor and Turner (1989), note that the technique has the advantage of being a quick and simple method of assessing enterprise performance. It is probably the most commonly used measure in farm analysis and planning and also is now used extensively in publications (Makeham and Malcolm, 1986). The Gross Margins per hectare of crop and per head of livestock are widely used for comparative analysis of activities on one farm and between farms in similar environments. For example, if the Gross Margins

(GM) on one farmer's maize crop is ¢150 per hectare and the average GM of a neighbouring farmer is ¢300, then he should seek advice on the technical reasons for his poorer performance given marketing conditions and both farmers using identical inputs. Valid comparisons can be made in terms production unit common to all of the farms or activities being compared. This unit can be land area, if the land used by each is equally suitable. It could also be per unit of labour, (Makeham and Malcom, 1986). The GM method is claimed to have more value for inter-farm comparisons than the whole farm efficiency factors because they are less influenced by farm size and type (Buckett, 1981).

Gross Margins are frequently criticised because they neglect fixed costs. Proponents of full costing, the time-consuming technique which attempts to allocate fixed costs to activities even if it is arbitrary, suggest that it is infinitely better than GM analysis. Properly undertaken, the GM method would help avoid such mistakes (Buckett, 1981).

In contradiction to the view normally help that the full costing is better than the Gross margins, it has been suggested that farmers have more control over fixed costs than over variable costs. This idea can have an element of truth in some situations. If a farmer has intentions of maximizing his Gross Margins, he possibly has little choice in the variable cost levels he must employ to attain his goal. He can, however, exercise his judgement on the machinery and other fixed costs items, (Buckett, 1981).

Phiri (1991) used the GM technique to determine the efficient resource use among different groups of small scale farmers. He compared the average GM per hectare and per unit of labour among the different groups of farmers. In his analysis, he noted that, if the GM per unit of input is greater for a given group of farmers, then that group used that input more efficiently than the other and vice-versa.

The strengths of the GM technique are the (i) it is a simple method of assessing efficiency, (ii) the records and accounting are easy and quick, (iii) it does indicate areas of strengths and weaknesses in terms of resource use (Taylor and Turner, 1989). The major weakness as has already been noted is the exclusion of fixed costs in the calculation of GM. This weakness is not a major problem as far as small scale agriculture is concerned. The reason is, small scale agriculture does not normally involve substantial investments in fixed cost items and hence their exclusion will have little, if any, impact on the analysis.

Though the use of gross margins may be beneficial, for policy purposes the profit maximizing approach of determining resource use efficiency is more preferable. This is because the gross margins analysis is more useful for the comparison of individual farms than aggregate farms for a given growing period. Since it is assumed that the production levels of small-scale farmers do not vary much over time, meaningful policy conclusions can be drawn if the production function approach in determining resource use efficiency is adopted.

2.5.2 Theoretical Framework of Analytical Methods

The structure of resources is viewed in two ways. One examines the proportions of the resources and the other concerns the composition of each individual resource. Below is the theoretical foundation for objective I.

Small scale agriculture in Africa is characterized by excess supply of land and limited labour and capital, (Mellor, 1966). With the economic transformation and changing agricultural technologies, more capital intensive technologies are adopted as observed in the developed countries to meet the fast growing population and industrialization. As a result, the type of farming system, the sizes of farms cultivated, the type of capital inputs employed, the age structure of farmers, the type of manpower used on the farms in terms of technical and managerial skill and the form of farm tenure among others in agriculture must change with changing times to move from subsistence production to commercial oriented production.

The theoretical foundation for objective II is that land problems and policies of a nation depend partly on the physical characteristics of the land itself but more importantly upon the stage of economic development, customary or legal rights and the prevailing national attitudes of the people of the country towards land, (La-Anyane, 1969). Customary institutions and prevailing attitudes determine the land tenure arrangements of a nation. There are many different types of tenure arrangements in Ghanaian agriculture. These arrangements influence the efficiency with

which inputs are used. The arrangements also affect the degree of uncertainty encountered in the operation of the farm, (Bishop and Toussaint, 1958). The specific features of land tenure which have constituted barriers to improvement in agriculture are the fragmentation of holdings, the difficulties involved in acquiring new land, the inability of a farmer to make permanent improvements or plant permanent crop on land which is commonly owned or on land which is held by pledging short-term lease, and the absence of registration (La-Anyane, 1969). The tenure system can and do shape the production structure and the land use pattern, (Ofori, 1973). The system can influence the organization of farms by placing constraints upon the accessibility and exploitation of opportunities on the land thereby affecting the security of use of land.

With resource use efficiency, the farmer is considered to be a rational producer and that he allocates resources in a way to maximize profit. A rigorous comparison of the allocative efficiencies of any groups of farms requires that the farms be (i) characterized by constant returns to scale (ii) that the farms be represented by the same production function and (iii) that the farms face the same configuration of input and output prices (Onyenwaku, 1991). To determine the allocative efficiency, a production function is estimated. The production function is assumed to satisfy the condition that the marginal physical product of any input is positive and should be declining. It is also assumed that all inputs can divided into two categories: fixed and

variable where in the short run the inputs are fixed and in the long run they are variable (Mansfield, 1994). A farm is said to be allocative or price efficient if it maximizes profit by equating the value of the marginal product of each variable input to its price.

Theoretically, it has been noted by Taylor and Turner (1989), that though full cost accounting has its advantages, for most farm businesses, it is impractical. As a result of this situation, a system has been developed which overcomes the problem of cost allocation largely by ignoring the costs which are difficult to allocate (regarding them as overhead cost) and concentrating solely on the performance of the enterprises relating to output and variable costs. This is called the Gross Margins system which has the advantage of being a quick and simple method of assessing enterprise performance. No fixed costs are taken into consideration. But it should be noted that when fixed cost is a substantial proportion of total cost, this method is unacceptable.

CHAPTER THREE

3.0 METHODOLOGY

3.1 Data and Sampling Technique

Both primary and secondary data were used for the analyses. The actual field work was done in April, 1995 but the data collected was based on the 1994 major growing season. Data on the 1994 minor growing season was not included because, according to the sampled farmers, harvest was very poor and insignificant as a result of poor rains.

A total of 100 farmers comprising 35 owner farmers, 50 sharecroppers, 9 fixed renters and 6 leaseholders were sampled and interviewed. A random sampling technique was used to select the studied farmers. This was accomplished by the help of an extension officer. At each studied village, farm households were picked with a sampling gab of one i.e. farm household selection was alternated. After a farm household was selected, any member of the household who is actively involved in the cultivation of maize and farmed during the studied period was selected for the interview. Personal interviews were carried out with the sampled farmers by the use of structured questionnaires in their homes. The extension officer was present throughout the interview period which lasted for about a month to confirm some of the information provided by the respondents because he has been working with them for most of the time.

Data was collected on the total output of maize harvested in kilos, the amount of mandays used by each farmer (both hired and family), the land sizes cultivated in hectares, quantity/value of fertilizer, weedicide, seed, cutlass hoe and basket used for the major growing season. The output price used is the average of the farm gate prices received by all the sampled farmers. The prices used to value fertilizer, weedicide, cutlass, hoe, seed and basket were 1994 district level prices obtained from the district extension department. The cost of labour for farm work was calculated by finding the average of the cost per manday and the cost of cooked/raw food for hired labour. with regard to price paid for the use of land by different categories of sampled farmers, different prices were obtained. For sharecroppers, the price paid for the use of land was calculated based on the portion of the value of output received by the landlord. The sampled owner farmers do not pay any rent on the use of land, but for purposes of this study, how much they would have paid if they were to rent land for farming was used to represent the cost of land to them.

Information was also collected on the types of cropping patterns, mode of land acquisition by tenant farmers, length of tenancy, age and gender structure of sampled farmers, cost estimates of inputs, and types of labour and capital used by sampled farmers.

Secondary data was also collected on the climatic conditions, topography, population density, and vegetation of the study area from the district extension service department. Information on the

types of soils present in the study area was obtained from secondary source.

3.2 Methods of Analysis

3.2.1 Structure of Resource Use

For the structure of resource use in agricultural production, two methods were used. One method based on Hill and Ray's (1987) approach was used to analyse the composition of the resources and the other method, based on the cost estimates of the resources was used to analyse the proportions of the resources. In Hill and Ray's approach, the field data obtained were either described in the raw form or presented in a frequency distribution tables or cross-tabulation depending upon the objective in question.

In the second approach, the share of each resource in total cost was estimated. This gives an indication of the extent to which each of the resources is employed (Olomola, 1991).

3.2.2 Comparative Efficiency of Resource Use

With regard to the comparative efficiency of resource use in maize production in the study area by owner and sharecropping farmers, the Gross margins method on one hand, and the allocative efficiency method, based on the profit maximizing approach on the other hand were used. These methods from the literature have been widely applied to analyse resource use efficiency. The results from both methods were compared to find out if there were any

any differences but more focus was given to the latter method for policy purposes.

3.2.2.1 Gross Margins

The Gross Margins of an enterprise, say a farm unit, is defined as the value of the total product of the farm unit in a given period of time less the total variable cost of the farm unit in the same period. The Gross Margins per unit of the inputs were computed and compared between sharecroppers and owner farmers to determine which of the two farmer groups used the resources more efficiently.

Mathematically, the Gross Margins formula is given as follows:

$$\text{Gross Margins} = Q_i P_i - \sum_{i=1} X_i r_i$$

where Q_i = Total output obtained by a farmer in the last crop year

P_i = Price of 1kg of maize received by an ith farmer

X_i = Total quantity of an i^{th} input used up in the course of production during the crop year.

r_i = Unit price of an i^{th} input used up in the course of production during the crop year.

i = 1, 2, ..., n.

In computing the Gross Margins per unit of an input say, labour, for a farmer, the total variable cost of production was deducted from the total output per farmer. The difference was then divided by the labour input to obtain the Gross Margins per unit labour for a farmer. The same procedure was applied to the other inputs for all the farmers. To compare the Gross Margins between the farmer groups, the average Gross Margins was computed for each farmer group. The decision criterion is, the higher the average Gross margins per unit of an input for a farmer group, the more efficient the group uses the input. This conclusion is based on whether there is a significant difference between the means of the Gross margins per hectare or per unit labour between the two farmer groups. The paired t-test was used to test whether there is any significant difference between the gross margins of the two farmer groups.

3.2.2.2 Allocative Efficiency

To compare the allocative efficiencies of owner and sharecropping farmers, it is assumed that these two groups of farms are characterised by (i) constant returns to scale (ii) represented by the same or neutral production function and (iii) facing the same configuration of inputs and out prices (Onyenqaku, 1991).

It is also assumed that the farmer is a rational producer and that he is a profit maximizer.

In determining the relative allocative efficiencies of the two farmer groups, a Cobb-Douglas production function was estimated using Ordinary Least Squares regression analysis. Cobb-Douglas production function was used among the other production functions because it is mostly used in applied research and easiest in handling mathematically (Koutsoyiannis, 1979).

Assuming output of maize is affected by land, labour and capital given other factors which might also affect output of maize. Then a production function is specified as follows:

$$Q = f(X_1, X_2, X_3, u) \ldots\ldots\ldots (1).$$

where Q = output of maize, X_1 = land, X_2 = labour, X_3 = capital and U = error term.

To estimate the Cobb-Douglas production function, the equation used is:

$$Q_i = AX_1^{a1}X_2^{a2}X_3^{a3}\ldots\ldots\ldots U_t \ldots\ldots\ldots\ldots (2)$$

where Q1 = total output of maize in kilos harvested by an ith farmer

A = a constant term

X_1 = total land area cultivated to maize in hectares

X_2 = total amount of labour used in mandays on the maize farms studied

X_3 = value of capital inputs used on the studied farms.

U_t = error term assumed to satisfy all the stochastic assumptions.

a_1, a_2, a_3, are the respective coefficients of land, labour and capital variables.

To obtain the estimation equation from equation 2, the log-log function was applied. The regression coefficients, the t-ratios, the R^2-ratios and the F-ratios were determined for sharecroppers, owner farmers and the poded sample.

A farmer is said to be allocative efficient if he maximizes profit by equating the value of the marginal product of each variable input to its unit price. Thus the allocative efficiency index for each farmer group was computed as follows:

$$MVP_{ij} = P_j MPP_{ij} = r_{ij} K_{ij}$$

which implies $$K_{ij} = \frac{MVP_{ij}}{r_{ij}} \quad \ldots\ldots\ldots\ldots\ldots\ldots (3)$$

where MVP_{ij} = marginal value product of the ith input for the jth farmer group

MPP_{ij} = the marginal physical product of the ith input for the jth farmer group

P_j = average price of per kilo maize received by jth farmer group

r_{ij} = price of the ith input paid by the jth farmer group

K_{ij} = the allocative efficiency index of the ith input of the jth farmer group.

Since the coeffiencients of land, labour and capital are straight elasticities, equation (2) is re-written to include the production elasticities as follows:

$$K_{ij} = \frac{P_j a_{ij} Q_j}{X_{ij} r_{ij}} \quad \text{where } MPP_i = a_{ij} Q_j / X_{ij}$$

a_{ij} = output elasticity of ith input for jth farmer group

Q_j = mean output for jth farmer group

X_{ij} = mean of ith input for jth farmer group.

Other parameters are as defined previously.

The allocative efficiency index is a measure of efficiency in resource use. The input is overutilized if $K<1$ and underutilized if $K<1$. Absolute allocative efficiency requires that $K = 1$ for all inputs (Onyenwaku, 1991; Ellis, 1992).

To test whether there was any difference in the coefficients of the inputs between the two farmers groups, the Chow test was used. Returns to scales were also computed to find out if the sampled farms are characterised by constant returns to scale.

CHAPTER IV

4.0 RESULTS AND DISCUSSION

4.1 Introduction

In this chapter is presented a discussion on the results of the analysis. The chapter begins with discussions on the composition and proportions of land, labour and capital which constitute the structure of the resources. In the discussion of the structure of the resources, comparisons are made with related studies where necessary. The second section of the chapter discusses the efficiency in the use of land and labour by sharecroppers and owner-operators.

4.2 Structure of the Resources (as defined by their Composition)

4.2.1 Land Structure

Land structure is considered in terms of farm sizes, type of cropping pattern and forms of land tenure.

4.2.1.1 Farm Sizes

The land areas cultivated to maize by the sampled farmers during the 1994 growing season ranged between 0 and 2.4 hectares. Table 1 shows the percentage distribution of land sizes cultivated solely to maize by sampled farmers. It is seen from the table that, 47% cultivated land sizes between 0 and 0.4 hectares, 20% between 0.41 and 0.60, 13% between 0.61 and 0.80, 5% between 0.81

and 1.0 and 15% cultivated land sizes greater than one. Cumulatively, 85% of the farmers cultivated land areas less than or equal to one hectare to maize only and 15% cultivated land areas greater than one hectare but less than or equal to 2.4 hectares. The distribution of land sizes cultivated to maize shows that a higher percentage of the farmers cultivated small areas. The distribution of land holdings in the area also compares with distribution by size holdings in the Eastern region (MOA, 1991). Asked why they operated land areas of such sizes, about 90% of the farmers responded that, the cultivated areas are based on their capabilities to manage the farm, particularly in terms of labour availability: 8% responded that, those were the land areas they could lay their hands on and the remaining 2% did not give any definite response. The implication of these responses is that, provided labour could be made available, larger areas could be cultivated.

Table 1: Distribution of land sizes cultivated to maize only in the 1994 major season

Land sizes in hectares	Number of farmers
0 - 0.4	47
0.41 - 0.60	20
0.61 - 0.80	13
0.81 - 1.0	5
> 1	15

Source: Appendix C.

4.2.1.2 Cropping Pattern

The predominant farming practice in the study area is mixed cropping. Out of the 100 farmers interviewed, 83% grew maize as an intercrop and 17% as a monocrop in the 1994 major crop season. Maize is intercropped mainly with cassava though there are few instances of a third crop (Table 2). It can be seen in Table 2 that out of the 83% who mix-cropped, most (76%) mix-cropped maize and cassava, 3% mix-cropped maize, cassava and cocoyam, 2% mix-cropped maize, cassava and plantain and 2% mix-cropped maize, plantain and cocoyam. The average land areas cultivated to the common types of cropping patterns i.e. maize-cassava intercrop and maize monocrop show that almost the same land sizes are cultivated to both types of cropping patterns.

Those farmers who monocropped maize attributed the practice to two main reasons: (i) land which is prone to waterlogging and therefore not suitable for cassava and (ii) the possibility of growing at least two crops of maize within the year. The distribution of farmers by reason for choice of cropping pattern in maize production is presented in Table 3.

Table 2: Distribution of Farmers by Type of Crop Mixtures

Type of Crop mixtures	% of Farmers	Average land area (Ha)
Maize only	17	0.6
Maize and Cassava	76	0.7
Maize, Cassava & Plantain	2	0.9
Maize, Cassava &Cocoyam	3	0.6
Maize, Plantain &Cocoyam	2	1.1
Total	100	0.7

Source: Field Data

Note: The mix-cropped farmlands are first cultivated to maize and later intercropped with cassava.

Table 3: Farmers' Reasons for Adopting Particular Cropping Pattern

Cropping Pattern	Reason	% of Farmers
Monocropping	1. area gets waterlogged and does not allow for cassava cultivation	13
	2. allows for continuous cropping	14
	Total	16
Mixed cropping	3. Security against crop failure	55
	4. land suitable for both maize and cassava	10
	5. Consume cassava and sell maize for other needs	6
	6. Cropping pattern inherited from our fathers	5
	7. Land use is maximized	8
	Total	84

Source: Field Data

It is observed from Table 3 that out of the 17 farmers who monocropped, 13 attributed the practice to a technical constraint. This implies that had it not been the waterlogged nature of the lands, they would have cultivated maize and cassava. In the case of mixed cropping, the major reason given for practising such a system is security against crop failure i.e. in case there is failure of the maize crop, the farmers would at least be left with a second crop.

4.2.1.3 Bush Fallow

This is a system where land is left uncultivated for a number of years to allow it to regenerate its fertility before it is cultivated again. This is a common practice in the study area. Data collected on the number of farmers who practise bush fallowing indicates that 89% of the farmers use the system and only 11% do not fallow land (Table 4).

It was found that the average number of years that lands are left to fallow in the area is three years, (Table 5). From table 4., 47.2% of the farmers stated 3 years as the period of fallow, 22.5% stated 2 years and 16.8% stated 4 years. 13.5% stated 5 years and above. This distribution shows that the average number of years land is left to fallow in the area is 3 years. This period of fallow has been drastically shortened compared to the fallow periods in the past which could range between 7 and 15 years. With this shorter fallow period, the soils may not fully regain their fertility and this may have negative implications on

production levels. It also means that the planning horizon of sharecroppers may be inadequate and this could mean little investment in the land which could result in low productivity.

Table 4: Distribution of Farmers by Reason for Practising or not Practising Bush Fallow

Practice	Reason	% of Farmers
Users	1. replenishment of soil nutrients	89
	Total	89
Non-Users	2. application of fertilizer and animal manure	3
	3. Not easy to acquire land for farming	8
	Total	11

Source: Analysed Field Data

Table 5: Distribution of Fallow Periods

Fallow Period (Years)	Frequency	% of Farmers
2	20	22.5
3	42	47.2
4	15	16.8
5	5	5.6
6	3	3.4
7	3	3.4
8	1	1.1
Total	89	100

Source: Appendix B.

4.2.1.4 Land Tenure System In the Study Area

Information obtained on the land tenure arrangements shows that owner-operation, share tenancy, fixed rent and leasehold systems are present in the study villages. Amongst these arrangements, sharecropping is widely practiced, followed by owner-operation, then fixed rent and lastly leasehold, (Table 6). Fixed rent and leasehold arrangements are not common in the study villages because of unavailable funds to rent or lease farmlands by prospective farmers.

It was discovered from the data collected that, farmlands can be acquired from community members, families, chiefs and landowners. Among these sources of land acquisition, community members form the major source of acquiring farmlands by tenant farmers (Table 7). The common mode of acquiring farmland by

tenants in the study villages is to provide a drink, usually local gin. In few cases where drinks are not demanded by landowners, tenants are made to pay a token amount in lieu of the drink. Acquiring farmland in the study villages is not a difficult task if the lands are available. The problem is with the length of tenancy which from the data collected is an average of three years after which the farmland should be left to fallow. Normally, the landlords do not specify the period these farmers can farm the land. In few instances, tenants are allowed to farm the land for as many years as the farmers deem necessary. This uncertainty about tenancy period can influence land use decisions by tenants, which may be inimical to land development.

Table 6: Distribution of farmers by type Tenurial Arrangement

Type of Farmer Groups	Number of farmers in each group (%)
Owner-operators	35
Sharecroppers	50
Fixed-renters (cash)	9
Leaseholders	6
Total	100

Source: Appendix C.

Table 7: Percentage Distribution of Farmers by Type of Tenure and Source of Land Acquisition

Source	Owner	Sharecropping	Fixed Rent	Leasehold	Total
Community Members	-	47	6	6	56
Family	12	1	2	-	18
Own Land	20	-	-	-	21
Chief	3	2	1	-	6
Total	35	50	9	6	100

Sources: Field Data.

In summary, the description on the structure of land use in maize production indicates that most of the farmers operate land sizes less than one hectare, that mixed cropping is widely practiced, that farmers are predominantly sharecroppers and owner operators and that fallow periods are short. Small farm sizes with limited use of improved technology of farming may have adverse implications on output because all things being equal, land area is positively related to output levels. Short fallow periods in the absence of use of fertilizer affects soil productivity and hence output.

4.2.2 Labour Structure

Labour is an important input in small-scale agricultural production. This is because the availability of labour determines the farm size in small-scale farming. It is known that small-scale agricultural production relies on family labour and therefore the

size of the adult farm family determines in most cases, the size of the family farms. Labour structure is examined in terms of its size (including household and hired labour), age and gender of farmers and type of labour by task.

4.2.2.1 Size of Labour Force

Different types and combinations of labour are used for maize production in the study area. In the 1994 growing season, hired labour (ie, by day labour and contract labour), exchange labour or "nnoboa", and family labour were used on the various farms. Family labour is reported to be used by 98% of the farmers (Table 8).

Table 8: Type of Labour Used on The Farms Studied

Labour Type	Percentage of Farmers Employing Labour Type
Family labour	98
Hired labour (contact and by day)	75
Exchange labour	9
Family labour ONLY	18
Hired labour ONLY	2
Family and hired labour ONLY	64
Family and exchange labour ONLY	5
Hired and exchange labour ONLY	7
All types of labour	4

Source: Appendix B.

From Table 8, it can be seen that 75 and 9 percent used hired labor and exchange labour respectively. Eighteen percent used only family labor, 2% used only hired labour and none used only exchange labour. Sixty-four percent (64%) used both family and hired labour 5% used both family and exchange labour and 7% used both hired and exchange labour. Family labour is the major source of farm labour and exchange or hired labour is used as supplementary labour. Hired labour, comprising of contract and by day labour was rarely used alone by the farmers. Hired labour in most cases was used to supplement the efforts of family labour though there were instances where hired labour employment was higher than family labour. It was observed that hired labour employment was mainly for specific farm tasks such as land clearing which is a strenuous task, and weeding under the crop. Although hired labour was rarely used alone by the farmers, its importance should not be glossed over since it is the second popular form of farm labour used (Table 8). It is observed from Table 8 that, 4% of the farmers interviewed used all forms of labour during the growing period. This small percentage is due to the small number of farmers who exchanged their labour. This implies that exchange labour is scarcely used in the study area. Farmer co-operative were not found in the study area.

A look at the average labour supply per hectare on mixed and monocropped farms shows that labour supply per hectare is higher on monocropped farms than on mix-cropped farms (Table 9). This finding is supported by work done by Kwadzo (1995) and Mensah

(1982) in which they found that the total labour supply per hectare on maize intercropped with cassava was less than the labour supply on maize monocrop. The supposed reasons are that: (i) on mixed-cropped farms there is less weed population compared to monocrop farms and as a result, the labour input requirement for controlling weeds is lower on mixed-cropped farms and (ii) on mixed-cropped farms, labour input is shared between/among the different crops and therefore the amount of labour input devoted tothe major crop is reduced. On the contrary, on monocrop farms, all the labour input is devoted to the single crop.

Information documented by Mensah (1982) on the average labour input per hectare at different locations on small-scale maize farms in Ghana indicates that for maize monocrop, the average labour input per hectare is 134 mandays. The average labour input per hectare on maize intercropped with cassava is 56 mandays. Comparing these figures i.e. 56 and 134 mandays to the ones obtained for this study i.e. 194 and 287 mandays in Table 9, it is observed that labour was not optimally employed onthe farms studied in this work. This might principally be due to the fact that farmers took longer time in completing specific tasks which could have been completed earlier had there been adequate labour input. Table 9 also shows the distribution of the average labor (hired and family) supply per hectare on mixed and monocropped farms. On the mix-cropped farms, hired labour constitutes 34% of the total labour input and family labour constitutes 66%. Hired labour on the monocropped farms constitutes 27% of total labour input and family labour constitutes 73% (Table 9). The presentation in Table 9 indicates that family labour is mostly used on both types of

cropping patterns. Kwadzo (1995) and (Atsu et al. 1983) have reported that less than 20% of the total labour input comes from hired labour on maize farms. The results of this study in terms of hired labour input usage differs from that of (Kwadzo, 1995 and Atsu et al., 1983). On both mixed and monocropped farms, the hired labour inputs are 34% and 27% respectively which are both higher than the 20% reported by (Kwadzo, 1995 and Atsu et al., 1983). This shows that hired labour is becoming increasingly important in terms of labour usage.

Table 9: Average Labour Supply per Hectare and Distribution of Hired & Family Labour Supply per Hectare on Mixed & Monocropped Farms for the 1994/95 Growing Season

Type of Cropping Pattern	Average Labour Supply in MD/Hec	Hired Labour Supply in MD/Hec.	Family Labour Supply in MD/Hec.	Total in %
Mix-Cropping	194	5497 (43%)	10569 (66%)	100
Monocropping	287	1299 (27%)	3574 (73%)	100

Source: Analysed data from Appendix F.

Family labour is noted to be the major source of labour for the farmers in the study area. It is, therefore, important to have knowledge about the composition of farm family sizes. It can be seen from Table 10 that 82% of the farmers have family sizes between 1 to 4,18% have family size between 5 to 9 and 1% have family size of 10. The average family size is computed to be 3.5.

Comparing this average figure to the average family size of 5.1 for rural households in the Eastern region of Ghana as reported in the 1984 Analysis of Demographic Data by the Ghana Statistical Services, it is clear that the family size in the study area is lower than the regional average. It is also important to note that not all the farm household members were engaged in farming during the cropping season. In the Table 10, it is observed that not all farm household members are in farming. In 95% of the cases, children in farm households attend school and only help when they are on vacation.

Table 10: Percentage of Household Members Engaged In Farming

Family Size (1)	No. of Farm Households (2)	Total Household Members (3)	% Farm Household Sizes (4)	Total Household Farmers (5)	% in Farming (5)(4) x 100
1	6	6	1.7	5	83
2	19	38	10.9	32	84
3	29	87	25	82	94
4	27	108	31	97	90
5	10	50	14.3	30	60
6	7	42	12	32	76
7	1	7	2	4	57
10	1	10	2.8	6	60
Total	-	348	100	288	83

Source: Appendix B.

4.2.2.2 Distribution of Type of Labour by Task

The production of maize involves a number of activities from land clearing through to harvesting, each of which was undertaken by specific type(s) of labour. Land clearing is considered very strenuous but time specific and so farmers prefer to hire labour to achieve this timely demand. However, due to financial constraints, the farmers try to handle the task themselves. This handicap causes delays depending on the size of the farm. Forty-two percent of the farmers hired labour for land clearing in addition to their own labour. Land clearing is carried out by men. The next task, land preparation, is mainly undertaken by the farmer himself with the help of his wife and sometimes children. Planting which follows land preparation when the rains set in is one of the important tasks on the farming calendar. This farm activity was mainly done by the farm family. In few instances, farmers employed the services of communal labour to complement their efforts. The next farm task is weeding or brushing under the crops. This task is also important since inability to control the weeds on timely basis may affect the yield. This task is considered difficult and requires some skill since the crop can be destroyed if not carefully undertaken. It was discovered that, 75% of the farmers prefer to use weedicide in controlling the weeds because it is considered more effective than manual weeding. In 22 cases, where weedicide was applied, the spraying was mostly performed by hired labour. Where weedicide was not applied, about 70.5% of the farm households interviewed performed the weeding by themselves, 19.2%

hired labour for the weeding, (Table 11). An estimate of the labour input used in manual weeding reveals that about 25% of the total family labour input was devoted to this task and 30% of the total hired labour input went in to the same task. These percentages show that weeding is an important task to the farmer. Harvesting ends the direct farm work. This task was undertaken mainly by the farm family. Communal labour services were sought for harvesting. In two instances, only hired labour was used for harvesting. This was only in situations where all farm activities were performed solely by hired labour. After harvesting, the produce are hauled by the same labour doing the harvesting for storage.

Table 11: Distribution by Type of Labour for Manual Weeding of Farms

Type of Labour	Frequency	& by Type of Labour
Family	55	70.5
Hired	8	10.2
Family and Hired	15	19.2
Total	78	99.9

Source: Field Data.

4.2.2.3 Age and Gender of Farm Household

The Analysed data on age distribution of the farm households shows that 24.3% are aged 19 years and below, 51.7% are within the age group 20 - 39 years, 21.8% aged between 40-59 years and 2% are aged above 60 years (Table 12). Cumulatively, 76% of the farm household are below 40 years. This age distribution indicates that there are more young people than older and middle aged farm household members in the study villages.

The gender composition also shows that 59.4% are males and 40.6% are females (Table 12). The percentage distributions of males and females include adult males and females and male and female children. This percentage gender distribution is consistent with what pertains in the country (GSS, 1995). The young farming population may have positive implications on productivity because it is believed that the younger the farming population, the more productive labour is and consequently higher outputs are obtained (Hill and Ray, 1987).

Table 12: Age and Gender Distribution of Farm Households

Age	Male	Female	Total	& of Total
0 - 9	46	24	70	24.3
20 - 39	78	71	149	51.7
40 - 59	42	21	63	21.8
60+	5	1	6	2.0
Total	171 (59.4%)	117 (40.6%)	288	100

Source: Analysed field Data.

In summary, some farm activities are labour and gender specific. Family labour was used in undertaking all farm operations but hired labour was employed for specific farm operations. The farm population is young because most of the farm hands fall within the economically active age group of 19-40 years.

4.2.3 Structure of Capital

The structure of capital inputs is examined in terms of the types and amounts of capital inputs employed. The amounts of the capital inputs is discussed under section 4.3 on proportions of the individual resources.

4.2.3.1 Types of Capital Inputs

Capital inputs that the farmers used during the last crop year were fertilizer, seeds both local and improved, weedicide, hoes, cutlasses, baskets, sacks and spraying machine. Cutlass is widely used in land clearing, land preparation and weeding. the number of cutlasses used by the farmers reflected in most cases the number of the farm family members who actually worked on the farms. Hoes are used but to a limited extent because the fields do not have many stumps. Spraying machines were used for spraying weedicides. One farmer owns a spraying machine while the others who sprayed weedicide either borrowed or hired the machine. Apart from the spraying machine which was borrowed or hired, all other inputs were owned by individual farmers. With regard to seeds, the improved varieties used were Obatanpa (15%), Dobidi (3%), the improved

varieties used were Obatanpa (15%), Dobidi (3%), Aberenji (12%) and Okomasa (5%). The remaining 65% of the farmers used the local variety. It should be noted that in most of the cases where improved varieties were planted, they were mixed with the local variety in the proportion of 2:1. Table 15 shows the distribution of farmers' reasons for not planting the improved variety of maize.

Table 13: Distribution of Farmers' Reasons for not Planting the Improved Variety of Maize

Reason	Frequency	% of Farmers
1. Not readily available and costly	55	55
2. Their use involves regular maintenance which will require extra labour	18	18
3. Less storable/resistant to infestation	40	40
4. Less tasty	20	20
5. For optimum yield, complementary inputs such as fertilizer and weedicide must be used	10	10
6. Reliability of the local variety has been tested	10	10

Source: Field Data.

The main reasons why the farmers do not use the improved varieties of maize are (i) cost and availability and (ii) because of poor storability and lower resistant nature of the improved varieties to infestation (Table 13). The implication is that high resistant and storable varieties must be developed and must also be affordable and readily available to the farmers.

It is also seen from the Table 14 that, use of improved inputs differ among farmer groups. The use of agrochemicals such as weedicide and fertilizer was limited. Out of the 100 farmers interviewed, 22% used weedicide, 7% used fertilizer and 35% used improved seeds. In absolute terms, it can be said that among the improved inputs, improved seed usage is mostly catching on with the farmers. The figures in parenthesis are the ratios of the number of farmers in a given group of farmers who used an input to the total number of farmers in that farmer group. Comparing the ratios among the groups of farmers by tenancy, it is observed that fixed/leasehold farmers have the highest proportion (0.5) of farmers using weedicide, followed by owner farmers (0.27) and then sharecroppers (0.10). with fertilizer use, the proportions of the groups are 0.07 for owner farmers, 0.02 for sharecroppers and 0.21 for fixed/leasehold farmers. The ratios for improved seed use are 0.71 for fixed/leasehold, 0.41 for owner farmers and 0.19 for sharecroppers. The ratios show that, in all three cases of input use, fixed/leasehold farmers rank first followed by owner-farmers and lastly, sharecroppers. The ratios seem to imply that sharecroppers tend not to employ improved inputs. But it should be

noted that due to the small number of farmers who used these improved inputs in each farmer group, a statistical test of significance between the ratios was not possible. Therefore it cannot be reliably concluded that sharecroppers tend not to employ improved inputs.

Table 14: Distribution of Weedicide, Fertilizer and Improved Seeds used Among Farmers in the Study District

Farmer Group	Weedicide	Fertilizer	Improved Seed
Owner-Operator	10 (.25)	3 (.07)	16 (.41)
Sharecropper	5 (.10)	1 (.02)	9 (.19)
Fixed-rent-Leaseholder	7 (.5)	3 (.21)	10 (.71)
Total	22	7	35

Source: Appendix C.

4.3 Structure of Resources in Terms of Proportions

The section on proportions of resources examines (i) the average total cost per hectare of each resource (ii) shares in the average cost per hectare to each input and (iii) the shares in average cost per hectare to inputs for different landholding groups i.e. owner farmers, sharecroppers, leaseholders and fixed rent farmers.

The computed average total cost per hectare of the individual inputs shows that land, labour and cutlass constitute the major cost items (Table 15).

Table 15: Average Total Cost per hectare of Inputs Used in Maize Production in ¢/hec.

Input	Average Total Cost/Hec.
Land	65625
Labour	44596
Weedicide	8571
Fertilizer	8320
Cutlass	12048
Basket (raphia and cane)	4113
Seed (improved and local)	5730
Sack	2417
Hoe	1947

Source: Appendix D.

Table 16 presents the average cost shares per hectare of the inputs. It is seen from the Table 16 that labour and land contribute 37.4% and 37.5% of cost respectively. Cutlass ranks third in terms of cost contribution (12.2%). The rest of the inputs, fertilizer, weedicide, basket, seed, sacks and hoes together constitute 12.8% of average cost. This cost composition shows that land, labour and cutlass are most important inputs to the farmers. Fertilizer, weedicide and improved seeds have little contribution to farmers' production costs. It can be seen from Table 16 that the share of cost per hectare of variable inputs (i.e. labour, cutlass, fertilizer, weedicide, raphia basket and seeds) is 60.4% and that of the fixed inputs (i.e. land, cane

baskets, sacks and hoes) is 30.6%. The cost sharing between fixed and variables inputs costs show that little investment is made in fixed capital items.

Table 16: Average Percentage Share of Inputs in Cost of Production

Inputs	% Share
Labour	37.4
Weedicide	5
Fertilizer	1.7
Cutlass	12.2
Basket	Raphia type (1.8) and cane (0.6)
Seed	Improved (1.3) and local (0.7)
Sack	1.2
Hoe	0.3
Land	37.5

Source: Appendix D.

Table 17 shows the average percentage cost sharing of the various inputs used by the different groups of sampled farmers in the study area. It is generally observed from the Table 17 that all the farmer groups except sharecroppers, have the highest cost contribution from labour. The cost contribution of labour for owner and leasehold farmers constitute more than 60% of total cost of production. That of fixed rent farmers is 32.2% of their total cost. The percent share of cost of labour for sharecroppers is 22.6%.

Table 17. Average Percentage cost Composition of Various Inputs per Hectare Among Farmer Groups

Inputs	Owner Farmer	Sharecropper	Fixed Rent	Leasehold
Land	-	60.4	21.6	14.3
Labour	63.3	22.6	32.2	68.2
Weedicide	9.95	2.3	8.6	1.5
Fertilizer	2.3	0.07	13.7	-
Cutlass	15.0	11.0	12.8	9.4
Seed	29.0	1.0	5.9	3.4
Raphiabasket	2.5	1.3	2.6	4.5
Cane basket	1.6	0.3	1.4	0.3
Sack	2.0	0.7	1.3	1.6
Hoe	0.4	0.2	0.4	-
Total	100	99.9	99.8	100.2

Source: Appendix D.

The average cost of land per hectare among the different farmer groups differ and is highest for sharecroppers. This is because the cost of land to sharecroppers is calculated as the value of produce received by the landlord. Owner farmers incur no cost on land ownership since in the study area, owners do not pay any land charges. The estimated percent cost shares of land per hectare per annum for fixed rent and leasehold farmers are 21.6% and 14.3% respectively. Land constitute the second highest cost contributor in their individual groups.

Cutlass is an important implement used by the farmers. It was the next highest cost component after labour and land. With owner farmers, cutlass constituted the second highest cost component

after land and labour but with the other farmer groups, it is the third highest cost component after land and labour. Comparing the percentage share costs of cutlass among the farmer groups, it is observed that there are no significant differences though the cost contribution is highest for owner farmers, followed by fixed rent farmers, then sharecroppers and lastly leaseholders (Table 17).

The agrochemicals used by the farmers are fertilizer and weedicide. It is seen from Table 16 that the cost contribution of weedicide constituted less than a-tenth of the total cost of production in all farmer groups even though variations exist. With regard to fertilizer, the cost contribution for owners is 2.3%, sharecropping (0.07%) and fixed rent farmers (13.7%). Leaseholders did not use any fertilizer. Comparing the cost contributions of the individual inputs of fixed rent farmers, it is observed that the cost contribution of fertilizer was the third highest after the cost of labour and land whereas with owner farmers and sharecroppers, the cost composition of fertilizer were among the lowest cost contributions of the inputs.

The cost contributions of seeds in all farmer groups are less than 6%. The cost share for owner farmers is 2.9%, that of sharecroppers is 1%, fixed rent farmers, 5.9%, and leaseholds, 3.4%. Of these cost contributions, two-thirds constitutes cost of improved seeds and the remaining one-third from local varieties. These cost contributions of seeds show that the amounts of improved seeds used by the farmers are very small within all farmer groups with the least amount used by sharecroppers (Table 17).

The other inputs used are basket (raphia and cane types), sacks and hoes. Their cost contributions are small compared to the other inputs. Aggregating the cost shares of these remaining inputs for the farmer groups, one obtains 6.5% for owner farmers, 2.5% for sharecroppers, 5.7% for fixed rent farmers and 6.4% for leaseholders. With the exception of sharecroppers, there are not much differences in the cost shares among the other farmer groups. Looking at the individual cost contributions of hoe for the farmer groups, it is seen that the shares are almost negligible. This shows that the use of hoes to farm in the study area is low.

In summary, the structure of capital inputs employed on the farms studied shows that there is little investment in fixed capital inputs. Employment of output enhancing technological inputs such as fertilizers, planting materials and weedicide was low. With the increasing population and the dwindling land to man ratio in Ghana, it is these improved inputs which could bring about increases in yield Atsu et al. (1983).

4.4 RESOURCE USE EFFICIENCY

4.4.1 Gross Margins Results

The comparison of the efficiency in resource use is restricted to sharecroppers and owner-operators although the sampled farmers included leaseholders and fixed renters. This is because, (i) in the literature, the controversy over the efficiency of tenancy systems focuses on sharecropping systems rather than leasehold and

fixed rent systems and (ii) sharecroppers and owner-operators formed the majority of farmers studied in this work.

The average Gross Margins per hectare and the average Gross Margins per unit of labour between the two groups of farmers were computed. The Gross Margins per unit of the other inputs such as fertilizer and weedicide were not included because of the small number of farmers who used these agro-chemicals in each of the two groups. Table 18 shows that, the average Gross Margins per unit of labour for sharecroppers was lower than that for owner-operators, i.e. ¢937 and ¢968 respectively. The Gross Margins per hectare was also found to be higher for owner farmers than for sharecroppers (Table 19). But statistical tests of significance (using the t-test) of the difference between the means of the Gross Margins per hectare and Gross Margins per unit of labour between the two farmer groups show no significant differences in the two cases. For the Gross Margins per unit of labour for the two farmer groups, the calculated t-value is 0.57 and the table values at 5% and 10% levels of significance are respectively 2.042 and 1.697. The implication is that the difference between the means of the Gross margins per unit of labour between the two farmer groups at both alpha-levels is insignificant. Regarding the test of significance between the means of the Gross Margins per hectare of the two farmer groups, the calculated t-value is 1.04. This t-value is less than the table values of 2.042 and 1.697 at the respective alpha levels of 5% and 10%. This second case also shows no significant difference between their means. These results

therefore mean that, in absolute terms, owner farmers used land and labour more efficiently than sharecroppers but the differences in land and labour use efficiencies are not significant between the two farmer groups. This finding corroborates the view held by the proponents of the equal efficiency that there is no difference in resource use efficiency between sharecroppers and owner farmers. The calculated coefficients of variations indicate that there is little deviations of the Gross Margins from the mean which implies that the results can be relied upon.

Table 18: Average Gross Margins per Labour Input for Farmer Groups

Farmer Group	Average Total Value of produce per Unit of labour input in ¢/MD	Average Total Variable Cost per Unit of labour input in ¢/MD	Average Gross Margins Unit of labour input in ¢/MD	coefficient of variation Average Gross Margins
Owner Farmer	1348	380	968	0.70
Sharecropper	1268	331	937	0.72

Source: Appendix D.

Table 19: Average Gross Margins per Hectare for Farmer Groups

Farmer Group	Average Total Value of produce per hectare in ¢/hec.	Average Total Variable Cost per hectare ¢/hec.	Average Gross Margins per/hec. in ¢/ha	coefficient of variation Average Gross Margins
Owner Farmer	207055	54558	152497	0.92
Sharecropper	260536	66481	194055	0.87

Source: Appendix E.

4.4.2 Allocative Efficiency

The results of the estimated Cobb-Douglas production function using the ordinary least squares method are presented in Table 20. The table shows the production elasticities, sample means, factor prices and allocative efficiency indices of land, labour and capital for sharecroppers, owner farmers and the pooled sample respectively. For each of the farmer groups, the allocative efficiency index of the variable, value of capital was not computed. This is because, the value of capital was an aggregate of the values of weedicide, insecticide, seed, hoe, cutlass and basket. As a result, the single factor price to use for capital to compare with its marginal vale product to determine efficiency becomes difficult. These inputs were aggregated due to inadequate data on them. Regarding fertilizer and weedicide, the number of farmers who used these inputs during the growing period was small even for the pooled sample. Therefore disaggregating these inputs into separate variables would not help for the analysis. In the

case of seed, since about five varieties of maize were used by the sampled farmers with different retail prices, the price per kilo of seed to use to compare with its marginal value product again becomes difficult to determine.

From table 20, the production elasticities of land, labour and value of capital for sharecroppers are 0.61, 0.48 and -0.04 respectively. The elasticities of land and labour are both positive and significantly different from zero at 5% level of significance while that of the value of capital is negative and insignificant. The negative coefficient might be due to the small number of sharecroppers who used fertilizer, weedicide and improved seeds (Table 14). Therefore the dominant factors which influence maize output are land and labour though land had a higher output effect than labour for sharecroppers. The R-squared is 55.7 which then implies that 55.7% of the total variation in the output of maize was mainly explained by land and labour. The computed F-ratio of 54.68 compared to the table value of 8.9 at 5% confidence level means that the F-ratio is significant implying that land, labour and value of capital jointly affect the output of maize.

The allocative efficiency indices for land and labour for sharecroppers are respectively 1.72 and 0.15 (Table 20). These indices indicate that both land and labour are inefficiently used in maize production by sharecroppers in the study area. The allocative efficency index for land means that land is underutilized i.e. less of it is used and 0.26 for labour means that labour is overutilized implying that more labour than required

to attain efficiency is used.

For owner farmers, the production elasticities are 0.33, 0.50 and 0.37 for land, labour and value of capital respectively. These elasticities imply that land, labour and value of capital inputs positively affect maize output but only labour and value of capital inputs significantly affect maize output at 5% level of significance while the effect of land, though positive, is insignificant at 0.05 alpha level but significant at 10% level of significance. The R-squared is 76.2 which means that about 76% of the total variation in the output of maize is accounted for by changes in land, labour and value of capital. The F-ratio in this case is also significant implying that land, labour and value of capital jointly affect the output of maize.

The allocative efficiency indices of land and labour for owner farmers are 2.98 and 0.27 respectively. These indices mean that both inputs are inefficiently used by owners on the maize farms studied. From the indices, land is underutilized while labour is overutilized by owner farmers.

Regarding the pooled sample, the production elasticities are 0.48, 0.53 and 0.18 for land, labour and value of capital inputs respectively (Table 20). All the elasticities are positive and significantly different from zero. The R-squared is 66.9% meaning almost 67% of the total variation in the output is accounted for by the changes in land, labour and value of capital. The test also shows that land, labour and value of capital jointly influence output of maize (Table 20).

The allocative efficiency indices for land and labour for the pooled sample are respectively 5.8 and 0.24 implying that both inputs are inefficiently used. The indices show that land is underutilized while labour is overutilized.

Looking at the allocative efficiency indices of land and labour for sharecroppers, owner farmers and the pooled sample, it is observed that all the three groups underutilized land and overtulized labour. The indices show that the pooled farmers underutilized land most, followed by owner farmers and then sharecroppers. This means that sharecroppers use land most efficiently among the three farmer groups. The most efficient use of land by sharecroppers is due to the fact that, land rent constituted the highest cost item (60%), among other inputs to sharecroppers, (Table 17). Therefore if they do not use land efficiently to obtain higher yields, they cannot meet the rent charges and the cost of other production inputs. Regarding labour, the indices show that owner farmers least overutilized labour, followed by sharecroppers and then pooled sample. This also means that owner farmers use labour most efficiently. This can be attributed to the fact that, labour input constituted the highest cost item among other inputs used by owner farmers, Table 17, which implies that more labour was hired by owner farmers.

The estimated scale elasticities (returns to scale) are 1.139 for sharecroppers, 1.109 for owner farmers and 1.183 for the pooled sample (Table 20). The deviations of the returns to scale from unity is non-significant for all the three samples implying that

all the three sample farms are characterised by constant returns to scale. The chow test shows that there is no significant difference between the production elasticities of owners and sharecroppers which implies that their production functions are the same.

The regression equation is as follows:

$\text{In } Q_i = I_n A + a_1 I_n X_1 + a_2 I_n X_2 + a_3 I_n X_{3t} \ldots U_t$

where Q = output of maize

A = a constant

a_1 a_2 and Q_2 are the production elasticities of land, labour and capital.

X_1, X_2 and X_3 are the indpendent varies of land, labour and capital respectively.

Table 20: **Production elasticities, marginal value products, factor prices and allocative efficiency indices for sharecroppers, owner farmers and the pooled sample**

Item	sharecroppers n=50	owner farmers n=35	pooled sample n=85
	Production elasticities		
land	0.612	0.331	0.487
Labour	0.483	0.505	0.529
V. Cap	-0.044*	0.373	0.177
Returns to scale	1.139	1.209	1.193
Const.	4.452	0.418	2.158
	Sample means		
land (ha)	0.544	0.757	0.632
labour (MD)	107.3	142.2	121.7
v. cap. (¢)	11004	18623	14141.9
	Marginal value products		
land (¢/ha)	127947	90119	116983
labour (¢/MD)	512	731	666
v.cap (¢)	-	-	-
	Factor prices		
land (¢/ha)	74258	30214	19864
labour (¢/MD)	2678	2678	2678
v.cap (¢)	-	-	-
	Allocative efficiency indices		
land	1.72	2.98	5.98
labour	0.15	0.27	0.24
R^2	55.7	78.3	65.7
Adj. R^2	52.8	76.2	66.9
F-ratio	54.7	37.2	54.7

Note: The F-ratios for sharecroppers, owners and the pooled sample are all significant at 5% confidence level.

All the production elasticities are significant at 5% confidence level except value of capital which is insignificant(*). ** means the coefficient is insignificant at 5% but significant at 10% confidence level.

CHAPTER FIVE

5.0 SUMMARY, CONCLUSION AND RECOMMENDATIONS

5.1 SUMMARY

The study looked at the structure of farm resources; land, labour and capital in maize production in the Asamankese District of the Eastern region of Ghana from two different perspectives: their composition and their proportions in production. Land tenure system and its importance to maize production in the study area were examined. Finally, a comparative assessment of the efficiency in resource use by sharecroppers and owner farmers was made.

Under the structure (i.e. composition) of resource use, it is observed that farm sizes were small, mixed cropping was widely practiced and rudimentary tools such as cutlass and hoes were used. Baskets and sacks were also used. The type of labour widely used for farm work is family labour though hired labour was found to be important in maize production. The age structure of the farm households shows that most of the farm hands are young people. A small number of farmers used agro-chemicals such as fertilizer, weedicide and improved seeds but in limited quantities.

Looking at the proportions of the resources, it was observed that labour and cutlass were the main inputs used by the sampled farmers. The other inputs, fertilizer, weedicide, seeds, basket, hoe and sack do not constitute major cost items. A comparison of the proportions of the various inputs used in farming among the

different farmer groups showed that, sharecroppers tended to employ less amounts of inputs.

With regard to the land tenure system in the area, factors such as mode of land acquisition, length of tenancy and forms of tenancies were discussed. The length of tenancy was found to average 3 years. Four types of land tenure arrangements exist in the area. They are share tenancy, owner operation, fixed rent and leasehold systems. Fixed rent and leasehold tenancies were found to be uncommon but owner and sharecropping systems are the main types of landholding arrangements. As far as the study area is concerned, the information gathered on the land tenure system indicates that land acquisition by tenant farmers does not involve any rigid demands from landlords. The problem identified with the use of land by tenant farmers is the short duration of tenancy period. Few tenant farmers are allowed to use the land for as many years as they deemed necessary but are not certain as to when they would be asked to leave the land. Most of the tenant farmers, about (90%) are allowed a maximum of three years to farm the land after which they have to abandon them to fallow.

Concerning the efficiency in the use of resources, the finding from the gross margins method is that, in absolute terms owner farmers tend to use both land and labour more efficiently than sharecroppers but statistically there are no significant differences in labour and land use efficiencies between the two farmer groups. The allocative efficiency indices of land and labour for sharecroppers and owner farmer show that both farmer

groups use land and labour inefficiently although from the nominal values of the indices, one farmer group tends to use land or labour more efficiently than the other. The result of the chow test showed that there is no significant differences between the coefficients of land, labour and capital of the two farmer groups which is consistent with the results of the gross margins.

5.2 CONCLUSIONS

The structure of land, labour and capital from the findings typifies small-scale agricultural production. In other words, the traditional way of farming has not changed in the area. This may have adverse implications on output since with traditional technology of farming, subsistence levels of production will continue to exist.

Regarding the cost structure of the various inputs for the farmer groups, sharecroppers used least amounts of the various inputs except land. This finding cannot be conclusive because it was impossible for the author to carry out a test of significance to substantiate whether there was actually any difference in the amounts of inputs employed among the farmer groups.

The short fallow period may discourage prospective tenant farmers because after deserting a land to fallow, one may find it difficult to acquire another since land may not be readily available and even if available, may sometimes not be at an accessible location. It is therefore important to take a critical look at the length of tenancy.

Concerning the efficiency in the use of land and labour between sharecroppers and owner farmers, no definite conclusion can be made based on the Gross margins as to which farmer group used land or labour more efficiently. This is because there were no significant differences in land and labour use efficiency between the two farmer groups.

Based on the allocative efficiency measure, the efficient use of land by the two farmer groups can be achieved by increasing the total land area under cultivation. Labour use efficiency can also be achieved by reducing the quantity of labour employed on the maize farms. These findings indicate that sharecropping systems are not generally less efficient than owner operation systems.

5.3 Recommendations

Based on the findings of the study, the following recommendations are made.

The present structure of land, labour and capital documented in this study with regard to maize production could serve as a reference point for comparison in future research if one wants to examine the effects of changing economic environment, increasing population and changing agricultural technology on the structure of resources.

The short duration of tenancy period could be increased to at least 15 years. This can be achieved by involving private landowners, farmers, government, chiefs, family heads and the local assembly to deliberate on the appropriate length of tenancy. The

major landowning group should be identified and a specified amount of money be paid to them from the District Assembly common Fund to serve as an incentive in addition to whatever they may receive from prospective tenant farmers. This in a way could make landowners rent their lands to prospective tenant farmers over this longer period of time suggested.

With the efficiency in the use of resource by sharecroppers and owner farmers, it is recommended that further studies be carried out to assess the comparative efficiency in the use of the resources, this time to include fertilizer and weedicide between the two farmer groups in a different district to augment the present study. It should be carried out in a different area because land tenure systems differ from one area of the country to another. In addition, since this work did not report adequately on fixed rent and leasehold systems, any study on tenancy systems could incorporate them. To improve upon whole farm efficiency or sharecropping and owner efficiencies, adequate credit must be provided to enable farmers employ the required levels of inputs. In employing the required amounts of inputs to achieve efficiency, farmers should receive intensive extension service.

5.4 Policy Directions

It is a policy of the region to improve agricultural productivity through efficient resource use; to increase income of farmers; improve diets of the people and raise the living standard of all engaged in agriculture. Among the measures outlined to

achieve these objectives are (i) to ensure continued new technological output and flow by strengthening research/extension linkage and (ii) to improve and strengthen the visiting capabilities of all field staff. The priority policy measure of the region is apparently Extension delivery. For maize production to increase in the area, then the use of improved inputs such as fertilizers, new planting materials, weedicide and new techniques of farming must be encouraged. Therefore, a regional policy should focus on research into why these improved inputs are underemployed. In addition, there should be land use policy which will guarantee prospective tenant farmers longer use of land for farming.

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A SAMPLE QUESTIONNAIRE ON THE STRUCTURE AND EFFICIENT RESOURCE USE IN MAIZE PRODUCTION AT THE WEST AKIM DISTRICT, EASTERN REGION

A. GENERAL

Questionnaire serial number: .....
Date of interview: .....
Interviewers code: .....
Location code: .....

B. SOCIO-ECONOMIC CHARACTERISTICS

1. Name of respondent: .....
2. Age: .....
3. Sex: .....
4. Marital Status: 1. Single 2. Married
   3. Divorced 4. Separated 5. Widowed.
5. Ethnicity: 1. Ewe 2. Akan 3. Krobo/Ada
   4. Ada 5. Others (Specify): .....
6. Distance between house and farm: .....
7. Place of birth: .....
8. Household Members Characteristics

Name	Sex M=1 F=2	Age	Relationship to head	Occupation	Education	Years in farming

Education Code : 1. Primary 2. Middle 3. JSS
4. 'O' level 6. 'A' level 7. Vocational/Technical
8. Post-Secondary 9. University 10. None.

Relationship Code: 0. Self 1. Wife/husband 2. Sons/daughter
3. Niece/nephew 4. Sister/brother
5. Sister/brother-in-las 6. Mother/Father-in-laws
7. Grandchild 8. No relation
9. Others (Specify) .....

SECTION B

LAND USE

9a. What was the size of land holding last year in hectares?
.....

b. Could you please tell why you cultivated land area of this size? .....

10. What proportion of this land holding was cultivated to maize last year in hectares?
Minor season .....
Major season .....

11. What was the number of location(s) of your land holdings?
.....

12. What variety or varieties of maize did you cultivate?
1. Okomasa 2. Obatanpa 3. Dobide 4. Abrotia
5. Local 6. Others (specify) .....

13. Why do you prefer to plant the local or the improved variety of maize? .....

14. What is the nature of the soils in this area?.
1. Sandy 2. coarse textured 3. clayey
4. loamy 5. other (specify) .....
b. Are they favourable to maize cultivation? 1. Yes 2. No.

15. What method of land preparation do you normally apply?
1. slash and burn 2. slash and burn 3. mechanised
4. other (specify) .....

b. Could you explain why you use this method above? .....

16. Do you practice bush following? 1 Yes 2. No.
(a) If Yes or No, why? .....
(b) If Yes, how long is a piece of land left to fallow in years? .....

FARMING PRACTICES

17. What type of farming do you undertake?
1. Mixed cropping 2. Mono cropping.

18. If mixed farming, what main crop(s) are mixed with maize?
1. cocoyam 2. yam 3. cassava 4. plantain
5. other (specify) .....

19. Which of these farming practice is prevalent in this area?
    1. OR 2. in Q 17.

20. Give reasons why you practice either mixed farming or monocropping .....

21. What method of planting do you normally adopt and why?
    1. row planting 2. traditional planting
    Why? .....

LAND TENURE

22. From whom did you acquire your land for farming?
    1. Chief 2. family head 3. own land
    4. government 5. other (specify) .....

23. What was the type of your holding?
    1. tenant 2. owner operator 3. tenant and owner
    4. other (specify) .....

24. If tenant farmers, what type?
    1. fixed rent (amount per acre per annum .....
    2. Abunu (sharecropping) .....
    3. Abusa (sharecropping) .....
    4. provision of labour (mandays per week) .....
    5. Other (specify) .....

25. Indicate the Quantity or Cash Value

Land Rent Option	Unit	Qty. of Output	Value of Output
Fixed Rent			
Abunu			
Abusa			
owners			
Other (specify)			

26. If abunu, how was cost shared? .....

27. What do you find wrong with the following systems?
    (a) Abunu .....
    (b) Abusa .....
    (c) Fixed rent .....
    (d) Leasehold .....

28. What is the mode of land acquisition in this area?
    1. provide drink?
    2. drink and cash?
    3. goat?
    4. Others (specify) .....

29. After your first approach to acquire land for farming, how long did it take before finally acquiring it?
    1. 0-1 month 2. 1-3 months 3. 4-6 months
    4. 7-12 months 5. greater than one year
    6. Others (specify) .....

30. As a tenant farmer, does the land owner influence your production decision? (1) Yes (2) No.
    If Yes, why? .....
    .....
    .....

31. Who decides what to grow? Tenant or landlord?

32. As a tenant farmer, are you restricted in the types of crops to grow by the landlord? 1 Yes 2. No.
    If Yes, what types of crops are you allowed to grow and why?
    .....
    .....

33. How long as a tenant farmer can you farm this type of land in years? .....

34. Is the length of period allowed you enough? Yes or No?
    If Yes or No, why? .....
    .....

35. If the response in Q34 is No, then what length of time will you consider adequate in years? .....

36. What was the going land rent per 0.4 Ha last crop season in cedis? .....

37. As an owner farmer, do you pay any levy to the local council or authority? (1) Yes (2) No.
    If Yes from Q37, how much did you pay last year in cedis?
    .....

SECTION C

Labour Use

38. What was the composition of your farm labour supply for last year in mandays?

Type of Labour

Family Labour	J	F	M	A	M	J	J	A	S	O	N	D
Own												
Wife/ husband												
Children over 15yrs												
Relations (adult)												
Hired Labour												
Male												
Female												
Child												
Others												
Communal												
Exchange Labour												
Others (specify)												

39. Amount of cash/kind spent each month on hired labour

Hired Labour	J	F	M	A	M	J	J	A	S	O	N	D
Male												
Female												
Child												
Others												
Communal												
Exchange Labour												
Others (specify)												

39 b. What was the cost of labour per day per hectare?

Minor season	Major season
.....	.....
.....	.....
.....	.....
.....	.....

39 c.

Hired Labour	Cash	Value of cooked food	Value of raw food
Male			
Female			
Child			
Exchange			
Communal			
Others ( )			

40. **Provide labour demand and period for the following farming activities**

Labour demand/Activity/Month in Mandays

Activity	J	F	M	A	M	J	J	A	S	O	N	D	AV LD	AV LS
1. land clearing														
2. land Prep.,														
3. Planting														
4. 1st Weeding														
5. 2nd Weeding														
6. Spraying														
7. Fert. appl.														
8. 3rd Weeding														
9. Bagging														
10. Carting														
11. Manure appl.														

AV LD = Average labour demand; AV LS = Average labour supply.

41. For which activity were you short of labour and why?

ACTIVITY **REASON**

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

42. **Machine Hours Used on Maize Last Year**

ACTIVITY	Machinery Cost/hour	PERIOD											
		J	F	M	A	M	J	J	A	S	O	N	D
Land clearing Land preparation Planting Spraying Fert. appln. Harvesting													

43. **Specific Tasks Undertaking by type of Labour and Crop budget**

Activity	1 Qty in units	2 Method 1=Manual 2=mechanical	Cost in cedis	Person responsible		
				Male	Female	Child
1. land clearing 2. land preparation 3. Planting 4. Fertilizer - NPK - Ammonia 5. Fert appln. 6. Manure 7. Weedicide - Weedicide appln. - Weeding 8. Pesticide spraying 9. Harvesting 10. bagging 11. Carting 12. Processing 13. Storage						

SECTION D

CAPITAL / CONSUMABLE INPUTS

44.

I t e m	Qty	Unit Price in cedis	useful life	1. rented 2. shared 3. owned
Hoe				
Cutlass				
Tractors				
Power tiller				
Spade				
Basket				
Sacks				
Spraying machine				
Seed				
Fertilizer				
Insecticide				
Other (specify) ..				

SECTION E

Output and Marketing Information

45. **Output**

Season	Crop variety	Output (Kg)	Home Consumpt	Qty Sold	Time of sale	Price/ Unit	Sale
Minor							
Major							

46. **Marketing**

Season	Qty Sold	Location	Time/month	Price	Revenue	Cost of Sale	
						Goods	Owners
Minor							
Major							

APPENDIX B

HO	FA	BD	CO	NN	FM	CM	OT	FS	PR	ST	FN
2	3	*		*	*	*			*		1
3	3	*			*	*			*		2
3	4	*			*				*		3
3	3	*			*			*			4
2	3	*			*			*			5
2	3		*		*				*		6
10	3	*			*	*		*			7
5	.	*			*	*			*		8
1	.				*	*				CHIEF	9
6	.				*	*				CHIEF	10
5	3	*			*	*			*		11
4	3		*		OWN				*		12
3	2				*				*		13
3	2	*			*			*			14
4	3				*	*		*			15
6	3				*	*		*			16
3	3				*				*		17
2	3	*			*	*			*		18
4	3	*			*	*			*		19
2	2	*			*	*			*		20
3	3			*	*			*			21
3	6				*	*			*		22
3	.				*					OWN	23
1	3				*				*		24
4	3		*		*					OWN	25
2	3	*			*				*		26
2	2				*					OWN	27
5	3	*			*				*		28
1	3				OWN					OWN	29
4	2	*			*				*		30
3	4	*			*			*			31
4	.			*	*				*		32
5	4				OWN					OWN	33
4	4	*			*				*		34
4	3	*			*	*			*		35
5	4	*			*	*			*		36
4	2				*	*				OWN	37

HO	FA	BD	CO	NN	FM	CM	OT	FS	PR	ST	FN
6	8			*	*				*		38
2	.	*			*				*		39
4	7	*			*	*		*			40
7	2				*	*		*			41
3	2				*					CHIEF	42
3	3				*				*		43
2	4				*	*			*		44
1	3		*						*		45
4	4		*		*				*	OWN	46
5	4				*						47
2	2				*	*			*		48
2	3			*	*					CHIEF	49
3	3	*			*				*		50
4	5	*			*				*		51
4	3	*			*				*		52
4	6	*			*				*		53
3	3	*			OWN	*			*		54
3	7	*			*				*		55
3	7	*			*					OWN	56
5	3	*			*				*		57
2	3	*			*	*		*			58
3	2				*			*			59
1	2				*			*			60
1	.		*								61
4	5		*		*					CHIEF	62
3	3		*		*	*		*			63
3	2		*		*					*	64
2	2		*		*				*		65
3	3		*		*	*		*			66
6	.	*			*				*		67
4	.										68
4	2										69
3	3										70
5	3										71
2	2										72
2	3										73
3	2										74

HO	FA	BD	CO	NN	FM	CM	OT	FS	PR	ST	PN
		*			*	*			*		68
		*			*	*					69
		*			*				*		70
		*			*			*			71
		*			*	*			*		72
		*			*	*			*		73
		*		*	*				*		74
6	6	*			*				*		75
4	.	*		*	*	*					76
3	5		*		*	*					77
3	3	*			*	*					78
2	3				*				*		79
2	4	*			*	*			*		80
4	4	*	*		*			*			81
4	3				*				*		82
3	2	*			*	*			*		83
3	.				*				*		84
4	2			*	*			*			85
4	4				*						86
3	3				*				*		87
3	3				*				*		88
5	5	*			*			*			89
4	2	*		*	*			*			90
2	2				*				*		91
6	3		*		*			*			92
3	4	*			*				*		93
4	4		*		*	*		*			94
4	3	*			*	*			*		95
2	5	*			*	*			*		96
5	4	*			*	*			*		97
5	4		*		*	*			*		98
3	3		*		*	*					99
4	3				*				*		100

Note: HO = household size
FA = fallow period
BD = type of labour (by day)
CO = type of labour (by contract)
NN = type of labour (exchange labour)
FL = type of labour (family labour)
CM = type of labour (communal labour)
OT = type of labour (others)
FS = type of labour family source of labour
PR = type of labour private source of labour
SL = type of labour stool land
FL = type of labour farmer serial number

APPENDIX C

QN	OU	LS	LZ	FT	WD	V1	V2	V3	V4	D1	D2	AG	D3	D4	D5	QT
1	750	78	.6	.	3.0	1	0	0	0	0	1	22	0	0	0	8.0
2	700	75	.4	.	.	0	1	0	0	1	0	22	0	0	1	4.0
3	225	99	.6	.	.	0	1	0	0	1	0	36	0	0	0	4.0
4	400	210	1.0	.	.	0	1	0	0	1	0	50	1	0	0	4.0
5	270	108	.4	.	.	0	1	0	0	1	0	46	1	0	0	6.0
6	200	56	.3	.	.	0	0	0	0	1	0	45	0	1	0	1.0
7	2000	340	.8	.	.	1	0	0	0	0	1	48	1	0	0	6.0
8	2100	342	1.2	.	3.0	0	1	0	0	0	1	32	0	0	0	27
9	850	96	.6	.	.	0	1	0	0	1	0	35	0	1	0	4.0
10	330	153	.4	100	.	0	1	0	0	1	0	42	0	0	0	4.0
11	800	121	1.2	.	50.0	0	1	0	0	1	0	32	0	0	1	10
12	150	49	.4	.	.	0	1	0	0	1	0	50	0	0	1	3.0
13	150	60	.4	.	.	0	1	0	0	1	0	22	0	0	1	4.0
14	132	83	.2	.	.	0	0	1	0	0	1	21	1	0	0	2.0
15	350	44	.4	.	.	0	1	0	0	1	0	38	1	0	0	3.0
16	1000	123	.6	.	.	0	0	1	0	0	1	35	1	0	0	4.0
17	300	49	.6	.	.	0	0	1	0	0	1	22	0	0	1	4.0
18	1350	322	.6	.	.	1	0	0	0	0	1	24	0	0	1	4.0
19	400	93	.8	.	.	0	1	0	0	1	0	35	0	0	1	4.0
20	198	148	.6	.	.	0	1	0	0	1	0	32	0	0	1	5.0
21	300	114	1.0	.	.	0	1	0	0	1	0	51	1	0	0	2.0
22	1214	318	.4	.	1.0	0	1	0	0	1	0	23	0	1	0	14
23	100	38	.4	.	.	0	1	0	0	1	0	42	1	0	0	2.0
24	225	39	.2	.	.	0	1	0	0	1	0	43	0	0	1	4.0
25	250	56	.4	.	.	0	1	0	0	1	0	73	1	0	0	3.0
26	816	299	.4	2	.	0	0	1	0	0	1	23	1	0	0	5.0
27	520	280	.8	.	.	0	1	0	0	1	0	65	0	0	1	3.0
28	350	139	.8	.	.	0	1	0	0	1	0	26	1	0	0	6.0
29	250	37	.4	.	.	1	0	0	0	0	1	20	0	0	1	2.0
30	650	131	1.6	.	.	0	0	1	0	0	1	44	1	0	0	10
31	500	110	.8	.	.	0	1	0	0	1	0	50	0	1	0	5.0
32	200	66	1.2	.	.	0	1	0	0	1	0	40	1	0	0	4.0
33	750	296	1.2	.	2.0	0	0	1	0	0	1	50	0	1	0	8.0
34	330	64	.7	.	.	0	1	0	0	1	0	42	0	0	0	6.0
35	160	44	.4	.	1.0	0	1	0	0	1	0	48	0	1	0	6.0
36	412	122	1.0	.	.	0	1	0	0	1	0	42	1	0	0	4.0
37	450	79	.8	.	.	0	1	0	0	1	0	43	0	0	1	13

QN	OU	LS	LZ	FT	WD	V1	V2	V3	V4	D1	D2	AG	D3	D4	D5	QT
38	340	34	.6	.	.	0	1	0	0	1	0	31	0	0	1	3.0
39	840	214	1.8	.	.	0	0	0	1	0	1	45	1	0	0	220
40	1310	321	1.2	.	.	0	1	0	0	1	0	49	1	0	0	6.0
41	154	46	.4	.	.	0	1	0	0	1	0	45	0	0	1	3.0
42	150	51	.3	.	.	0	1	0	0	1	0	28	0	0	1	2.0
43	640	289	.6	.	.	0	1	0	0	1	0	28	0	1	0	10
44	550	141	1.0	.	.	0	0	1	0	0	1	48	0	0	0	15
45	400	268	.6	.	.	0	1	0	0	1	0	39	0	0	1	5
46	150	84	.4	.	.	0	1	0	0	1	0	71	1	0	0	2.5
47	750	269	.8	.	.	0	0	1	0	0	1	31	0	1	0	7.0
48	250	112	.3	.	.	0	1	0	0	1	0	40	0	0	1	10
49	160	70	.3	.	.	0	1	0	0	1	0	80	0	0	1	6.0
50	160	89	.4	.	.	0	1	0	0	1	0	41	0	0	1	2.0
51	100	95	.6	.	.	0	1	0	0	1	0	70	0	0	1	8.0
52	140	58	.4	.	.	0	1	0	0	1	0	71	0	0	0	4.0
53	500	177	1.2	.	.	0	1	0	0	1	0	44	0	0	1	10
54	140	199	.4	.	.	0	1	0	0	1	0	62	1	0	0	2.0
55	300	75	.3	.	.	0	1	0	0	1	0	55	0	0	1	10
56	180	71	.2	.	.	0	1	0	0	1	0	26	0	0	1	5
57	166	34	.2	.	.	0	1	0	0	1	0	20	1	0	0	2.0
58	97	20	.3	.	.	0	1	0	0	1	0	20	1	0	0	2.0
59	500	278	.6	.	.	1	0	0	0	0	1	60	1	0	0	8.0
60	4200	373	2.0	.	.	1	0	0	0	0	1	57	1	0	0	36
61	512	74	.3	.	.	1	0	0	0	0	1	39	0	0	0	4.0
62	350	74	.3	.	.	1	0	0	0	0	1	41	1	0	0	2.0
63	310	41	.8	.	.	1	0	0	0	0	1	39	1	0	0	1.6
64	172	60	.2	.	.	0	1	0	0	1	0	45	1	0	0	1.5
65	600	286	.4	.	.	1	0	0	0	0	1	45	0	0	0	10
66	648	290	1.0	25	25	1	0	0	0	0	1	45	0	0	0	13
67	1700	330	.8	.	.	1	0	0	0	0	1	41	1	0	0	16
68	600	61	.7	.	.	1	0	0	0	0	1	40	0	0	0	7.0
69	350	62	.4	.	.	1	0	0	0	0	1	38	1	0	0	7.2
70	600	26	.4	.	.	1	0	0	0	0	1	31	0	0	0	5
71	525	74	1.2	75	75	1	0	0	0	0	1	35	0	0	0	6.0
72	874	300	1.2	.	.	0	0	0	0	0	1	31	0	0	0	18
73	1386	324	1.2	.	.	0	1	0	0	1	0	46	0	1	0	15
74	3404	250	2.4	150	150	0	0	0	1	0	1	49	1	0	0	36

QN	OU	LS	LZ	FT	WD	V1	V2	V3	V4	D1	D2	AG	D3	D4	D5	QT
75	225	41	.4	.	2.0	0	1	0	0	1	0	34	1	0	0	4.0
76	674	69	.6	.	.	0	1	0	0	1	0	48	1	0	0	8.0
77	100	33	.3	.	5.0	0	1	0	0	1	0	30	0	1	0	1.6
78	200	59	.4	.	.	0	1	0	0	1	0	50	1	0	0	4.0
79	300	43	.3	.	.	0	1	0	0	1	0	36	0	1	0	2.0
80	116	47	.3	.	.	0	1	0	0	1	0	61	0	0	1	2.0
81	250	58	.3	.	.	0	1	0	0	1	0	52	0	0	1	2.0
82	160	71	.3	.	.	0	0	0	1	0	1	29	1	0	0	4.0
83	600	180	.4	.	.	0	0	0	1	0	1	54	1	0	0	6.0
84	160	41	.3	.	.	0	1	0	0	1	0	20	0	1	0	2.0
85	300	37	.6	.	.	0	1	0	0	1	0	31	0	0	1	5.0
86	830	243	1.6	.	.	0	1	0	0	1	0	54	1	0	0	13
87	1020	309	2.0	.	.	0	1	0	0	1	0	50	0	0	0	20
88	492	68	.6	.	.	0	1	0	0	1	0	43	0	0	1	6.0
89	126	73	.4	.	.	0	1	0	0	1	0	35	0	1	0	4.0
90	340	58	.8	.	.	0	1	0	0	1	0	35	0	0	1	10
91	300	38	.4	.	1.5	1	0	1	0	0	1	39	0	0	1	4.0
92	540	103	.4	.	.	0	0	0	0	0	1	40	0	1	0	6.6
93	120	36	.4	.	.	1	0	0	0	0	1	36	0	1	0	3.0
94	500	74	.6	.	.	0	1	0	0	1	0	48	0	0	1	5.0
95	550	87	.6	.	.	0	1	0	0	1	0	43	0	0	1	6.0
96	800	101	.8	.	.	1	0	0	0	0	1	52	1	0	0	10
97	600	115	.6	.	.	0	1	0	0	1	0	48	0	1	0	6.0
98																
99																
100	350	74	.3	.	.	1	0	0	0	0	1	41	1	0	0	2.0

Note:

QN = farmer serial number
OU = output of maize in kilos per hectare
LS = labour supply in mandays
LZ = land area cultivated to maize in hectare
FT = fertilizer quantity used in kilos
WD = quantity of weedicide in kilos
V1 = dummy variable for maize variety Abeleehi
V2 = dummy variable for maize local variety
V3 = dummy variable for maize variety (Obaatampa)
V4 = dummy variable for maize variety (Okomasa)
D1 = dummy variable for local variety
D2 = dummy variable for local improved variety
D3 = dummy variable for local owner farmer
D4 = dummy variable for local Abunu farmer
D5 = dummy variable for local Abusa farmer
AG = age of farmer
QT = quantity of seeds in kilos.

APPENDIX D

ESTIMATED COSTS OF INPUTS PER HECTARE

QN	LA	CL	WD	FT	CT	BT	SD	SK	CB	HO	LD
1	.6	69000	22500	.	3667	11667	10000	2500	.	.	10000
2	.4	124000	.	.	5500	.	.	.	.	500	.
3	.6	28000	.	.	11000	2333	2333	1667	.	.	8333
4	1.0	78404	.	.	8800	.	.	7000	.	.	.
5	.4	72500	.	.	16500	5250	.	.	7200	.	.
6	.3	20000	.	.	14667	2333	1333	1333		.	94714
7	.8	29250	56250	.	27500	2625	.	1250	.	1500	.
8	1.2	30000	4500	.	3667	2042	.	500	.	.	11905
9	.6	21667	.	.	7333	8750	.	.	.	.	201214
10	.4	48000	.	75000	38500	10500	.	5000	.	2722	50000
11	1.2	24167	.	4167	3667	2917	.	.	.	.	63143
12	.4	32500	.	.	16500	2625	.	.	.	.	35500
13	.4	.	.	.	16500	.	.	2250	.	.	35500
14	.2	6400	.	.	11000	1750	12000	5000	.	.	.
15	.4	19000	.	.	11000	35100	.	1000	.	.	.
16	.6	65000	.	.	7333	3500	.	.	4800	.	.
17	.6	.	.	.	7333	.	4000	2000	.	.	47333
18	.6	95333	.	.	7333	.	6667	3000	6666	3333	21350
19	.8	12500	.	.	5500	2333	.	1000	.	.	47333
20	.6	72500	.	.	7333	1050	2083	.	.	.	31240
21	1.0	.	.	.	4400	.	.	600	.	3000	.
22	.4	20250	11250	.	11000	1750	12250	7500	.	.	430970
23	.4	.	.	.	5500	.	.	750	.	.	.
24	.2	.	.	.	12000	7000	.	.	.	3000	106500
25	.4	25000	.	.	16500	7000	.	3000	.	1000	
26	.4	25000	.	.	11000	5250		4000	.	1000	47333
27	.4	2250	.	12500	5500	1313	.	4000	.	.	.
28	.8	46250	.	.	13750	1750	.	.	.	.	61533
29	.8	.	.	.	8250	8750	.	2188	.	.	.
30	.4	6000	.	.	27500	.	.	2500	.	.	59166
31	1.6	58125	.	.	2750	2188	483	1125	1125	2500	.
32	.8	7500	.	.	11000	1750	.	1250	.	.	88750
33	1.2	.	.	.	3667	4375	.	.	.	.	.
34	1.2	15833	7500	.	14667	.	.	.	.	.	88750
35	.7	75714	.	.	9428	.	2571	.	3429	.	28571
36	.4	7500	18750	.	11000	.	.	.	.	.	56800
37	1.0	7400	.	.	6600	.	.	800	3600	.	.
38	.8	.	35000	.	13750	.		.	4800	.	53297
39	.6	21467	.	.	3667	.	.	.	2000	1667	53676
40	1.8	93333	.	.	2444	.	1000	2083	3333	.	.

QN	LA	CL	WD	FT	CT	BT	SD	SK	CB	HO	LD
41	1.2	18417	.	.	9167	.	.	2292	6067	.	.
42	.4	1425	.	.	11000	1500	.	.	3600	.	36446
43	.3	11667	.	.	22000	4667	2667	833	.	.	47333
44	.6	32800	.	.	7333	.	.	1250	4000	.	.
45	1.0	72500	.	.	4400	.	7500	.	5000	.	.
46	.6	41333	.	.	7333	2333	.	.	.	.	63143
47	.4	.	.	.	22000	.	.	.	.	.	.
48	.8	1065	.	.	5500	3500	1750	.	.	.	133196
49	.3	.	.	.	7333	4667	8333	.	.	.	75733
50	.3	32000	.	.	14667	7000	.	.	.	.	50457
51	.4	38500	.	.	4400	3500	.	.	.	.	50457
52	.6	66667	.	.	16500	2917	1500	.	.	.	15809
53	.6	37333	.	.	29333	2625	4000	.	.	.	34742
54	.4	94500	.	.	14667	2333	3000	.	.	.	21667
55	1.2	74000	.	.	16500	5250	3000	.	.	.	39476
56	.4	60000	.	.	5500	11667	.	.	.	.	.
57	.3	66667	.	.	22000	.	.	1500	.	.	94667
58	.2	120000	.	.	29333	3500	.	.	.	2500	85200
59	.2	.	.	.	11000	1166	.	1000	.	.	.
60	.3	.	.	.	22000	.	.	.	.	.	.
61	.6	124333	.	.	7333	.	4000	1500	1600	.	.
62	2.0	15000	11750	22500	3667	.	8250	1500	800	.	.
63	.3	126667	.	.	2200	.	.	.	.	600	.
64	.3	71000	.	.	24200	.	.	.	.	3111	.
65	.8	42275	12500	.	7333	.	1875	.	.	.	.
66	.2	30000	.	.	2750	.	.	.	.	.	.
67	.4	28750	32500	.	33000	2625	20000	24000	5600	.	37500
68	1.0	50000	19500	8500	22000	1750	7800	.	.	.	10000
69	.8	95000	30000	.	2750	.	10000	5000	3000	.	.
70	.7	26286	40000	.	6286	1500	2143	2000	.	.	.
71	.4	72000	25000	.	11000	.	.	5000	.	.	.
72	.4	64250	26250	.	5500	2625	8750	1833	800	.	.
73	1.2	22833	40833	12500	3667	1458	11250	2875	833	.	25000
74	1.2	68667	.	.	3667	.	.	1313	1333	.	8333
75	1.2	20942	.	.	11000	.	.	3438	3000	.	164010
76	2.4	6123	16667	31250	1833	.	.	2500	2133	.	.
77	.4	50000	20000	.	11000	.	3750	4000	.	.	.
78	.6	46533	.	.	11000	2917	.	.	.	.	.
79	.3	3333	13333	.	7333	.	.	833	.	.	47286
80	.6	29208	1500	.	3667	4667	.	.	.	.	47333

QN	LA	CL	WD	FT	CT	BT	SD	SK	CB	HO	LD
81	.4	68000	.	.	16500	5250	.	.	.	.	.
82	.3	.	.	.	14667	4667	.	.	.	.	142000
83	.3	37333	.	.	36667	4667	.	.	.	.	36663
84	.3	.	.	.	22000	4667	.	.	.	.	37836
85	.3	.	.	.	14667	.	5333	.	.	.	.
86	.4	.	.	.	16500	8750	.	.	.	.	.
87	.3	.	.	.	14667	4667	.	.	.	.	75686
88	.6	222	.	.	14667	1750	.	.	.	.	47333
89	1.6	8750	.	.	6875	.	3750	.	850	.	.
90	2.0	20000	.	.	4400	1750	.	.	.	.	5000
91	.6	6183	.	.	3667	.	5000	.	.	.	77627
92	.4	62500		.	16500	4375	.	.	.	833	44730
93	.8	10000	.	.	8250	2625	.	.	.	.	40233
94	.4	45000	30000	.	16500	4375	.	.	.	.	71000
95	.4	105563	.	.	11000	4375	12500	.	.	.	.
96	.4	70000	.	.	5500	7000	3650	2000	.	.	.
97	.6	46850	.	.	11000	3500	.	5000	.	.	78857
98	.6	46417	.	.	14667	4667	.	1875	.	.	86809
99	.8	4400	.	.	13750	1750	.	.	2400	.	.
100	.6	79167	.	.	11000	2917	.	.	.	.	142000

Note:

QN = farmer serial number
LA = land area in hectare
CL = cost of labour per hectare
WD = " " weedicide per hectare
FT = " " fertilizer " "
CT = " " cutlass " "
BT = " " basket " "
SD = " " seed " "
SK = " " sack " "
CB = " " basket (cane) "
HO = " " hoe " "
LD = " " land " "

APPENDIX E

CALCULATION OF GROSS MARGINS FOR OWNER AND SHARECROPPING FARMERS

THE VARIABLES ARE LISTED IN THE FOLLOWING ORDER:

OUTPUT	VALTOUTP	TVARCOST	GROSSMAR	TOTLABSU	TOTLANAR	GROSSMPL	GROSSMPUL	ATVPHEC	ATVCHEC	ATVPL	ATVCL
1400	397600	88704	308896	210	1.0	1471	308896	397600.0	88704.0	1893.33	422.40
270	76680	37700	38964	108	.4	361	97450	191700.0	94250.0	710.00	349.07
2000	568000	85900	482100	340	.8	1418	602625	710000.0	107375.0	1670.59	252.65
132	37488	23750	13738	83	.2	170	68690	187440.0	118750.0	451.66	286.14
350	99400	13400	86000	44	.4	1955	215000	248500.0	33500.0	2259.09	304.55
1000	284000	46200	237800	123	.6	1933	396428	473333.3	77000.0	2308.94	375.61
300	85200	5450	79750	114	1.0	670	79750	85200.0	5450.0	747.37	47.81
100	28400	2900	25500	38	.4	671	63750	71000.0	7250.0	747.37	76.32
250	71000	19400	51600	56	.4	921	129000	177500.0	48500.0	1276.86	346.43
816	231744	12700	219044	299	.4	736	547610	579360.0	31750.0	775.06	42.47
350	99400	8000	91400	139	.8	658	114392	124250.0	10000.0	715.11	57.55
650	184600	97100	87500	131	1.6	668	54616	115375.0	60687.5	1409.16	741.22
200	56800	8000	48800	66	1.2	739	40761	17333.33	6666.67	860.61	121.21
412	117008	14000	103008	122	1.0	844	103008	117008.0	14000.0	959.08	114.75
840	238560	186800	51760	214	1.8	242	28851	132533.3	103777.8	1114.77	872.90
1310	372040	37700	334340	321	1.2	1042	278997	310033.3	31416.67	1159.00	117.45
640	181760	27760	154000	289	.6	533	256762	302933.3	46266.67	628.93	96.06
150	42600	8800	33800	84	.4	402	84500	106500.0	22000.0	507.14	104.76
140	39760	34900	4860	199	.4	24	12150	99400.0	87250.0	199.80	175.38
166	47144	5100	42044	34	.2	1237	210220	235720.0	25500.0	1386.59	150.00

OUTPUT	VALTOUTP	TVARCOST	GROSSMAR	TOTLABSU	TOTLANAR	GROSSMPL	GROSSMPUL	ATVPHEC	ATVCHEC	ATVPL	ATVCL
97	27548	3000	24548	20	.3	1227	81732	91826.67	10000.0	1377.40	150.00
500	142000	81700	60300	278	.6	217	100406	23666.7	136166.7	510.79	293.88
4200	1192800	119400	1072400	373	2.0	2878	536700	596400.0	59700.0	3197.86	320.11
512	145408	52100	93308	74	.3	1261	311027	484693.3	173666.7	1964.97	704.05
350	99400	34380	65020	47	.3	879	358828	331333.3	114600.0	1343.24	464.59
310	88040	54940	33100	41	.8	807	41517	110050.0	68675.0	2147.32	1340.0
172	48848	13308	35540	60	.2	592	177700	244240.0	66540.0	814.13	221.80
1700	482800	112300	370500	330	.8	1123	463125	603500.0	140375.0	1463.03	340.30
350	99400	48200	51200	62	.4	826	128000	248500.0	120500.0	1603.23	777.42
3404	966736	229036	737700	250	2.4	2951	307280	402806.7	95431.67	3866.94	916.14
225	63900	35400	28500	41	.4	695	71392	159750.0	88500.0	1558.54	863.41
674	191416	38466	152950	69	.6	2217	254822	319026.7	64110.0	2774.14	557.48
200	56800	35900	20900	59	.4	354	52250	142000.0	89750.0	962.71	608.47
160	45440	6000	39440	71	.3	555	131372	151466.7	20000.0	640.00	84.
600	170400	10100	160300	180	.4	890	400750	426000.0	25250.0	946.67	56.11
830	235720	31500	204220	243	1.6	840	127708	147325.0	19687.50	970.04	129.63
540	153360	54290	99070	103	.4	962	247675	383400.0	135725.0	1488.93	527.09
120	34080	34500	-420	36	.4	-12	-1050	85200.0	86250.0	946.67	958.33
800	227200	46200	181000	101	.8	1792	226250	284000.0	57750.0	2249.50	457.43

Note: OUTPUT : Total output of maize obtained by a farmer
VALTOUTP : Value of total output
TVARCOST : Total variable cost of production
GROSSMAR : Gross margins
TOTLABSU : Total labour supply
TOTLANAR : Total land area cultivated to maize
GROSSMPL : Gross margins per unit of labour
ATVPHEC : Average total value product per hectare
ATVPHEC : Average total variable cost per hectare
ATVPL : Average total value product per unit labour

APPENDIX F

LABOUR SUPPLY BY TYPE IN MANDAYS

HL	FL	TL	TLHEC	HLHEC	FLHEC	PQ	FM
32	46	78	130	53	77	250	M
44	31	75	188	78	110	300	M
14	85	99	165	23	142	300	M
112	98	210	210	112	98	200	M
24	84	108	270	60	210	200	M
14	42	56	187	47	140	250	M
35	305	340	425	44	381	300	N
142	200	342	285	118	167	300	M
30	66	96	160	50	110	300	M
12	141	153	383	50	353	500	M
66	55	121	101	55	46	300	N
21	28	49	123	53	70	350	M
.	60	60	150	.	150	300	M
6	77	83	415	30	385	350	M
4	40	44	110	10	100	350	M
38	95	123	205	47	158	300	M
.	49	49	82	.	82	500	M
182	140	322	536	303	233	350	M
38	55	93	116	47	69	300	M
93	55	148	247	155	92	300	M
7	107	114	114	7	107	250	M
25	293	318	795	62	733	300	N
.	38	38	95	.	95	200	M
.	39	39	195	.	195	350	M
14	42	56	140	35	105	500	M
10	30	40	100	25	75	400	M
58	241	299	748	145	603	300	M
142	138	280	350	177	173	300	M
.	139	139	174	.	174	250	M
2	35	37	93	5	88	250	M
99	32	131	82	62	20	500	N
64	46	110	138	80	58	350	M
.	66	66	55	.	55	250	M
93	203	296	247	78	169	300	M
38	26	64	91	37	54	300	M
8	36	44	110	20	90	350	M

HL	FL	TL	TLHEC	HLHEC	FLHEC	PQ	FM
8	114	122	122	8	114	350	M
54	79	133	166	67	99	300	M
6	28	34	57	47	10	400	M
192	22	214	118	107	11	250	M
110	203	321	268	99	169	450	M
.	46	46	115	.	115	350	M
.	51	51	170	.	170	300	M
112	177	289	482	187	295	250	M
84	57	141	141	84	57	500	M
132	136	268	447	220	227	350	M
.	84	84	210	.	210	250	M
200	69	269	336	250	86	350	M
63	49	112	373	210	163	350	M
12	58	70	233	40	193	300	M
49	40	89	223	123	100	300	M
50	45	95	158	83	75	300	M
28	68	96	160	27	133	350	M
52	6	58	145	130	15	350	M
111	66	177	148	93	55	300	M
49	150	199	498	123	375	300	M
20	55	75	250	67	183	250	M
40	31	71	355	200	155	200	M
.	34	34	170	.	170	250	M
.	20	20	67	.	67	300	M
1	277	278	463	1	462	400	N
92	281	373	187	46	141	300	M
36	38	74	247	120	127	350	N
34	40	74	247	114	133	400	N
26	15	41	51	33	18	500	M
11	49	60	300	55	245	300	M
100	186	286	715	250	465	500	M
170	120	290	290	170	120	500	N
300	30	330	413	375	38	250	N
12	49	61	87	17	70	250	M
24	38	62	155	60	95	300	N
17	9	26	65	43	22	300	M
44	30	74	62	37	25	400	M
200	100	300	250	167	83	300	M

HL	FL	TL	TLHEC	HLHEC	FLHEC	PQ	FM
178	196	324	270	107	163	300	M
170	80	250	104	72	32	300	M
24	17	41	103	60	43	250	N
33	36	69	115	55	60	250	M
.	33	33	110	.	110	300	M
15	14	29	48	25	23	300	N
34	25	29	148	85	63	500	M
.	43	43	143	.	143	500	N
20	27	47	157	67	90	300	M
.	58	58	193	.	193	300	M
8	63	71	236	26	210	350	M
.	180	180	450	.	145	350	N
.	41	41	136	.	136	350	M
.	37	37	62	.	62	300	M
100	143	243	152	63	89	500	M
149	160	309	155	75	80	300	M
4	64	68	113	7	106	300	M
25	48	73	183	63	120	400	M
10	48	58	73	13	60	300	M
18	20	38	95	45	50	350	M
36	67	103	258	90	168	350	M
32	4	36	90	80	10	250	N
26	48	74	123	43	80	500	M
30	57	87	145	50	95	300	M
46	55	101	126	58	68	350	M
45	70	115	192	75	167	350	M

Note :

HL = Hired labour supply in mandays
FL = Family labour supply in mandays
TLHEC = Total labour supply per hectare
HLHEC = Hired labour supply per hectare
FLHEC = Family labour supply per hectare
PQ = Per kilo price of output received by a farmer
FM = Type of cropping pattern
FM =