

**ECONOMIC ANALYSIS OF SMALL-SCALE WHEAT PRODUCTION IN
TANZANIA: A CASE STUDY OF KARATU DISTRICT**

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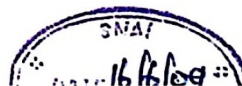
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**A DISSERTATION SUBMITTED IN PARTIAL FULFILMENT OF THE
REQUIREMENTS FOR THE DEGREE OF MASTER OF SCIENCE IN
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ABSTRACT

This study identifies factors that effect small-scale wheat production in Karatu district, Arusha region. Specifically the study aimed at identifying inputs utilization and their effects on small-scale wheat production, examining relative profitability of major crop enterprises; and identifying socio-economic factors influencing wheat production in the district. A survey was conducted and 70 small-scale farmers were interviewed. Secondary data were collected from SARI, SACCOS and banks. Primary data were analyzed in the SPSS programme using descriptive statistics, gross margin and linear regression model. The study revealed that the majority of the farmers did not have access to credit due to high interest rate, lack of collateral items and high risk on investment. The major production problems were pest and diseases, unreliable rainfall and supply of inputs, unfertile soil, weed infestation and poor extension services. Gross margin analysis indicated that wheat is more profitable than maize and beans. However many farmers did not opt to produce wheat because of food preference for maize and beans, which is consistent with the hypothesis that alternative crops enterprise (maize and beans) are more desirable venture in the study area. Regression model indicates that, wheat yield is influenced by labour availability, capital used for the purchase of inputs, maize acreage and access to research services. These variables accounted for 80% of the variation in yield. The results indicated that wheat was the most profitable enterprise compare to other competing crops (maize and beans). Based on these findings, it is recommended that future plans to improve wheat production in the district, should consider encouraging the participation of skilled manpower. This strategy could be achieved through creating attractive production environment such as introducing special credit programmes in the district and provision of information on inputs, agricultural technology and markets.

DECLARATION

I, Sifuni Joshua, do hereby declare to the Senate of Sokoine University of Agriculture that this dissertation is my own original work and that it has never been submitted nor concurrently being submitted for a higher degree award to any other University.

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The above declaration confirmed

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DEDICATION

This work is dedicated to my wife Magreth Sifuni and my parents Joshua Paulo and Helena Paulo for their Love and my sister Mary Msangi who supported me during my secondary education.

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LIST OF ABBREVIATION

NSGRP	-	National Strategy for Growth and Reduction of Poverty
URT	-	United Republic of Tanzania
FAO	-	Food and Agriculture Organization
BOT	-	Bank of Tanzania
DRC	-	Democratic Republic of Congo
DALDO	-	District Agricultural and Livestock Development Officer
SAPs	-	Structural Adjustment Programmes
SSA	-	Sub- Saharan African
SARI	-	Selian Agricultural Research Institute
SPSS	-	Statistical Package for Social Sciences
GM	-	Gross Margin
TATIC	-	Tanzania Agricultural Trade Information Center
TR	-	Total Revenue
TVC	-	Total Variable Cost
VIF	-	Variable Inflation Factor
OLS	-	Ordinary Least Square
SACCOS	-	Savings and Credit Cooperative Societies
NGOs	-	Non- Governmental Organizations

CHAPTER ONE

1.0 INTRODUCTION

1.1 Overview of Tanzanian Agriculture

Agriculture remains the largest sector in the Tanzania economy and its performance has a significant effect on output and corresponding income and poverty levels. In 2004, the sector contributed approximately 51 percent of foreign exchange, 75 percent of total employment and 47 percent of the Gross Domestic Product (GDP) (TATIC, 2006). Higher and sustained agricultural growth is needed to meet Tanzanian's National Strategy for growth and Reduction of Poverty (NSGRP) and Millennium Development Goals of halving poverty and food insecurity by 2015 (URT, 2006). Maize, rice and wheat are the main cereal crops that contribute to agricultural growth and are the major sources of food (URT, 1989).

1.2 Wheat Production

In Tanzania wheat is mainly grown in Manyara, Arusha, Iringa, Kilimanjaro, Mbeya, Rukwa and Tanga regions. Tanzania produces approximately 68 000 tonnes of wheat per year (URT, 2005). Arusha and Manyara regions account for about 62 % of the area under wheat cultivation and 73% of the total production (Mlay *et al.*, 1989). However, wheat production in Arusha region has been declining and its production decreased from 41,200 tonnes in 1995/96 to 10 800 tonnes in 2002/03 (URT, 2005). In spite of this decrease in wheat production, wheat remains the preferred food grain in towns, while the rural population lives mainly on other cereals. As people continue to migrate to towns, consumption of wheat is likely to grow faster than that of other cereals (Choudhri, 1987).

The average wheat yield for Tanzania is only 1.67 t/ha compared to the potential yield of 4 to 5 t/ha. In both northern and southern Tanzania, the large-scale farmers are realizing relatively high yields approaching 2 t/ha. The small-scale wheat producers in the southern highlands, who can rarely afford the cost of fertilizers, often harvest less than 1 t/ha because of the poorer soils existing in the area (Saunders, 1991).

1.3 Wheat Consumption

Wheat and flour consumption in Tanzania has increased in the last few years as government control over trade has been reduced. New mills have been established and per capita consumption, is increasing albeit slowly. The majority of the milling and baking operations are located around urban areas, especially in Dar es Salaam. The wheat and related products (mainly bread) are consumed in the urban areas. As people move into towns, consumption rate of wheat in the coming years is likely to grow faster than that of all other cereals. Unless there is greater emphasis in the research and development of wheat, Tanzania's wheat production will remain inadequate for long time (FAO, 2001). Bread is still viewed as high value food by most Tanzanians and its demand is moderately price elastic as rice, maize based food products and other traditional starch based dishes remain main staples. The level of consumption growth (estimated at about 5% in 2001) has not big enough to have any noticeable effect on the wider population, particularly the rural poor. Domestic Wheat production in Tanzania is estimated at 5% of total demand with the balance being met through imports. Import figures average 350 000 metric tones annually and are forecasted to increase as milling capacity is on the increase (Mary, 2002). Wheat imports, which account for more than 80% of cereal imports, are partly re-exported to the neighbouring countries such as Uganda and the Democratic Republic of Congo (DRC) (BOT, 2007).

1.4 Problem Statement

Wheat in Karatu district is among the major sources of income to the majority of the farmers. Also apart from its major contribution towards farmers' income earnings, it has been an important source of income in Arusha region. However, wheat production in Karatu has been declining over years.

Production statistics indicate that wheat yield in the district was 15 250 tonnes in 1994/95 and only 4521 tonnes in 2000/01. This change is mainly attributed to decrease in wheat acreage and productivity. In 1994/95 wheat yields per ha was about 2.5 tons for small-scale farmers. In 2000/01, total wheat area planted in the district dropped from 4320 to 2800 ha and the average yield per ha was 1.6 tons (DALDO, 2005).

In general it is hypothesized that the fall in wheat production is attributed to several factors. These factors include inadequate capital, general decline in wheat price, competition in resource use between wheat and alternative crops, bad weather conditions and poor sharing of information between farmers, policy makers, researchers and development agents. Without the exchange of information, no innovation would be able to spread on agricultural sector (Gesa *et al.*, 2002).

1.5 Justification of the Study

Currently the production systems in the semi-arid areas, particularly in northern zones are characterized by poor production and management practices, low adoption of improved technologies and household involved are often food insecure. With such circumstances the farming communities, which are looking for more droughts tolerant crops, have to acquire technologies that can be compatible with current farming systems and have better cash value (Massawe, 2001). Developing agriculture requires endless effort to get alternative

crops like wheat so as to substitute traditional crops i.e. maize and rice whose productivity is falling due to drought. This problem has not been addressed properly in Tanzania. Most studies such as Mary (2002) and Jacqueline (1999) were on large-scale (state) wheat farms and less attention was placed on small-scale wheat farms. This study analyses the problems in small-scale wheat production and therefore, the findings and information obtained from this study are expected to be useful to and utilized by both government and non-government organization, policy makers, planners and extension workers to design strategies for the sustainable small scale production in Tanzania.

1.6 Objectives

1.6.1 General objective

The general object is this study is to identify factors that affect small-scale wheat production in Karatu district.

1.6.2 Specific objectives

- i. To identify inputs utilization and their effects on small-scale wheat production
- ii. To examine relative profitability of major crop enterprises carried by small-scale farmers.
- iii. To identify socio-economic factors influencing small-scale wheat production.

1.6.3 Hypotheses

- i. Sizes of land, labour and capital utilization have no influence on small-scale wheat production.
- ii. Wheat production is relatively less profitable crop than other major crops such as maize and beans.
- iii. Household socio-economic factors have no influence on small-scale wheat production.

CHAPTER TWO

2.0 LITERATURE REVIEW

2.1 Overview

This chapter reviews some of the literature related to wheat production and marketing. The chapter is comprised of nine sections. The first section provides the meaning of productivity and relationship between factor of production and output. The second section deals with theory of production and its implication on wheat production in Tanzania. The third section identifies the impact of agricultural credit on agriculture and resources ownership and utilization. The fourth section identifies the effect of structural adjustment policies on agricultural production in Tanzania. The fifth section describes the trade off between poverty and resource utilization in agriculture. The sixth section describes the price of wheat as an incentive in resources utilization. The seventh part identifies different constraints to wheat production in Tanzania. The eighth section is about diminishing role of small-scale farmers in wheat production. The last part reviews the analytical tools used in this the study.

2.1 The Concept of Productivity

Productivity may simply mean ability to produce. It describes a relationship between sources or means of producing and what is produced. The broadest definition of productivity is the ratio between output and the total factor inputs required to achieve it. It can be defined as a ratio of the total value of goods and services produced to the total cost of all inputs used in the production process. This relationship is quantitative and therefore, measurable (Joseph, 1984). Increased productivity can be a function of good utilization of capital, labour and land (factors of production).

2.2 The Theory of Production

Henderson and Quandt (1995) define the production process as the transformation of inputs into output. In most cases a producer uses several inputs such as capital, labour and land to produce an output. Boehlje and Eidman (1984) argue that apart from profit or return maximization, other goals of a farmer are; to increase net worth, control a large business or farm, reduce borrowing needs and to improve living standard, having a neat and well kept farmstead and providing community service. A production process is cost efficient if it cost less of the inputs to produce more of the output. This efficiency can be explained by the optimization behaviour under the assertion that a producer wants to maximize output for a given cost or minimize cost for a given output level. The maximization of output is a proxy for profit maximization. Output maximization is constrained optimization since resources are limited, and if available there could be a problem of improper input combination or management. In this case it is worth to observe that fixed costs do not play a direct role in optimizing decisions. Once the production unit is established, fixed costs must be paid for.

To determine the profitability of alternative production opportunities, the physical data must be combined with price and cost information as well as data on the availability of other resources. Thus, it is necessary to combine the information provided by appropriate physical and biological sciences with price information and appropriate decision making procedures in making production decisions Boehlje and Eidman (1984). To get reliable and meaningful estimates it is essential to include all the relevant variables that are considered in the production process, which are labour, capital and land. A brief discussion of these factors is provided below:

2.2.1 Labour

Labour is one of the factors that influence production. Whatever output is produced labour must be applied. In many instances labour is measured in man-days, i.e. the amount of work done in a day usually 8 hours by an average adult person. Considering agronomic practice of wheat like seed sowing, herbicide application, pesticide application and cultivation the crop could be labour intensive. Thus labour availability and utilization are likely to influence wheat production in Karatu district.

2.2.1.1 Labour productivity

Labour productivity is increasingly acknowledged as one of the major aspects in economic analysis. Labour productivity in conjunction with population and output trends, is used in economic growth models to forecast output and employment, as well as the distribution of manpower and other resources between different sectors of the economy. It also serves as a basis for analysis of the relative dynamism of different economic activities.

2.2.2 Land

According to Kaiza and Marandu (1999) agricultural land ownership is still guided by the traditional system of land ownership. Individual rights to agricultural land in villages are well recognized and respected. However, there is ample evidence of continued pervasive rural poverty and hunger, which are attributed to static and low-productive agrarian structures. The underutilization of land resources by some and the intensive, degrading use of marginal lands by multitudes of land-poor peasant farmers still characterize contemporary agrarian structures (Jolyne and Susana, 1998). Poor utilization of land affects the productivity of most crops grown in rural area of Karatu district.

2.2.3 Capital

Capital plays a crucial role in any production process. This means the extent of farmer's access to capital for use in his farm limit the extent of his access to productive resources of all kinds. It is evident, that there is always an element of capital investment associated with the use of each and every productive resource involved in the farm. Lack of capital for the purchase of physical inputs such as farming tools and low levels of technology are among the major factors affecting crop production in developing countries leading to underdevelopment of agriculture (Sekondo, 1988). As a result of shortage of own-capital most farmers tend to rely on borrowing (credit).

2.3 Impact of Credit on Agriculture and Resources Ownership

Credit is often considered to be a key element in the modernization of agricultural and other rural sectors. Credit is not only expected to remove a financial constraint, but also to accelerate the adoption of new technologies. Many Sub-Saharan Africa countries have undertaken targeted credit programs to support rural activities because credit is an integral part of commercialization of the rural economy and a vital instrument for economic development (World Bank, 1994).

Ngasongwa (1978) found that agricultural credit remove financial constraints, which face the peasants and provides incentive for the peasant to adopt new technologies, which can accelerate agricultural development. Also availability of agricultural credit accelerates the utilization of resources by either hiring or buying resources. According to Temu (1988) agricultural credit has the potential to act as a force to the development of this sector.

Credit empowers people by allowing them to create employment through starting or improving wheat production that generates income or revenue for themselves and their

families. Credit can be used as working capital so that farmers' efforts become more productive. For instance, micro-finance providing credit and saving services to the self-employed poor enables them to initiate or expand small income generating activities (Coates, 1997).

The present worldwide view considers credit as an important factor in reducing poverty amongst poor people in rural areas in the developing countries. Credit can facilitate rural resource mobilization and allocation to sound investment and integrates rural development within macro-economic development; makes rural people more self-sufficient; and provides financial intermediation services (World Bank, 1990).

Unavailability of credit institutions in most of rural areas causes the underutilization of resources in agricultural production. The basic assumption in providing credit to farmers is that most rural farmers are poor and that they have low rate of personal income and saving, which inhibit their ability to make any effective investment in agriculture. Lytuu (1994) noted that despite its importance many credit institutions are however, not accessible to small farmers. He pointed out that many credit institutions have found it difficult to deal with smallholders' farmer mainly because of lack of adequate collateral, the high incidence of default and administrative costs associated with small loan.

Many of the problems which faced agriculture in developing countries in the late 1970 and early 1980 were the sectoral reflection of macroeconomic distortions, coupled with government's desire to control all the prices of major food and export crops (e.g. wheat). Due to these problems, structural adjustment programmes (SAPs) were implemented in many Sub-Saharan African (SSA) countries with the aim of stimulating more agricultural production and exports (Helleiner, 1987; Riddell, 1992).

2.4 Structural Adjustment Policies and Crop Production in Tanzania

According to Nkwera (1994), producer prices are among the most important and effective way of influencing agricultural output. The late 1970's was a period of global recession. During this period high interest rate, declining commodity prices and internal and external economic imbalances in the developed countries created unfavourable conditions to developing countries. At the same time, developing countries such as Tanzania were experiencing prolonged economic disturbances and inefficiency which affected their production, distribution and financial system (Bagachwa, 1994). The 1980's saw the advent of structural adjustment programme (SAP's), which were designed to address these economic problems.

2.4.1 Impact of SAPs and response of smallholder farmers

Smith (1989) argues that, policies adopted under SAPs such as expenditure reduction and increased taxation, affect agriculture especially wheat, maize and rice production. He argues further that a severe contraction in domestic credit limits the seasonal and long-term finance available both for agriculture production and Marketing. The poor credit services could also lead to less investment into the agricultural sector.

Attempts to pass on part of the cost of services previously provided by the government to rural consumers led to decreased use and/ or a reduction in the cash available for food and agricultural input purchases. This oversight can adversely affect agricultural production in the short and long-run. Other attempts to raise tax revenue for example; increase in import duties and sales or export taxes also directly affect the agricultural output prices (Smith, 1989).

Kashuliza and Mbiha (1995), in their study conducted in some parts of Tanzania regions found that after trade liberalization farm inputs were supplied by shop owners in most of the surveyed areas. The study found that some of the farmers interviewed indicated that the price of the farm inputs was too high and could not be covered by the expected crop return. As a result some of the wheat farmers purchased and used lesser amounts of inputs in their farms than the recommended or optimal amounts.

Kilimwiko (1994) observed that farmers in the southern highlands applied insignificant and insufficient quantities of fertilizers on their farms, which adversely affected their crop production and the food security situation. Most of small-scale wheat farmers in northern part of the Tanzania have reduced their wheat acreage because of poor access to credit and high input cost (Kilimwiko, 1994).

Apart from the negative impact they have had on the social services sector, the SAPs have also been accused of harming the environment. A strong case is presented concerning the issue of whether agrarian economies can reconcile economic growth, which is mainly agriculture based, with environmental conservation (Mbelle, 1992). The SAPs aimed to increase agricultural output and help farmers to realize more revenue when prices are stabilize; these policies have encouraged intensive production of some crops (e.g. high value crops) through the use of more industrial chemicals, which accelerates the degradation of environment thereby lowering its productivity in the long run. Therefore low production of cereal crops such as wheat is partly due to the implementation of SAPs. It is reasonable to believe that to some extent, the implementation of SAPs, has extended the line of poverty and encouraged poor utilization of resources in some industries.

2.5 Trade off between Poverty and Resource Utilization in Agriculture

Given the predominant role of agriculture in the livelihoods of most Tanzanians, any strategy for reducing poverty and hunger in the country must centre on rapid growth in the agricultural sector. Farmers need the government's support to make investments aimed at increasing agricultural productivity. However these investments could depress commodity prices and farm incomes if there are no reliable markets for produce. Poorly functioning markets, weak domestic demand, and lack of export possibilities are major constraints on farmers' agricultural growth prospects (Amani, 2005).

The agricultural sector plays an important role in the Tanzanian economy and has the potential to advance the country's objectives of growth and poverty reduction. The performance of the Tanzanian economy has been driven by the performance of the agriculture sector, due to its large share in the economy. Smallholder farming dominates agricultural production, and a large proportion is for subsistence. Since poverty is predominantly a rural phenomenon, and agriculture is a major economic activity for rural population, it follows that successful poverty Reduction depends on the performance of the agricultural sector (Amani, 2005). The aggregate supply response depends heavily on reallocation of productive factors like land, labour and capital to agricultural sector or factor productivity improvements (Simon, 1998). Insufficient utilization of these productive factors led to poor wheat farm management. Wheat production can only be successful when there is careful and timely application of a year long sequence of well-integrated management practices.

All management practices that affect the soil will in turn affect the crop, as there is no single management practice that can be evaluated in terms of its overall effect on crop yield. Thus most of the wheat farmers are lacking one or two of productive factors, which

contribute to the observed low performance of the wheat industry in the country as whole (Stanslaus, 1993). Moreover most of poor people's resources are underutilized. According to James *et al.* (1992) those captured in the poverty trap do not produce enough beyond subsistence needs to invest in knowledge and skills as well as improved inputs needed to increase their productivity.

In summary capital is one of the essential productive factors required by most small-scale farmers. Capital helps to facilitate the utilization of the resources and encourage introduction of new technology to the agricultural sector. Obviously both utilization of resources and introduction of new technologies to agricultural sector will increase wheat production. In this case revenue from wheat might be used to diversify the use of their resources in order to produce other food and cash crops. Increased food availability and income are factors showing that poverty level has been reduced.

Enhancing access to capital has the potential to encourage wheat and other farmers to identify and exploit opportunities for improving farm income and hence increasing production and productivity (Lofchie, 1987).

2.6 Incentive Packages on Wheat Production and Resource Allocation

Wheat production in Tanzania has been decreasing due to various reasons, the major one being low level of institutional support from the government. Farmers have been requesting the government to improve supportive services to the sector but this effort has been futile (Felix, 2006). Certainly there is a need to motivate farmers to grow more wheat and help them to market their produce at a competitive price.

Donge (1994) and Sambu (2000) have identified that the price, price policy and market opportunity factors are the main reasons for the decline in the wheat production in Tanzania. It is widely held that insufficient price incentives for agricultural producers are the main impetus behind the disappointing growth of African agriculture (World Bank, 1981).

Theory suggests that there is no single factor, which determines the farmers' decision in the production and resource allocation process (Jones and Muthuura, 1989). Smith (1989) reported that, state directives and material incentives are the two ways to motivate farmers to direct labour and resources to specific crops.

James *et al.* (1992) postulated that input suppliers who seek short run benefits could restrict crop productivity in the entire system. These suppliers can raise input prices to discourage farmer's use of these inputs in production, resulting into low production per unit area. The high cost of consumer goods and their limited availability are also disincentive for farmers to increase their marketed surplus.

2.7 Constraints to Wheat Production

Wheat is grown entirely under rain fed condition. Production falls short of requirements and the country relies heavily on wheat import. Wheat is apparently not grown in many areas due to several factors; the following are constraints to wheat production in Tanzania.

2.7.1 Seeds

Breeders supply seed of commercially grown varieties and advanced wheat lines to the foundation Seed Farmers. From this point, breeders have had minimal input. The process of seed production is lengthy and during this long seed multiplication phase farmers must

continue to use the old varieties that often succumb to diseases. Breeder involvement during the whole process of seed production and distribution is now being sought in an attempt to increase the efficiency of the operation. The capacity of the Foundation Seed Farms to produce seed is limited due to the unavailability of adequate equipment for seeding, harvesting, and cleaning the seeds. Seed producer Companies are also faced with similar problems in addition the fact that their contract growers are inexperienced and often produce seed that does not conform to the required standard. This problem together with the inefficient seed distribution infrastructure stands out as the major problems for the country's seed production industry (Saunders, 1991).

2.7.2 Soil moisture

Wheat growing areas in Tanzania vary in moisture contents and availability, which in bad years are directly linked to differences in yield levels among various producers. However lack of moisture is not a major yield reducing constraint. Studies conducted in northern Tanzania revealed that even an average of 350mm of rainfall, which is well distributed, could lead to modest wheat yield. Usually, rainfall in the wheat growing areas of Tanzania is above this average, but it is not always well distributed (URT, 2005).

2.7.3 Weeds

Large-scale state and small-scale farms, which produce more than 90% of the wheat in Tanzania, grow wheat under monoculture. As a result, certain weed species such as *Setaria verticillata* Beuv., *Datura* spp. L., and sedges have become the dominant weeds. Control of these weeds requires at least two herbicides one to control grass weeds and other to control broadleaf weeds. Herbicides are expensive and yet very important in wheat production. Weed control in wheat is therefore the single most expensive operation (Mkunga and Gillis, 1990).

2.7.4 Price of wheat

Statistics shows that wheat prices are lower for local than for imported wheat. However, at the consumer level, there are no price differentials between imported and locally produced wheat. It would therefore, appear that the local, large-scale wheat producers' are subsidizing imported wheat. Large-scale wheat production is highly mechanized, but since the costs of machinery, fuel, lubricants, and spare parts are more expensive in Tanzania than in the countries where the imported wheat is produced, the large-scale producers are at a disadvantage. This is one of the reasons why some farmers are abandoning wheat production (Saunders, 1991).

2.8 Diminishing Role of Small-scale Farmers in Wheat Production

As a result of global competition, growing wheat is increasingly becoming unprofitable because local producers have to compete with producers from other countries. Unless small-scale farmers can sell their wheat profitably, they may not grow it for marketing. Wheat products sell over 200% higher than wheat at the farm gate. Thus, a large proportion of the poor people cannot afford to consume wheat products and hence demand is not increasing for this market niche. Although there is potential for increasing production in the future, consumption will not greatly increase among the majority of low-income people without a price subsidy for the finished products (Nbondi and Sariah, 1988).

2.9 Review of Analytical Tools

Three analytical tools were used in this study namely descriptive, gross margin and regression analysis. This part reviews relevant studies, carried out by different scholars on the same topic and justifies the choice of analytical tools adopted in this study.

2.9.1 Gross margin analysis

Most often new technologies in smallholder agriculture aim at increasing farm productivity by the fact that increasing income is one of immediate objective of the individual farmer or a group activity (Mutayoba, 2005). Johnsen *et al.* (2003) stated that the cost involved might hinder the adoption of expensive but more rewarding technologies. Thus, one-way to comprehend the relative economic-importance of the agricultural enterprises is to compare their gross margins. To define the concept of Gross margin, one needs to distinguish between variable and fixed costs. Variable costs are that costs which increase or decrease as output changes (Cramer *et al.*, 2001). Variable costs in wheat production are cost for inputs such as pesticides, fertilizer, wheat seeds and herbicides. Gross margin of farm activity is the difference between the gross income accrued and the variable costs incurred. Gross margin analysis is simple, but in many cases sufficiently powerful tool for economic analysis (Makeham *et al.*, 1986).

According to Daudi (2006) the advantages of gross margin analysis include its simple interpretation to draw logical interrelationship between economic and technological parameters. Gross margin analysis has the following limitation; it is not able to take into account variations in fixed costs within and/ or among enterprises and fails to make allowance for complementary and supplementary relationship between enterprises (Pomeroy and Trinad, 1995). Phiri (1991) cited by Mkude (2003) argues that, although gross-margin is not a good measure of profitability, it remains to be the most satisfactory measure of farmer's profitability in small agriculture. In this study gross-margin analysis is used to measure relative profitability of major crops under small-scale production in Karatu district.

Damian (1999) found that it was useful to study the gross margins of various crops grown in the study area to establish the relative economic profitability of the selected crops. The patterns of resource use change with improvement in technology and shifts in prices of both products and inputs. It is generally accepted that when resources are scarce producers tend to allocate more resources to enterprise, which give high returns per unit resource. In this study the gross margin for maize and beans are compared with wheat to gauge their relative profitability. The assumption is that high returns will warrant future production of that crop, as transferable resources will be switched from the low paying enterprise to a high paying ones (Damian, 1999).

2.9.2 Regression analysis

Regression analysis is a statistical tool for estimating the relationship between two or more variables. It involves a variable to be explained called the dependent variable and additional explanatory variables that induce changes in the dependent variable (Daniel, 1999). According to Nyimbo (2001) regression analysis is usually associated with a number of problems depending on the type of data used, nature and form of regression equation employed in the analysis. The common problems encountered when cross-sectional data are used in regression analysis are multicollinearity and heteroscedasticity.

Mashaka (1993) noted that there is a positive relationship though not significant between output and available resources and cropping practices. He pointed out that the relationship is logical because more output would demand more land, more labour and more capital. In his regression model a weighted total output of all crops was estimated as a function of three independent variables-namely land, labour, and capital. In this study the same model is used to identify factors that affect wheat production in Karatu district. The

independent variables are labour, area under wheat production, area under maize production, working capital and access to extension services.

Philip (2001) Used regression analysis to determine factors, which affect farms' profitability. The key variable that were included are: size of the farm, education level of the farmers and access to credit and extension services. He concluded that the sizes of the farms have positive effect on their profitability. With respect to access to credit the analysis revealed that it has a strong positive influence on profitability of all enterprises studied. In this study working capital is used instead because access to credit tends to boost working capital. Credit can be used as working capital so that farmers' efforts become more productive, especially in enhancing agricultural development for poor rural families especially in Karatu district. For instance, micro-finance providing credit and saving services to the self-employed poor enables them to initiate or expand income generating activities. Other independent variables used were availability of extension services and education level that influenced significantly the profitability of medium scale farms. In this study other independent variables include area under maize production as competing crop, labour devoted on wheat production and farmers accessibility to research services.

Simon (1998) in his study on peasants resource use under free market conditions and factors affecting its optimal allocation used gross margin and regression analysis. In this study one of the specific objectives is to identify resources utilization and their effect on small-scale wheat production. Gross margin analysis and regression analysis are used to analyze factors that affect small-scale wheat production in Karatu district. Also in this study credit is considered as the main source of capital to small-scale wheat farmers. Credit empowers wheat farmers by allowing them to create employment through starting or

improving wheat production that generates income or revenue for themselves and their families.

CHAPTER THREE

3.0 METHODOLOGY

3.1 Conceptual Frame

Conceptually an economic analysis of small-scale wheat production is essential as a guideline in identifying important variables and for effective and efficient data collection. Scarborough and Kydd (1992) stress that such framework should help to indicate the most useful areas on which to focus limited research resources, and to ensure that data collected are relevant to the objectives of the research. This section presents a brief summary of the conceptual frame used for gathering information through field survey and review of secondary sources of data. In general, this process was guided by objectives of the study.

As stated in chapter one the general objective of the study was to identify factors that affect small-scale wheat production. The specific objectives were to identify inputs utilization and their effects on small-scale wheat production; examine relative profitability of major crop enterprises carried out by small-scale farmers; and identify socio-economic factors influencing small-scale wheat production.

To meet these objectives and identify variables for data collection, a conceptual frame for selecting variables and respondents in small-scale wheat production was developed. The focus of this study was to enhance small-scale wheat production, which to a great extent is influenced by working capital, area under wheat production, area under maize production, household's labour supply and access to extension services. For the purpose of this study the emphasis was on the influence of capital on the performance of small-scale wheat production. The concentration on capital was based on the fact that unlike other countries, most small-scale farmers in Tanzania have adequate land and labour resources. Also access

to agricultural support services, such as extension services, appropriate inputs, agricultural research services and financial services have great influence on wheat production. Optimal utilization and management of these resources can lead to improved small-scale wheat production. Also it was assumed that all the factors hypothesized to affect wheat production are influenced by the prevailing government policies (Figure 1).

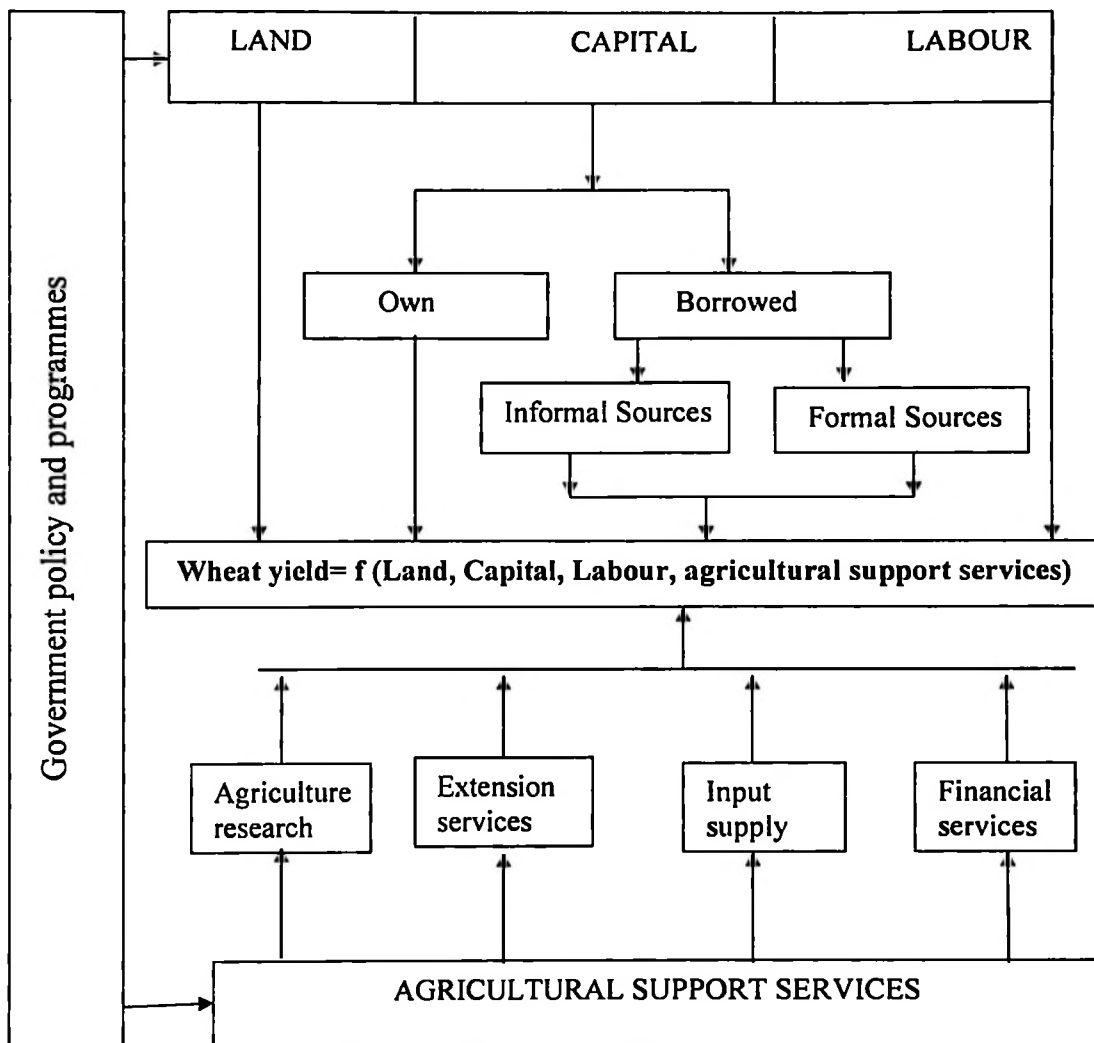


Figure 1: Factors determining performance of small-scale wheat production

3.2 Description of the Study Area

3.2.1 Location and population

Karatu district is one of the seven districts of Arusha region. It was formed out of the Old Mbulu District Council in 1995. Karatu district has four divisions, which are Karatu, Mbulumbulu, Endabash and Eyasi.

The district is located south of the equator between latitudes $3^{\circ} 10' - 4^{\circ} 00'S$ and longitudes $34^{\circ} 47'E - 35^{\circ} 56'E$. Karatu district share borders with Mbulu to the South and Iramba and Meatu to the Northwest. The district is estimated to have approximately 3300 square kilometers, with Lake Eyasi occupying 1600 square kilometers. The majority of the people living in the district belong to the 'Iraqw tribe, while others small tribes are Barbaig and Hadzabe whose occupations are pastoralism, hunting and fruits gathering, respectively.

According to the 2002 census Karatu district population was 178 434 with 92 895 male and 85 539 female and annual population growth rate is about 2.4%. The average population density is 52 people/km² with low density in the western zone along Lake Eyasi (7-10 persons/km²) and higher density (100 persons/km²) in Karatu and Mbulumbulu divisions.

3.2.2 Climate

The climate varies from one to another area in the district. In Eyasi basin the annual rainfall is between 300-400 mm while in Karatu town it ranges from 900 mm to 1000 mm. The wettest month is April when the rain intensity can be very high, which may result into more great erosion when soil is bare. In most places short and long rain are separated by one or two month of slightly less rainfall. The district experiences four seasons, which are, short rainy season extending from November to December; short, hot and dry season

from January to March; the long rainy season is between March to mid May and the long and cold season is from June to October.

3.2.3 Economic activities

The economy of Karatu district is mainly based on agriculture and livestock keeping. Within the district there are no industries. Other people get their income by doing petty business in their retail shops, especially in Manyara, Karatu town, Endabash, Oldeani and Mang'ola trading centre.

3.2.4 Crops and livestock

The district has 102 578 ha that are suitable for cultivation. The main cash crops are wheat, coffee, onion, barley and pigeon peas while food crops are maize, beans, finger millet and sorghum. The main crop diseases are gray leaf spot, wheat leaf rust and coffee berry. Numbers of livestock in the district are 153 900 cattle of which 2830 are dairy cattle; 136 527 goats (95% dairy goat) 63 360 chicken and 16 219 pigs. Mbulumbulu division is the major producer of wheat. Therefore, the research was conducted in Mbulumbulu division.

3.3 Research Design

The research design was cross sectional survey. A cross-sectional survey entails asking questions to a representative sample of the population at a single point in time. According to Babbie (1990) and William (2002) this design is useful for description purpose as well as for the determination of relationships between variables at the time of the study. The approach allows for collection of in-depth information on specific cases at one point in time.

3.4 Sample and Sampling

3.4.1 Preliminary survey

A preliminary survey was conducted before the main survey. Questionnaire pre-testing was conducted using a sample of 10 farmers from Rhotia Kati and Kainam Rhotia villages. During the survey respondents were sampled from Mbulumbulu division in Karatu district. The division was purposefully selected because 80% of their small-scale farmers were wheat producers. Random sampling was used to obtain six villages in which, a sample of 70 small-scale wheat farmers was selected using systematic sampling method.

3.5 Data Collection

Most of the primary data were collected through interviews. The data included inputs costs, crop acreage, yield, wheat prices and socio-economic variables. A checklist was used to collect secondary data from relevant sources such as Selian Agricultural Research Institute (SARI), Karatu district council and the Ministry of Agriculture Food security and cooperatives. Additional information on wheat production was collected from district research institutions.

3.6 Data Analysis

Data collected from primary sources were coded and analyzed using Statistical Package for Social Sciences (SPSS). Three methods of analysis were used namely descriptive, gross margin and regression analysis.

3.6.1 Descriptive statistics

Descriptive analysis involved the use of means, standard deviation, ranges, cross tabulation and frequency distributions. These statistics provided insightful information related to resources utilization and their influences on small-scale wheat production.

3.6.2 Gross margin analysis

It was useful to compute gross margins for the three competing crops (wheat, maize and beans) so as to establish the relative economic profitability of these crops. Therefore it was necessary to identify revenue and variable costs for each crop. Common examples of variable costs in crop production include seeds, fertilizers and pesticides. The most important fixed costs in agricultural production are own land, family labour, farm buildings and farm machinery and implements. However, these costs are not used in the computation of gross margins as they do not change with the level of output. The gross margin of a farm activity is the difference between the gross income earned and the variable costs incurred (Makeham and Sokoni, 1986). Therefore gross marginal analysis helps to know where the resources will be allocated.

According to (Ferris and Malcolm, 2000), gross margin analysis has the following limitations:

- i. Gross margin is not a profit figure; fixed costs have to be taken into account before arriving at a profit figure;
- ii. Gross margins can vary widely from one year to the next. This is due to differences in market prices, weather condition and efficiency. Gross margins can also differ considerably from farm to farm. This variation can result from differences in performance levels or differences in the overall system of production or record keeping methods. Comparison to average gross margins can be useful but it should be done over a number of years. However, it is always a benchmark point in the assessment of the enterprise.

Each crop enterprises-gross-margin will be calculated using the following formula

$$GM_i = \sum_{i=1}^n \frac{(TR_i - TVC_i)}{Mandays} \dots\dots\dots (1)$$

Where:

GM_i = Gross margin per ha for activity i

TR_i = Total revenue per ha for activity

TVC_i = Total variable cost per ha per

3.6.3 Regression analysis

A regression model was used to identify socio-economic factors that affect small-scale wheat production in the study area. Regression equations generated by ordinary least square are associated with several problems depending on the type of data used and the nature and form of the regression model employed in the analysis. The common problems encountered in the regression analyses include multicollinearity, heteroscedasticity and autocorrelation (Gujarati, 1988; Maddala, 1988). However cross-sectional data and production data that have been used in this study are likely to suffer from heteroscedasticity and multicollinearity problems.

3.6.3.1 Heteroscedasticity

Heteroscedasticity problem occurs when the error variance is not constant. This problem complicates analysis because many methods in regression analysis are based on an assumption of equal variance (Henry, 2004). The presence of heteroscedasticity leads to one main problem. The problem is that the ordinary least squares estimators while still linear and unbiased, but can no longer provide minimum variance. This makes the ordinary least squares estimators unreliable, i.e. the variance will be large leading to small t -values. The small t -values associated with large variance leads to a situation whereby the

explanatory variables' parameters are rejected more frequently than necessary (Gujarati, 1995).

To contend with this situation in the study, a natural logarithm transformation of the variables was adopted. Furthermore, relevant tests were performed to ascertain that the basic assumptions governing linear regression procedure were not violated. It is important to note that changing the functional form of the model can take care of the heteroscedasticity problem. That is why the transformation of the variables was employed in this study to take care of the problem of heteroscedasticity.

3.6.3.2 Multicollinearity

Multicollinearity occurs when independent variables are highly correlated. According to Mendenhall *et al.* (2005) when two or more of the independent variables are correlated, you cannot determine their respective individual contributions to the reduction in SSE, the sum of square of deviations between the observed and the predicted values of Y.

There are number of ways to detect multicollinearity problems:

- i. Multiple correlation analysis: Since multicollinearity can arise from high correlations between a single variable and a set of independent variables it can be detected through multiple correlation analysis. Suppose we have four independent variables, X_1 , X_2 , X_3 and X_4 . Multiple correlation analysis can be conducted by treating one of these (eg X_4) as the Y variable and then examining the multiple correlation of the remaining three variables with X_4 . The multiple correlation coefficient (R) will indicate the correlation between the set of variables and X_4 in the same way that r indicates the correlation between a single X and a single Y variable. The same process can be repeated treating each of the other variables (X_1 , X_2 and X_3) as the Y variable.

- ii. Multicollinearity diagnostics within multiple regression procedures: The commonly used diagnostic statistics for multicollinearity are the variable inflation factor (VIF) and tolerance measures. The latter are based on the multiple correlation approach. Variables that have a low tolerance indicate presence of multicollinearity. The rule of thumb is that any variable that has a tolerance of 0.2 or less or a VIF of 5 is likely to be correlated with others.

The regression model adopted in this study is specified as follows:

$$y = \alpha + b_1L + b_2A + b_3Ed + b_4K + b_5Z + \lambda D + U_i, \dots\dots\dots(2)$$

Where:

- y = Yield of wheat in kg/ha obtained for last season.
- L =Labour available within the family measured in adult equivalents
- A = Crop area under wheat (ha)
- K =Working capital in Tshs used for purchase of wheat inputs per ha.
- Z = Crop area under maize (ha)
- α =Intercept (constant term)
- λ =Coefficient of Dummy variable
- D =Access to extension services (1 if yes, 0 if no)
- b_1-b_5 = Regression coefficients,
- U_i =Error term.

CHAPTER FOUR

4.0 RESULT AND DISCUSSION

4.1 Overview

This chapter presents results and discussion for the data obtained from the survey. The results are divided into three parts; the first section presents descriptive statistics showing characteristics of sampled wheat growers. The second part presents a detailed discussion of enterprise budgets and gross margins. The last part provides regression results and its discussion.

4.2 Household Variables

4.2.1 Age of respondents

The age of interviewed farmers ranged from 25 to 85 years, with an average of 55 years (Table 1). Farmers with 64 years and above constituted 7.1%. Most of the respondents were between 25-34, 35-44 and 45-54 years old and their percentages were 25.7, 27.1 and 25.7 respectively. Respondents between the age group of 55-64 years were 14.3%. Results show that the middle-aged member who were 25-34, 35-44 and 45-54 years were the main producers of wheat in the study area. The age distribution revealed that there is little involvement of a young people in wheat production. This situation is very common across many rural areas in the country and is attributed to the fact that most of the young people migrate to urban areas to seek for employment and better living. Also the participation of people over 64 years was very small compared to others because they are not strong enough to work on farm.

Table 1: Age of respondents

Age group	Frequency	Percentage
25-34	18	25.7
35-44	19	27.1
45-54	18	25.7
55-64	10	14.3
>64	5	7.1
Total	70	100.0

4.2.2 Sex of respondents

Majority of the respondents (98.6%) were males, while only 1.4% were female (Table 2). The over representation of males could be accounted by the fact that most males were the head of the households. It is a common practice that household's heads are the most powerful and main planners for their households and are the ones who were interviewed. Also it is uncommon for women to own production resources like land and capital. According to Cagatay *et al.* (1995) women have limited access to the means of production such as land and support services such as credit.

Table 2: Sex of respondents

Gender	Frequency	Percentage
Male	69	98.6
Female	1	1.4
Total	70	100.0

4.2.3 Marital status of the respondent

Table 3 below shows that 97.1% of the respondents were married; while 1.4% were single and 1.4% were widowed. The higher percentage of married people seems to suggest that they ventured into wheat production as a means of generating extra income to support their

families. Also the result supports the view that most of the singles tend to move town in their efforts to search for employment opportunities, good infrastructure and other basic needs.

Table 3: Marital status of respondent

Marital status	Frequency	Percentage
Married	68	97.1
Single	1	1.4
Widow	1	1.4
Total	70	100.0

4.2.4 Education level

Table 4 below represents the frequency and percentages of sampled wheat growers and their education levels. The majority of the respondents (95.7%) reported to have formal education, 85% primary education and 8.6% secondary education. Only 1.4% attended adult education. These data indicate that most wheat farmers are knowledgeable, thus can implement new innovation easily.

Table 4: Education level of respondents

Education level	Frequency	Percentage
Primary education	60	85.7
Secondary education	6	8.6
Adult education	1	1.4
None	3	4.3
Total	70	100.0

4.2.5 Agricultural extension services

Results from Table 5 show that about 62.9 % of small- scale farmers did not get agricultural extension services. About 37.1% of small-scale wheat farmers received extension services. In spite the fact that services were offered, farmers indicated that most of extension officers visited them during planting and harvesting seasons for the purpose of collecting data on acreages of different crops grown and crop yields. Normally the ministry of agriculture and cooperatives and ministry of livestock require such information. Also the result shows that most of the farmers who received services were the progressive farmers as they were capable to seek extension service even from the private sectors.

Table 5: Agricultural extension services

Respondents	Frequency	Percentage
Received extension services	26	37.1
Not received extension services	44	62.9
Total	70	100.0

4.2.6 Advantages of wheat production

Results from Table 6 show that most of the respondents chose to cultivate wheat so as to increase family income. Result shows that, 72.2 percent of the respondents chose to cultivate wheat because it is a cash crop. The remaining percentage is accounted for by respondents who decided to cultivate wheat because its farm operations are relatively easy (11.4%), it is a drought tolerant crop (8.6%) and it serves dual purposes as food and cash crop (7.1%).

Table 6: Reasons favouring wheat production

Reasons	Frequency	Percentage
It is a cash crop	51	72.2
Easy farm operations	8	11.4
It serves as food & cash crop	5	7.1
It is a drought resistance crop	6	8.6
Total	70	100.0

4.2.7 Agricultural credit

Credit service to small-scale farmers is very important so as to meet the cost of inputs. In spite of the importance of credit to small-scale farmers, the result indicates that 95% of respondents did not have access to credit (Table 7). Table 8 shows that the main reasons for not borrowing were; respondents' unawareness of credit sources (36.8%), high interest rate (25%), lack of collateral (19.1%), low return on investment (11.8%) and risk associated with borrowing (7.4%).

Results show that, the majority of the farmers were not accessible to credit services. Enhancing access to service would facilitate diversification of crop enterprise and promote the adoption of good management practices in wheat production. Also according to surveyed data farmers with access to credit realized better yield than those without access to credit. Farmers who received credit produced an average of 2.4 tons per hectare while the average for farmers who did not borrow was 1.7 tons per hectare.

Table 7: Credit status of respondents

Respondent	Frequency	Percentage
Borrowers	3	4.3
Non borrowers	67	95.7
Total	70	100.0

The majority of the farmers gave several reasons as to why they did not borrow to boost wheat production. The following are the main reasons suggested by farmers.

Table 8: Reasons for not borrowing

Reasons	Frequency	Percentage
Lack of credit facilities	3	19.1
High interest rate	17	25
Not aware of credit sources	25	36.8
High risk	5	7.4
Low income obtained from crop	8	11.8
Total	70	100.0

4.2.9 Land ownership

Means to acquire land in Karatu district, just like in other places varies widely. Results in Table 9 show that 42.9% of the respondents acquired land through inheritance. About 27.1% of respondents acquired land from the village government. Other respondents leased land from other villagers (22.9%) and some were granted land rights through purchase (7.1%). It is obvious from these statistics that purchasing of land was not a common practice in Karatu district. Therefore land for wheat production is probably not a serious problem in the district.

Table 9: Mode of land acquisition

Mode of land acquisition	Frequency	Percentage
Inherited	30	42.9
Bought	5	7.1
Hired	16	22.9
Given by village government	19	27.1
Total	70	100.0

4.2.10 Land utilization

Table 10 presents land utilization during the 2004/05 farming season. The total land that was utilized in the season is 236.6 ha representing 90% of the total land owned. Hectares located to wheat were 66.9ha (25.45%), hectares located to maize were 61.6ha (23.44%), hectares located to pigeon peas were 56.0 (21.30%); hectares located to beans were 45.9 (17.47%), hectares for finger millet were 4.6 ha (1.75%) while hectares located to flowers were 1.6 ha (0.6%).

Table 10: Land utilization

Crop	Frequency	Percentage
Wheat	66.9	25.45
Maize	61.6	23.44
Pigeon peas	56.0	21.30
Beans	45.9	17.47
Finger millet	4.6	1.75
Flowers	1.6	0.6
Total	236.6	90.0

4.2.11 Problems in wheat production

Table 11 shows that, the major problem for wheat growers in Karatu district was presence of pests and diseases (44.3% respondents) followed by poor quality of farm inputs (24.3%), unreliable rainfall (12.9%) and low soil fertility (10%). Other problems were weed infestation 7.1% and poor extension services (1.4%).

Table 11: Problems in wheat production

Crop	Frequency	Percentage
Pests and diseases	31	44.3
Poor quality of farm inputs	17	24.3
Unreliable rainfall	9	12.9
Unfertile soil	7	10.0
Weed infestation	5	7.1
Poor extension services	1	1.4
Total	70	100.0

4.3 Competing Uses of Resources between Wheat, Maize and Beans

Several years, Tanzania has been undertaking measures to encourage food production particularly maize and beans (Margaret *et al.*, 2003). The emphasis has been on expansion of maize and beans acreage, promoting biological innovations (i.e. research on seeds) and granting subsidy to maize producers. These policies made maize and beans production more attractive not only as a subsistence food crops but also as additional sources of income to producers (Kaaya, 1981). An increase in maize and beans production implies more allocation of labour and land to these crops and reduced labour supply and land to wheat production, especially in areas where all these crops are important. Farmers in Karatu district grew various food crops alongside wheat and there is evidence to suggest that crop enterprise competition existed as maize and beans competed with wheat in resource use. Using budgeting techniques, gross margins for the three enterprises were computed (Table12).

Table 12: Gross margin for wheat, maize and beans 2004/05 farming season

Item	Wheat	Maize	Beans
Gross average yield (kg/ha)	1822	1119	640
Average price per kg (Tshs)	354	137	349
Gross return (Tshs/ha)	644 988	153 303	223 360
Cost for physical inputs (Tshs/ha)	112 973	46 698	49 198
Gross margin (Tshs/ha)	532 015	106 605	174 162
Total mandays	90	105	100
Cash returns per manday (Tshs)	5911	1015	1742

Results indicate that wheat was the most profitable enterprise with a gross margin of Tshs. 532 015 per hectare followed by beans with a gross margin of Tshs 174 162 per hectare and maize with gross margin of Tshs 106 605 per ha. Considering labour requirements and return on labour, wheat has the highest return on labour followed by beans and the maize (Appendix 1,2 and 3).

Wheat is more profitable than maize and beans and under normal circumstance farmers were expected to allocate more resources to wheat production. However, it competes with maize and beans because they are considered as staple food in this district. Traditionally iraqw tribe preferred maize and beans as their main food. This habit outweighs its relative profitability and the overall effect is in line with the proposition that for some farmers the alternative crops enterprise (maize and beans) may be more desirable venture to undertake than wheat.

Labour demand for wheat production was lower than beans and maize, especially after land preparation. Maize was found to be more labour intensive than wheat and beans. About 105 man-days were required to work on one hectare of maize and 100 man-days were required for beans. Labour required in wheat production was 90 man-days per

hectare. Figure 2 below demonstrates graphically labour requirement and return to labour for wheat, maize and beans.

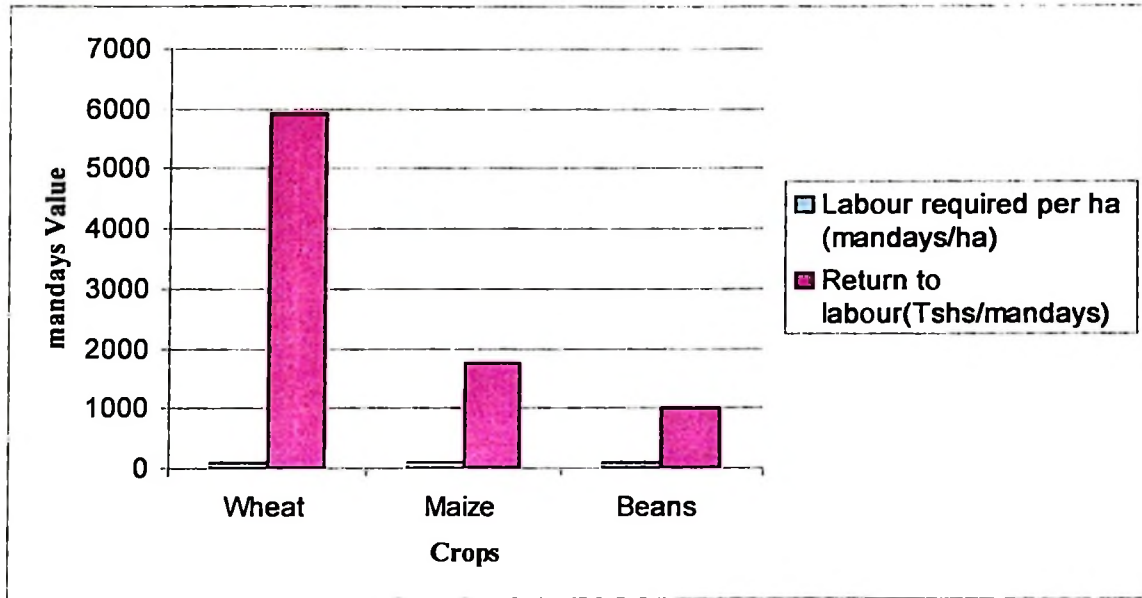


Figure 2: Labour requirement and return to labour

4.4 Regression Model

Regression analysis was adopted to establish the relationship between wheat yield per unit area (Y) in Karatu district and labour available within families measured in adult equivalent (L); wheat acreage in hectare (A), working capital in Tshs/ha used for purchase of wheat inputs (K); maize acreage in hectare (Z) and indicator or dummy (D) for access to extension services (1 if yes, 0 otherwise)

The following tests were conducted to assess whether the independent variable were not correlated and the heteroskedasticity assumption was not violated.

4.4.1 Multicollinearity

The multicollinearity problem was tested using the variance inflation factor (VIF) and results indicated that the VIF values were below the minimum threshold of 5, which indicates that the problem was not severe (Appendix 4).

4.4.2 Heteroskedasticity

Data used in this study are cross-sectional data and are more likely to be afflicted by heteroskedasticity. Therefore, it was necessary to check whether the error terms do not have a constant variance. Two methods were used to determine whether or not the data are heteroskedastic. First, a visual inspection was conducted by plotting the residuals against the fitted values. The scatter graph indicated varying variances. The Breusch-Pagan test was then applied to the data as a post-estimation test of an OLS regression model under the null hypothesis that there is constant variance or no heteroskedasticity.

4.4.3 Corrected model estimates

The method used to correct for heteroscedasticity problem was transformation of variables. Gujarati (1995) reveals that through careful analysis of residuals, one can make educated guesses of the likely pattern of heteroscedasticity and transform the original data in such a way that in the transformed data there is no heteroscedasticity. In the presence of heteroscedasticity OLS estimators of standard errors are biased and one cannot be certain which way the bias will go. In the present model the bias is upward, that is it overestimated the standard errors (Gujarati, 1995).

To correct the heteroskedasticity problem and to improve the efficiency of hypothesis testing, heteroskedasticity-robust variances were used to calculate robust standard errors

for correcting problem (Green, 2000). The corrected model results are presented in Table 13.

Table 13: Results for regression model

Dependent Variable: Wheat output supply in Karatu district

Variable	DF	Parameter Estimate	Standard Error	t Value	Pr > t
Intercept	1	129.40361	258.88221	0.50	0.6189
labor	1	-2.40622	13.33938	-0.18	0.8574
whearea	1	1029.30970	119.88091	8.59**	<.0001
maizarea	1	-250.99878	116.61262	-2.15*	0.0351
reserch	1	109.91938	109.94938	1.00	0.3212
wcapital	1	0.00959	0.00154	6.23**	<.0001

*Significant at (p<0.05)

***Significant at (p< 0.001)

The estimated specific model for wheat output per unit area is as follows:

$$y = 129.404 - 2.406L + 1029.310A + 0.010K - 250.100Z + 109.950D$$

$$(0.50) \quad (-0.18) \quad (8.59)^{***} \quad (6.23)^{***} \quad (-2.15)^{**} \quad (1.00)$$

R square = 0.786

R² (adjusted) = 0.769

F value = 47.06 at 0.0001

The results indicated that, the independent variable accounts for 77% of the variations in the observed output. The parameter estimates for wheat area, working capital and access to research services have positive sign showing that wheat output in the survey area could increase if more land, working capital and extension services are devoted to wheat production. The coefficient for area under maize has a negative sign showing that wheat output per hectare in the survey area could decrease if more land is allocated to maize production.

Area under wheat and working capital are statistically significant at 0.001 significance level and maize acreage is statistically significant at 0.05 significant level. The parameter estimates shows that, an increase in wheat area by one hectare on average is expected to increase total wheat yield by 1029 kg after allowing other factors in the equation to be constant. Similarly, an increase in working capital by Tshs 1000 per hectare is expected to increase wheat yield by 10 kg worth Tshs 3540 (354 wheat price per kg x 10kg). This implies that there is a return on investment amounting to Tshs 2540 (3540-1000) resulting from an additional working capital of Tshs 1000 while allowing other factors in the model to remain unchanged. With respect to access to extension services, it is expected that farmers who have access to this service will realize more Kilogrames (110) of wheat than farmers who have no access to the service. This is likely because most of farmers who have access to extension services are getting proper information about wheat production. The model also shows that an increase in one hectare of maize is expected to reduce wheat yield by 250 kg/ha. This yield reduction could be accounted by the fact that resources under household particularly capital would be spread to meet capital requirements of both crops.

4.4.4 Summary of regression results

- i. Total wheat yield at the farm level was highly associated with wheat acreage, the amount of working capital spent for purchase of physical inputs used in wheat production and area under maize production.
- ii. Positive relationship exists between wheat area planted and wheat yield per ha. This is logical since when the size of area under wheat production increases it is obviously that plant density will be high leading to more output.

- iii. The positive sign in amount of working capital leads to more yield because a wider capital base enables wheat farmers to access input such as fertilizer and herbicides and to carry out recommended agronomic practices appropriately. This access leads to an increase in both the production per unit hectare and the quality of the wheat produced.

- iv. The positive relationship between farmers accessible to extension services and wheat output is logical because through extension services farmers get proper technical advices and knowledge on how to produce wheat. This leads to increase in both the production per unit hectare and quality of wheat produced.

The coefficient of determination R^2 (adjusted), indicate that 77% of variation observed in wheat output realized by small-scale farmers is explained by the variables included in the empirical model. The F-test for the overall fit was statistically significant at $\alpha = 0.01$. This implies that independent variables included in the model are jointly significant at that probability level.

CHAPTER FIVE

5.0 CONCLUSIONS AND RECOMMENDATIONS

5.1 Overview

The specific objectives of the study were to: identify inputs utilization and their effects on small-scale wheat production; examine relative profitability of major crop enterprises carried by small-scale farmers; identify socio-economic factors that influence small-scale wheat production. This chapter presents a summary of the main findings in relation to the above objectives, evaluates the implications of the findings and makes recommendations to improve wheat production. The last part of this chapter presents suggestions for the future research work.

5.2 Summary

The study found that smallholder wheat growers in Karatu district seem to have household characteristics, which are common to most rural of household settings elsewhere in Tanzania. Among the important enterprise in this study is wheat production which contributes significantly to cash earnings realized from the crop production. However, maize and beans production competes with wheat resources simply because are food crops. Farmers faced many problems in their production activities among many others pests, diseases, unavailability of farm inputs and insufficient of soil moisture and nutrients content were found to be the most prominent ones.

Regarding household factors, results indicate that available capital to finance wheat production and wheat farm size are significant explanatory variables for the specified model. Therefore an increase in wheat farm size through encouraging small-scale farmers to expand their farms and provision of enough working capital through credit can

tremendously improve both wheat yield and quality on small-scale farms. Therefore increasing in working capital will facilitate utilization of land and labour in wheat production. Also results revealed that most of small-scale farmers had low education level of not more than standard seven. This implies that most of the youths who completed secondary education were not fully involved in wheat production. Therefore there is a need for the Government to find methods, which can involve youths in the district in this important agricultural activity of wheat production.

In term of resources, the majority of the smallholders acquired land either through inheritance or user rights granted by village authorities acquired. Land therefore, as a resource is not yet a problem. A large proportion of land was allocated to wheat though, there is a possibility to increase the size under wheat production either by reducing acreage for other crops or utilization of uncultivated land considering the total size owned. Similarly labour was not a serious problem in small-scale farms in Karatu district. Family labour is the major source of labour in wheat production. Estimates show that on average each family had eight people working on farm. The main problem faced by farmers was small working capital. Due to lack of working capital, most of small-scale farmers were using less or poor quality farm inputs. Most of the farmers depended on credit to raise their capital, but in the study area very few small-scale farmers had access to credit. Most of the farmers claimed that they were not aware of the availability of credit.

The study also showed that, most of smallholder wheat growers in the study area, do not get adequate agricultural research and extension services. According to Nicodemus (2003), many agricultural technologies have been developed by the research system but have not reached farmers. As a result 20.4% of Tanzanians living in rural areas are food poor and 38.7% of the rural population lives below the basic poverty line. Part of this state of affairs

can be attributed to a weak research, extension farmer linkage. A strong research-extension-farmer linkage would assist in making sure that research problems being investigated are addressing farmer's production problems and technologies generated by researchers are effectively disseminated to farmers.

5.3 Conclusion

The results of this study indicate that smallholder wheat production is a potentially profitable enterprise. However, it is evident that growers in Karatu district may increase the level of production from the amount they are producing now. This increase could be achieved through full utilization of land. Availability of labour was not a problem, but labours were also underutilized. Results indicated that each household has an average of 8 people (adults). This labour was employed in 2 ha, (average hectares per household in 2004/05). Therefore, labour and land are not scarce but inadequate working capital is the main problem among small-scale farmers. Insufficient of working capital is major factor contributing to the underutilization of domestic resources. Also the results indicated that wheat was the most profitable enterprise compare to other competing crops (maize and beans).

5.4 Policy Recommendations

Based on the findings of this study, it is proposed that future plans aiming at improving wheat production in the district should consider the following:

- (i) Encouraging the participation of skilled manpower through creating attractive production environment such as good transportation and communication infrastructure in rural areas.

- (ii) Introducing special credit programmes in the district. The lending institutions should be encouraged to revisit the regulations that are associated with the provision of loans so as to make small-scale wheat farmers eligible to those loans. The system of scrutinizing and approving credit applications both at the farmers' credit committee level and at the financing institutions level should be fairly simple, and less bureaucratic and very efficient. One example of credit programme is establishment of Savings and Credit Cooperative Societies (SACCOS), which are grass-roots financial institutions which have stood the test of time as effective micro financial institutions, offering members a convenient home for their savings and an access point for loans.
- (iii) Make wheat production a lucrative venture through better provision of information on inputs, available agricultural technology, markets and through improving basic infrastructure particularly roads, transport as well as market information and creating conducive environment for domestic producers of inputs to produce them through attractive investment policy.
- (iv) With respect to extension services it is proposed that the government may take measures aiming at encouraging agricultural extension agents to visits small-scale farmers. These measures may include increasing the number of extension agents and improving their mobility by providing reliable transport.

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APPENDICES

Appendix 1: Costs and returns of maize per hectare^aAverage yield (kg) 1119.^bAverage price per kg Tshs 137

Gross return Tshs. 153303

Input requirements and Costs**(i) Labour inputs (Manday)^c**

Operation	Mandays
Land preparation	45
Planting	5
Weeding	15
Fertilizer application	5
Harvesting	20
Crop haulage and marketing	15
Total	105

(ii) Physical input Costs^d

Item	unit	Qty	lifespan (yrs)	unit cost	Total cost (Tshs)
Seeds	kg	22	1	1000	22000
Fertilizer	kg	100	1	240	24000
Hoe	pcs	4	5	2000	400
Panga	pcs	2	9	1341	298
Total					46,698

Total cost of physical inputs (Tshs/ha) 46 698

Gross margin (Tshs/ha).....106 605

Return to labour (Tshs per mandays) 1015

^aAverage yield as computed from the survey data^bAverage price per kg as computed from the survey data^cLabour requirements obtained from survey data^dPhysical input costs as computed from survey data.

Appendix 2: Costs and returns of beans per hectare^aAverage yield (kg) 640.^bAverage price per kg Tshs 349

Gross return Tshs. 223 360

Input requirements and Costs**(i) Labour inputs (Manday)^c**

Operation	Mandays
Land preparation	45
Planting	5
Weeding	15
Pesticide application	5
Harvesting	15
Crop haulage and marketing	15
Total	100

(ii) Physical input Costs^d

Item	unit	Qty	lifespan (yrs)	unit cost	Total cost (Tshs)
Seeds	kg	30	1	1200	36 000
Pesticides	ltr	25	1	500	12 500
Hoe	pcs	4	5	2000	400
Panga	pcs	2	9	1341	298
Total					49 198

Total cost of physical inputs (Tshs/ha) 49 198

Gross margin (Tshs/ha).....174 162

Return to labour (Tshs per mandays) 1742

^aAverage yield as computed from the survey data^bAverage price per kg as computed from the survey data^cLabour requirements obtained from survey data^dPhysical input costs as computed from survey data.

Appendix 3: Costs and returns of wheat per hectare^aAverage yield (kg) 1822.^bAverage price per kg Tshs 354

Gross return Tshs. 644 988

Input requirements and Costs**(i) Labour inputs (Manday)^c**

Operation	Mandays
Land preparation	50
Planting	5
Herbicide application	5
Manure application	5
Pesticide application	5
Harvesting	10
Crop haulage and marketing	10
Total	90

(ii) Physical input Costs^d

Item	unit	Qty	lifespan (yrs)	unit cost	Total cost (Tshs)
Seeds	kg	180	1	286	51 480
Pesticides	ltr	25	1	500	12 500
Fertilizer	kg	4	1	1000	4000
Oxy plough	pcs	1	18	46 228	2568
Hand hoe	pcs	4	5	2000	400
Panga	pcs	2	9	1341	298
Sprayer	psc	1	2	34 196	17 098
Bicycle	pcs	1	6	58 178	9696
Wheel barrow	pcs	1	6	89 600	14 933
Total					112,973

Total cost of physical inputs (Tshs/ha) 112 973

Gross margin (Tshs/ha).....532 015

Return to labour (Tshs per mandays) 5911

^aAverage yield as computed from the survey data^bAverage price per kg as computed from the survey data^cLabour requirements obtained from survey data^dPhysical input costs as computed from survey data.

Appendix 4: Test for Multicorellinanity

Estimated model is:

$$Y = 604.042 - 6.936L + 1439.477A + 0.003K - 373.5Z - 127.458D + ut$$

$$(3.201) \quad (-0.517) \quad (11.241)^{***} \quad (3.503)^{**} \quad (-2.769)^{**} \quad (-0.950)$$

Standard Error of Estimates (SEE)= 487.68

R (adjusted) square 0.780

Dependent variable	R	R square	R square (Adjusted)
Number of labour available in the family	0.280	0.078	0.020
Hectare allocated to wheat production	0.488	0.238	0.190
Hectare allocated to maize production	0.192	0.037	0.024
Access to research of the respondents	0.185	0.034	0.027
Working capital in Tshs.	0.493	0.243	0.195

Appendix 5: Farmer's questionnaire

TITLE: Economic analysis of small-scale wheat production in Tanzania. A case study of Karatu District. Arusha region.

Questionnaire No..... Date of interview.....
 Division.....
 Ward.....village.....
 Interviewer's name..... Name of the respondent

A. Household Identification Variables

1. Name of the household head
2. Age
3. Gender..... 1= Male, 2=Female
4. Marital Status of the household head
- 1=Married, 2=Single, 3. =Divorced, 4. =Widow
5. Level of education
- 1= None 2= Adult education, 3= Primary education, 4= Secondary education, 5=Others (specify).....

6. Household Composition

<u>Name of person</u>	<u>Gender</u> 1=Female 2=Male	<u>Age</u> (year)	<u>Status</u> 1=Single 2=Head(M) 3=Wife 4=Son 5=Daughter 6=Mother 7=Father 8=Other	<u>Education</u> 0=No formal Educ 1= ClassI-IV 2= ClassI-VII 3= FormI-IV 4= FormV-VI 5= High Educat. 6= Adult Educat	<u>Main occupation</u> 1=Pre-School age 2=At School 3=Farming 4=Permanent (wage) Labour 5=Casual Labour 6=Own Business 7=Unemployed 9=Looks after cattle 10=Others (Specify)

B. Farm Activities

7. What convinced you to cultivate wheat?
8. Who convinced you to cultivate wheat.....
1. Neighbor, 2=Extension Officer, 3=Relative, 4=Politician, 5= Others (Specify).
9. Besides Wheat, what other crops do you grown?
 Rank your crops according to the order of preference importance

(i) Food Crops.

(1)..... (2).....

(ii) Cash Crops

(1)..... (2).....

10. Give criteria used for ranking.....

.....

11. State the harvesting periods of crops you mentioned in question 11.

Crop	Period
.....
.....
.....
.....

12. What are the most critical problems in wheat production?

.....
.....

13. How do you think these problems can be solved?.....

.....

C. Farm Resources and Input Availability and Use

I. Land availability and Use

14. What is the total area owned by the family?

..... Hectare(s)

15. How did you acquire this land?

- 1=Inherited
- 2=Bought
- 3=Hired
- 4=Given by village government
- 5=Accessed a free land
- 6=Others (Specify).....

16. Give actual hectares allocated to the different enterprises last season

Enterprise	Hectares
Wheat
Maize
Bean
Pigeon pea
Others (Specify)

II Labour Availability and Use

17. Give the number, age and gender of household members and who were available for the farm activities in 2004/05 season.

Age group	Males	Female	Total
Below 10 years			
10-14 years			
15-18 years			
19-50 years			
Above 50 years			

18. Indicate labour used for wheat enterprise in 2004/05 season

Activity	Family labour (Manday)	Exchange Labour (Manday)	Hired Labour (Manday)	Total Payment (Tshs)	
				Cash	Inkind
Land preparation					
Manure/Composition Application					
Planting					
Wheat training					
Weeding					
Pesticide Application					
Harvesting					
Sorting, grading and Marketing					

19. Indicate labour used for maize and beans production in 2004/05 season

Crop	Operation	Manday(s)
Maize	Land preparation	
	Planting	
	Weeding	
	Fertilizer Application	
	Harvesting	
Beans	Land preparation	
	Planting	
	Weeding	
	Fertilizer Application	
	Harvesting	

D. Investment and Equipment Costs

20. Indicate the number, life span, acquisition price and year of acquisition.

Item	Number	Life span Year(s)	Acquisition	
			Original price	Year
Ox- plough				
Hand hoe				
Panga				
Sprayer				
Bicycle				
Others (Specify)				

E Farm Inputs Information

21. Indicate inputs, sources, prices and cost

Input	Source	Quantity	Unity price	Cost
Inorganic Fertilizers	SA			
	Urea			
	TSP			
	Others			
Organic Fertilizers	Compost			
	FYM			
	Cow's manure			
	Goat's manure			
	Others			
Pesticides				
Hired labour				
Seeds				

F. Output, Consumption and Marketing

22. (a). (i) Has output (yield) of wheat increased since 1998?

1. = Yes 2. = No

(ii) If yes, what was the most important reason for the increase?

.....

22. (b). (i) Has output (yield) of wheat decreased since 1998?

1. = Yes 2. = No

(i) If yes, what was the most important reason for the decrease?

.....

.....

23. How do you get information on market prices of wheat?

1=Direct visit to the market

2=Cross checks with fellow farmers

3=Hear from friend

4=From extension officers

5=From NGOs

6=From Traders

7=Others (Specify)

24. What has been the price trend of wheat produce for the last three years

1= Increasing

2= Decreasing

25. From 24 above, if it is increasing / decreasing, why?

1= Few/many buyers in the market

2=Low supply/high production

3=High/low demand

26. Give marketing information as indicated for 2004/05

Amount produced	Amount Consumed	Amount sold	Amount stored	Unit Price	Revenue	Transport cost

27. Do you know different buyers of wheat in your area?

1. = Yes 2. = No

28.If yes mention them

(i).....

(ii).....

(iii).....

G. Inflow and Outflow of Income

29. How much money did you get in 2004/2005 by source of income?

Source of Income	Amount sold (bags/kg/no)	Money obtained
Sales of crops		
a). Wheat		
b). Maize		
c). Beans		
d). Pigeon peas		
e). Other crops (specify)		
Subtotal (crops)		
Livestock Sales		
a). Cattle		
b). sheep/goats		
c). Chicken/poultry		
Subtotal (livestock)		
Non agricultural Income		
a).Informal sector		
b). Salary		
c). Remittances		
Subtotal (non agricultural)		
Grand total		

H. Credit Available and Uses

- 30. Did you take credit for wheat production during the last season?
1= Yes 2= No
- 31. If yes, what was the source of credit that you received?
1= Bank 2= Traders 3= Others farmers 4= Cooperative union 5=Other (Specify)
- 32. What is the amount of credit that you received.....
- 33. Indicate the allocation of credit among the crop enterprises

ENTERPRISE	TSHS.
Wheat
Maize
Bean
Pigeon pea
Others (Specify)

- 34. Did you receive the amount of credit that you requested for?
1= Yes 2=No
- 35. If no, what were the reasons for provision of the above?
.....
.....
- 36. Have you returned the credit?
1= Yes 2= No
- 37. If no, why?
- 38. If yes what was the repayment procedure?
1= In cash 2= In kind 3= Others (specify)
- 39. If in cash what was the amount per year? (Tsh)
- 40. What was the repayment period?
- 41. If the answer to question 29 is No, why?
1=lack of credit facilities 2= High interest rate 3= Not aware of credit availability
4=High risk 5=Low income obtained from crop.
- 42. In your opinion do you think that credit is helpful?
1= Yes 2 = No
- 43. If yes Why?
- 44. If no why?
.....
- 45. Do you keep the farm record?
1= yes 2= No
- 46. Do you have access to agricultural extension officers?
1= Yes 2 = No
- 47. If yes how many times
1=Once per season
2=2-3 times per season
3=4-5 times per season
4=more than 5 times per season

48. Where do you receive extension services?

- 1=Extension officer
- 2= Training centre
- 3= on my farm plot
- 4=On demonstration plots
- 5=During meeting
- 6=Through farmers' groups
- 7=Others (specify).....

49. What type of advices do you get from a village extension officer?

- 1=Crop protection
- 2=crop management
- 3. =Marketing issues
- 4. Others (specify).....

50. Do you have access to agricultural research services?

- 1=yes 2= no

51. If No why?
.....

52. If yes what types of services do you get from researcher?

- 1=Crop protection
- 2=crop management
- 3= grain storage
- 4= Others (Specify)

53. Plans for wheat Production

- 1=Expand production
- 2=Reduce production
- 3=Continue producing the same
- 4=Others (specify).....

I THANK YOU FOR YOUR COOPERATION

