RESOURCE USE EFFICIENCY AMONG SMALL SCALE WHEAT FARMERS IN UASIN GISHU DISTRICT, KENYA

Already done

BY

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DECLARATION

This thesis is my original work and has not been presented for a degree in other University.

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This thesis has been submitted for examination with our approval as University Supervisors.

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ABSTRACT

This study evaluates the efficiency of the resources used by the small-scale wheat producers in Uasin Gishu District. The aim of the study is to suggest ways of increasing the productivity of these farms and hence the rural incomes as the sale of wheat is a source of revenue to the farmers. Increased productivity of the small-scale wheat producers is a step towards national self-sufficiency in wheat flour which is a basic foodstuff. The objective therefore, was to determine the marginal productivity of the resources and then establish the efficiency of their use.

A Cobb-Douglas production function was fitted to data collected from a cross-section sample of 50 farmers. Efficiency of resources used was determined by using the student t-distribution to test whether the ratio of the Marginal Value Product (MVP) and Marginal Factor Cost (MFC) i.e (MVP/MFC), differed significantly at 5% level from 1.0. The results indicated that the resources engaged in small-scale wheat production are being used inefficiently. The ratio MVP/MFC for wheat seed, Diamonium Phosphate (DAP) fertilizer, mechanized land preparation and Herbicide were all significantly different from 1.0 at 5% level.

The detected inefficiency is attributed to risk aversion by the farmers. It is expressed in cutting back on quantity of inputs used. The Ministry of Agriculture should have their own demonstration farms where recommended level of inputs are used and sound husbandry practices are observed. The eminent high

quality yields will convince farmers on the benefits of using the recommended level of inputs. An aggressive extension service, workshops and field days to disseminate the idea is a necessary back-up service.

CHAPTER ONE

INTRODUCTION

1.1 Contribution of Agriculture to the Economy

The Agricultural sector contributed 28.9% of the Gross Domestic Product (GDP[1]) in 1988, (Economic Survey, 1989). Agriculture and the informal sector employ over 70% of the entire work force. It includes virtually all workers from low-income families, (Sessional Paper No. 1 of 1986 page 1). Therefore in addition to providing rural incomes and food for the population. the agricultural sector must lead Kenya in economic growth by raising productivity and income of farmers, herdsmen and workers in the informal sector.

It has been estimated that by the year 2000 the population of Kenya will be 35 million people and the urban population will be between 9 to 10 million people, (Sessional Paper No. 1 of 1986 Page 1). In addition to providing food security for the population the farmers will have to generate farm family incomes that should grow by at least 5% a year for the next 15 years. Agriculture is to absorb new farm workers at the rate of over 3% a year with rising productivity. The farmers also have to supply export crops sufficient for a 150% increase in agricultural export earnings by the year 2000, (Sessional Paper No. 1 of 1986 page 62).

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[1] Gross Domestic Product (GDP): It is the total monetary value calculated at market price of all final goods and services produced in an economy over a given period of time typically one year.

It is becoming increasingly difficult to meet these objectives in the face of rapid population growth, rapid urbanization and a virtually fixed supply of land. Alleviation of land fixity lies in adopting appropriate technology[2] in the form of high yielding varieties, fertilizer use, irrigation practices and small-farm machinery. But still, growth in production of maize, wheat, milk and other food crops necessarily depends upon increased yields from land already under food crops.

1.2 The Production and Consumption of Wheat in Kenya

The main cereals consumed in Kenya are maize, wheat, rice, sorghum and millet. In his study on Food Demand Projections in Kenya, Shah (1975) noted that on the basis of per capita cereal consumption, wheat is the second most important cereal after maize.

Table 1.1 shows that despite this fact, the domestic production of wheat has continued to be below the flour consumption requirement.

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[2] Here refers to method of production which is suited to the skills of the farmers and within their capacity to own and which is in keeping with their need.

Table 1.1: Wheat Production, Imports and Flour Consumption (1983 - 1987)

`000 tonnes

Year	Production*	Imports	Flour Consumption
1983	251.3	18.9	271.7
1984	144.4	140.3	224.0
1985	201.1	149.9	293.6
1986	254.4	115.3	303.6
1987**	160.9	217.9	289.3

* Includes retention for seed

** Provisional

Source: Economic Survey, 1988

Table 1.1 shows that the deficit between the domestic production of wheat and the flour consumption requirement has continued to widen. In 1983, the gap was 20,400 tonnes and has grown to 128,400 tonnes in 1987. Thus Kenya has continued to experience a rise in wheat imports. Kenya imported 18,900 tonnes in 1983, but this rose to 217,900 tonnes in 1987. It is therefore eminent that there is an increasing demand for wheat flour in the country. The widening of the gap between wheat flour consumption requirement and the domestic production of wheat can be attributed to a number of factors. First there is population increase. The rapid increase of the population creates more demand for wheat flour. Secondly due to the pressure on land, there is fragmentation of the holdings. This leads to diversion of land to other competing enterprises which have a comparative advantage like maize. Productivity of land parcels devoted to wheat growing has not risen to cope with demand. It therefore calls for a more efficient and intensive use of resources devoted to wheat production, in order to increase productivity.

1.3 The Wheat Growing Areas

Table 1.2 shows the major wheat growing areas in Kenya. These include Narok, Nakuru, Trans-Nzoia, Uasin Gishu and Nyandarua Districts. Table 1.2: Wheat Production in Five Districts 1973 - 1983 in 90kg bags

Year	Trans Nzoia	Uasin Gishu	Nakuru	Nyandarua	Narok	Total
1973	77,431	568,769	459,104	62,170	69,018	1.236,492
1974	104,070	517,010	579,258	77,566	235,754	1.513.658
1975	119,571	550,208	565,295	73,465	364,065	1,672,604
1976	143.000	745,800	525,000	92,224	483,100	1,989.124
1977	106,873	474,000	525,630	165,168	367,800	1.639.471
1978	6,900	471,450	286,440	125,984	288,728	1,179,502
1979	67,659	650,790	192,020	16,978	86,460	1.013,907
1980	171,712	700,000	614,724	92,929	256,000	1,835,365
1981	144,403	958,920	782,950	70,194	348,488	2.304.955
1982	92,795	815,358	716,628	39,169	374,000	2,037,950
1983	120,920	1,061,750	700,000	68,922	425,000	2,376,592

Source: Paul Kere, (1986)

Table 1.2 indicates that Uasin Gishu is the leading wheat producer. In 1973, Uasin Gishu produced 45.9% of the total wheat production in Kenya. Nakuru was second producing 37.1% of the total. In 1976, Uasin Gishu led again, producing 37.5% while Nakuru produced 26.4%. Narok produced 24% and Nyandarua produced 4.6%. Uasin Gishu again produced the highest percentage in 1983, having 44.6%. Nakuru District produced 29.5% of the total wheat in the country. This clearly shows that Uasin Gishu is an important wheat growing area in Kenya.

1.4 The Study Area

The study was conducted in Uasin Gishu District, the major wheat producing area in Kenya (see Fig. 1). The district is bordered by Trans Nzoia to the North, Elgeyo Marakwet to the East, Nakuru to the South, Nandi to the west and Kakamega to the North-west.

The District extends for 3,784 square kilometers. It ranges in altitude with Timboroa in the east as the highest point rising up to 2100 metres above sea level and Kipkarren in the west, with an altitude of 1500 metres above sea level being the lowest point.

1.5 Climate

The mean annual rainfall is 1124 mm and is reliable and is evenly distributed within the district. It falls in one long season covering the period between March and September, peaking during May and August. The average temperatures are 18°C[3] but can rise upto 26°C during the dry spell covering November to February. Temperatures can fall to 8.4°C during the cool weather. All these factors combine to create a highland equatorial climate with areas to the east of the district and south-east receiving slightly higher amount of rainfall than the other areas. The difference however is insignificant because the whole district is a high agricultural potential area.

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3 °C stands for degree centigrade

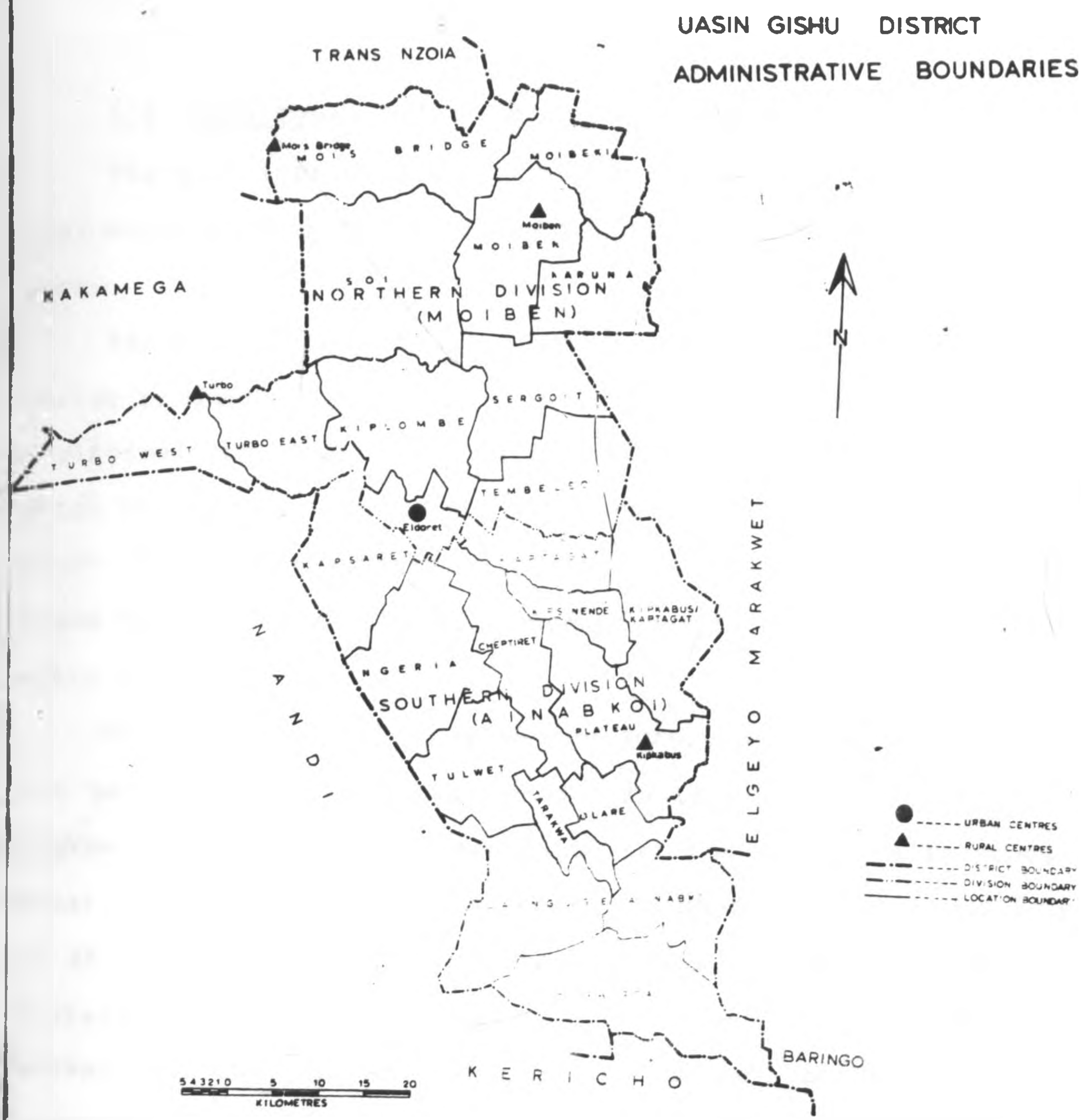

Fig 1

SOURCE: Ministry of Planning and National Development, District Development Plan: Uasin Gishu 1989-1993

1.6 Soil Types And Wheat and Production

The soil types include red loam soils, red clay soils, brown clay soils and brown loam soils, all derived from tertiary volcanic rocks.

The fertile Uasin Gishu Plateau is the largest wheat and malt barley producing area of Kenya with the largest area of the agro-ecological zone LH3. It is called the wheat (maize) - barley zone which is the best zone of the wheat producing area (Jaetzold et al 1983). Though the soils are suitable for wheat, Uasin Gishu is a mixed farming area. The main enterprises include maize, wheat and dairy cattle.

Uasin Gishu District with the agro-ecological zone LH3[4], is the best zone of the wheat producing ones. Therefore it is a region the country has to depend on for the domestically produced wheat. It is noted that an expansion in wheat production at a rate of 4% is an ambitious target in the face of continued land sub-division, (Sessional Paper No. 1 1986 page 72). According to a survey on the Kenyan agricultural Sector conducted by the International Bank for Reconstruction and Development, land segmentation was found to be contributing to a decline in wheat production, IBRD (1973).

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[4] LH3 refers to Semi-humid Lower Highland Zone. It is a wheat/maize - barley zone. Reference can be made in Farm Management Handbook of Kenya Vol. II Part B on Central Kenya, Section on Uasin Gishu. Compiled by Jaetzold et al (1983).

1.7 Holding Size And Wheat Production

Table 1.3: Proportion of households with various holding sizes in hectares

District	Households without Holding	Upto 0.8	0.84-1.6	1.64-2.4	2.44-3.2	3.24-4.0	4.4-6.0	6.4 - 8.0	Over 8.0	Total
Trans Nzoia	7	45	19	12	5	5	2	1	4	100
Uasin Gishu	3	28	11	10	5	10	11	10	12	100
Nakuru	22	25	23	10	4	7	3	4	2	100
Nyandarua	2	27	21	10	9	3	7	5	16	100

Source: Economic Survey, 1989

Table 1.3 highlights the results of land subdivision. In Trans Nzoia District, 96% of the households have holding sizes less than 8 hectares. In Nakuru District the percentage is even higher, being 98%, with 22% being squatters, without holdings. 84% of the households in Nyandarua District have holdings of below 8 hectares in size. It is from these land parcels of 8 hectares and below that production for subsistence and sale takes place.

Table 1.3 shows that in Uasin Gishu District, 88% of the households have holdings of below 8 hectares, and is where the majority of the population within the district resides. It is in these land parcels that wheat production takes place.

The Sessional Paper No. 1 of 1986 stated that a wheat expansion rate of 4% is an ambitious target in the face of continued land sub-division. Data from the Economic Survey (1989) have shown that in wheat producing areas, majority of the households live in holdings of 8 hectares and below. Uasin Gishu District has 88% of the households living on holdings of this size. These are the facts which have focused the study to wheat producers in 8 hectares and below.

Ottichilo et. al. (1988) examined maize and wheat production in Kenya during the long rains. The findings revealed that in Uasin Gishu district, the sub-division of farms adversely deterred the expansion of wheat. To compensate for the decrease in the size of holdings, an increase in productivity is necessary. Thei achievement lies in the resources engaged in small-scale wheat production being used more efficiently or the introduction of a new technology.

The issue to be addressed therefore is to increase domestic production with the available resources. This can be achieved by:

(i) Technological change: This will involve the introduction of new kinds of inputs in the production of wheat. This can be in the form of wheat varieties, machines and fertilizers.

(ii) Allocative efficiency: This is the re-organization of the inputs which are currently being used in order to improve their efficiency.

Allocative efficiency is the use of the resources at hand, with the existing level of technology to maximize the output. Resources are used inefficiently if the same resources can be used to provide higher output or the same output can be produced using a lower level of the resource inputs (Heady 1953).

Efficiency in resource utilization is a must if the output per unit of input has to be increased. The possibility of this happening within the small- scale wheat farming is of primary concern in this study.

1.8 Problem Statement

It is evident from Table 1.1 that the domestic wheat production is below the wheat flour consumption requirement in Kenya. There is therefore, a deficit in the wheat production which has continued to grow over the years. The country is dependent upon foreign sources of wheat for 33-40% of domestic needs. The dependence on foreign imports is likely to continue unless there is a reversal of production events.

A major strategy of the 1984 - 1988 Development Plan was to maintain broad self-sufficiency in basic foodstuffs. The plan further states that the achievement of self sufficiency is through the establishment of a framework of policies that will:

> "optimize the allocation of resources to their most productive use through the setting of price levels that reflect changes in imports and export parities".

The above strategy has been tried in wheat production by announcing the producer price at the beginning of every growing season as a production incentive. Despite the use of this strategy, domestic production has over the years remained below consumption requirement. Therefore, producer price setting as a production incentive seems to be an inadequate means to promote domestic production. A strategy to augment producer price or replace it is therefore necessary.

Among the major Wheat producers is Uasin Gishu District. From table 1.2 for any given year, Uasin Gishu[5] has been producing the highest percentage among the five districts which predominantly produce wheat.

In Table 1.3, 88% of the households in Uasin Gishu have holdings of 8.0 hectares and below. In sessional paper No. 1 of 1986, it was stated that a wheat expansion rate of 4% is an ambitious target in the face of continued land sub-division. Further to this Ottichilo (1988) in his study of wheat and maize production in Kenya during the long rains, found that in Uasin Gishu District, The subdivision of farms adversely deterred the production of wheat. With expansion in production deterred in the major wheat producing district by sub-division of land parcels, the increase in production of wheat has to depend on the small farms. It calls for an increase in farm productivity. Hence resources have to be used efficiently to get higher output per unit input. The study intends to evaluate the efficiency of resources used by the small scale wheat producers.

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[5] Uasin Gishu District with the agro-ecological zone LH3 is the best zone of the wheat producers.

The aim is to find means of improving the efficiency of the resources which will result into higher productivity and be a step towards achievement of self-sufficiency as advocated in the development plan. It will also augment producer price setting as a production incentive.

1.9 Justification

Since farmers with holdings of 8 hectares and below also produce wheat, an increase in the efficient use of resources engaged in small-scale wheat production will be a step towards the achievement of self sufficiency in wheat, a basic foodstuff

1.10 Objective of the Study

To evaluate the efficiency of resources used in wheat production by the small-scale wheat producers. Profitability of the wheat and maize enterprise is evaluated as well since maize production is competitive to wheat production.

Specific Objectives

1. To determine the marginal value product (MVP) of resources used in small-scale wheat production.
2. To determine efficiency with which the various inputs are used by the small scale farmers in wheat production.
3. To determine whether the farmers achieve the expected level of profitability in wheat and maize enterprises.

1.11 Hypotheses to be Tested

1. The ratio (MVP/MFC) for wheat seed is not significantly different at 5% level from 1.0, where MVP stands for Marginal Value Product and MFC stands for Marginal Factor Cost

2. The ratio (MVP/MFC) for DAP(Diamonium phosphate) fertilizer is not significantly different from 1.0 at 5% level.

3. The average gross margin per hectare of wheat is significantly below the Ministry of Agriculture Guidelines at 5% level.

1.12 Organization of the Study

This study is organized in five chapters. The first chapter presents the introduction, problem statement, the objectives and hypotheses tested. The second chapter is on literature review of the subject under study.

The third chapter discusses the methodology employed in the study. The fourth chapter deals with the presentation of the findings and explains how the results conform or deviate from the theoretical expectations.

The fifth chapter deals with the Conclusion and policy recommendations arising from the results of the study. The appendices and bibliography then follow.

CHAPTER TWO

LITERATURE REVIEW

2.1 The Supply Response of Wheat Farmers

Most studies on Kenya's wheat industry have emphasized the marketing aspect, especially pricing. This has been in the form of supply responsiveness of the wheat farmers. There is lack of information as concerns the production aspect with reference to resource use. Production is an important area because the future economic development of Kenya seems bleak if her limited resources are not utilized more efficiently.

A study done by Ashcraft *et. al*. (1977) on the wheat industry in Kenya indicated that, wheat production in Kenya faced a decline. He attributed the decline to the pattern of land ownership, variations in wheat prices and the influence of alternative profitable enterprises contributing to a shortfall in the area and output of wheat.

Producer price for wheat is announced at the beginning of each season because wheat is a scheduled crop. But as Ashcraft *et al*. *Ibid* noted, this has not helped in stopping decline in production. The decline is attributed to the fact that the prices of wheat inputs have continued to rise. Therefore even though prices are fixed at the beginning of each season, the profitability of the enterprise is what will move the farmers to respond.

Meilink (1985) in studying scope and impact of agricultural pricing in Kenya noted that Kenya is a high cost producer of wheat. In view of this fact a means of raising the output per unit cost incurred in the production of wheat is certainly desirable. This may take the form of a technological change or re- allocation of existing resources. Kere (1986) stated that small scale wheat growing be encouraged as its success may stop wheat hectareage decline.

In India, the farm management data in 1962 revealed an inverse relationship between farm size and yields per acre. A study done by Deolalikar (1981) revealed that the hypothesis of the small farm sector being more productive than the large farm sector could not be rejected at low levels of agricultural technology, but can be rejected at higher levels. Therefore the inverse relationship between yields and farm size although valid for a traditional agriculture, cannot be assumed to exist in an agriculture experiencing technological change. These small scale farms which have new technology in the form of machinery and high yielding varieties, cannot be assumed to have higher yields unless established. Gitu et. al. (1985) noted that the demand for wheat products is rising as Kenyan's taste and preferences change. They expressed the fact that wheat hectarage peaked only in mid 1950's and the late 1960's and since then wheat hectarage has declined. The decline in hectarage calls for more intensive methods of production.

In his study on maize and wheat production response, Maitha (1974) used the Fisher's distributed lag model and regressed time series information of acreage planted with the crop at time "t" on producer price at time "t-1". He used acreage rather than output as the dependent variable because variation in seasonal conditions means that farmers have no control of actual output. However, acreage planted indicates farmers' planned output. His findings were that the wheat and maize farmers are significantly responsive to price changes and therefore the present system of fixing producer prices at low levels seems to discourage production.

Even though higher producer price is one way to stimulate wheat production, there is a danger of diverting land away from maize production in preference for wheat and hence would minimize the overall benefits for the country, IBRD (1973). An increase in the productivity of the land under wheat, will increase output and reduce the possibility of wheat encroaching on area presently under maize crop.

An investigation of the supply responsiveness of wheat farmers in Kenya was done by Kere (1986). He used lagged variable model of time series data of hectarage planted in period `t' and regressed it on hectarage planted in period `t-1', the actual producer price for period `t-1', the yield of wheat in period `t-1', the mean annual rainfall in year `t' and the time trend.

He noted that since Kenya has continued to experience production deficit in wheat, the effectiveness of producer price setting as a production incentive becomes more crucial. After analysis, he found out that despite the responsiveness of farmers to price, the rapid urbanization means more demand for wheat products.

2.2 Weakness of the Supply Response Studies

The studies so far quoted have been on supply response. All of them are based on macroeconomic time series data based on the pioneering work of Nerlove (1958). In general, they estimate equations in which the dependent variable is typically area planted under the crop in question at a given time. The independent variable include various formulations of the lagged dependent variables, expected prices, expected values for other economic variables especially prices of substitutes and climatic conditions. Such a formulation has an inherent weakness in it and does not allow the grasping of the circumstances of the farmers.

Wolgin (1973) pointed out these weaknesses. He stated that the problem is in the choice of acreage as the dependent variable. If all other inputs increased in the same proportion as acreage and if production exhibited constant returns to scale, the output elasticity would be roughly equivalent to the elasticity of land inputs. However, other factors of production (those purchased in the market) are not likely to increase in the same proportion as land area increases. Hence these inputs are likely to have a high marginal product relative to their price (they are in short supply due to the farmers' limited access to credit) and output is likely to increase by a much smaller proportion than does acreage. Therefore these studies overestimate the elasticities of output with respect to price.

The other objection to the macroeconomic approach deals with error of omission. These studies do not really have much to tell about how responsive farmers are, but only how responsive they seem to be given the economic conditions they find themselves in. In other words, they tell us nothing about what the price response would be were some of the constraints upon resource use lifted. And if I may add, they tell us nothing about efficiency of resource use and the possibility of re-allocation of resources for higher productivity rather than an increase in area under the crop, a remote possibility.

2.3 Studies on Efficiency of Resource Use

A deviation from this concept of supply response of the wheat farmers would be a study of resource use in the farms. This is a micro-economic farm-firm study. An increase in the production of wheat relies mainly on the efficiency with which the farmer uses the scarce resources at hand. Efficiency refers to the degree to which producers are achieving the greatest possible output given available resources and techniques, (Pachico, 1980).

Economic efficiency can be decomposed into two components:-

(i) Technical efficiency; and

(ii) Price or allocative efficiency.

A firm is said to be technically efficient than another if it consistently produces larger quantities of output from the same quantities of measurable inputs. On the other hand a firm is said to be price or allocative efficient if it maximizes profits.

Pachico (1980) stated that if farmers are inefficient in their management of resources, then agricultural production can be raised by simply improving the allocation of resources without having to develop new technologies. In developing countries, like Kenya, there is a concern to produce as much as possible with scarce resources.

Allocative efficiency of the Kenyan peasant farmer has not received much attention. One such study was conducted by Moock (1973) in Vihiga Division of Kakamega District. He tested the average allocative efficiency in the use of phosphatic fertilizer (P_2O_5), nitrogenous fertilizers (N), and man-hours of labour. His findings were that maize farmers used too much labour and too little phosphatic and nitrogenous fertilizer. He reported that the differences between marginal value product and cost of the inputs was brought about due to misallocation. He attributed this to the fact that smallholders face certain "hidden costs" or there are `ulterior benefits' which cannot be grasped by the standard system of accounting.

Using data from the Small Farm Sample Cost Survey (SFSCS) conducted in 1969 - 1970 by the Statistical Division of Ministry of Finance and Planning, Wolgin Op Cit investigated the allocative efficiency of these farmers. The investigation included the effect of risk on the behaviour of farmers. The bottlenecks that limit agricultural production and the response of farmers to change in the price vector were also under study.

His argument was that risk aversion plays an important role in the behaviour of the farmer. The farmer who would only be willing to grow high risk crop if they fetch a higher pay-off in expected return. His findings were that the only question of inefficiency related to the under-utilization of total resource use, and this he attributed to factor scarcity due to under-developed factor markets.

In conclusion, he stated that the farmers were constrained in the total quantity of resources they were able to use by imperfections in factor markets. He further found out that farmers were efficient in their allocation of resources across crops. The farmers were risk averse and tended to employ fewer resources in high return high risk crops than would be predicted by profit maximizing theory.

In a study of efficiency of resource utilization in small-scale maize and cotton farming in Machakos and Meru Districts, Matovu (1979) tested the hypothesis that small scale farmers are efficient in the utilization of available resources in the production of maize and cotton. His findings were that maize farmers utilized labour and NPK fertilizer efficiently, family labour was inefficiently utilized. In cotton production, efficiency was achieved in the use of hired labour. Pesticides and family labour were inefficiently utilized.

The inefficiency in the use of family labour in maize indicates that there is no prescription that resources are allocated so as to maximize output valued at market prices. But it is because farmers strive for self-sufficiency in maize. In cotton, farmers used a lot of family labour as it is labour intensive especially in land preparation and harvesting. Its operations took place when labour was not involved in other activities and a lot of family labour was therefore employed into cotton production.

Schultz (1964) investigated the allocative behaviour of farmers in poor agricultural communities. His findings were that an increase in agricultural production cannot be achieved by re-allocating the factors of production of farmers bound by traditional agriculture. These findings cannot be assumed to apply to the small scale wheat producers in Kenya. These farmers are not bound by traditional factors and practices, but have experienced modernization in their production in the form of high yielding varieties, tractors, combine harvesters and pesticides agrochemicals.

Chennareddy (1967) studied a dominant agricultural productive area in South India, the West Godavari District for productive efficiency. His investigations supported the views that in a traditional and technologically stagnant agriculture, farmers are aware of efficient use of traditional inputs.

His conclusion therefore was that agricultural production in India may not be increased by increasing all inputs in the traditional state of the arts. But it lies in the introduction of modern technology in package of new input, agricultural education, special skills and techniques, and competent guidance in farm planning. But short run program was not possible due to lack of sufficient supply of modern inputs at fair prices, sufficient production credit, favourable market prices and agriculturally trained people for massive extension work.

The foregoing account implies the introduction of new measures to stimulate productivity and economic growth of the concerned farmers. Such a study was conducted by Welsch (1965) on Abakaliki Rice Farmers in Eastern Nigeria. In his study of their response to economic incentives, he stated two hypotheses:

(i) That peasant farmers in an underdeveloped traditional type of agriculture respond to economic incentives by allocating efficiently the factors of production at their disposal.

(ii) That their savings and investment decisions tend to maximize returns to scarce resources.

The result of his study showed that the present factors were allocated as efficiently as they could be and economic drive appeared to be present in the farmers studied. The data were consistent with hypothesis that farmers in an underdeveloped agriculture respond to economic incentives by allocating very efficiently the factors of production at their disposal, given the level of technology.

Of special interest is Welsch's recommendation for further development of the potential of rice. Among his recommendations was the introduction of a package of new factors of production for rice to become again a vehicle for development. This package consisted, among other things, high yielding fertilizer responsive varieties, hand powered mechanical weeding and harvesting tools and small garden tractors.

The existence of economic drive in the small scale wheat farmers cannot be denied. Though using the same input as the large scale farmers, they insist on growing wheat for revenue generation. The "package" talked of by Welsch could be very applicable to the Kenyan small-scale wheat producers.

An investigation of efficiency of resource allocation in Indian agriculture by Sahota (1968) revealed that the Indian farmers had allocated their resources efficiently. His study covered different crops and farm sizes in various Indian States. There were few significant inefficiencies of resource allocation in Indian agriculture. Sidhu (1974) further confirmed this when he studied wheat farmers in Punjab. He noted no evidence of inefficiency among the wheat farmers. It cannot be assumed to apply to the Kenyan case as the environment of production differs.

Pachico (1980) has reported that traditional farmers are frequently allocatively efficient. These small scale wheat farmers are no longer under traditional practices but modern methods of production. Achieving greater agricultural productivity can be through increasing allocative efficiency among these farmers. The possibility is what this study seeks to establish. The empirical results will add to the existing body of information.

CHAPTER THREE

METHODOLOGY

3.1 The Area Studied and Unit of Analysis

This study was done in one of the major wheat growing areas of Kenya, Uasin Gishu District. The focus of the study was on small scale wheat growers who are distributed throughout the whole district. The study therefore extended to cover all the four administrative divisions of Kesses, Ainabkoi, Soy and Moiben. The farmers studied produced both maize and wheat. This was for comparison of profitability and reasons for farmers preference of one over the other. The survey used the 1988 estimate of yields and inputs used by the farmers.

3.2 Sampling Procedure

A register of farmers in Uasin Gishu is not available because many of the farmers are new and have not been registered. In this regard, a sample of 50 farmers was selected using the multistage sampling procedure. The first stage was the selection of all the four administrative divisions namely: Kesses, Moiben, Soy and Ainabkoi. Fifteen farmers were selected from each of these divisions, using the Training & Visiting[6] register.

The number of T and V units in each division was listed down. The distribution of T and V were Soy 12, Kesses 14, Moiben 17 and Ainabkoi 10.

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6 T & V: Training and Visiting Unit refers to the Agricultural Officer who visits farmers every two weeks.

From these units, three T and V units were randomly selected from each of the divisions. From the selected T and V units, five farmers were selected to be interviewed. In each T and V unit, the number of farmers was known. If there are 20 farmers in the T and V unit, then the fourth farmer from a selected starting point would be interviewed. In Kesses division, the sixth farmer was interviewed from the selected T and V unit. In Moiben division, the fifth sampling unit in the selected T and V unit was interviewed. In Soy division, the tenth sampling unit in the selected T and V was interviewed. In Ainabkoi division, the second sampling unit was interviewed.

3.3 Methods of Data Analysis

The use of descriptive statistics is employed to describe the farming practices of the small scale farmers. Aspects captured by the questionnaire relating to seed, machinery and credit will also be discussed using tables.

The analysis of resource productivity in wheat production employs the following production function of the Cobb-Douglas type:

$$Y = AX_1^{b_1} X_2^{b_2} \text{---------} X_n^{b_n} e^u \quad \text{------} \quad (3.1)$$

Where:

Y = Gross Output of Wheat.

A = A Constant

$X_1, X_2 \ldots X_n$ = The inputs

$b_i, b_2 \ldots b_n$ = The regression coefficients

Ordinarily it is assumed that the value of each b_i is less than 1, which assumes that the marginal product of each input decreases with increase in its utilization. b_l is the elasticity of production which indicates the percentage by which the value of output increase with each 1% increase in the use of a particular resource.

The computationally attractive characteristic of the Cobb-Douglas is that it becomes linear in the logarithms of the variables, (Yotopoulos (1976)). Therefore equation 3.1 can be written mathematically to the base e as

$$\ln Y_i = \ln A + b_1 \ln X_1 + b_2 \ln X_2 + \ldots + b_n \ln X_n + \ln e \ldots (3.2)$$

Estimates can be done by least squares regression assuming that the residual term is independently distributed from firm to firm with a mean of zero and finite variance. The logarithmic equation makes the elasticity of production constant over the entire production surface so that equal increments of input add the same percentage to total output at all levels of input usage.

All the variables to be included in the analytical model are standardized to per hectare basis by dividing through by hectares under wheat cultivation which includes land implicitly in the production model. Moock (1973) stated that dividing through by hectares does not remove the inherent contribution of land from the production process.

Dividing equation 3.2 through by hectareage under wheat "L" we obtain:

$$\ln (Y/L) = \ln A + b_1 \ln(X_1/L) + b_2 \ln(X_2/L)) + \text{-----} + b_n \ln(X_n/L) + U \text{ ------------------------ } (3.3)$$

Y/L	:	The quantity of wheat produced in kilogrammes per hectare.
A	:	Is a constant
X_1/L, X_2/L --- X_n/L	:	Inputs divided by land area (L) in hectares
b_1, b_2, --- b_n	:	Regression coefficients
U	:	The error term

3.3.1 The Marginal Value Product

The Marginal Physical Product (MPP) of an input is the addition to the total physical product attributable to the last unit of input to the production process, the fixed input remaining constant, [Ferguson *et al*. (1980)]. Heady *et al*. (1961) state that generally, the marginal physical product of a resource depends on the quantity of the resource that is used, and on the level of other resources with which it is combined in the whole production process. Estimates of the marginal physical product are derived at the geometric mean of a variables. The geometric mean of a variable is the arithmetic mean of the logarithm of the values of the variable. [Wonnacott *et. al*. (1984)]. The geometric mean[7] is obtained by multiplying

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7 Geometric mean of $X_n = (X_n . X_{ni}\ X_{n3}\ \text{---}\ X_{nn})^{1/n}$ This equivalent to the arithmetic mean of $\ln X_1$, $\ln X_2$, $\ln X_3$ --- $l_n x_n$

all the n items under a variable and then taking the n^{th} root. Yotopoulos (1967) is also of the opinion that the estimate of marginal product at the geometric mean is the most relevant in the context of a Cobb Douglas application. In this study output the dependent variable (Y) is measured as the gross output of wheat per hectare. The estimate will gives the marginal physical product. A formula derived from Yotopoulos (1967) was therefore used to estimate the marginal value product of resource X_i in producing crop Y_j, as follows:

$$MVP = b_i \frac{\overline{Y}_j}{\overline{X}_i} \text{ -------------------- } 3.4$$

$\overline{Y_j}$ = The geometric mean output of the crop Y_j

$\overline{X}_i$ = The geometric mean of the i^{th} input used to produce the crop Y_j

b_i = The regression coefficient associated with resource i.

3.3.2 <u>To Determine the Efficiency of Resource Use</u>

Leftwich et al. (1988) states that the marginal resource cost of a resource is the change in the firm's total cost for a one-unit change in the employment level of the resource. This one unit change in the employment level refers to a unit change in the factor (resource) concerned. This therefore is the marginal factor cost (MFC).

This study adopted the methodology employed by Chennareddy (1968) Op Cit and Welsch (1963) Op Cit in determining the average allocative efficiency. The values for the marginal value product (MVP) were calculated following the method which has already been noted. The marginal factor cost (MFC) of resource is unit cost of the resource.

The regression coefficient which would give a MVP/MFC ratio of 1.0 was calculated using a formula from Heady (1954), as follows:

$$\bar{b} = P \frac{\bar{X}}{\bar{Y}} \qquad 3.5$$

$\bar{b}$: The regression coefficient necessary to get a ratio of MVP/MFC = 1.0

$\bar{X}$: The geometric mean of the resource

$\bar{Y}$: The geometric mean of the output

P : The marginal factor cost (MFC)

The student t-distribution was used to test for statistically significant difference between the coefficient required to make MVP/MFC = 1.0 which here is $\bar{b}$ and those obtained from the regression analysis. A statistically significant difference between the two would be an indication of inefficiency in the resource use.

The t-statistic was calculated as follows:

$$t = \frac{b - \bar{b}}{S.E} \qquad \text{------------------- } 3.6$$

b = The regression coefficient from the sample regression

$\bar{b}$ = The regression coefficient necessary to get MVP/MFC = 1.0

S.E = The standard error of the sample regression coefficient

According to Yotopoulos (1976) the Cobb-Douglas production function has the following advantages:

(a) Its simple functional form is computationally economical and yields statistically significant estimates of the coefficients without imposing excessive demands upon data accuracy.

(b) Its estimation provides important information that is generally consistent with some *a priori* notions of economic theory, such as the extent to which a factor's marginal productivity declines as the level of input increases, given the quantities of all other factors of production. This is the property of positive but declining marginal product.

(c) Heady (1946) adds that regression coefficients give elasticities of production which are independent of the unit of measurement.

The limitations of the Cobb-Douglas production function include some of its properties which seem unrealistic, such as the unitary elasticity of substitution among factors and the strictly linear expansion path. Yotopoulos (1976) states that the shortcoming become more obvious when one considers more than two factors.

3.4 Variables in the Model

(a) Dependent Variable

The dependent variable in the model is the total quantity of wheat produced in kilogrammes per hectare.

(b) Independent Variables

(i) Wheat Seed

This is entered into the production model as the quantity of seed used per hectare expressed in kilogrammes used for planting. Because production cannot take place without seed, it is expected a priori that the regression coefficient of this variable will be positive.

(ii) Mechanized Land Preparation

Land under wheat is prepared by tractor-drawn implements. Land preparation is an indispensable operation in production. It is expected a priori that the regression coefficient associated with this variable will be positive. This variable is entered in the production model as the cost incurred per hectare by hiring the tractor to plough and harrow for the farmer.

(iii) Chemical Fertilizer

This is entered in the production model as the quantity of DAP (Diammonium Phosphate) in kilograms per hectare used at planting.

(iv) Herbicide

This variable is entered in the production model as quantity of herbicide used in litres per hectare. It is an important component and it is expected to have a positive regression coefficient.

(v) Time of Planting

The time of planting relative to the start of the rains has an influence on the realised yields. Marimi (1975) noted that a delay in planting for eight days after the onset of rains can cause upto 84% reduction in realized yields. Since one is either late in planting or not late, this variable is entered in the model as a dummy variable with two values, 1 and 0. That is: 1 for late planting and 0 otherwise. The regression coefficients attached to this variable will represent the effect of late planting on wheat yields, [Wonnacott et. al. (1987)].

3.5 Gross Margin Analysis

In the measurement of the profitability of maize and wheat enterprises gross margin analysis was used. Gross margin is the gross output less the variable costs, all in Kenya shillings. If land is the most limiting resource to production, then the enterprise which gives the highest gross margin per hectare will receive the priority in as far as land allocation is concerned. Any deviation from this will be explained depending on the findings. There can be socio-cultural variables and externalities beyond the farmers' control like machinery availability and skill of operations.

The gross margin analysis has its limitations, and these include the following:

(a) It does not account for fixed costs and changes in the fixed costs.

(b) It does not give an indication of net profits. To get net profits, fixed costs will have to be deducted from the gross margin. A fixed cost like permanent labour cannot be attributed to a given enterprise. It therefore means that farm profit is easier to calculate. This involves subtracting the total fixed costs from the gross margin of all the enterprises.

(c) Misinterpretations can arise. Farmers using hired machinery, will realise lower gross margin than those who own the machines. Hiring costs will be attributed to the wheat enterprise. For a farmer who owns a tractor, he uses it on all his enterprises, including maize. Therefore machinery costs cannot be attributed to a particular enterprise.

(d) Gross margin has no allowance for complementarity and the inter-relations which exist among the enterprises.

(e) Outputs and costs changes from one growing season to another. Therefore a change of gross margin for the same enterprise from season to season will be experienced.

Despite these limitations, this study will use gross margin analysis to show the profitability of wheat and maize in small farms of eight hectares and below in Uasin Gishu.

CHAPTER FOUR

RESULTS AND DISCUSSION

4.1 Descriptive Analysis

Chapter four is devoted to description of the results. A total of 50 farmers with holdings of 8.0 hectares and less were considered. Wheat was either grown on owned land or rented land as depicted in Table 4.1 below.

Table 4.1: Categories of Land Under Wheat

Category of Land	Total Number of Farms	
Owned Land	36	(72)*
Rented Land	14	(28)
Total	50	(100)

* Figure in parenthesis indicates the relevant percentage.

About 72% of the farmers used their own holdings to grow wheat. The remaining 28% rented land due to land scarcity on their own holdings.

Wheat Seed

Table 4.2 below gives an indication of the seed source.

Table 4.2: Sources of Wheat Seed

Seed Source	Total Number of Farms
Bought from KGGCU	9 (18)*
Bought from other farmers	12 (24)
Those who kept their own	29 (58)
Total	50 (100)

* Figure in parenthesis indicates the relevant percentage.

About 58% of the farmers kept their own seed from the previous harvest. The Kenya Grain Growers Co- operative Union (KGGCU)[8] sold 50 kg bags at KShs. 350 per bag. There were 24% of farmers who bought seed from fellow farmers. They bought at a price of KShs. 300 per 50 kg bag. Keeping seed from the previous harvest and buying seed from fellow farmers at cheaper prices cuts the production costs.

8 KGGCU: It refers to the stockist of Agricultural Inputs.

The seed kept by farmers' experience different conditions as shown in table 4.3 below:

Table 4.3: Condition of Kept Seed

Condition	Total Number of Farms
Weevil damage	24 (48)*
Beetle damage	16 (32)
Rotting	10 (20)
Total	50 (100)

* Figure in parenthesis indicates the relevant percentage.

Out of the fifty farmers, 24 complained of weevil damage to the kept seed. The result is poor germination of the seeds, poor resistance to pests and diseases and therefore likely low yields. Weevil damage to kept seed is due to lack of copper oxychloride treatment. The quality of kept seed is lower than the certified seed from KGGCU.

The major reason for planting seed from own farm is the perceived saving in costs of buying seed every year. The farmer therefore buys one 50 kg bag and multiplies it and keeps using it for the next two years.

Table 4.4 shows the variability in seed rate.

Table 4.4: Seed Rate Kilogramme per Hectare

Kg/Ha	Total Number of Farms
50 - 74	13 (26)*
75 - 99	18 (36)
100 - 125	19 (38)
Total	50 (100)

* Figure in parenthesis indicates the relevant percentage.

About 36% of the farmers use seed rates of over 75 kg/Ha. And 38% use a seed rate over 100 kg/Ha. The high seed rate is prompted by low viability of the seed from own farm and the chaff in it. The farmer therefore increases the seed rate to make up for the poor seed being used. The recommended seed rate is 75 kg/Ha from the National Plant Breeding Station, Njoro (1987).

Table 4.5 shows the farmers' views as to the solutions to the problems facing them as far as seed is concerned.

Table 4.5: Suggestions to Solving the Seed Problems

Suggestions	Total Number of Farms
Cooperatives to buy for farmers	8 (16)*
Lower the seed price	22 (44)
Avail seed in time	10 (20)
Better methods of storage	10 (20)
Total	50 (100)

* Figure in parenthesis indicates the relevant percentage.

Of the farmers interviewed 44% were of the opinion that the price of wheat seed was too high. Hence the reason why farmers keep their own seed or buy from other farmers. The consequence is that the potential production of the small-scale farmer is not realised - seed is an important input and if it is not certified seed, then the crop will not yield as high. Keeping seed is further practiced by farmers because KGGCU does not avail seed in time.

Manual Labour in Wheat

Most of the operations in wheat are done by machines. The use of manual labour is therefore minimal.

Table 4.6 below shows the labour used in wheat production.

Table 4.6: Labour Used in Wheat Production

Type of Labour	Total Number of Farms
Temporary	40 (80)*
Permanent	10 (20)
Total	50 (100)

* Figure in parenthesis indicates the relevant percentage.

Eighty percent of farms utilize temporary labour in wheat production. Wheat production is undertaken by the use of machinery. The harvesting is also done by combine harvesters. The labour engaged in production is tied to machinery used in operation. Therefore labour in itself is not considered in the production function. The permanent labour employed is mostly tractor drivers.

Land Preparation

Land preparation for the small-scale farmer is done by hired tractors. The tractor does the ploughing and the harrowing. The operations are done only once to cut on hiring charges. These activities take place in May, when the fields are about to be planted. Hiring cost ranges from KShs. 375 per Hectare to KShs. 625 per Hectare. The fact that the small-scale farmer does not own a tractor pre-disposes him to some constraints as illustrated in the Table 4.7.

Table 4.7: Farmers' View on Tractor Hiring

Constraints	Total Number of Farms
Unavailability	19 (38)*
High rates of hiring	18 (36)
Lateness of operations	13 (26)
Total	50 (100)

* Figure in parenthesis indicates the relevant percentage.

There is peak demand of tractors during ploughing and planting. Out of the fifty farmers, 19 experienced unavailability of the tractor when needed. Another 36% reported high cost of hiring tractors and 26% experienced lateness in operations due to lack of prompt availability.

To ease the above mentioned constraints the farmers suggested remedial measures as shown in Table 4.8.

Table 4.8: Machines for Modification to Suit Small-Scale Wheat Production

Machine	Total Number of Farms
Tractors	15 (30)*
Combine harvester	23 (46)
Planter	8 (16)
Harrow	4 (8)
Total	50 (100)

* Figure in parenthesis indicates the relevant percentage.

There were 46% of the farmers who wanted modifications on combine harvesters to suit small- scale farmers. And out of the fifty farmers 30% of the farmers wanted a modification on the tractors. Table 4.9 highlights the modifications which the farmers wanted on tractors and harvesters.

Table 4.9: Changes the Farmers Desire on Implements

Modification	Total Number of Farms
Smaller size	31 (62)*
Ox-drawn	5 (10)
Simplify operations of seed drill and combine harvesters	14 (28)
Total	50 (100)

* Figure in parenthesis indicates the relevant percentage.

The small-scale producer desired a small sized combine harvester and tractor which will suit their holding size. The farmers reported that they lack the necessary expertise to calibrate the seed drills. They reported a need for simpler machines. This was the view of 28% of the farmers. 62% of the farmers wanted smaller size machinery. A further 10% suggested ox-drawn implements, but currently there is no land to keep oxen.

Use of Fertilizer:

Table 4.10: Fertilizer Used in Wheat Production

Type of Fertilizer	Total Number of Farms
18:46:0 (DAP)	27 (54)*
20:20:0	8 (16)
Mixture of the above two	7 (14)
Foliar spray	6 (12)
No Fertilizer	1 (2)
C.A.N. (Calcium Ammonium Nitrate)	1 (2)
Total	50 (100)

* Figure in parenthesis indicates the relevant percentage.

Fifty four per cent of the farmers use Diammonium Phosphate (DAP) fertilizer at planting. 16% use the compound fertilizer 20:20:0. 14% of the farmers prefer a mixture of the two. The farmers who mix the DAP and 20:20:0 allege to higher yields due to the practice.

Table 4.11: Fertilizer Application Rates

Rate of Application Kg/Ha	Total Number of Farms
50 to < 100	37 (74)*
100 to <150	13 (26)
Total	50 (100)

* Figure in parenthesis indicates the relevant percentage.

The fertilizer rates vary widely. 74% of the farmers use rates of between 50 to 100 kg per hectare. Fertilizer is a major input in the production process as it is expected to increase productivity.

Table 4.12 highlights some of the constraints realised in the use of fertilizer.

Table 4.12: Constraints in Fertilizer Use

Constraints	Total Number of Farms
Not available	18 (36)*
Too expensive	27 (54)
No tractor to apply	5 (10)
Total	50 (100)

* Figure in parenthesis indicates the relevant percentage.

A total of 54% of the farmers claimed that fertilizer was expensive. A further 36% were affected by unavailability of the fertilizer when necessary at planting. Fertilizer is an important input in realising higher productivity. The impact of fertilizer application can be realised if adequate quantities are applied at planting.

Table 4.13: Remedial Measures to Fertilizer Problems

Remedy	Total Number of Farms
Lower prices	31 (62)*
Avail when needed	19 (38)
Total	50 (100)

* Figure in parenthesis indicates the relevant percentage.

From the farmers' view point the lowering of fertilizer prices would enable them use more of the input. Also the second handicap relates to lack of fertilizer when needed. The result is lateness in planting which prevents the achievement of high yields.

Agro-chemicals

A variety of agro-chemicals were used to control weeds. The farmers spray their wheat crop against the broad leaved weeds like black jack and grasses. The various herbicides used by farmers are shown in Table 4.14.

Table 4.14: Herbicides used by the Farmers

Herbicides	Total Number of Farms
Bactril MC	4 (8)*
Stomp	4 (8)
Benvil Combi	3 (6)
Murphamine	2 (4)
Shellamine	35 (70)
None	2 (4)
Total	50 (100)

* Figure in parenthesis indicates the relevant percentage.

Majority of the farmers used Shellamine. The farmers use Knapsack sprayers and the operation is done 24-30 days after planting. The constraints to the use of agro-chemicals is presented in Table 4.15.

Table 4.15: Constraints to Agro-chemicals use

Constraints	Total Number of Farms
Lack of equipment	21 (42)*
Lack of labour	9 (18)
Unwillingness of tractor owners	5 (10)
Ineffective with heavy rains	6 (12)
Not available when needed	9 (18)
Total	50 (100)

* Figure in parenthesis indicates the relevant percentage.

Forty two per cent of the farmers lack the necessary spraying equipment. And 9 out of the 50 farmers experienced a labour shortage. Another 10% found it difficulty in convincing the tractor owners to come and do the exercise. These factors contribute to lateness in the operations and consequently wheat yields get depressed.

Time of Planting

The recommended time for planting is the third week of May. Farmers plant from May to July. Table 4.16 shows the spread of planting time. Since in planting one is either late in planting or not, there are only two categories.

Table 4.16: Farmers Response to Planting Time.

Category	Total Number of Farms
Late in planting	26 (52)*
No lateness in planting	24 (48)
Total	50 (100)

* Figure in parenthesis indicates the relevant percentage.

Table 4.16 shows that 52% of the farmers were late in planting of their crop. The factors which contributed include unavailability of the inputs when needed and their scarcity.

Harvesting of Wheat

The farmers use hired combine harvester. The owners of the combine harvesters who are also the large-scale producers, prefer to work on the other large farms first. The small farms are attended to last. There are constraints to harvesting of wheat in the small farms.

Table 4.17: Constraints in Harvesting of Wheat

Constraints	Total Number of Farms
Lateness in harvesting	24 (48)*
High charges for hire	13 (26)
Unwillingness to work on small farms	13 (26)
Total	50 (100)

* Figure in parenthesis indicates the relevant percentage.

A major drawback experienced by 48% of the farmers was lateness in harvesting. The number of combine harvesters is not adequate to meet to demand. Due to the smallness of the farms 26% of the farmers experienced difficulties in getting the combine harvester owners to work on their farms. The same percentage found the hiring charges too high.

Table 4.18 represents the farmers view as to how best to solve problems related to harvesting.

Table 4.18: Farmers Suggestions to Solving Combine Harvester Problem

	Total Number of Farms
Form Co-op to buy combine harvesters	18 (36)*
Late or early planting but not with the large scale farmers	13 (26)
Engage in Other Enterprises	13 (26)
Small-scale producers should plant at the same time	6 (12)
Total	50 (100)

* Figure in parenthesis indicates the relevant percentage.

Upto 36% of the farmers were of the opinion that they should form cooperatives to help in buying combine harvesters. Others felt that the best way out is to plant late or early relative to large scale farmers. Their wheat will therefore be ready before or after the large-scale owners have harvested theirs. Another 26% were of the opinion that wheat growing should be abandoned by small-scale producers. Planting at the same time for several farmers in a block of several hectares would mean that large tracts would be ready and-make it easier and attractive for the combine harvester owners to work on the small plots. A common feature of all this is that they advocate institutional or communal action.

The farmers also felt that the government had a role to play is solving the combine harvester problem. Table 4.18 lists their views on the role the government ought to play.

38 per cent of the farmers felt that combine harvester hire services should be availed. Another 22 per cent were of the opinion that small combine harvester, which would be cheaper to buy and work conveniently on the small farm is a sole responsibility of the government. It is clear that institutions are being called upon to help in solving the small-scale producers handicap to higher productivity. The solution will create an incentive on the part of the small-scale farmers too.

Table 4.19: The Role of Government In Solving Combine Harvester Problem

Role	Total Number of Farms
Combine harvester hire service	19 (38)*
Subsidize the purchase price	8 (16)
Credit facility to buy one	7 (14)
Government to come up with smaller harvester	11 (22)
Harvesting charges to be fixed by Government	5 (10)
Total	50 (100)

* Figure in parenthesis indicates the relevant percentage.

As the producer of wheat, the farmers have their suggestions as to how to increase productivity of wheat in their holdings. A summary of various reasons is presented in Table 4.20.

Table 4.22: Means of Increasing Productivity as seen from the Farmers' View-point

Strategy	Total Number of Farms
Low priced inputs	20 (40)*
Machinery availability	15 (30)
High yielding varieties	8 (16)
Improved Farm Management techniques	7 (14)
Total	50 (100)

* Figure in parenthesis indicates the relevant percentage.

To the farmer, low priced input would mean high profitability and low production costs. More farmers would take up to wheat production. 40% of the farmers are of the view that low priced input would result into high productivity. They anticipate more intensive use of the inputs. Timely availability of machinery would minimize delay in operations, so the 30% would have better yields.

From the farmers' view-point, the government has a role to play in the increasing of farm productivity as well. The following represents suggestions as to the actions which could be taken by the government.

Table 4.21: Government's Role in Increasing Wheat Productivity

Role	Total Number of Farms
More incentives like producer price increase	21 (42)*
Improved credit terms	16 (32)
Suitable implements for small farms	13 (26)
Total	50 (100)

* Figure in parenthesis indicates the relevant percentage.

It is the opinion of 42% of the farmers that higher producer price is needed. Of the remaining 32% want better credit terms and 26% feel that suitable implements would be a solution. The opinion of farmers suggests that they lag the motivation to produce and the means heavily fall on the Government. The government as an institution must therefore pioneer efforts to increase wheat productivity in small scale farms.

After harvesting, the farmers transport their wheat on lorries to the National Cereals and Produce Board for sale. The minimum charge is KShs. 1,000 per trip. The table below summarised the handicap to transportation.

Table 4.22: Problems in Wheat Transportation

Problem	Total Number of Farms
Too expensive	31 (62)*
Means not available	19 (38)
Total	50 (100)

* Figure in parenthesis indicates the relevant percentage.

If the harvesting period is characterised with heavy rains then the roads become impassable. Whether a farmer has ten bags or fifty, the transport rate being KShs. 10 per bag, he will be forced to pay the minimum charge of KShs. 1,000. Transport is therefore very expensive as 31 farmers experienced. Not all the harvested wheat is sold. Table 4.23 below illustrates what happens to harvested wheat.

Table 4.23: Storage Problems

Problem	Total Number of Farms
Lack of suitable structures	25 (50)*
Damage in storage	17 (34)
No problems	8 (16)
Total	50 (100)

* Figure in parenthesis indicates the relevant percentage.

The result of the damage in storage is poor seed for the following year and therefore low yields. The seedlings are less resistible to pests and diseases.

Credit

The following table summarises the use of credit in wheat production.

Table 4.24: Credit Use in Wheat Production

	Total Number of Farms
Using credit	19 (38)*
Not using credit	31 (62).
Total	50 (100)

* Figure in parenthesis indicates the relevant percentage.

As to why only 38% of the farmers use credit the following table summarises the reasons.

Table 4.25: Reasons for Not Using Credit

Reason	Total Number of Farms
Credit terms unfavourable	17 (34)*
No need for credit	10 (20)
No collateral	23 (46)
Total	50 (100)

* Figure in parenthesis indicates the relevant percentage.

The profit made in wheat goes to paying the interest for the credit. 34% of the farmers feel that this makes the credit unattractive. Another 20% had enough funds and 46% had no security to acquire the credit for production.

As to whether they would like to have credit or not, the response is in the table below:

Table 4.26: Is Credit Necessary?

	Total Number of Farms
Yes	29 (58)*
No	21 (42)
Total	50 (100)

* Figure in parenthesis indicates the relevant percentage.

About 58% of the farmers needed credit. The table below gives out the various reasons for this need.

Table 4.27: The Need for Credit

	Total Number of Farms
Inputs are expensive	29 (58)*
No other income source	14 (28)
Uncertainty in production	7 (14)
Total	50 (100)

* Figure in parenthesis indicates the relevant percentage.

The farmers need credit to meet production costs as inputs are expensive. The use of sub-optimal quantities will result in lower yields than should be the case.

Wheat and maize are the major cropping enterprises which are grown alongside. Wheat demands machinery from its planting upto harvesting. Therefore, the farmer has to have enough money always to hire the needed machinery. Below is a table which indicates the response of the farmers to the question of wheat growing.

Table 4.28: Reasons for Growing of Wheat

Reason	Total Number of Farms
Large tract of land	2 (4)*
Wheat is more profitable	9 (18)
Mechanized Production	39 (78)
Total	50 (100)

* Figure in parenthesis indicates the relevant percentage.

Ease of production is the key reason why wheat is favoured. Most of the work is done by machines. This fact ties well with lack of labour during peak demands. Therefore maize enterprise would experience an acute labour shortage during the weeding and harvesting time.

Table 4.29: Enterprise which Compete with Wheat

Enterprise	Total Number of Farms
Maize	25 (50)*
Dairy	21 (42)
Horticulture	4 (8)
Total	50 (100)

* Figure in parenthesis indicates the relevant percentage.

Maize is the main crop competing with wheat. 50 per cent of the farmers experience this competition. Table 4.30 shows the area of competition.

Table 4.30: Area of Competition between Wheat and Maize

	Total Number of Farms
Compete for land	25 (50)*
Compete for labour	14 (28)
Compete for Agro-chemicals	11 (22)
Total	50 (100)

* Figure in parenthesis indicates the relevant percentage.

Half the farmers interviewed noted that the competition between maize and wheat is in the area of land. 50% of the farmers had more of the total holding under wheat than maize. Maize is more labour intensive and labour is not only scarce but also expensive. Wheat production is mechanized and the ease of operation and the fact that wheat gives farmers revenue have given additional advantage to wheat.

Out of the fifty farmers, 14 felt that maize production could use family labour. The farmer is saved from having to hire labour expensively. Maize is also a staple food and is not prone to damage especially by rain as wheat is.

The future of wheat in the farmers' farm was sought. The response shown in Table 3.31.

Table 4.31: The Future of Wheat Production

	Total Number of Farms
Phase it out	18 (36)*
Decrease land devoted to it	11 (22)
Increase its production	9 (18)
No change anticipated	12 (24)
Total	50 (100)

* Figure in parenthesis indicates the relevant percentage.

Out of the farmers interviewed 36% are bent on phasing out wheat in the near future. 22% plan to decrease further the area under wheat currently. 18% hope to increase productivity if they have more money for the purchase of inputs.

There is need to intensify production and offer incentives to promote wheat production.

Of the 50 farmers under consideration, 72% grew wheat on their own farms and 28% on rented land. About 58% used their own kept seed from the previous harvest. Experience of 48% is that damage was witnessed on kept seed by weevils, beetles and rotting. About 38% used a seed rate of between 100 - 125 Kg/Ha, while the recommended is 75 Kg/Ha.

The Labour use is minimal and 80% is temporary. Land preparation is mainly done by hired tractors. The constraints include high rates for hiring as 36% experienced and unavailability at peak demand as 38% observed. The farmers' view is that small size combine harvester which would be cheaper could suit the small-scale producer, this was the view of 46%. Majority - 54% use DAP for planting at rates ranging between 50 to 100 Kg/Ha. On Agrochemicals 70% used Shellamine. About 48% experience lateness in harvesting.

The overall contention is that the Government should solve storage problems. Check the escalation in production costs and design harvesting methods which are suitable for small-scale wheat producers. The third option is crucial as 76% grow wheat due to mechanised production. Wheat and maize compete for land. The view as held by 50%. In response to the competition, 36% are considering phasing out wheat. About 22% will increase land devoted to wheat.

4.2 Regression Analysis

In this section, certain factors that affect wheat are analysed using regression analysis. The analysis employs the Cobb-Douglas function of the form given in equation 3.3. Data from each of these selected farms was fitted onto the standardized Cobb-Douglas function in linear form.

$$\ln(Y/L) = \ln A + b_1 \ln(X_1/L) + b_2 \ln(X_2/L) + --- b_n(\ln X_n/L) + U$$

Y/L : The total quantity of wheat produced in kilogrammes divided by land area (L) in hectares

A : Is a constant

X_1/L, X_2/L --- X_n/L : Inputs divided by land area (L) in hectares

b_1, b_2 .... b_n : Regression coefficients

The variables in the function are defined as listed below.

Y : The gross output of wheat in kilogrammes per hectare.

X_1 : The amount of seed used in kilogrammes per hectare.

X_2 : The cost of land preparation in shillings per hectare.

X_3 : The quantity of DAP used in kilogrammes per hectare.

X_4 : The quantity of herbicides used in litres per hectare.

X_5 : The time of planting: 1 for late planting 0 otherwise.

Results

Wheat Production Function

$$\ln Y = 4.140 + 0.697 \ln X_1 + 0.409 \ln X_2 + 0.289 \ln X_3 + 0.240 \ln X_4 - 0.958 \ln X_5$$

S.E	(1.228)	(0.048)	(0.211)	(0.086)	(0.064)	(0.379)
t-valve	3.21	14.52	1.93	3.36	3.75	2.52

R^2 = 0.4160

DF = 44

S.E : The standard error of coefficients

R^2 : The coefficient of multiple determination

D.F : The number of degrees of freedom

There is a positive relationship between the quantity of wheat seed used and the quantity of wheat output. The regression coefficient is significantly different from zero at 5% level. The coefficient indicates that a 5% increase in the quantity of wheat seed used results in a 0.697% increase in the gross output of wheat in kilogrammes.

Land preparation bears a positive regression coefficient. The regression coefficient is significantly different from zero at 5% level. A 1% increase in expenditure on machinery will result into 0.409% increase in the gross output of wheat.

Fertilizer contributes to the quantity of wheat output positively and significantly at 5% level. A 1% increase in fertilizer use will result into a 0.289% boost in wheat output.

Herbicides contribute to wheat production positively and significantly at 5% level. A 1% increase in the use of herbicide results into a 0.240% rise in wheat output. The coefficient for time bears a negative sign. It indicates that late planting reduces wheat output. The reduction is significant at 5% level.

4.3 The Coefficient of Multiple Determination

The coefficient of multiple determination (R^2) is shown in the regression equation. The coefficient indicates how much of the variation observed in the value of wheat produced is explained by the independent variables. For the farms, 41.6% of the observed variation is explained by the independent variables in the function.

A factor which contributes to the low value of R^2 is the error in measuring the variables. A gunny bag full of wheat is taken to weigh 90 kilogrammes. This is not the case considering that the kept seed has a lot of chaff in it. The quantity of seed to be used in planting is always approximated by the farmers, an error in measurement occurs. An important factor which results into the low R^2 value is the plant population. Plant population can have a positive or negative influence on yield depending on crop density per unit area. Given the available level of plant nutrients and other requirements in a specified unit area, there exists an optimum plant population.

4.4 The Geometric Means and Marginal Value Products

The geometric mean of the variables was calculated as explained in Section 3.3.1 of Chapter 3 and equation 3.4 in the same chapter and section was used to calculate the marginal value productivities. Table 4.32 shows the values obtained from the calculations.

Table 4.32: The Geometric Means and Marginal Value Products of Variables Used in Wheat Production

Variables	Geometric Mean	Marginal Value Product
Y: Output (Kg)	1807.635	-
X_1: Seed (Kg)	150.073	3.529
X_2: Land Preparation (Kshs.)	84.513	8.748
X_3: DAP Fertilizer (Kg)	38.847	13.261
X_4: Herbicides (litres)	25.397	9.964
X_5: Timeliness in planting	90.492	-19.13

Source: Author's calculation

The marginal value productivity of wheat seed and land preparation is KShs. 3.529 and KShs. 8.748. It implies an additional shilling spent on wheat seed will contribute KShs. 3.529 to the total wheat output. An additional shilling spent on preparing land will contribute KShs. 8.748 to wheat output.

The marginal value productivity of DAP fertilizer is Kshs. 13.261. Therefore an additional shilling spent on fertilizer will result into a KShs. 13.261 increment in wheat output. An additional shilling spent in herbicide will result into KShs. 9.964 addition on the value of wheat output. A one week delay in planting will cause a depression in yields which will result into a KShs. 19.13 loss on the wheat produced.

4.5 Determining the Efficiency of Resource Use

The method for determination of the efficiency of resource use is discussed in Section 3.3.2 of Chapter 3. Equations 3.5 and 3.6 are used. The results in Table 4.33.

Table 4.33: The Average Allocative Efficiency in the Use of Selected Resources in Wheat Production

Resource	MVP	MFC	MVP/MFC	b	$\bar{b}$	S.E	$t = \frac{b - \bar{b}}{S.E}$
Seed	3.529	7.00	0.504	0.697	0.581	0.048	2.41
Land Preparation	8.748	1.00	8.746	0.409	0.0467	0.211	1.717
DAP	13.261	6.64	1.997	0.289	0.142	0.086	1.709
Herbicide	8.964	8.28	1.203	0.240	0.116	0.064	1.698

Source: Author's calculation

4.6 Hypothesis Testing On Resource Use Efficiency

From the calculation, the following hypotheses put forward were tested.

1. The ratio MVP/MFC of wheat seed is not significantly different from 1.0 at 5% level. From the Table 4.33 at 1% significance level the ratio is different from 1.0. It

indicates that wheat seed is inefficiently used. It can be attributed to the use of seed kept at home. The wheat farmers' use their own seed from the previous harvest. Because of poor storage and the consequent damage the seed used can result into low plant population per given area. There is weevil damage to farmers' own kept seed. The farmers do not treat their own seed with Copper Oxychloride. The result is poor germination, poor resistance to pests and diseases and the plant population is prone to lodging. The quality of kept seed is much lower than the certified seed from KGGCU. about 74% of the farmers use seed rate between 75 - 125 Kg/Ha. The recommended is 75 Kg/Ha, but due to poor quality seed the yields are depressed.

2. The ratio MVP/MFC of DAP is not significantly different from 1.0. at 5% level. From the calculation, this ratio is significantly different from 1.0 at 5% level of significance. It reflects that the DAP is inefficiently utilised. The recommended application rate for fertilizer is 3.7 bags/Ha. The farmers' use between 1 bag/Ha (50Kg) to 3 bags/Ha (150Kg). There is underutilization of fertilizer. More use would result into more wheat being produced.
3. The ratio MVP/MFC for land preparation is not significantly different from 1.0. at 5% level.

From the analysis it is significantly different form 1.0 at 5% level of significance. It indicates inefficiency. Land preparation is meant to prepare good seedbed for planting. Weeds must be eradicated in the process and a seedbed with good water retention should be achieved. Due to unavailability of hired tractor in good time during peak demand, the process is done inefficiently in an effort to plant in time.

4. The ratio MVP/MFC for Herbicide application is not significantly different from 1.0 at 5% level.

The ratio is significantly different from 1.0 at 5% level of significance. Spraying is supposed to take place 24 - 30 days after planting. unavailability within the required duration due to high demand at peak season and lack of spraying equipment result into delay in the use of herbicide.

4.7 Gross Margin Analysis

Gross margin will be used to ascertain the profitability of maize and wheat production. It also gives an indication of what the farmers achieve and what the Agricultural Extension Officers recommend.

The expected gross margin per hectare for wheat and maize for Uasin Gishu as estimated by the District Agricultural office is presented in Appendix 1 and 2. The District guidelines are drawn by the Farm Management Division with the help of the District Crops Officer.

At the beginning of the growing season, farmers are approached to avail their farms as models. The selected farms are supervised by extension officers. The inputs however are to be supplied by the farmer. These act as demonstration farms for field days. Apart from suggestions by the Agricultural extension agent as to what to do, the discretion lies with the farmer as he is responsible for input purchase. The calculation is in appendix 3 and 5.

Table 4.34 Farmers yields and the District Guidelines for Wheat

Area (Ha)	1.6	4.0	District Guideline
Yields (bags/Ha)	42.5	37.5	25
GM/Ha (KShs)	4,304.80	4,122.70	1,606.60

Source: Authors calculation

The 1.6ha farm achieved 17.5 bags/ha higher than the district guideline. The 4.0 ha farm achieved 12.5 bags/ha higher. The 1.6 ha farm used 1.87 bags/ha of certified seed and 0.625 bags/ha of his own kept seed. High yields are attributed to superior quality of the certified seed used. The 4.0 ha farm used 1.25 bags/ha of certified seed and 3.5 bags/ha of his own kept seed. The lower quality of kept seed depressed the yields.

Table 4.35 Farmers yields and the District Guidelines for Maize

Area (Ha)	0.8	1.2	District Guideline
Yields (bags/Ha)	37.5	57.5	50
GM/Ha (KShs)	4,025.20	5,212.40	2,894.10

Source: Authors calculation

The 0.8 ha farm got lower yields than the district guideline and the 1.2 ha farm. The 0.8 ha failed to use inputs in right quantities. The farmer used one bag of fertilizer per hectare instead of one and a half bags per hectare as recommended. The 0.8 ha farm did not further use dust to control stalk borer. The 1.2 ha farm achieved higher yields because of using dust to control stalk borer. The farmer used 1.6 bags per hectare of fertilizer hence the good yield realised.

Table 4.36 gives a summary of the gross margin realised per hectare by the farmers on the average achieve against the district guidelines. The aim is to test for significant difference in the yields statistically.

Table 4.36: Comparison of Gross Margin/Ha: The District Guideline
and the average achieved by farmers.

	Wheat	Maize
District Guideline KShs./Ha	1,606.60	2,894.10
Achieved by Farmers KShs./Ha	4,213.80	4,618.80

Source: Authors Calculation

4.8 Hypothesis Testing On Levels of Gross Margin Per Heactare

Statistical tests used the student t- distribution, which was calculated as follows:

$$t = \frac{\bar{X} - U}{S/\ n}$$

$$S^2 = \frac{1}{n-1} [\Sigma x_i^2 - \frac{(\Sigma x_i)^2}{n}]$$

Where:

$\bar{X}$: The average gross margin per hectare in Kenya shillings for wheat.

U : The recommended district guidelines gross margin

S : The standard deviation

n : The number of observations

S^2 : The variance of the sample

The third hypothesis is stated below.

3. The average gross margin per hectare for wheat is significantly different at 5% level from the Ministry of Agriculture guidelines, so taht:

$H_o : \bar{x} = u$ $H_1 : \bar{x} \neq u$

The critical value of t = 2.021. The calculated t value 6.047 falls in the rejection region. The average gross margin/ha of wheat grown by the farmers is significantly higher than what the Ministry of Agriculture guidelines give. In maize production, the calculated t - value is 2.493. it falls in the rejection region. Therefore the average gross margin per hectare of maize grown by the farmer is higher than the district guideline. It is significant at 5% level.

CHAPTER FIVE

SUMMARY, CONCLUSIONS AND POLICY IMPLICATIONS

5.1 Summary

Wheat is an important cereal crop because of increase in wheat flour consumption. A higher demand for wheat is bound to be created due to rapid urbanization. The sale of the crop by the producers also give a source of revenue. With the sub-division of large farms, reliance on the small-scale farms for wheat production is bound to increase. It is with this background that this study was undertaken. The major objective was to evaluate efficiency of the resources used by the small-scale producers of wheat.

A total of 50 farmers were interviewed and data collected on wheat seed, mechanical land preparation, DAP fertilizer, herbicides and planting time was fitted to a Cobb-Douglas production function. From the analysis, the relevant marginal value products and the marginal factor costs were compared and tested using the student t-distribution. If the ratio of MVP/MFC was significantly different from 1.0 it was a sign of inefficiency in the use of resources. Gross margin analysis was done to ascertain the profitability of maize and wheat enterprises. Tests for statistical difference between the gross margin per hectare of wheat and maize as stated in the ministry of Agriculture district guidlines and the level achieved by the farmers was also done..

The results indicate that resources are inefficiently used. It is supported by the fact that the ratio MVP/MFC is significantly different from 1.0 for seed, land preparation, DAP and herbicide.

Maize is grown alongside wheat. It is a staple food crop consumed directly after harvesting. Wheat is grown due to its minimal labour requirement. The sale of wheat is also a valuable source of revenue for the farmers.

5.2 Conclusion

The small scale wheat producers have an economic drive. It is expressed by persistent wheat production, a crop which is not consumed directly on the farm but is sold for revenue.

These farmers are rational decision makers. Their aim is to maximize profits given the prices they face in the market. The observed inefficiency can be attributed to risk aversion. The use of low rates of input is an element of risk aversion behaviour exhibited by the farmers. In wheat growing, so much input is bought from the market. Keeping of seed is an element of risk aversion as the farmer does not spend liquid cash to buy seed.

The goal of production also influences these farmers. Self sufficiency within the home is a primary goal. The growing of wheat is meant to generate cash for home expenditure. Maize is grown to meet the subsistence needs of the farmer.

5.3 Policy Implication

The study has revealed that the small-scale wheat farmer is innefficient. The detected inefficiency is in the use of all inputs. Farmers use kept seed from previous harvest, but it is a cost cutting measure which inherently has a risk aversion element in it. The same reason can be advanced for low rates of fertilizer use.

A remedial measure on seed damage because of poor storage is the improvement of storage facilities at the farm level. Farmers have got to be convinced on appropriate input application. The achivement of this can be through demonstration farms. The ministry of agriculture should have their own demonstration farms. These farms should use the recommended level of inputs. The quantity of wheat harvested from the demonstration farms can convince the farmers on the need and benfits of appropriate input usgae. A more aggresive extension service backed with field days and farmers workshops will disseminate the ideas as practised on the ministry of Agriculture demontration farms.

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Appendix 1

The Ministry of Agriculture District Guidelines for Uasin Gishu District for the year 1988 is as indicated below in Appendix 1 and 2.

A <u>Wheat</u>

Inputs	Cost/Unit (Kshs.)	Total Cost/Acre (Kshs.)
Ploughing	200.00	200.00
Harrowing x 2	150.00	300.00
Fertilizer	265.70	443.35
Seed	350.00	350.00
Planting	160.00	160.00
Spraying	63.00	63.00
Gunny bags x 10	22.75	227.50
Harvesting	200.00	200.00
Transport	1000.00	100.00
Misc.		120.00
Total Variable Cost		KShs. 2163.85

Gross Margin = Total Ouput - Variable Costs

Product Yields = 10 bags per acre

Product Price = 280.65 per bag

Gross Output = 10 x 280.65
= 2806.50

Gross margin = 2806.50 - 2163.85
= 642.65

Gross Margin = KShs. 642.65 per acre

Appendix 2

B <u>Maize: Variables Costs</u>

Inputs	Cost/Unit (Kshs.)	Total Cost/Acre (KShs.)
Ploughing	200.00	200.00
Harrowing	150.00	150.00
Planting	150.00	150.00
Seed	104.00 per 10kg bag	104.00
Fertilizer	295.70 per 75kg bag	443.35
CAN (topdressing)	180.00 per 7g kg	270.00
Weeding x 2	200.00	400.00
Dust	45.00	45.00
Labour for dusting	50.00	50.00
Stooking	100.00	100.00
Harvesting	5.00 per bag x 40	200.00
Transport to store	70.00	70.00
Shelling	4.00 per bag x 20	80.00
Transport	10.00 per bag	200.00
Misc.	140.00	140.00
Total Variable Costs	KShs.	2,602.35

Gross Output = 20 bags per acre

Produce Price = KShs. 188.00

Gross Margin = Total Output - Variable Cost

Total Output = Product Yield x Produce Price
= 20 x 188.00

Gross margin = 3760 - 2602.35

= KShs. 1157.65 per acre

Appendix 3

The Average Gross Margin as calculated from the sample is indicated below:

A WHEAT CROP: Season: May to September

Size: 4 acres of wheat

VARIABLE COSTS:

	TYPE	AMOUNT	PRICE/UNIT KShs	TOTAL COST
1	Land clearance	-	-	-
2	First ploughing	1	200/acre	800.00
	Second ploughing	-	-	-
3	First harrowing	1	150/acre	600.00
	Second harrowing	1	100/acre	400.00
4	Bought seed	3 bags	350/bag	1050.00
	Kept seed	1 bags	350/bag	350.00
5	Planting	1	150/acre	600.00
6	Fertilizer	10	332/bag	3320.00
7	Top dressing	-	-	-
8	Shellamine	1	414/acre	1656.00
	Application cost	-	-	-
9	Pesticide	-	-	-
	Application cost	-	-	-
10	Foliar feed	-	-	-
	Application cost	-	-	-
11	Hand weeding	-	-	-
12	Harvesting	1	200/acre	800.00

	TYPE	AMOUNT	PRICE/UNIT KShs	TOTAL COST
13	Gunnies		21.90/bag	876.00
14	Threshing	-	-	-
15	Transport	1 lorry	1000/trip	1000.00
	Working capital (subtotal)			11,452.00
	Interest on working capital			
	(13% of 50% of subtotal)			744.40
	Total variable costs (KShs)			12,196.40

Product Yield = 68 bags

Product Price = 280.65 per bag

Gross output = Shs. 19,084.20

Gross Margin = 19,084.20 - 12.196.40

Gross Margin = 6,887.80

Gross Margin /Acre = Shs. 1,721.95/Acre

Appendix 4

B MAIZE CROP: Season: April to December
Size: 2 acres
Yield: 15 bags/acre Price per bag: KShs. 210.75
Total Yield: 30 bags Total value: KShs. 6,322.50

	TYPE	AMOUNT	PRICE/UNIT KShs	TOTAL COST
1	Land clearance	-	-	-
2	Seed bed Preparation	1 1	250/acre 200/acre	500.00 400.00
3	Seed	1 bag	260/bag	260.00
4	Planting	1	150/acre	300.00
5	Weeding	1	160/acre	320.00
6	Fertilizers	2 bags	354/bag	708.00
7	Top dressing	-	-	-
8	Dust	-	-	-
9	Herbicide	–	–	–
10	Harvesting			200.00
11	Shelling	25 bags	4/bag	100.00
12	Gunnies	-	-	-
13	Labour	-	-	-
14	Transport	-	-	125.00
	Working capital (subtotal)			2,913.00
	Interest on working capital (13% of 50% of subtotal)			189.30
	Total variable costs (KShs)			3,102.30

Gross margin/acre (6,322.50 - 3102.30)/2 = Kshs. 1,610.10/Acre

Appendix 5

A WHEAT CROP: Season: May to October

Size: 10 acres
Price per bag: KShs. 280.65

Yield: 15 bags/acre
Total value: KShs. 42,097.50

Total Yield: 150 bags

VARIABLE COSTS:

	TYPE	AMOUNT	PRICE/UNIT	TOTAL COST KShs
1	Land clearance	-	-	-
2	First ploughing	1	200/acre	2000.00
	Second ploughing	-	-	-
3	First harrowing	1	150/acre	1500.00
	Second harrowing	1	100/acre	1000.00
4	Bought seed	5 bags	350/bag	1750.00
	Kept seed	14 bags	300/bag	4200.00
5	Planting	1	130/acre	1300.00
6	Fertilizer	27 bags	332/bag	8864.00
7	Top dressing	-	-	-
8	Herbicide	5 litres	110/acre	550.00
	Application cost	1 man	20/person	20.00
9	Pesticide	-	-	-
	Application cost	-	-	-
10	Foliar feed	-	-	-
	Application cost	-	-	-
11	Hand weeding	-	-	-
12	Harvesting	10	130/acre	1300.00
13	Gunnies	150 bags	21.90/bag	3285.00
14	Threshing	-	-	-
15	Transport	1 lorry	1000/trip	1000.00

Working capital (subtotal)	26,769.00
Interest on working capital (13% of 50% of subtotal)	1,740.00
Total variable costs (KShs)	28,508.90

Gross margin/Acre = Shs. 1358.85

Appendix 6

B MAIZE CROP: Season: April to December

Size: 3 acres
Yield: 23 bags/acre Price per bag: KShs. 210.75
Total Yield: 69 bags Total value: KShs. 14,541.75

	TYPE	AMOUNT	PRICE/UNIT KShs	TOTAL COST
1	Land clearance	-	-	-
2	Seed bed Preparation	1	200/acre	600.00
3	Seed	1 bag	260/bag	260.00
4	Planting	1	150/acre	450.00
5	Weeding	1	140/acre	420.00
6	Fertilizers	5 bags	332/bag	1660.00
7	Top dressing	-	-	-
8	Dust	3 tins	45/tin	135.00
9	Herbicide	_	_	_
10	Harvesting			525.00
11	Shelling			420.00
12	Gunnies	69 bags	21.90/bag	1511.10
13	Labour			1000.00
14	Transport			800.00
	Working capital (subtotal)			7,781.10
	Interest on working capital (13% of 50% of subtotal)			505.80
	Total variable costs (KShs)			8,286.90

Gross Margin: 14,541 - 8,286.90

Gross Margin/Acre : 6,254.84 /3 = KShs. 2,084.95

C O N F I D E N T I A L

UNIVERSITY OF NAIROBI

DEPARTMENT OF AGRICULTURAL ECONOMICS

Questionnaire used for the survey

Questionnaire used to collect data on resources used in wheat production in 1988

A. 1. Interview running number (IRN) ----------------------

2. Farmer's Name ---------------------------------------

3. Location --

4. Sub-location --

5. Date of Interview -----------------------------------

6. Time interview started ------------------------------

7. What is the total area of your farm? ---------- Acres

8. What is the total area under wheat last year ---- Acres

9. Of the area under wheat last year

Was owned ----------- Acres

Rented ----------- Acres

Other ----------- Acres

Total ----------- Acres

10. How many bags (90 kg) did you produce last year yield ------- bags value @ ------- KShs. per bag. Gross Value ----- KShs.

B. Seed

11. Where do you buy seeds

    (i) KGGCU

    (ii) From fellow farmers

    (iii) Kept my own ----- go to 15

    (iv) Other (specify) --------------

12. Why did you use that type of seed?

    (i) High yielding

    (ii) Stores better

    (iii) Produce better grade wheat for higher pay

    (iv) Others were not available

    (v) It is cheaper to buy

    (vi) Does better with this rainfall regime

    (vii) It germinates faster

    (viii) Leaves the land for other operations

    (ix) Others (specify)

13. What variety did you use?

    (i) Kongoni -------------

    (ii) Tembo ---------------

    (iii) Others (specify)

14. Why did you use that variety?

    (i) It produces better quality wheat for higher pay

    (ii) It matures faster

    (iii) It has better yield

    (iv) It does not lodge

(v) Less susceptible to diseases and pests

(vi) It was the only one available

(vii) It is harvested easily

(viii) Other (specify)

15. Why do you prefer to keep

(i) Seed is expensive so it saves money

(ii) Intended for consumption but remained

(iii) There was no transport to deliver them to buyers

(iv) Have better resistance to pests and diseases

(v) Better yields

(vi) Others (specify)

16. Are bought seeds treated? Yes/No.

17. How do you keep yours treated/not treated ---- go to 18

18. Treated with what

(i) Copper based dusts

(ii) Ash

(iii) Mixed with bought seed

(iv) Other (specify)

19. Does keeping your own seed expose them to damages? Yes/No

20. Which ones?

(i) Weevils

(ii) Beetles

(iii) Rotting

(iv) other

21. Does this result in:

(i) Low yields

(ii) Poor germination?

(iii) Poor resistance to pests and diseases

(iv) Lodging

(v) Other

22. Amount of seed bought ----------kg

23. Amount of seed kept ----------- kg

Total amount used -------------- kg

What is the seeding rate ------- kg

24. What are the problems with seed?

(i) Not available

(ii) Too expensive

(iii) Others

25. What are your suggestions for solving these problems?

(i) For cooperative to be buying for use

(ii) Low priced seed

(iii) Avail the seeds in time

(iv) Better storage methods should be devised

(v) Others (specify)

26. What do you do with harvested seed?

(i) Store some as seed

(ii) Consume some at home

(iii) Sell some for money

(iv) Other (specify)

C. Family Labour used in Wheat Production

27.

Category	Task	Hours/Day	Days/Weeks	Months
Husband				
Wives				
Children over 15 years				
Relatives living on farm or helping				
Total Man-hours				

D. Hired Labour

Which category (i) Casuals

(ii) Permanent

(iii) Others (specify)

28.

Category	Number	Kind of work	Hours/Day	Days/Week	Months
Total Man-hours					

E. <u>Mechanized Land Preparation</u>

29. What is your first step in land preparation?

(i) Clearing the land ----- go to 30

(ii) Ploughing ---------- go to 31

(iii) Other (specify)

30. What do you use?

(i) Family labour

(ii) Hired labour

(iii) Let the animals graze on it

(iv) Use tractor driven mowers

(v) Others (specify)

31. What do you use?

(i) Tractor ------ go to 32

(ii) Oxen ------ go to 32

(iii) Other (specify)

32. Do you

(i) own tractors/oxen

(ii) Hired

(iii) Other (specify)

33.

Category	Type	Kind of Work	Hrs/Day	Days/ Week	Cost/ Unit	Total Cost
Tractor	Hired					
	Owned					
	Other (specify)					
Oxen	Hired					
	Owned					
	Other (specify)					
Other	Hired					
	Owned					
	Other (specify)					

34. What are the problems in hiring labour to help you in wheat production?

(i) Not available

(ii) Too expensive

(iii) Unreliable

(iv) Other reasons (specify)

35. What problems do you have in hiring tractors?

(i) Unavailability

(ii) Too expensive

(iii) No equipment of our own

(iv) High charges in transporting them to our land

(v) Loss of time in land preparation

(vi) Other (specify)

36. Do you experience any problem in the use of tractors in small farm land preparation?

(i) Yes

(ii) No

37. What are the problem(s)?

(i) Hiring costs

(ii) Lateness in preparing land

(iii) Too expensive

(iv) Not available

(v) Other (specify)

38. Do you ever use oxen for any operation?

(i) Yes ------- go to 41

(ii) No --------- go to 39

39. Why don't you use oxen?

(i) Not keep oxen ----- go to 40

(ii) No equipment used in oxdriven

(iii) Never been taught how to

(iv) Other (specify)

40. Why

(i) No land to graze

(ii) No equipment is ox-driven

(iii) Sell them when young

(iv) Other (specify)

41. Which one

(i) Grazing on the land

(ii) Ploughing

(iii) Threshing

(iv) Planting

(v) Other (specify)

42. Which machines would you like to be modified to fit small farm wheat production?

(i) Tractors

(ii) Combine harvesters

(iii) Planters

(iv) Other (specify)

43. What modifications or change would you like to see in them/it

(i) Smaller size

(ii) Ox-drawn

(iii) Simplify its operation

(iv) Other (specify)

44. Are there any new methods of harvesting and land preparation you would suggest?

(i) Yes ------- go to 45

(ii) No

(iii) Other (specify)

45. Which one

(a) <u>Harvesting</u>

(i) Sickle to harvest and use threshing machine

(ii) Smaller combine harvester

(iii) Ox-driven harvester

(iv) Tractor driven harvester

(v) Other (specify)

(b) <u>Land Preparation</u>

(i) Use of smaller tractors

(ii) Use of ox-drawn equipment

(iii) Others (specify)

46. What solutions would you suggest to these problems?

(i) By the farmers

(ii) By the Government

F. Fertilizer

47. Fertilizer application rate ------ kg/acre

Type of Fertilizer	Time when Used	Amount used
Total Amount (Kg)		

G. Herbicides

Application rate(s) ----- litres/acre

Type of Fertilizer	Time when Used	Purpose	Amount Used	Cost/Unit (KShs.)	Total Cost (KShs.)
Total Cost (KShs.)					

49. What problems do you experience with fertilizers?

(i) Not available

(ii) Too expensive

(iii) Demands too much labour to apply

(iv) No tractor to be used in application

(v) Others (specify)

50. What remedy would you suggest?

(i) Lower prices

(ii) Avail them in good time

(iii) Others (specify)

51. What problems do you encounter in using the agro-chemicals?

(i) No equipment to apply them

(ii) No labour to apply them

(iii) No tractors available readily

(iv) They are toxic

(v) They are not effective

(vi) They are not available when needed

(vii) Others (specify)

52. When did you plant your wheat last year?

Week ----------- Month --------

53. Was there a delay?

Yes --------- go to 54

No --------

54. What was the cause?

(i) Tractors were not available in good time

(ii) Seeds were not available in good time

(iii) Fertilizer was not available in good time

(iv) Land preparation delayed

(v) Rains delays in felling

(vi) Others (specify)

55. How do you harvest your crop?

(i) Using combine harvester ----- go to 56

(ii) Use of sickle

(iii) Other (specify)

56. Where do you get the harvester?

(i) Owned ----- go to 57

(ii) Hired

(iii) Other (specify)

57. What is the rate of hiring one?

------- Kshs./Acre

58. What acreage did it work for you? -------

59. Are there charges for bringing the combine harvester to your farm? How much? -------

60. What are the problems experienced in harvesting wheat?

(i) No combines in good time

(ii) Too expensive to hire

(iii) They are unwilling to work on our farms

(iv) Others (specify)

61. What are the possible solutions?

(a) By you as farmers

(b) By the Government

62. After harvesting what do you do with the wheat?

(i) Transport to KGGCU ----- go to 63.

(ii) Store in the house for some time ----- go to 65

(iii) Keep for consumption

(iv) Keep for seed

(v) Others (specify)

63. What mode of transport

(i) Lorries

(ii) Pick-ups

(iii) Others (specify)

64. What are the problems of transportation?

(i) Too expensive

(ii) Unavailable means

(iii) Others (specify)

65. Where do you store them?

(i) In bags

(ii) In cribs

(iii) On the floor

(iv) Others (specify)

66. What are the problems of storage?

(i) No suitable storage facilities

(ii) Damage in storage

(iii) Others (specify)

67. Do you use credit for wheat production?

(i) Yes ----- go to 68

(ii) No ----- go to 69

(iii) Others (specify)

68. Which source

(i) AFC

(ii) Relatives/friends/neighbours

(iii) Organised lending groups

(iv) Commercial banks

(v) Others (specify)

69. Why don't you?

(i) No credit available ---- go to 70

(ii) Credit available but no collateral

(iii) I don't need it

(iv) Others (specify)

70. Would you like to have credit?

(i) Yes ------- go to 71

(ii) No ------- go to 72

71. Why do you need it?

(i) Inputs are expensive

(ii) No other source of income

(iii) Uncertainty in wheat production

(iv) Others (specify)

72. Why don't you like credit?

(i) Have enough funds

(ii) Credit terms unfavourable

(iii) Wheat not profitable enough to pay back

(iv) Others (specify)

73. What form of credit would you like?

(i) Co-operative where you take inputs and they deduct from your sale of harvested wheat

(ii) Credit covering fertilizer and Agro-chemicals only.

(iii) Credit scheme for the whole operation.

(iv) Others (specify)

74. Why do you insist on wheat growing?

(i) Large size of land

(ii) Lack of labour work on other enterprises

(iii) Wheat is more profitable

(iv) Most work is done by machines hence it is easier to produce.

(v) Others (specify)

75. What enterprises compete with wheat?

(i) Maize

(ii) Dairy

(iii) Vegetables

(iv) Others (specify)

76. In what area?

(i) Compete for land

(ii) Compete for labour

(iii) Compete for fertilizer and agro-chemicals

(iv) Other (specify)

77. How do you resolve the competition?

(i) Grow them in rotation

(ii) Reduce the area under wheat

(iii) Reduce the area under the enterprise

(iv) Others (specify)

78. Are there any Enterprises you prefer to wheat?

(i) Yes ----- go to 79

(ii) No

79. Which one?

(i) Maize

(ii) Dairy

(iii) Others (specify)

80. Why do you prefer this enterprise?

(i) More paying

(ii) Staple food

(iii) Easy to operate

(iv) Others (specify)

81. What can you say is the effect of the enterprise on your wheat production?

(i) None at all

(ii) Replacing wheat

(iii) Grow them alternately

(iv) Other

82. What can you say about your future wheat production?

(i) I will decrease land devoted to it

(ii) I will phase it out

(iii) I will increase its production

(iv) I will not change

(v) Other _(specify)

83. Why have you taken that stand?

84. Can you suggest ways of increasing productivity of wheat?

(i) By the farmers

(ii) By the Government

85. Do you prefer dairy to wheat?

(i) Yes ------ go to 86

(ii) No ------ go to 87

86. Why?

(i) Higher paying

(ii) Tradition

(iii) Easier to operate

87. Why not?

(i) Dairy is more expensive

(ii) Dairy needs more land

(iii) Other (specify)

88. If you had more land would you increase your dairy enterprise instead of wheat? Yes/No

Why?

89. Do you prefer maize to wheat? Yes/No

Why?

90. If you had more land would you increase wheat or maize acreage per season? Yes/No

Why?

ENTERPRISE COSTING

Total farm size ---------------------------------- Acres

Land under wheat, 1988 -------------------------- Acres

Land under Maize in 1988 ------------------------ Acres

A. Wheat Crop Season from --------- to ---------

Size -------- Acres

Yield ------- bags Value ------------ KShs.

Gross value ---------------- KShs.

Variable Cost

Type	Amount	Price/Unit	Total Cost (Kshs.)
1. Land clearance			
1b Land clearance			
2. First ploughing Second ploughing			
3. First harrowing Second harrowing			
4. Bought seed Kept seed			
5. Planting			
6. Fertilizer			
7. Top-dressing			
8. Herbicide Application costs			
9. Pesticide - Fungicide Application costs			

Type	Amount	Price/Unit	Total Cost (Kshs.)
10. Foliar feed Application costs			
11. Weeding by hand			
12. Insecticide Application			
13. Harvesting			
14. Gunnies			
15. Threshing			
16. Transport/ Loading			
17. Gunny bags			
18. Labour/Others			
Working Capital (Sub-Total)			
Interest on Working Capital			
Interest on Working Capital (13% of 50% of Sub-total)			
Gross Value - Total Variable Costs			

Gross Margin per Acre ------------ Kshs.

Maize Crop:

Long rains of 1988 from ---- to ---- Size ----- Acres

Output: Yield ---- Bags Value @ KShs. per bag

Gross value ------ KShs.

Variable Costs:

Type	Amount Used	Cost per Unit (Kshs.)	Total Cost (Kshs.)
1. Land clearance			
2. Seedbed preparation			
3. Seed			
4. Planting			
5. Weeding			
6. Fertilizers			
7. Top-dressing			
8. Dust			
9. Herbicide			
10. Harvesting			
11. Shelling			
12. Gunnies			
13. Labour			
14. Transport			
15. Other(s)			
Working Capital Sub-total			
Interest on Working Capital (13% of 50% of Sub-Total)			
Total variable Cost (Kshs.)			
Gross Output - Total Variable Cost			

Gross Margin ----------- KShs/Acre