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FACTORS INFLUENCING RELATIVE PROFITABILITY OF ALTERNATIVE CROPS IN KENYA: IMPLICATIONS FOR MAIZE POLICY

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FACTORS INFLUENCING RELATIVE PROFITABILITY OF ALTERNATIVE CROPS IN KENYA: IMPLICATIONS FOR MAIZE POLICY

By

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ABSTRACT

FACTORS INFLUENCING RELATIVE PROFITABILITY OF ALTERNATIVE CROPS IN KENYA: IMPLICATIONS FOR MAIZE POLICY

By

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Relative profitability of maize *vis-a-vis* that of alternative annual crops in Kenya is determined using household level data from six districts in three provinces of Kenya. Taking into account whether farmers are *net buyers* or *net sellers* of maize, the profitability results are used together with other empirical information to determine the main constraints to agricultural commercialization.

The results show that profitability varies by region, by type of crop enterprise, and by type of technology employed. The main constraints to agricultural commercialization are: (1) low relative profitability of some alternative crops compared to that of maize and its inter-crops; (2) small land size holding and low productivity potential; (3) unavailability of sufficient water necessary for crop production; (4) lack of adequate market openings for alternative crops and (5) lack of an enabling environment for commercial agriculture.

This study also found that 73 percent of the farmers would prefer to grow maize even if it was relatively unprofitable because their main concern is to ensure a sufficient supply of maize, the main staple. The study concludes that it is indeterminate whether policies that lead to reduced maize prices such as, removal of import tariff will necessarily lead to reduced maize acreage; and a subsequent shift to cultivation of alternative crops.

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CHAPTER ONE

INTRODUCTION

1.1 Background

Since the advent of market liberalization, spearheaded by the IMF and the World Bank, there has been increasing debate on its impact on producers and consumers in developing countries. The proponents of market liberalization anticipated that the process would create opportunities for farmers to increase their incomes by shifting from subsistence farming to commercial farming (World Bank, 1997). Liberalization has involved reforms to macroeconomic and trade policies designed, *inter alia*, to improve price incentives for production of tradables (Doward *et al.*) and, hence, bid resources away from the production of non-tradables. In the context of the agricultural sector, tradables are viewed as high-value, export-oriented crops while non-tradables are viewed as low-value food crops.[1]

Liberalization also involved reforms to sectoral policies such as the removal of controls on inter-regional trade and, pan-regional and pan-seasonal prices. The controls were removed in order to generate spatial and temporal arbitrage, which would in turn stimulate private trade from surplus to deficit areas, as well as encourage private

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[1] Tradables are commodities that are traded in the world market and usually include crops that are commonly referred to as cash crops, commercial crops, export crops or crops with a high ratio of value to transport costs per unit while non-tradables are commodities that are not traded internationally. They are usually referred to as food crops, subsistence crops or crops with low value per unit relative to transport costs.

participation in storage, especially of grain, to smooth commodity supply across time and space. With trade of food commodities in the hands of the private sector, it was expected that the 'pieces' of the *structural transformation paradigm* would fall in place and thus spur economic growth.

While various definitions of structural transformation are provided in the literature, this study adopts the definition put forth by Staatz (1994). Staatz defined structural transformation as:

> *" a process by which increasing proportions of employment and output of the economy are accounted for by sectors other than agriculture. The economy becomes less agriculturally oriented in a relative sense, although agriculture and, more broadly, the food system continue to grow absolutely and generate important growth linkages to the rest of the economy."*

This means that structural transformation entails a net transfer of resources, especially labor, to other sectors of the economy. But, as Staatz points out, such a transfer of resources requires the following four conditions in order to occur. These are:

1. Low food prices relative to wages in off-farm activities;
2. Assurance of a sufficient food supply to urban consumers;
3. Existence of a low-cost exchange system; and
4. Existence of an effective information system.

Low food prices relative to wages in off-farm activities are crucial because those leaving agriculture need assurance that they will be able to buy food from their wages. If this assurance is missing, then farmers will be reluctant to give up own production to meet household consumption needs. Additionally, an assurance of sufficient food supply is

necessary because, not only do workers require the ability to afford food, but they also require sufficient food to be a available. Existence of a low-cost exchange system and an effective information system are necessary to reduce transaction costs, which must be low in order to ensure low food prices.

In the literature, structural transformation is commonly confused with three other closely related concepts: *agricultural transformation, agricultural commercialization,* and *agricultural diversification.* Timmer (1997) distinguishes between these latter

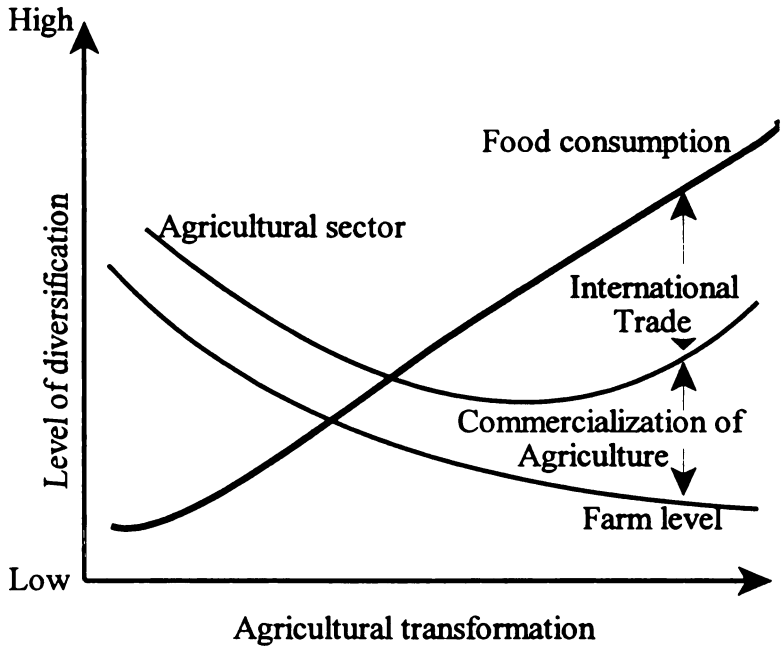

Figure 1. Relatonships between agricultural transformation, agricultural diversification and agricultural commercialization.

Source: Timmer, P.C. 1997. Farmers and markets: The political Economy of new paradigms. Amer. J. Agr. Econ. 79. 623.

concepts and clarifies how they relate to structural transformation. In Figure 1, the horizontal axis represents the level of agricultural transformation which accompanies economic growth. Movement to the right reflects the fact that with economic growth, the level of agricultural transformation increases as part of structural transformation. Agricultural transformation is said to occur whenever the share of agriculture in a country's labor force and total output declines both in cross sectional and time series samples. The vertical axis, on the other hand, represents the degree of agricultural diversification. In the early stages of agricultural transformation, the degree of diversification at the individual farm level is high with little specialization. This phase is characterized by incomplete markets for local produce with few mechanisms for dealing with crop production and marketing risks. As markets develop, farmers tend to specialize in one or just a few crops. Hence, farmers with different resource endowments and agro-ecological conditions will tend to specialize in different crops. The increasing specialization by individual farmers leads to decreased crop diversity at the individual farm level, while leading to increased diversity at the agricultural sector (aggregate) level. As structural transformation increases, agricultural transformation also increases and the gap between the levels of diversification at the (individual) farm and at the aggregate level increases. This gap indicates the degree of commercialization. Therefore, the degree of commercialization is a proxy for economic growth. *i.e.* the higher the degree of commercialization, the higher the level of agricultural transformation and by implication, greater economic growth. Hence, understanding the constraints to agricultural

commercialization is essential for understanding what is slowing down agricultural transformation in Kenya.

Agricultural commercialization may be defined as the proportion of agricultural production that is marketed and can be measured along a continuum from zero to 100 percent (Govereh *et al.*, 1999), where zero percent represents no commercialization and 100 percent represents complete commercialization. Complete commercialization implies that the farming household sells all the produce (crop) from his farm and consumes none itself. This would suggest that the farmer cultivates his land and grows crops for sale and then uses the cash earned to buy what he needs for his household's consumption.

Figure 1 also shows that as international trade increases, food consumption patterns become more diversified than domestic production patterns. Hence, as structural transformation occurs, the combination of agricultural commercialization and international trade, which accompanies it, leads to a situation whereby individual farmers depend more on the market for their food supplies and less on their own production.

The structural transformation paradigm and subsequent advocacy for market liberalization are mainly based on, among other things, empirical evidence which shows that all countries that have substantially improved real incomes have gone through structural transformation (Timmer, 1990)[2], whereby their agricultural sector's share of GDP declined over time. Hence, some economists believe that if developing nations implement structural adjustments to their economies as espoused by the transformation

[2] Cited in Staatz (1994).

paradigm, the economies of these nations will grow absolutely and hence the welfare of citizens in these nations would improve.

1.2 The situation in Sub-Saharan Africa

After almost two decades of embracing market reforms, economic growth still remains elusive to most African countries. This has led many social scientists to question the relevance of the reforms for promoting economic growth in Africa. Following their study on cash crop marketing, Doward *et al.* concluded that in sub-Saharan Africa smallholder agriculture has generally responded weakly to structural adjustment and market liberalization. **Why is this the case?** The search for an answer to this daunting question is currently the central theme of the research agenda for many researchers in Africa as evidenced by, among others, the presentations at the recent Fourth International Workshop on Agricultural Transformation in Africa.[3] This question is the focus of this study, with Kenya used as a case study to provide information to answer it.

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The author attended the workshop, which was held in June 27-30, 1999, Nairobi, Kenya, sponsored by Egerton University's Tegemeo Institute of Agricultural Policy and Development, Michigan State University, and The Eastern and Central Africa Programme for Agricultural Policy Analysis (ECAPAPA).

1.3 Problem Statement

While liberalization occurred in several sectors of the Kenyan economy, the agricultural sector has received most attention from policy makers and researchers. Specifically, the maize sub-sector has drawn tremendous attention in the last few years because maize is the most important crop in Kenya and policies affecting its availability greatly impact the farming sector and the food industry.

Liberalization of maize marketing in Kenya, which started in late 1980s, mainly focused on the decontrol of the maize market, *albeit* very gradually, and the restructuring of the National Cereals and Produce Board (NCPB), the major maize marketing agency. In the pre-liberalization period, non permit inter-district maize movement was limited to two 90-kg bags. This limit was first raised to 10, then to 44, and finally to 88 bags over a period of nine years before free movement was finally allowed (Lewa and Hubbard, 1995). The introduction of free movement has facilitated ease of transfer of maize from surplus to deficit regions. As a result, the NCPB's role in maize marketing has been reduced to being a residual buyer for the purpose of stocking strategic reserves.

There are varying views as to the effects that these liberalization measures have had on consumers and producers. Jayne *et al.* (1997) argue that, "*liberalization has conferred substantial benefits to urban consumers*" as people are now able to get maize and mill it themselves. One can also hypothesize that liberalization has also conferred benefits to producers who now have access to a wider market, enabling them to receive competitive prices and timely payments for deliveries. However, some government

interventions remain in place that affect, among other things, maize prices. For example, the government is still involved in the trade of imported maize – both by deciding who imports (*i.e.* the government issues import licenses) and by imposing an import tariff. Also, the NCPB continues to set maize prices for its depots.

Donors have criticized these government interventions as key obstacles to Kenya's agricultural development. However, the government has usually defended the interventions, arguing that they are in the best interest of the agricultural sector. For instance, a number of cabinet ministers argued that, "*unless the government reverses the liberalization process, the agricultural sector was bound to collapse*" (Daily Nation, December 14, 1998). In March 1998, the Ministers of Finance and Agriculture jointly announced the suspension of the maize import tariff, which was at 25 percent during the month of April, in order to "*ensure* that *imported maize was affordable to consumers*" (Daily Nation, March 11, 1998). However, in October 1998, the President reversed his ministers' decision and raised the tariff from 25 percent to 32.5 percent, arguing that "*the (importation) trend can't be allowed to continue because it leads to increased dependency on imported goods*" (Daily Nation, October 1, 1998). These and many similar examples, illustrate the erratic nature of government intervention in the maize sub-sector.

Some authors have criticized the import tariff, arguing that the tariff (which raises maize prices) actually hurts more rural households than it protects because the majority of rural households (61 percent) are net buyers of maize (Jayne *et al.*, 1998; 2000). Thus, the purchasing power of these households is reduced by higher maize prices. Other authors have argued that high maize prices (or high food costs in general) impede agricultural

commercialization based on non-food crops because high food costs force farmers to produce food (maize) for themselves, rather than rely entirely on the market for their supplies. However, this argument is based on the assumption that farmers' cropping decisions are based on the expected net returns to the alternative crops and that a stable market exists for the non-food crops (Owuor, 1998; Omamo, 1998; Jayne, 1994). Implicitly, the arguments are also based on the assumption that the riskiness of growing alternative crops is either lower than that for maize, or at least is not important enough to offset the assumed higher returns that the alternative crops would provide.

Furthermore, the arguments for shifting resources away from food crop production also assume that food crops and export crops are substitutes in production. Lamb (2000) provides evidence from several sub-Saharan African countries which shows that only in the *short run,* are food crops and export crops substitutes in production. But even in the *short run,* as Lamb acknowledges, such shifts in resource allocation might result in declines in agricultural output leaving countries vulnerable to declines in domestic food without adequate foreign exchange earnings to purchase food in world markets. A possible explanation for lowered total agricultural output in the short run is that it may take several years for export crops such as tea or coffee to produce output for the market while food crop production falls immediately. It is therefore unclear whether most countries would successfully go through the intervening short run period of declining domestic food stocks in order to realize long run impacts of the shifts in resource allocation.

This study makes an empirical contribution to the search for the reason(s) why market reforms have not had the anticipated impacts in Kenya. Farm-level data collected from rural households in Kenya are analyzed to determine the main constraints to agricultural commercialization-- a necessary first step to agricultural and structural transformation.

1.4 Study Objectives

The objectives of this study are:

1. To determine the constraints to agricultural commercialization in Kenya; and
2. To identify strategies for addressing these constraints in order to increase rural incomes.

To address the objectives of this study, the profitability of maize is estimated and compared with the profitability of major alternative crops in selected districts in Kenya. More specifically, this study uses household-level data that was collected in 1999 to analyze variations in profitability of maize and major alternative crops across:

(a) regions of high and low potential for maize production; and

(b) different farming categories (*i.e.* whether households are net buyers or net sellers of maize).

This study focuses on maize because first, it is the most important food staple for the majority of Kenyan households and, second, because agricultural commercialization is anticipated to occur via diversification away from maize production towards greater

production of higher value crops. The specific crops that are alternatives to maize vary by region, depending on agro-climatic conditions, physical infrastructure and institutional settings unique to each district. In this study, alternative crops are defined as the most important crop grown in each district besides maize.

1.5 Significance of the study

It is of critical importance to determine the constraints to agricultural commercialization and identify strategies for addressing the constraints in order to increase rural incomes in Kenya. First, understanding the constraints faced by farming households can help policy makers to understand the underlying logic of farmers' actions. Second, this study contributes to the pool of information regarding the on-going debate on why structural transformation has been slow in occurring in developing countries.

1.6 Organization of Study

This thesis is organized as follows: Chapter Two presents background information about the role of maize in Kenya. First, data are presented to document the importance of maize as the staple food crop for the majority of the Kenyans and as a source of rural incomes. Then, maize supply and demand trends over the past two decades are reviewed -- highlighting the present level of production, geographic location of production and

demand, the effect of crop seasonality on prices, and government interventions in the maize sub-sector which have sought to reverse the decline in maize production.

Chapter Three presents a focused review of maize marketing liberalization in Kenya from 1980 to date. In addition, relevant empirical studies are cited that highlight the main concerns in Kenya about maize production and marketing, as they relate to current attitudes of policy makers. The analytical framework used in this study is also presented in this chapter.

Chapter Four presents the research design, including details about the characteristics of the survey areas - location, agro-ecology and agriculture. A brief description of the data, sampling method and survey implementation is also presented.

Chapter Five reports the empirical results. A detailed discussion of the relative profitability of various crop enterprises is presented, along with a discussion on the implications of the results. Inferences based on these results and discussion form the basis of the conclusions presented in Chapter 6.

CHAPTER TWO

BACKGROUND: THE MAIZE NATIONAL SITUATION

Maize is the most important crop in Kenya and policies affecting its availability have a great impact on the farming sector and the food industry. Three major issues concerning maize still remain as challenges for policy makers: the perennial shortage of domestic maize supply during off-season months, relative to the year round demand; the inefficiencies of the maize distribution system, given the geographically dispersed areas of supply and demand; and the continuing state of poverty that characterizes the majority of maize farmers, despite substantial effort by the government to improve farm productivity and profitability.

This chapter provides a brief description of the national maize situation, highlighting the importance of the crop, the supply and demand trends and the key issues concerning the commodity in order to clarify the content and findings of the study.

2.1 Importance of maize in Kenya

Maize is the most important food crop in Kenya. Over 70% of Kenya's population consume it as their main staple and over 75% of rural households cultivate the crop, both as a source of food as well as a source of farm income (GOK, 1997; Hassan and Karanja, 1997). Because maize forms a major part of the Kenyan diet, while at the same time being

a major source of farm income for majority of rural households, the crop has great economic and political significance in the country. Thus, the government places high priority on increasing maize production, as well as on improving maize farmers' incomes.

2.2.1 Maize production: volume, area and yield

The area under maize production stabilized in mid-1990s at around 1.4 million hectares with limited potential for expansion (GOK, 1997). Currently, maize yields average about 2 mt per hectare, although a potential exists for increasing yields to over 6 mt per hectare (ibid). While maize production has fluctuated greatly from year-to-year, national production has increased from 1.3 million mt to slightly over 2 million mt over the last two decades (Fig. 2). Sharp drops in production have mainly been due to severe drought. For example, the droughts of 1984/85 and 1993/94 are responsible for the low output in those production periods.

While maize production grew at an average annual rate of 4.4% during the 1980-90 period, production declined by 1.8% annually during the 1990-95 period (Nyoro and Jayne, 1999). This declining trend in maize production continues to be a major concern for the government of Kenya, as well as for other stakeholders in the agricultural sector.

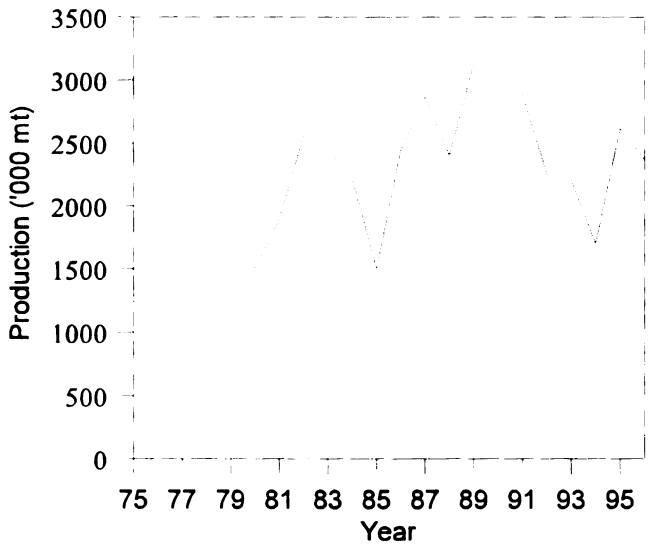

Figure 2. Maize production in Kenya - 1975 - 1996

Source: Kenya MOALDM and CBS, Statistical Abstracts[4]

2.2.2 Maize Production system

Although maize is produced under a variety of farming systems, about 75% of the crop is produced by small-scale farmers who employ a wide range of farming practices. While some small-scale farmers use tractors or oxen for specific activities (*i.e.* ploughing and harrowing), most carry out all other farming activities by hand using either family or hired manual labor. In contrast, large-scale farmers follow a highly mechanized production system in which they use tractors to carry out most of their farm activities. In addition,

[4] Figures obtained from Table 1 in Nyangito, H. 1998.

they plant hybrid seed, apply fertilizer, and a majority use herbicides for weed control rather than manual labor.

Labor used for farm activities is available under a variety of arrangements. Relatively well-off farmers employ one or more permanent workers as laborers, while most farmers hire labor only for specific activities such as weeding. While almost all farming households utilize family members as the main source of labor, they typically hire labor to supplement family labor during peak activity periods.

Maize cropping regimes are extremely complex. Large-scale farmers mainly cultivate maize as a mono-crop (pure stand), but small-scale farmers almost always practice inter-cropping. Legumes (*i.e.* beans, cowpeas, and pigeon peas) are most commonly inter-cropped with maize, although some farmers inter-crop maize with root crops and tubers. The crop mix ranges from two to six crops on the same plot, with seeding rates for each crop varying widely - even within a very small geographical area. It is indeed accurate to say that the crop mixes are as varied and as many as there are farming households.

2.2.3 Geographic location of production

The bulk of Kenya's maize is produced in the highlands of the Rift Valley Province, which is located to the western part of the country. Trans-Nzoia District leads the Province in maize production, followed by Nandi, Uasin Gishu, Nakuru, Kericho and Bomet Districts, respectively. Trans-Nzoia, Nandi and Uasin Gichu Districts produce

above two million bags (90 kg/bag) of maize each. This figure of two million bags from a single district is significant because it exceeds the (individual) production level of Central Province, Coast, Eastern, North Eastern or Nairobi Province. Besides the Rift Valley Province, Nyanza and Western are the only other provinces, whose production exceeds two million bags per year. These data highlight the fact that most of the maize production areas are located in the Western part of Kenya.

In 1998, Nyanza, Western and Rift-Valley Provinces accounted for over 85% of Kenya's total maize production (Table 1). Therefore, it is not surprising that the government usually responds promptly to the grievances of maize farmers from western Kenya. For example, in 1999, when the price of one 90-kg bag of maize fell to Ksh 600 ($0.11/kg)[5] -- which farmers saw as being far below their costs of production -- farmers organized themselves and held back the sale of maize and demanded a price of Ksh 1,500 per bag ($0.28/kg). Farmer protests intensified, resulting in the government agreeing to purchase one bag of maize at Ksh 1,200 ($0.22/kg) through the NCPB – which in essence set a floor price for maize.

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[5] The January - March 1999 average exchange rate was Ksh. 60.60 = 1 USD.

Table 1. Maize production in Kenya by Province, 1998

Province	Area in hectares	Production (90-kg bags)	Percent of total production (%)
Rift Valley	473,380	14,968,171	54.7
Western	184,442	5,172,006	18.9
Nyanza	164,982	3,614,499	13.2
Eastern	480,505	1,808,110	6.6
Central	137,377	1,317,098	4.8
Coast	29,317	422,848	1.5
Nairobi	2,585	45,601	0.2
North Eastern	3,152	30,565	0.1
Total	**1,475,740**	**1,475,740**	**100.0**

Source: Kenya MOALDM

2.2.4 Geographic location of demand

The greatest demand for maize grain comes from large-scale millers who are mainly based in Nakuru and Nairobi. These firms mill the grain into flour and pack it in 2-kg bags for distribution to consumers in urban as well as rural areas across the country. The majority of maize buyers are based in the central and eastern parts of the country, which are maize deficit areas. Traders also supply maize grain directly to consumers in deficit areas. Usually, wholesalers buy maize from Nakuru, Uasin Gishu, Nandi Kericho, Bomet, Trans-Mara and Trans-Nzoia districts and transport it to the high-demand deficit areas of Kisumu, Siaya, Nairobi, Machakos and Kitui (Nyoro *et al.*, 1999). Once in the

deficit regions, the maize is sold to retailers who re-sell it as grain to consumers or who first mill it and then sell it as maize flour.

2.3.1 Crop seasonality

Generally, the domestic maize supply is largest during the peak harvest months of August to October and becomes tight from March to May. The extreme seasonality of the crop causes severe market price fluctuations during the year. On average, maize prices in the major markets of Kenya gradually rise during the lean months (February to July), abruptly dropping during the peak harvest months (August to October), and then remain low until January (Fig.3). Because crop seasonality affects the behavior of maize prices, it has critical implications for the proper timing of maize import arrivals. If imports arrive during the peak harvest period, then they may cause prices to fall below what they usually are and hence reduce the profitability of maize to farmers.

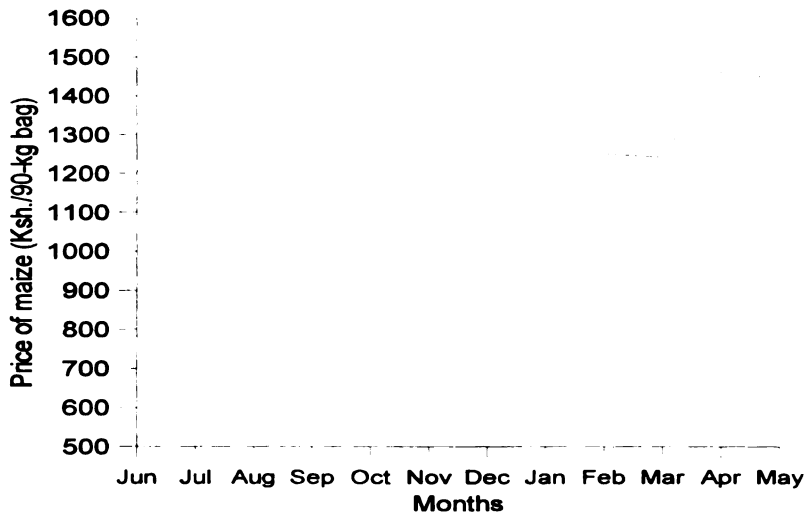

Figure 3. Average maize prices for major markets in Kenya - June, 1998-May, 1999

Source: Kenya MOALDM - farm management handbooks, District reports. Various issues.

2.3.2 Domestic supply and imports

Table 2 shows the domestic production, marketed volumes, exports, and imports of maize for the period 1975/76 to 1995/96[6]. During the 1970s and 1980s, Kenya was generally self-sufficient in maize production. However, the first half of the 1980s was characterized by considerable shortfalls, due to the droughts of 1981 and 1984, leading to

[6] These and other data presented in this thesis do not take into account cross-border trade with neighboring countries.

imports during that period. In the 1990s, production shortfalls required the government to import maize in most years, especially after 1992. Also, the demand for maize has been increasing due to the rapid annual population growth, which is estimated at about 3%. But, achieving commensurate growth in maize production, estimated at 4% per annum, remains elusive (GOK, 1997). While other constraints to sustained growth of the maize sub-sector may exist, the Development Plan of 1997-2000 identified three key constraints: unreliable marketing and uncertainty in the sale of surpluses, inadequate farmer use of improved seeds and fertilizers; and low profitability as a result of low yields and poor marketing conditions.

Table 2. Total production, marketed production, exports and imports of maize, 1975/76 - 1995/96, Kenya

Year	Total Production '000 mt	Marketed production '000 mt	Exports '000 mt	Imports '000 mt
1975/76	1375.2	487.8	120.8	0.0
1976/77	1597.1	564.7	113.0	0.0
1977/78	1671.4	424.0	8.0	0.0
1978/79	1620.0	330.2	23.0	0.0
1979/80	1606.5	241.7	120.0	0.0
1980/81	1888.3	217.9	0.0	224.0
1981/82	2560.0	472.9	1.0	77.0
1982/83	2450.1	571.3	1.0	89.0
1983/84	2214.8	637.1	123.0	0.0
1984/85	1500.0	560.6	47.0	405.0
1985/86	2440.3	582.9	18.0	125.0
1986/87	2870.0	669.5	228.0	0.7
1987/88	2400.0	651.9	248.0	0.0
1988/89	3140.0	485.3	167.0	0.0
1989/90	3030.0	625.9	110.0	0.0
1990/91	2890.0	509.3	160.0	0.0
1991/92	2252.7	303.5	18.7	0.0
1992/93	2205.0	324.1	0.42	414.4
1993/94	1698.3	241.8	0.11	12.9
1994/95	2620.8	316.0	0.17	650.4
1995/96	2369.7	401.0	221.5	10.8
1996/97	2214.0	NA	2.6	1,101.0
1997/98	2430.0	NA	9.1	368.8
1998/99	2250.0	NA	30.5	73.5
1999/00	1800.0	NA	NA	NA

NA = data not available.

Source: Kenya MOALDM and CBS, Statistical Abstracts[7], FAO Statistical Database.

[7] Figures obtained from Table 1 in Nyangito, H. 1998. FAO database provided the figures for period after 1997.

Due to the gap between domestic supply and demand that has existed since the early 1990s, maize imports have increasingly been the means by which Kenya mitigates inadequate domestic supply (Table 2) . In some years, imports have been large enough to depress domestic prices. For example in 1997, 1.1 million mt of maize were imported, an amount that is equal to about 50% of Kenya's total production. Obviously, imports are inevitable since the country is no longer self-sufficient in maize production. However, in recent years, farmers have reacted negatively towards importation manifesting their reaction in protests and riots. Protests and riots by farmers are a key indicator of the (perceived) impact of imports on producers' incomes. However, no empirical studies have been conducted to determine if the alleged low prices, that led to farmer protests, were mainly due to the arrival of imports. In contrast researchers who have analyzed the impacts of maize imports have mainly documented their positive impacts on consumers, due to lower prices, and are silent about the impact on producers (e.g. Argwings-Kodhek, 1999; Argwings-Kodhek and Jayne, 1996).

2.3.4 Government intervention

Considering the economic and political importance of maize, the government has historically intervened in the maize trade in spite of its policy to liberalize the sub-sector. The mode of intervention has been varied and sometimes erratic. To date, one way that the government intervenes in the maize trade is via imposing an import tariff, which it sets

at various rates depending on the desired outcome. In addition, in some years the government has set a floor price, as happened, most recently in 1999. With respect to the floor price, the overriding policy issue is, "at what level should support prices be set to balance the different interests in the commodity system (including maize producers and consumers).

Based on his analysis of data from various sources, including farm surveys, Nyangito (1998) concluded that the country has a comparative advantage in producing maize (as compared to importing maize), *although it does not necessarily have a comparative advantage in exporting maize.*[8] However, regarding what is needed to ensure growth in the maize sub-sector, Nyangito provides a list of recommendations that must be implemented if food security is to become a realizable objective in Kenya[9]. These recommendations include:

(a) the need to streamline the farm input delivery system in order to make affordable inputs available to farmers;

(b) the need to enhance farmers' knowledge regarding the appropriate use of inputs;

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[8] Italics mine.

[9] These recommendations are indeed similar to those found in most policy documents such as the National Development Plans of Kenya and sessional papers.

(c) the necessity to invest in developing high-yielding maize varieties;

(d) the urgent need to improve Kenya's road and market infrastructure; and

(e) the need to remove market distortions.

The first four recommendations are unequivocally essential for increasing, not only maize production, but also the production of all crops because they lead to improved efficiency in crop production and marketing. However, the last recommendation on the removal of market distortions is moot. Currently, the main distortionary policy in the maize sub-sector is the import tariff. The debate on this issue is on-going and has garnered advocates who hold opposite views regarding whether or not the tariff should be removed. The arguments in support of the tariff hinge on its importance as a tool for protecting maize producers from competition with imported maize. As a result of the tariff, domestic prices are usually kept higher than world prices -- which creates an incentive for continued (and increased) production. The need to encourage domestic production stems from the fact that maize is the most important crop in Kenya, especially as a staple food crop.

The argument for removing the import tariff is based on (welfare) economic theory. It is also based on household food security concerns for many households who are net maize buyers. According to economic theory, removal of the tariff will lead to higher social welfare. This is because the resulting gain in consumer surplus is far greater than the loss in producer surplus. In theory, consumers can compensate producers for their loss and still be left with a surplus. Hence, for the economy in general, the removal of the tariff is likely to be beneficial. However, in practice it is difficult for consumers to compensate

producers for their loss because of the complexity of an appropriate transfer program and the costs of administering such a program may be prohibitively high. Therefore producers lose out as a result of removing the tariff. Reconciliation of the above views for informing policy requires a detailed analysis of the distributional impacts on both consumers and producers which is beyond the scope of this study.

CHAPTER THREE

RELATED STUDIES, THEORY AND METHODS

This chapter contains a focused review of the literature of related studies, theory, and analytical methods. It starts with a brief review of the structural transformation paradigm and how the process works to bring about economic growth. This is followed by a review of the challenges that the structural transformation process has placed on Sub-Saharan Africa, followed by a discussion of the analytical framework.

3.1 Structural Transformation: setting the stage

Theoretically, the process of agricultural transformation has four main stages (Timmer, 1990). The first stage is characterized by a predominantly agrarian economy in which the priority is to 'jump start' agriculture. During this stage the rest of the economy, outside agriculture, is so small that there is a need to tax agriculture in order to kindle the rest of the economy. However, it is essential in this stage that some of the government's revenues are reinvested back into the agricultural sector to improve productivity and promote growth.

In the second stage, the agricultural sector continues to grow and plays a primary role in the economy, as the main contributor to economic growth. The sector provides, among other things, food, a market for factor inputs, and raw materials for industry. During this stage market linkages between agriculture and the rest of the economy are established.

The third stage is characterized by an agricultural sector that has fully been integrated into the rest of the macro-economy. In this stage the agricultural sector becomes more vulnerable to risks and uncertainties caused by events that may occur both in other sectors of the economy and those that are external to the economy. Also, there is a push to make agriculture more efficient in an effort to keep farming profitable, while maintaining low food prices. An efficient agricultural sector becomes necessary to stimulate the required shift of resources, such as labor from the agricultural to the non-agricultural sector.

Finally, in the fourth stage of the structural transformation process, the economies of developing countries resemble those of industrialized nations. In this stage, food commodities constitute a small share of the consumer's budgets and, agriculture's share of GDP is relatively small. Income distribution becomes a political issue and there are now greater concerns about the environment and equity issues.

At each stage, a critical set of specific policies are required to ensure successful transformation to the next stage. Hence, as a country moves from one stage to the next, it is essential to develop a dynamic and adaptive policy environment. In reality however,

countries tend to protect their agricultural sectors as they become more developed (McCalla, 1969; Anderson and Tyers, 1989). Thus, it becomes increasingly difficult to remove subsidies and tariffs initially instituted to promote growth in the agricultural sector because producers need to be cushioned -- even though free trade is believed to be more beneficial for the economy as a whole (Bhagwati,1988; Timmer,1990; Krugman, 1991).

3.2 Structural Transformation: the Sub-Saharan African challenge

Many scholars believe that structural transformation is the vehicle through which rich countries achieved economic growth and there is a substantial literature devoted to the topic (*e.g.* Timmer, 1990; Staatz, 1994; Tomich *et al.* 1995). To support the view that structural transformation is responsible for transforming poor countries to rich ones, a number of scholars draw parallels between the success story in East Asian economies with the failures in African economies. For instance, Gabre-Madhin and Johnston (1999) state that there are lessons to be learned from Taiwan's experience for accelerating Africa's structural transformation process. Roemer (1991) is also in agreement with the choice of Taiwan as a role model for African economies, but adds Thailand, Malaysia and Indonesia to the list. Other scholars have not only embraced the idea that structural transformation is the process by which economies develop, but they also believe that the process has been occurring in Africa. Furthermore, they believe that the declining growth rates recorded

since the mid-1980s are temporary and that African economies are now 'back' on the path to recovery (Badiane, 1999).

However, other economists offer contradictory evidence. For example Dorward *et al.*, argue that African economies have responded weakly to structural adjustments. While the structural transformation paradigm may be a legitimate vehicle for economic growth in general, they argue that the way neoclassical economists expected it to occur in Africa was myopic. Thus, they advocate for a paradigm shift towards a theory of "Institutional Development Policy" that incorporates institutional changes in the transformation process. Timmer (1997) also argues for the need to develop a new development paradigm that explicitly takes into account market failures instead of accepting the notion of perfect and complete markets. In this study, some evidence is provided that, in part, supports this latter viewpoint, albeit, anecdotally. In contrast, other scholars including Yumkella *et al.* (1999) accept the model envisioned by Badiane, take the structural transformation process as given, and move on to incorporate current forces such as moving towards globalization, value added, and international trade (especifically WTO) into their models.

Eicher (1999) however, blames the economic woes of Africa on, *inter alia,* readily available food aid, limited political power of farmers, inconsistent and frequently changing assistance strategies of donors, and a historical focus on industrialization as the engine of economic growth besides Africa's own woes such as poor leadership, corruption and civil wars. Eicher's view is similar in part to the view held by Schultz (1990) in his article, 'Investing in people: the economics of being poor'. Schultz attributed the cause of failed economic policies in developing countries to a failure to focus on the key factors of

production, arguing that the decisive factor of production is the improvement of human capital and not space, energy, and land.

After reviewing the work of Collier and Gunning (1999); Platteau and Hayami (1998); Hayami and Ruttan (1985); and Tomich *et al.* (1995) on Africa's weak economic performance and on the structural transformation process, Gabre-Madhin and Johnston (1999) identify an important gap. Missing from the literature is any attempt to account for adverse effects of what these authors call, 'a prolonged period of rapid growth of a country's labor force on the structural transformation process'. The implication of this is that an important factor that may help explain why structural transformation has had been slow in Africa, may have been left out of most scholars' analyses.

3.3 Analytical framework

This study focuses on assessing the profitability of maize, compared to alternative crops in several districts of Kenya. The profitability of various crop enterprises was determined for each crop enterprise using a farm management procedure that is commonly used for computing gross margins for farm enterprises. Specifically, the procedures outlined in Boehlje and Eidman (1984) and the methods recommended by Dillon and Hardaker (1980) were used to guide the analysis. The specific procedures followed in estimating different cost items are discussed below.

For the enterprises where it was possible, (*i.e.* mono-crop maize and maize bean inter-crop) profitability is estimated by type of technology used and also by the market position of farming households (*i.e.* whether they are net maize buyers or net maize sellers). In addition, a relative profitability index table is presented that provides a comparison of profitability estimates of maize/beans inter-crop with those of other enterprises. Also a table is provided that shows a comparison between the observed cultivation decisions and what the results suggest should be cultivated on the basis of expected profitability using farm-gate prices.

3.3.1 Land preparation

Land preparation involves land clearing, ploughing, and harrowing to prepare a field for planting. Farmers in all the study areas used a wide range of methods to prepare their land. Most farmers in the Rift Valley Province used tractors for ploughing and harrowing, while those in Western and Eastern Provinces used animal draft power or hand hoeing. Most farmers who used a tractor, hired a private tractor owner to plough their land for a fee. While the cost of using hired tractor services varied by region and by season, farmers generally paid about Ksh 1,000/acre in most areas. When computing tractor costs, the actual amount paid for hiring the tractor was used. For farmers who owned a tractor and used it to carry out their farm activities, the average rental fee for tractor services in their villages was used as proxy for the cost of land preparation.

Most farmers who used oxen for animal draft power owned their oxen. However, some farmers hired oxen to plough their land. Where hired oxen were used, the actual amount paid by the hiring household was used to compute the cost of draft power. Otherwise, the average cost of hiring oxen in the village where the farmer lived was used as a proxy for the cost of oxen ploughing services.

A majority of the farmers in the sample mainly used family labor to prepare their land, although a few used hired labor. Where farmers employed hired labor, the actual amount paid for hiring that labor was used as the cost of hired labor. On the other hand, family labor was valued at its opportunity cost (i.e. the hired wage rate for that activity). In all the study areas, there was a well-developed market for hired labor for carrying out different farm operations. Costing family labor at its opportunity cost was justified because a family member could hire out his/her labor services in lieu of working on the family farm. However, to accommodate the 'conventional wisdom' that rural labor markets in Africa are thin, this study incorporates family labor into the analysis in two different ways. First, assuming the non-existence of a labor market, family labor is excluded from the calculation of the production costs and is regarded as a residual claimant after paying for all cash costs. Second, assuming the existence of a complete labor market, family labor is explicitly valued at its opportunity cost and included in the computations to estimate production costs.

Land preparation cash costs varied greatly across regions, depending on whether or not farmers used hired services (tractor, oxen). These costs were highest in the Rift Valley Province where hired tractor services for ploughing and harrowing were most commonly

used, and lowest in Eastern Province where most farm activities were carried out using family labor. However, when the cost of family labor is valued at its opportunity cost and included as a cash cost, land preparation costs are comparable across all enterprises and regions.

3.3.2 Planting, weeding, harvesting and other activities

Planting, weeding, harvesting, shelling, stooking, pruning, and threshing were carried out almost entirely using hired and family labor rather than machinery. As these activities are carried out at different plant growing stages, it is essential that households schedule their labor to ensure its timely availability. Thus, even households who appear to have sufficient family labor actually hire labor at some point during the year in order to complete farm activities such as weeding on time. Weeding, which is carried out two and sometimes three times per cropping season, is by far the most labor intensive activity and timeliness in weeding is especially crucial to ensure good yields.

In order for the plants to take full advantage of the initial nitrogen flush, planting needs to be done within the first fortnight after the onset of the rains. A delay in planting after the onset of the rains reduces the crop's potential yields.[10] However, weeding and harvesting must also be carried out at specific stages of plant growth. For instance, if crops are not weeded or harvested on time, yield reductions are likely to occur; first,

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[10] Author's knowledge based on training in agronomy and crop production

through losing the battle for nutrients and sunshine to weeds and, second, through direct losses due to spoilage and vermin attack.

The sum of the cost of ploughing, harrowing, planting, weeding, harvesting, and shelling/threshing equals total operation costs for crop production. While these costs vary across regions and across different crop enterprises, some commonalities exist that cut across all enterprises. For example, in this study, the cost of family labor accounts for a very large share (over 40% in most cases) of total production costs. This underscores the importance of giving a careful treatment to family labor. If family labor is undervalued or otherwise excluded as a cost item, then the resulting gross margins would be excessively large and would provide misleading evidence as to the profitability of the enterprises.

3.3.3 Material input costs

The main purchased inputs used by farmers in this sample were planting materials (seed) and fertilizer. As only a few farmers (less than 1%), used chemicals-- either for weed control or pest control-- these costs did not merit formal treatment as separate cost items. The cost of seed/planting material per acre was computed by multiplying the divisional average quantity planted per acre by the divisional average price of the seed at planting time. A similar computation method was used to estimate the cost of fertilizer per acre. All prices used were the average of divisional level observations. The sum of the

seed/planting material costs and fertilizer costs makes up the material costs reported in this study.

The cost of operations described above, plus seed and fertilizer costs, were summed to obtain total production costs for each crop enterprise. As a consequence of the two ways in which family labor is valued, as explained earlier, two estimates of production costs are reported and used when calculating gross margins, viz, production costs without family labor included as a cash cost; and production costs with family labor valued at its opportunity cost. Table 3a below contains a summary of some of the descriptive information on the sample for this study for the maize/beans intercrop.

Table 3a. Some descriptive information for maize/bean intercrop farmers

	Province					
	Rift Valley		Western		Eastern	
	NBHI	NSHI	NBHI	NSHI	NBLI	NBHI
number of observations	31	23	16	11	12	15
total land size (acres)	11.3	14.0	4.9	10.1	4.2	2.8
area planted to maize/beans	2.2	1.8	1.7	3.3	1.4	1.0
area planted to other crops	2.3	3.0	0.6	0.8	0.8	0.4
% of hhs using hybrid maize	89.7	96.0	76.2	92.3	16.7	31.3
% of hhs using fertilizer	97.4	100.0	100.0	100.0	16.7	100.0
% of hhs with non-farm income	23.1	20.0	14.3	53.8	33.3	25.0

/1 NBHI is net maize buyer, high input user
NBLI is net maize buyer, low input user
NSHI is net maize seller, high input user

Source: Survey data, 1999

3.3.4 Prices

The prices used to value crop output were based on recall by farmers of what prices they received when selling produce and what prices they paid when buying produce. The selling prices are mainly farm-gate because most farmers sold to traders who came to their farms, while buying prices are retail prices in local markets where farmers obtain their groceries. To value yield, distinction is made between the prices faced by consumers from those faced by producers. The farm-gate prices are used to value the produce from net selling households while retail prices are used to value the produce from net buying households. Furthermore, we value all commodities at the average district level prices. With respect to seasonality, we used the weighted mean price across the month in which the commodity was sold.

During the study period, there was a 25% tariff on maize imports in place and it is believed that it led to artificially higher maize prices at that time. In an attempt to account for the effects of the tariff on relative profitability of crop enterprises, a sensitivity analysis is carried out on maize prices reflecting the 25% import tariff and enterprise profitability is then estimated using the adjusted prices. The results are reported which show what profitability would have been without the tariff compared to when there was a tariff in place.

3.3.5 Yield

Yield estimates for the crops planted were obtained by asking farmers to recall the output they actually obtained from a specific plot. These plot-level yield figures were then converted to per acre yield values and used to estimate total revenue by multiplying them by the appropriate output prices. Total revenue was computed as a product of the yield in kilograms per acre and price per kilogram of produce.

3.3.6 Labor

Labor use was estimated by asking farmers what type of labor (*i.e.* hired or family) they utilized and how much they used per given activity. With respect to hired labor, the actual amount of money paid by the farmer was recorded for each activity and included as part of the production cash costs of the farmer. With respect to family labor, the number of family members that performed different tasks was recorded together with the time it took to complete the task. These figures of family labor use were then converted to mandays per acre for each activity and valued at the district average wage rate, which was used as the opportunity cost for family labor.

In computing gross margins, family labor is treated in two ways. First, it is excluded from calculations as a cost item and regarded as the residual claimant. Returns to family labor and management are estimated by dividing the resulting figure of gross margins per

acre by the total number mandays used. Second, family labor is valued at its opportunity cost and included as a cost item in the calculations of gross margins.

3.3.7 Gross margins

Gross margins are obtained by subtracting total production costs from total revenue per acre. Total production costs were estimated as discussed above. Total revenue, on the other hand, was defined as the value of the total output per acre-- whether or not the output was sold. Therefore, total revenue includes the output, which is sold, used for household consumption, used on the farm for seed, and used as in-kind-payments. The production costs per acre were obtained as the value of all inputs used in production, excluding the value of in-kind labor payments of labor (*i.e.* meals provided to workers). Family labor, which is valued at its opportunity cost is also included as a cost item. Although production costs usually also include fixed costs in this analysis they are excluded.

The difference between total revenue and production costs is defined as the gross margin per acre. Gross margins are a measure of the return to the family for both its production management and all capital invested in the land. Therefore, in this analysis, gross margins represent the profitability of an enterprise per acre. Net margins per acre are a measure of profitability after accounting for the opportunity cost of family land. Net margins are estimated as gross margins per acre, minus the land rental rate. They are a

measure of profitability that takes into account the farmer's forgone opportunity to rent his/her land.

CHAPTER FOUR

RESEARCH DESIGN

4.1 Characteristics of survey areas

Kenya, located on the east coast of Africa with the Equator running almost straight through the middle of the country, has an area of 582,644 Km^2 (224,900 Sq. miles). The country has a great diversity of physical features, which can be distinctively divided into five main zones. The low-lying arid and semi-arid lands of the north and northern-eastern province cover nearly two-thirds of the country. The coastal belt which runs along the Indian Ocean from the Kenya-Tanzania border to the Somali border, is a well watered area receiving rain twice a year from the north-easterly and south-easterly monsoons. The Nyika Plateau (dry wilderness), situated between the coastal belt and the central highlands, is a dry area of low rainfall. Here, the vegetation consists of short grass with scattered acacia trees. This area, which is best described as dry savanna, supports most of Kenya's wildlife population.

The fourth and most productive zone is the central highlands -- a raised volcanic block split from north to south by the Great Rift Valley, a 8,700 kilometre ditch on the surface of the earth (sometimes 80 Km wide) which stretches from the Dead Sea in Jordan to Beira in Mozambique. The eastern wall of the Valley is dominated by Mt. Kenya, a giant extinct volcano rising to 5,199 metres (17,058 ft.a.s.l.). A combination of good

rainfall, fertile soils, and suitable climate makes the region one of the richest agricultural areas in the world. The western slopes, including the Mt. Elgon region, are fertile and well-watered. They receive most of their rains from the inland sea of Lake Victoria (the second largest fresh water lake in the world). From the western flanks of the central highlands, the land slopes down to the lake basin. The lake basin is hot and moist and receives heavy rainfall from the lake. Its vegetation is mainly savanna woodland. The vast mass of Lake Victoria creates its own local weather systems. Kenya, one of the most prosperous agricultural countries in Africa, is the third largest tea producer in the world and the biggest producer of pyrethrum in addition to a great variety of other crops.

Kenya's altitude ranges from sea level to 5,199 metres, making its climate vary greatly from high humid temperatures of the coast to the often cold and wet regions of Aberdares, Cherangani, and Mau Escarpment, Mt. Elgon, and Mt. Kenya. With the equator traversing the country, the country has only two seasons - the long rains season and the short rains season. Sunshine is experienced throughout most days of the year, although it becomes cooler during the months of June, July and August.

Administratively, Kenya is divided into eight provinces: Western, Nyanza, Rift Valley, Central, Nairobi, Eastern, North Eastern and Coast. In turn, each province is divided into several administrative districts. This study was carried out in six districts which were selected from three provinces. *i.e.* Uasin Gishu and Trans Nzoia Districts in the Rift Valley Province, Kakamega and Vihiga Districts in the Western Province, and Machakos and Makueni Districts in the Eastern Province.

4.1.1 Uasin Gishu and Trans Nzoia Districts

4.1.1.1 Location and size

Uasin Gishu and Trans Nzoia Districts are two of the 17 districts in the Rift Valley Province of Kenya (Fig. 4). Uasin Gishu lies approximately between latitudes 0^0 03' and 0^0 55' North of the equator and longitudes 34^0 50' and 35^0 37' East. It shares common borders with seven Districts: Trans Nzoia (north), Marakwet and Keiyo (east), Koibatek (southeast), Kericho (south), Nandi (west) and Kakamega (northwest) Districts.

Trans Nzoia District lies approximately between latitudes 0^0 52' and 1^0 18' North of the equator and longitudes 34^0 38' and 35^0 23' East. It has common borders with the Republic of Uganda to the west and five Districts: Bungoma and Kakamega (south), West Pokot (north), Marakwet (east), and Uasin Gishu (southeast) Districts.

Both Uasin Gishu and Trans Nzoia Districts are divided into six administrative divisions with the former covering an area of 3,218 square kilometres, while the latter covers an area of 2,467 square kilometres.

4.1.1.2 Agro-Ecology

Uasin Gishu District is a highland plateau with a terrain that varies greatly with altitude, which ranges from 1,500m to 2,100 metres above sea level (mas). The district's

general landscape is characterized by an undulating plateau, with no significant mountains and valleys. Annual rainfall in the district is high, reliable, and evenly distributed throughout the year. Annual rainfall averages 960 mm, with the wettest months being May and August.

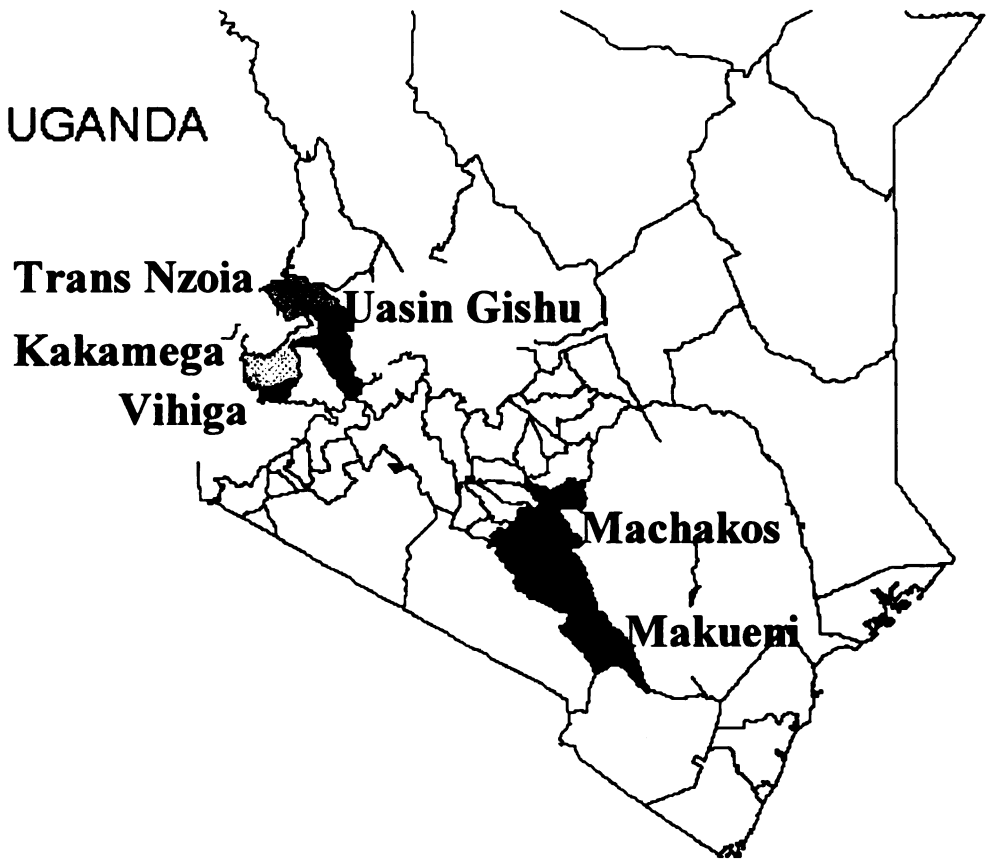

Figure 4. Map of Kenya showing study districts

The district consists of three major agro-ecological zones (AEZs), viz. the Upper Highland zone (UHZ), the Upper Midland zone (UM) and the Lower Highland zone (LHZ). Most of the district falls within the LH_2 and LH_3 zones which are suitable for growing maize, wheat, barley, sunflower and rearing of cattle and sheep.

Trans Nzoia District is also a highland plateau with gentle undulations rising steadily to Mt. Elgon in the Northwest and to the foot of the Cherangani Hills to the East. The average elevation for most of the district is 1,800 mas, although the Cherangani Hills reach an elevation of 3,371 mas. The northern part of the district is quite hilly, making communication very difficult -- especially during the rainy season when the roads become practically impassable. Rainfall is fairly well distributed throughout the year, with an annual average of 1,296 mm. Trans Nzoia District has a pronounced bimodal rainfall pattern, with the short rains falling during April- June and the long rains falling during between July- October.

The district also has three major agro-ecological zones: UHZ, UMZ and LHZ. As expected, each AEZ is more suited for certain agricultural activities and less so for others. Cattle and sheep are mainly raised in the UHZ (16% of district), although they are also raised in the other zones. Farmers in the UMZ, which covers 50% of the District, mainly cultivate maize, sunflower, coffee, wheat, barley, and horticultural crops. Farmers in the LHZ, which covers 34% of the district, mainly cultivate pyrethrum, wheat, tea, maize, barley, sunflower, coffee, and horticulture crops.

4.1.2 Kakamega and Vihiga Districts

4.1.2.1 Location and size

Kakamega and Vihiga Districts are two of the six districts in the Western Province (Fig. 4). Kakamega District lies approximately between latitudes 0^0 15' and 1^0 North and longitudes 34^0 20' and 35^0 0' East. It is bordered by seven districts: Busia, Siaya and Bungoma (west), Nandi and Uasin Gishu (east), Trans Nzoia (north), and Vihiga (south) Districts.

Vihiga District, which was carved out of Kakamega District, lies approximately between latitudes 0^0 and 0^0 15' North and longitudes 34^0 30' and 35^0 0' East. It is bordered by four districts: Kakamega (north), Nandi (east), Kisumu (south), and Siaya (southwest) Districts.

Kakamega District is divided into 14 administrative divisions and covers an area of 3,020 square kilometres. Similarly, Vihiga District is divided into six administrative divisions and covers an area of only 541 square kilometres.

4.1.2.2 Agro-ecology

Kakamega District's topography ranges from 1,250m to 2,000 mas. The northern, central, and eastern part of the district is generally hilly, rising gradually to an elevation of

1,600m to 2,000m where the district meets the Nandi escarpment. The southern part of the district is relatively flat, has well drained soils, and heavy rainfall, making it suitable for sugar cane production. The district has a bimodal rainfall pattern, with the long rains falling during March-June and the short rains falling during July-September. The driest months of the district are December and January, when most farmers prepare their land. On average, annual rainfall varies from 1,000 mm in the northern parts to 2,400 mm in the southern parts of the district.

Kakamega District falls under four agro-ecological zones. The UM_0 zone, which is mainly a forest zone, (*i.e.* Kakamega forest) supports very little crop production. The UM_1 zone is a tea-coffee zone, while maize and sunflower are most suited for the UM_4 zone. Sugar cane is mostly grown in the LM_1 zone, while other minor crops are cultivated to varying degrees across all the AEZs.

Vihiga District lies on the eastern fringes of the Rift Valley's lake basin. Its latitude ranges between 1,300m and 1,500 mas and slopes gently from west to east. The district is characterized by undulating hills and valleys with very little flat land, mainly in the southern part of the district. The district's hilly topography makes accessibility to most parts very difficult, except for areas that fall within Sabatia, Tiriki and Luanda Divisions. Annual rainfall, which ranges between 1800mm and 2000 mm, is fairly reliable from year-to-year. Like Kakamega District, Vihiga District also has a bimodal rainfall pattern, with the long rains falling during April-June and the short rains falling during September-November.

Vihiga District falls into UM_1 and LM_1 agro-ecological zones. The UM_1 zone has fertile, well-drained, dark red soils which support tea, coffee and millet production, while the LM_1 has soils that mainly support sugar cane and maize production.

4.1.3 Machakos and Makueni Districts

4.1.3.1 Location and size

Machakos and Makueni Districts are two of the 12 districts that comprise Eastern Province (Fig. 4). From north to south, Machakos District stretches from latitude 0^0 45' to latitude 1^0 31' south and lies between longitudes 36^0 45' and 37^0 45' east. It borders eight districts: Kitui and Mwingi (east), Makueni (south), Kajiado (west), Nairobi city and Thika (northwest), Murang'a and Kirinyaga (north), and Mbeere (northeast) Districts.

Makueni District lies between the equator and latitude 1^0 35' south and longitudes 37^0 10' east and 38^0 30' east. It borders four districts: Kajiado (west), Taita Taveta (south), Kitui (east), and Machakos (north) Districts.

Machakos District is divided into 11 administrative divisions and covers an area of 6,051 square kilometres. Makueni District is divided into 14 administrative divisions and covers an area of 7,440 square kilometres.

4.1.3.2 Agro-ecology

Machakos District is largely a plateau that rises from 700m to 1,700 mas with interruption by an escarpment and a series of hills. The district, which is generally hot and dry, has a bimodal rainfall pattern. The long rains fall during April-May, while the short rains fall during October-December. The annual average rainfall ranges from 500mm to 1,300mm, with significant regional and seasonal variations within the district and very low rainfall reliability.

Makueni District is generally low lying, rising from about 600m to 1,900 mas above sea level. The major land features in the district are the Chyulu, Mbooni, and Kilungu Hills in the western and southwestern part of the district. These hills receive good rainfall and support coffee and horticultural production. In the rest of the district, rainfall is generally low -- averaging less than 1,000 mm annually. Makueni District has a bimodal rainfall pattern. The long rains fall during April-May, while the short rains fall during November-December. Like Machakos District, Makueni is also hot and dry most of the year.

Machakos District falls under the lower and upper middle agro-ecological zones. The UM_2 zone, which covers the upper slopes of the hill masses of Iveti, Mua and Kangudo, has an average rainfall of 1,000mm -- which is sufficient to support maize, coffee and citrus fruit production. The LM_3 and UM_3 zones, which cover the lower slopes of the hills and parts of Matungulu, have an average annual rainfall of 850 mm -- making them marginally suitable for maize, beans, pigeon peas and cowpeas production. Most of

the district falls under the relatively arid LM_4, LM_5, UM_4 and UM_5 zones. With an average rainfall of only 600-650 mm, the main activities in these zones are growing of pigeon peas, bee-keeping, and ranching.

Makueni District falls under the LM_2 - LM_6 and UM_4 - UM_6 zones. The LM_2 zone is characterized by red clay soils on the hill masses of Mbooni and Kilungu, where most of the districts' coffee, maize and citrus fruits are grown. The slopes of these hills and adjacent areas of Nziu and Ukia fall under the LM_3, UM_3, LM_4 and UM_4 zones, which have medium potential for production of maize, coffee and pigeon peas production. About 60% of the district falls in the LM_5, LM_6 and UM_6 zones, which have very low potential for crop production. In these zones, the most common activity is livestock rearing -- although maize, sorghum and pigeon peas are also cultivated there.

4.2 Agriculture

The cropping patterns in Kenya are greatly diversified and vary from region-to-region. As reported in an earlier study (Argwings-Khodek *et al.,* 1999) and confirmed by this study, maize and maize inter-crops account for over 25% of the cropped area nationally. However, the proportion of land under maize cultivation is much higher than the national average (*i.e.* 25%) in five of the districts studied, as shown in Table 3b (below) which summarizes the relative percent of land allocated to major crops between 1992 to 1995 in Uasin Gishu, Trans Nzoia, Kakamega, Vihiga, Machakos, and Makueni

Districts. Uasin Gishu and Trans Nzoia Districts have a high potential for crop production, with over 80% of their combined area classified as suitable for arable farming. On the other hand, Kakamega and Vihiga Districts are classified as having medium agricultural potential, although small pockets exist within the districts that have high potential for crop production. Farmers in both Machakos and Makueni Districts mainly grow food crops such as maize, beans, pigeon peas and cowpeas to meet their household requirements.

Table 3b. Percent of crop land under cultivation of major crops, 1992-95 average by District, Kenya

Crop	Uasin Gishu %	Trans Nzoia %	Kakamega %	Vihiga %	Machakos %	Makueni %
Maize	48	69	44	39	52	8
Wheat	32	3	*a*	*a*	*a*	*a*
Beans	18	22	26	20	20	38
Cowpeas	*a*	*a*	*a*	*a*	11	22
Pigeon peas	*a*	*a*	*a*	*a*	10	16
Tea & coffee	*a*	*a*	*a*	34	*a*	*a*
Sugar cane	*a*	*a*	26	*a*	*a*	*a*
Others	2	6	4	7	7	16

a Traces of the crop found in the district or crop not grown at all.

Source: District Development plans, 1997-2001 - various issues.

4.3 Data

To address the objective of this study, data were collected via a retrospective farm survey. A structured questionnaire was used to interview farmers from the selected six districts in Kenya. The data collected included household socioeconomic characteristics, land size holding and area planted to major crops, crop output, prices of produce, quantity and cost of hired labor, quantity of family labor, and quantity and prices of material inputs.

Crop output data were based on farmers' recall of what they harvested from a given plot during the short and long rains seasons preceding the interview date. The recall period varied from four months in Eastern Kenya to six months in Western Kenya. As farmers were knowledgeable about the sizes of their plots and the quantities harvested from their plots, it is possible to accurately estimate farmers' crop yields.

Retail prices at which farmers sold their crops were gathered from farmers who actually made sales. In addition, village level selling prices were obtained to corroborate the price information obtained from farmers. Prices of material inputs were also collected, both at the farm- and at the village-level.

4.4 Sampling

On the basis of average annual rainfall, Kenya's agricultural land is classified as having high or low potential for crop and livestock production. Typically, areas receiving an annual rainfall of less than 1,000 mm are classified as low potential, while those receiving above 1,000mm are classified as high potential. This broad classification was followed in this study.

A multi-stage sampling procedure was used to select the farmers that were interviewed. Respondents were selected using an existing sampling frame that includes farmers in all the provinces in Kenya. This sampling frame was developed in 1997 under the auspices of the Kenya Agricultural Monitoring and Policy Analysis Project (KAMPAP), a joint collaboration between Egerton University/Tegemeo Institute, Kenya Agricultural Research Institute, and Michigan State University.[11]

To construct the sampling frame, the KAMPAP researchers used a multi-stage probability proportional to size (PPS) sampling design. First they compiled a list of all administrative districts and divisions and assigned them an Agro-ecological zone (AEZ) classification based on information reported in Farm management handbooks.[12] The thirty

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11 Details regarding sampling frame's design are contained in Argwings-Kodhek (1998) and Jayne *et al.* (1998). And additional details were obtained via personal communication with Joseph Owuor, the researcher who designed the sampling frame.

12 Farm management handbooks are annual reports that contain basic agricultural

five distinct AEZs that were identified were then grouped into eight categories: Coastal lowlands, Lowlands, Lower Highlands, Upper-Lower Midlands, Lower Midlands, Upper highlands, Upper Midlands1, Upper Midlands2. From each category, at least two AEZs were randomly chosen. A total of 17 AEZs formed the first stage sampling frame.

In the second stage, the researchers chose at least two divisions[13] from each AEZ. They then compiled a list of all locations in the chosen divisions and randomly selected one location to identify the villages to be sampled. In the third stage, one village was randomly selected from each of the locations chosen in the second stage.

At the village level, a list of all households was compiled with the help of local leaders. All the households in each village were numbered by the research team to ease the selection process. Households in each village were then selected using systematic random sampling.

For this study three provinces were selected, comprised of two districts each (Fig. 4), based on geographical location, agro-ecology and diversity of crops cultivated. These are:

Rift Valley Province:	Uasin Gishu and Trans-Nzoia Districts.
Western Province:	Kakamega and Vihiga Districts.
Eastern Province:	Makueni and Machakos Districts.

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published by the Ministry of Agriculture and Livestock Development for each district.

[13] Each district is administratively made up of divisions, which are in turn made up of locations. The location are themselves made up of villages.

For the remainder of this thesis, the Rift Valley Province, the Western Province, and the Eastern Province will be referred to represent the sampled districts from each province respectively. Note further that the discussions in this thesis do not in anyway assume that the results from the sampled districts can necessarily be generalized to the entire province.

A total of 80 households were selected from each province on the basis of whether they were net maize buyers or sellers, as well as whether they used high or low levels of inputs for maize production, as determined from the existing KAMPAP 1997 rural household survey database. While determining which households were net maize buyers or sellers was fairly straight forward, the classification of households into high and low input users was based on the amount of fertilizer used on maize, as well as the use or non-use of hybrid maize seed. Households who used less than 20 kg/acre of fertilizer on maize were classified as low input users, while those who used 20 kg/acre or more were regarded as high input users. Table 4a shows the number of households sampled from each province, based on the category they belonged to.

Table 4a. Number of households sampled from each province, 1997 data.

Province	Net maize buyer		Net maize seller		Total
	low input user	high input user	low input user	high input user	
Rift Valley	none	40	none	40	80
Western	25	30	none	25	80
Eastern	27	41	none	12	80

Source: KAMPAP database, 1997

Once the data were collected and analyzed, the households were again classified according to whether they were net maize buyers or sellers and whether they were low or high input users based on the survey results. Tables 4b and 4c show the number of households that fell into different categories similar to those in Table 4a above. Table 4b shows household classification based on, among other criteria, the level of input use on mono-crop maize plots while Table 4c is based on the level of input use on maize/beans inter-crop plots. The figures in parentheses are the percentage of households within that cell that use hybrid maize. Additionally, it is only these cells with parenthesized percentages that are used to calculate gross margins presented in Chapter Five.

Table 4b. Number of households sampled from each province by household market position and by level of input use on mono-crop maize plots, 1999 survey.

Province	Net maize buyer		Net maize seller		Total
	low input user	high input user	low input user	high input user	
Rift Valley	2	8 (100%)	1	10 (100%)	21
Western	0	9 (77.8%)	3	4	16
Eastern	26 (38.5%)	23 (42.9%)	1	3	53

Source: Survey data, 1999

Table 4c Number of households sampled from each province by household market position and by level of input use on maize/beans inter-crop plots, 1999 survey.

Province	Net maize buyer		Net maize seller		Total
	low input user	high input user	low input user	high input user	
Rift Valley	4	31 (89.7%)	1	23 (96%)	59
Western	2	16 (76.2%)	1	11 (92.3%)	30
Eastern	12 (16.7%)	15 (31.3%)	1	2	29

Source: Survey data, 1999

4.5. Survey implementation

The actual administration of the survey of the 240 households turned out to be an extremely smooth and successful operation. The questionnaire was administered by myself, with assistance from a team of eight enumerators. All the enumerators had prior experience in questionnaire administration, which they had gained from their participation in KAMPAP I and II surveys. Three of them were and still are Research Assistants with Tegemeo Institute, while the rest were unemployed at the time -- although they had also participated in the said KAMPAP surveys.

The exercise started with an initial week of office training on administering the questionnaire and pre-testing it in nearby villages. The questionnaire was then refined to make it easier to administer and more appropriate, based on the pre-test results. Once the actual survey begun, the entire team met every evening to edit the completed questionnaires and discuss any difficulties that they encountered. The strategy used was to go into one village as a team and complete the questionnaires for the households in that village before moving to the next. This strategy proved to be useful in ensuring high quality work, as I was able to address any issues that were unclear as they arose. In addition, the strategy led to the development of a strong team work spirit that had spillover benefits which increased enumerator morale and eliminated of any form cheating on the questionnaires.

The success of the survey was made possible by the availability of sufficient funds through the Food Security II project in collaboration with Tegemeo Institute. Tegemeo Institute provided a four-wheel drive vehicle which made it possible for us to access all households, a feat that would have proved difficult owing to the poor condition of rural roads in Kenya. In addition, Tegemeo Institute provided office space, which made the coordination and management of field resources and activities much easier than they would have otherwise been.

The survey proper was carried out during a six week period, followed by data entry and initial cleaning which took two months. All the data were entered in SPSS by one of the Research Assistants under my supervision.

CHAPTER FIVE

ANALYSIS AND RESULTS

The first step in data analysis was data cleaning. Data were checked for logical inconsistencies and verified against questionnaires to make sure that all data were correctly inputted. Frequencies and other descriptive statistics were then conducted for all variables and outliers identified. All inconsistencies were addressed before beginning detailed analysis.

Data analysis focused on estimating production costs, yields, and gross margins of the selected crop enterprises in each of the three provinces in which survey data were collected. Also, analysis was carried out to determine farmers' perceptions about maize prices and how these perceptions influence their decisions at the farm level. Finally, this chapter concludes with a discussion of the factors that constrain agricultural commercialization in Kenya.

5.1.1 Mono-crop maize profitability

The gross margins for mono-crop maize were computed using data from fields where farmers planted maize as a pure stand. The analysis was carried out according to the contiguous groups depicted in Tables 4b above. Tables 5a, 5b, and 5c report the average gross margins for mono-crop maize for Rift Valley, Western, and Eastern Provinces respectively.

Table 5a. Gross Margins for Mono-crop Maize for Rift Valley Province.

Item	Net maize buyer High input user	Net maize seller High input user
	n=8	n=10
YIELD		
Harvest (kg/acre)	1,463.50	1,783.50
Price (Ksh/kg)	12.5	8.9
REVENUE		
Maize (Ksh/acre)	**18,293.75**	**15,873.15**
PRODUCTION COSTS		
Seed/planting material		
Quantity (kg/acre)	8.90	9.30
Price (Ksh/kg)	91.00	91.00
Total cost (Ksh/kg)	**809.90**	**846.30**
Fertilizer/manure		
DAP (Kg/acre) @ **Ksh 25/kg**	46.70	53.00
MAP (Kg/acre) @ **Ksh 24/kg**	62.50	62.50
20:20/23:23 (Kg/acre) @ **Ksh 24/kg**	24.00	41.70
Urea (Kg/acre) @ **Ksh 17.20/kg**	69.00	
CAN (Kg/acre) @ **Ksh 19/kg**	50.00	
Total cost (Ksh/acre)*	**1,322.50**	**1,601.10**
Operations costs		
Cash costs (Ksh/acre)**	4,864.70	7,545.80
Family labor (mandays/acre)	24.10	17.60
Family labor (Ksh/acre)	1,687.00	1,232.00
Total cost (Ksh/acre)	6,551.70	8,777.80
Total Production Costs (Ksh/acre)[1/]	**6,997.10**	**9,993.20**
Total Production Costs (Ksh/acre)[2/]	**8,684.10**	**11,225.20**
Gross margins (kshs/acre)		
Excl. family labor (Ksh/acre)	11,296.65	5,879.95
Incl. family labor (Ksh/acre)	**9,609.65**	**4,647.95**
Land rent (Ksh/acre)	1,750.00	1,750.00
NET MARGINS		
Excl. family labor (Ksh/acre)	9,546.65	4,129.95
Incl. family labor (Ksh/acre)	**7,859.65**	**2,897.95**
Return to family labor (Ksh/manday)	396.13	234.66

1/ Excluding family labor costs 2/ Including family labor costs

* The total cost of fertilizer is a weighted average cost that includes all cash costs paid by farmers for all types of fertilizers/manure. The prices used for computations are divisional level average prices which differ slightly from the regional level prices reported in the table. Furthermore, the figure for total cost also includes cost of fertilizers for which quantities were not reported because farmers failed to recall them but remembered what they paid.

** Cash costs are costs of ploughing, harrowing, planting, weeding, harvesting, shelling, and all other miscellaneous farm operations costs.

Table 5b. Gross Margins for Maize Mono-crop for Western Province.

Item	Net maize buyer High input user
	n=9
YIELD	
Harvest (kg/acre)	1,400.00
Price (Ksh/kg)	12.50
REVENUE	
Maize (Ksh/acre)	**17,500.00**
PRODUCTION COSTS	
Seed/planting material	
Quantity (kg/acre)	15.20
Price (Ksh/kg)	91.00
Total cost (Ksh/kg)	**1,383.20**
Fertilizer/manure	
DAP (Kg/acre) @ **Ksh 26/kg**	56.70
Urea (Kg/acre) @ **Ksh 22/kg**	56.60
CAN (Kg/acre) @ **Ksh 25.50/kg**	50.00
Total cost (Ksh/acre)*	**1,406.70**
Operations costs	
Cash costs (Ksh/acre)**	5,600.00
Family labor (mandays/acre)	44.10
Family labor (Ksh/acre)	3,087.00
Total cost (Ksh/acre)	8,687.00
Total Production Costs (Ksh/acre)[1/]	**8,389.90**
Total Production Costs (Ksh/acre)[2/]	**11,476.90**
Gross margins (kshs/acre)	
Excl. family labor (Ksh/acre)	9,110.10
Incl. family labor (Ksh/acre)	**6,023.10**
Land rent (Ksh/acre)	2,000.00
NET MARGINS	
Excl. family labor (Ksh/acre)	7,110.10
Incl. family labor (Ksh/acre)	**4,023.10**
Return to family labor (Ksh/manday)	161.23

[1/] Excluding family labor costs [2/] Including family labor costs

* The total cost of fertilizer is a weighted average cost that includes all cash costs paid by farmers for all types of fertilizers/manure. The prices used for computations are divisional level average prices which differ slightly from the regional level prices reported in the table. Furthermore, the figure for total cost also includes cost of fertilizers for which quantities were not reported because farmers failed to recall them but remembered what they paid.

** Cash costs are costs of ploughing, harrowing, planting, weeding, harvesting, shelling, and all other miscellaneous farm operations costs.

Table 5c. Gross Margins for Maize Mono-crop for Eastern Province.

Item	Net maize buyer Low input user	Net maize buyer High input user
	n=26	n=23
YIELD		
Harvest (kg/acre)	232.10	341.00
Price (Ksh/kg)	13.00	13.00
REVENUE		
Maize (Ksh/acre)	**3,017.30**	**4,433.00**
PRODUCTION COSTS		
Seed/planting material		
Quantity (kg/acre)	8.40	10.00
Price (Ksh/kg)	75.00	75.00
Total cost (Ksh/kg)	**630.00**	**750.00**
Fertilizer/manure		
DAP (Kg/acre) @ **Ksh 30/kg**	6.50	12.80
Total cost (Ksh/acre)*	**195.00**	**384.00**
Operations costs		
Cash costs (Ksh/acre)**	2,312.70	3,491.30
Family labor (mandays/acre)	46.10	59.80
Family labor (Ksh/acre)	2,305.00	2,990.00
Total cost (Ksh/acre)	4,617.70	6,481.30
Total Production Costs (Ksh/acre)[1/]	**3,137.70**	**4,625.30**
Total Production Costs (Ksh/acre)[2/]	**5,442.70**	**7,615.30**
Gross margins (kshs/acre)		
Excl. family labor (Ksh/acre)	(120.40)	(192.30)
Incl. family labor (Ksh/acre)	**(2,425.40)**	**(3,182.30)**
Land rent (Ksh/acre)	1,500.00	1,500.00
NET MARGINS		
Excl. family labor (Ksh/acre)	(1,620.40)	(1,692.30)
Incl. family labor (Ksh/acre)	**(3,925.40)**	**(4,682.30)**
Return to family labor (Ksh/manday)	(35.15)	(28.30)

1/ Excluding family labor costs 2/ Including family labor costs

* The total cost of fertilizer is a weighted average cost that includes all cash costs paid by farmers for all types of fertilizers/manure. The prices used for computations are divisional level average prices which differ slightly from the regional level prices reported in the table. Furthermore, the figure for total cost also includes cost of fertilizers for which quantities were not reported because farmers failed to recall them but remembered what they paid.

** Cash costs are costs of ploughing, harrowing, planting, weeding, harvesting, shelling, and all other miscellaneous farm operations costs.

The results show that for the Rift Valley and the Western Provinces, farmers who planted mono-crop maize were all high input users with those in the Western Province being net maize buyers only. The Rift Valley Province had both net maize buyers and net maize sellers. The Eastern Province on the other hand, had both low and high input users although they were all net maize buyers. However, the classification of 'high input user' in the Eastern Province was modified to include households that used at least 10 kg of fertilizer and above. This was done because of the low level of purchased fertilizer use in the province on mono-crop maize plots.

Table 5a shows that for the Rift Valley Province sample, gross margins average Ksh. 11,297 (US $ = Ksh. 60.60) per acre, excluding family labor costs for net maize buyers and Ksh. 5,880 for maize net sellers. However, when family labor costs are included, the gross margins decline to Ksh. 9,610 and Ksh 4,648 for net maize buyers and net maize sellers respectively. Further, when land rent is deducted, the gross margins become Ksh. 7,860 and Ksh. 2,898 per acre, with family labor costs included for net maize buyers and net maize sellers respectively.

Farmers in the Western Province sample realized average gross margins of Ksh. 9,110 per acre excluding family labor costs and Ksh. 6,023 per acre including family labor costs (Table 5b). These figures are lower than those realized for net maize buyers in the Rift Valley Province but are higher than those realized by the comparable group of farmers in the Eastern Province. The gross margins for net buyers, high input users, in the Eastern Province sample averaged Ksh. -192 per acre excluding family labor costs and Ksh. -3,182 per acre including family labor costs (Table 5c). Similarly, net maize buyers but low input

users in the Eastern Province sample realized average gross margins of Ksh. -120 per acre and Ksh. -2,425 per acre before and after accounting for family labor costs respectively.

These results show that the profitability of the mono-crop maize progressively declines from areas of high potential to areas of low potential for crop production. In addition, family labor costs, when included as a production cost, greatly reduce the gross margins. As a result of including family labor, the gross margins decline by at least Ksh. 1,000 in all areas. The results also show that the gross margins realized by net maize buyers are generally higher than those realized by net maize sellers within the same province although this is in part driven by the higher retail prices used to value maize yields for net buyers.

5.1.2 Maize/bean inter-crop

As discussed in the preceding section, some farmers grow maize as a pure stand in all of the three provinces covered in the study. However, the most common cropping pattern for growing maize was a maize/bean inter-crop, although farmers also planted maize and other legume inter-crops. Tables 6a, 6b and 6c report gross margins for maize/bean inter-crops for the Rift Valley, Western and Eastern Provinces respectively.

Table 6a shows that for the Rift Valley Province sample, gross margins average Ksh. 14,167 per acre, excluding family labor costs for net maize buyers and Ksh. 10,817 per acre for maize net sellers. However, when family labor costs are included, the gross

margins decline to Ksh. 9,134 per acre and Ksh 8,388 per acre for net maize buyers and net maize sellers respectively. Further, when land rent is deducted, the gross margins become Ksh. 7,384 and Ksh. 6,638 per acre, when family labor costs are included for net maize buyers and net maize sellers, respectively.

In the Western Province sample, net buying households realized average gross margins of Ksh. 16,037 per acre excluding family labor costs and Ksh.12,692 per acre including family labor costs (Table 6b). Net selling households realized average gross margins of Ksh. 12,882 and Ksh. 11,242 with and without family labor costs respectively. Unlike for the mono-crop maize enterprise, these gross margins are higher than those realized by farmers in the Rift Valley Province. The gross margins for net buyers, high input users in the Eastern Province sample averaged Ksh. 2,482 excluding family labor costs and Ksh. -2,063 including family labor costs (Table 6c). Similarly, net maize buyers but low input users in the Eastern Province sample realized average gross margins of Ksh. 4,048 and Ksh. 1,933 before and after accounting for family labor costs respectively.

These results show that in all Provinces, the gross margins for the maize/bean inter-crop are substantially greater than the respective gross margins for the maize mono-crop. This result partially explains why the maize/bean inter-crop is the cropping pattern followed by most farmers. In addition, the results also show that the gross margins realized by net maize buyers are generally higher than those realized by net maize sellers within the same province although this is again, at least in part, due to the higher retail prices used to value maize yields for net buyers. Again, gross margins decrease substantially when family labor costs are included at their opportunity cost.

Table 6a. Gross Margins for Maize/beans inter-crop for Rift Valley Province.

	Net maize buyer High input user	Net maize seller High input user
YIELD	n=31	n=23
Maize harvest (kg/acre)	1,171.00	1,464.50
Beans harvest (kg/acre)	98.50	104.80
Maize price (Ksh/kg)	12.50	8.90
Beans price (Ksh/kg)	48.00	48.00
REVENUE		
Maize and beans (Ksh/acre)	**19,365.50**	**18,064.45**
PRODUCTION COSTS		
Seed/planting material		
Maize quantity (kg/acre)	9.00	9.10
Beans quantity (kg/acre)	11.60	14.60
Maize price (Ksh/kg)	91.00	91.00
Beans price (Ksh/kg)	48.00	48.00
Total cost (Ksh/kg)	**1,375.80**	**1,528.90**
Fertilizer/manure		
DAP (Kg/acre) @ **Ksh 25/kg**	42.00	52.50
MAP (Kg/acre) @ **Ksh 24/kg**	62.50	47.20
20:20/23:23 (Kg/acre) @ **Ksh 24/kg**	53.30	70.80
Urea (Kg/acre) @ **Ksh 17.20/kg**	42.60	
CAN (Kg/acre) @ **Ksh 19/kg**	31.30	62.50
Total cost (Ksh/acre)*	**1,645.00**	**1,910.00**
Operations costs		
Cash costs (Ksh/acre)**	2,177.30	3,808.90
Family labor (mandays/acre)	71.90	34.70
Family labor (Ksh/acre)	5,033.00	2,429.00
Total cost (Ksh/acre)	7,210.30	6,237.90
Total Production Costs (Ksh/acre)[1/]	**5,198.10**	**7,247.80**
Total Production Costs (Ksh/acre)[2/]	**10,231.10**	**9,676.80**
GROSS MARGINS		
Excl. family labor (Ksh/acre)	14,167.40	10,816.65
Incl. family labor (Ksh/acre)	**9,134.40**	**8,387.65**
Land rent (Ksh/acre)	1,750.00	1,750.00
NET MARGINS		
Excl. family labor (Ksh/acre)	12,417.40	9,066.65
Incl. family labor (Ksh/acre)	**7,384.40**	**6,637.65**
Return to family labor (Ksh/manday)	172.70	261.29

[1/] Excluding family labor costs [2/] Including family labor costs

* The total cost of fertilizer is a weighted average cost that includes all cash costs paid by farmers for all types of fertilizers/manure. The prices used for computations are divisional level average prices which differ slightly from the regional level prices reported in the table. Furthermore, the figure for total cost also includes cost of fertilizers for which quantities were not reported because farmers failed to recall them but remembered what they paid.

** Cash costs are costs of ploughing, harrowing, planting, weeding, harvesting, shelling, and all other miscellaneous farm operations costs.

Table 6b. Gross Margins for Maize/beans inter-crop for Western Province.

Item	Net maize buyer High input user	Net maize seller High input user
YIELD	n=16	n=11
Maize harvest (kg/acre)	1498.7	1332.2
Beans harvest (kg/acre)	78.8	112.6
Maize price (Ksh/kg)	12.5	9.4
Beans price (Ksh/kg)	56	56
REVENUE		
Maize and beans (Ksh/acre)	**23,146.55**	**18,828.28**
PRODUCTION COSTS		
Seed/planting material		
Maize quantity (kg/acre)	9.9	8.8
Beans quantity (kg/acre)	14.1	9.5
Maize price (Ksh/kg)	91	91
Beans price (Ksh/kg)	56	56
Total cost (Ksh/kg)	**1,690.50**	**1,332.80**
Fertilizer/manure		
DAP (Kg/acre) @ **Ksh 26/kg**	52.10	53.50
20:20/23:23 (Kg/acre) @ **Ksh 24/kg**	50.00	
Urea (Kg/acre) @ **Ksh 22/kg**	44.90	25.50
CAN (Kg/acre) @ **Ksh 25.50/kg**	33.30	48.70
Total cost (Ksh/acre)*	**2,508.30**	**2,108.70**
Operations costs		
Cash costs (Ksh/acre)**	2,911.2	2,505.0
Family labor (mandays/acre)	66.9	32.8
Family labor (Ksh/acre)	3,345.0	1,640.0
Total cost (Ksh/acre)	6,256.2	4,145.0
Total Production Costs (Ksh/acre)[1/]	**7,110.00**	**5,946.50**
Total Production Costs (Ksh/acre)[2/]	**10,455.00**	**7,586.50**
GROSS MARGINS		
Excl. family labor (Ksh/acre)	16,036.55	12,881.78
Incl. family labor (Ksh/acre)	**12,691.55**	**11,241.78**
Land rent (Ksh/acre)	2,000.00	2,000.00
NET MARGINS		
Excl. family labor (Ksh/acre)	14,036.55	10,881.78
Incl. family labor (Ksh/acre)	**10,691.55**	**9,241.78**
Return to family labor (Ksh/manday)	209.81	331.76

[1/] Excluding family labor costs [2/] Including family labor costs

* The total cost of fertilizer is a weighted average cost that includes all cash costs paid by farmers for all types of fertilizers/manure. The prices used for computations are divisional level average prices which differ slightly from the regional level prices reported in the table. Furthermore, the figure for total cost also includes cost of fertilizers for which quantities were not reported because farmers failed to recall them but remembered what they paid.

** Cash costs are costs of ploughing, harrowing, planting, weeding, harvesting, shelling, and all other miscellaneous farm operations costs.

Table 6c . Gross Margins for Maize/beans inter-crop for Eastern Province.

Item	Net maize buyer Low input user	Net maize buyer High input user
	n=12	n=15
YIELD		
Maize harvest (kg/acre)	212.6	239.9
Beans harvest (kg/acre)	78.3	69.3
Maize price (Ksh/kg)	13.0	13.0
Beans price (Ksh/kg)	51.0	51.0
REVENUE		
Maize and beans (Ksh/acre)	**6,757.10**	**6,653.00**
PRODUCTION COSTS		
Seed/planting material		
Maize quantity (kg/acre)	12.0	8.9
Beans quantity (kg/acre)	12.6	15.3
Maize price (Ksh/kg)	75.0	75.0
Beans price (Ksh/kg)	51.0	51.0
Total cost (Ksh/kg)	**1,542.60**	**1,447.80**
Fertilizer/manure		
DAP (Kg/acre) @ **Ksh 30/kg**	9.7	67.3
Total cost (Ksh/acre)*	**291.00**	**2,019.00**
Operations costs		
Cash costs (Ksh/acre)**	875.8	704.0
Family labor (mandays/acre)	42.3	90.9
Family labor (Ksh/acre)	2,115.0	4,545.0
Total cost (Ksh/acre)	2,990.8	5,249.0
Total Production Costs (Ksh/acre)[1/]	**2,709.40**	**4,170.80**
Total Production Costs (Ksh/acre)[2/]	**4,824.40**	**8,715.80**
GROSS MARGINS		
Excl. family labor (Ksh/acre)	4,047.70	2,482.20
Incl. family labor (Ksh/acre)	**1,932.70**	**(2,062.80)**
Land rent (Ksh/acre)	1,500.00	1,500.00
NET MARGINS		
Excl. family labor (Ksh/acre)	2,547.70	982.20
Incl. family labor (Ksh/acre)	**432.70**	**(3,562.80)**
Return to family labor (Ksh/manday)	60.23	10.81

[1/] Excluding family labor costs [2/] Including family labor costs

* The total cost of fertilizer is a weighted average cost that includes all cash costs paid by farmers for all types of fertilizers/manure. The prices used for computations are divisional level average prices which differ slightly from the regional level prices reported in the table. Furthermore, the figure for total cost also includes cost of fertilizers for which quantities were not reported because farmers failed to recall them but remembered what they paid.

** Cash costs are costs of ploughing, harrowing, planting, weeding, harvesting, shelling, and all other miscellaneous farm operations costs.

5.1.3 Beans

Because very few of the sampled farmers grew beans as a mono-crop, only in the Rift Valley and in the Eastern Provinces were there enough cases to analyze this enterprise. Table 7 reports gross margins for mono-crop beans. Gross margins per acre averaged Ksh.8,861 for the Rift Valley Province and Ksh. 6,737 for the Eastern Province, excluding family labor costs. When family labor costs are included as a cost, gross margins decrease to Ksh.3,582, and Ksh.2,412 for the Rift valley and the Eastern Provinces, respectively. However, for the Eastern Province, the gross margins remain positive whereas, for the maize mono-crop and, for high input users, the maize/bean inter-crop, gross margins were negative when family labor was valued at its opportunity cost. These results also show that beans are more profitable in the high potential area than in the low potential area.

Table 7. Gross Margins for Beans Mono-crop

Item	Rift Valley Province	Eastern Province
YIELD	**(n= 18)**	**(n=37)**
Harvest (kg/acre)	280.00	218.00
Price (Ksh/kg)	48.00	51.00
REVENUE		
Beans (Ksh/acre)	**13,440.00**	**11,118.00**
PRODUCTION COSTS		
Seed/planting material		
Quantity (kg/acre)	34.70	35.30
Price (Ksh/kg)	48.00	51.00
Total cost (Ksh/kg)	**1,665.60**	**1,800.30**
Fertilizer/manure		
DAP (kg/acre)	61.10	1,215.00[3/]
Price (Ksh/kg)	25.00	1.10
Total cost (Ksh/acre)	**1,527.50**	**1,336.50**
Operations costs		
Cash costs (Ksh/acre)**	1,386.20	1,244.20
Family labor (mandays/acre)	75.40	86.50
Family labor (Ksh/acre)	5,278.00	4,325.00
Total cost (Ksh/acre)	**6,664.20**	**5,569.20**
Total Production Costs (Ksh/acre)[1/]	4,579.30	4,381.00
Total Production Costs (Ksh/acre)[2/]	**9,857.30**	**8,706.00**
GROSS MARGINS		
Excl. family labor (Ksh/acre)	8,860.70	6,737.00
Incl. family labor (Ksh/acre)	**3,582.70**	**2,412.00**
Land rent (Ksh/acre)	1,750.00	1,000.00
NET MARGINS		
Excl. family labor (Ksh/acre)	7,110.70	5,737.00
Incl. family labor (Ksh/acre)	**1,832.70**	**1,412.00**
Return to family labor (Ksh/manday)	**94.30**	**66.30**

[1/] Excluding family labor costs [2/] Including family labor costs[3/] Manure

** Cash costs are costs of ploughing, harrowing, planting, weeding, harvesting, shelling, and all other miscellaneous farm operations costs.

5.1.4 Wheat

Wheat was grown only in the Rift Valley Province, where farmers have relatively larger land holdings and the agro-ecology supports this crop. As wheat production is relatively capital intensive, only households which can finance relatively higher cash outlays cultivate this crop. Therefore, wheat may not be substitutable in production with maize except for households with sufficient capital resources. Table 8 reports gross margins for wheat, which averaged Ksh. 11,333 without accounting for family labor and Ksh. 11, 053 when it is included at its opportunity cost. These figures are not very different from one another, reflecting the relative low importance of family labor in wheat production.

Compared with the crop enterprises discussed earlier (*i.e.* mono-crop maize, maize/beans inter-crop, and mono-crop beans), wheat appears to be the most profitable enterprise for farmers in the Rift Valley Province, although these farmers do not allocate as much land for wheat as they do for maize and beans. While other reasons may explain why farmers allocate only a small share of their land to wheat, these results suggest that the main factor is a capital (cash) constraint. A relatively higher cash investment is required to cultivate wheat and labor cannot be easily substituted for these machinery costs[14].

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[14] The total costs of production for wheat, excluding family labor are Ksh. 8,313 compared to an average of Ksh. 6,205 (*i.e.* 25% lower) for mono-crop maize.

Table 8. Gross Margins for Wheat

Item	Rift Valley Province
YIELD	**(n=31)**
Harvest (kg/acre)	893.00
Price (Ksh/kg)	22.00
REVENUE	
Wheat (Ksh/acre)	**19,646.00**
PRODUCTION COSTS	
Seed/planting material	
Quantity (kg/acre)	83.90
Price (Ksh/kg)	22.00
Total cost (Ksh/kg)	**1,845.80**
Fertilizer/manure	
DAP (kg/acre)	67.80
Price (Ksh/kg)	25.00
Total cost (Ksh/acre)	**1,695.00**
Operations costs	
Cash costs (Ksh/acre)**	4,772.40
Family labor (mandays/acre)	4.00
Family labor (Ksh/acre)	280.00
Total cost (Ksh/acre)	**5,052.40**
Total Production Costs (Ksh/acre)[1/]	8,313.20
Total Production Costs (Ksh/acre)[2/]	**8,593.20**
GROSS MARGINS	
Excl. family labor (Ksh/acre)	11,332.80
Incl. family labor (Ksh/acre)	**11,052.80**
Land rent (Ksh/acre)	1,750.00
NET MARGINS	
Excl. family labor (Ksh/acre)	9,582.80
Incl. family labor (Ksh/acre)	**9,302.80**
Return to family labor (Ksh/manday)	**2,395.7**

[1/] Excluding family labor costs

[2/] Including family labor costs

** Cash costs are costs of ploughing, harrowing, planting, weeding, harvesting, shelling, and all other miscellaneous farm operations costs.

5.1.3 Irish potatoes, cassava and sweet potatoes

Gross margins for irish potatoes are presented in Table 9. In the Rift Valley Province, gross margins average Ksh. 13,950 per acre before accounting for family labor and decrease to Ksh. 5,956 per acre after accounting for it. In the Eastern Province, gross margins average Ksh. 6,151 per acre and Ksh. 2,777 per acre before and after accounting for family labor respectively. First, these results show that irish potatoes are more profitable in high potential areas than in low potential areas. Second, they indicate that family labor costs, as a percent of total production costs, is large (*i.e.* 49 % and 51% for the Rift Valley and Eastern Provinces respectively). In addition, in the Rift Valley Province, production of irish potatoes is relatively more labor intensive than wheat. Thus, profitability analysis based only on cash costs shows that irish potatoes are more profitable than wheat production in Rift Valley. However, when family labor costs are taken into account, the profitability falls to one-half of the corresponding figure for wheat.

Cassava, which is a drought tolerant crop, is mainly grown in the Western and in the Eastern Provinces. In the Western Province, the gross margins for cassava are Ksh. 8,415 and Ksh. 2,330 while in the Eastern Province, the gross margins are Ksh. 4,701 and -1,329 (Table 10), before and after accounting for family labor, respectively. These results also show that cassava production's main input is family labor. Therefore, analysis of profitability of cassava that does not explicitly account for family labor, overestimates its relatively profitability.

Table 9. Gross Margins for Irish Potatoes

Item	Rift Valley Province	Eastern Province
YIELD	**(n=15)**	**(n=8)**
Harvest (kg/acre)	2,030.70	721.90
Price (Ksh/kg)	11.00	13.00
REVENUE		
Irish Potatoes (Ksh/acre)	**22,337.70**	**9,384.70**
PRODUCTION COSTS		
Seed/planting material		
Quantity (kg/acre)	448.90	159.40
Price (Ksh/kg)	11.00	13.00
Total cost (Ksh/kg)	**4,937.90**	**2,072.20**
Fertilizer/manure		
DAP (kg/acre)	85.30	
Price (Ksh/kg)	25.00	
Total cost (Ksh/acre)	**2,132.50**	
Operations costs		
Cash costs (Ksh/acre)**	1,317.50	1,161.90
Family labor (mandays/acre)	114.20	48.20
Family labor (Ksh/acre)	7,994.00	3,374.00
Total cost (Ksh/acre)	**9,311.50**	**4,535.90**
Total Production Costs (Ksh/acre)[1/]	8,387.50	3,234.10
Total Production Costs (Ksh/acre)[2/]	**16,381.50**	**6,608.10**
GROSS MARGINS		
Excl. family labor (Ksh/acre)	13,950.20	6,150.60
Incl. family labor (Ksh/acre)	**5,956.20**	**2,776.60**
Land rent (Ksh/acre)	1,750.00	1,000.00
NET MARGINS		
Excl. family labor (Ksh/acre)	12,200.20	5,150.60
Incl. family labor (Ksh/acre)	**4,206.20**	**1,776.60**
Return to family labor (Ksh/manday)	**106.80**	**106.90**

1/ Excluding family labor costs 2/ Including family labor costs

** Cash costs are costs of ploughing, harrowing, planting, weeding, harvesting, shelling, and all other miscellaneous farm operations costs.

Table 10. Gross Margins for Cassava

Item	Western Province	Eastern Province
YIELD	**(n=18)**	**(n=8)**
Harvest (kg/acre)	1,801.70	916.30
Price (Ksh/kg)	6.00	6.00
REVENUE		
Cassava (Ksh/acre)	**10,810.20**	**5,497.80**
PRODUCTION COSTS		
Seed/planting material		
Quantity (kg/acre)	1,360.00	530.00
Price (Ksh/kg)	1.00	1.00
Total cost (Ksh/kg)	**1,360.00**	**530.00**
Operations costs		
Cash costs (Ksh/acre)**	1,035.40	266.70
Family labor (mandays/acre)	121.70	120.60
Family labor (Ksh/acre)	6,085.00	6,030.00
Total cost (Ksh/acre)	**7,120.40**	**6,296.70**
Total Production Costs (Ksh/acre)[1/]	2,395.40	796.70
Total Production Costs (Ksh/acre)[2/]	**8,480.40**	**6,826.70**
GROSS MARGINS		
Excl. family labor (Ksh/acre)	8,414.80	4,701.10
Incl. family labor (Ksh/acre)	**2,329.80**	**(1,328.90)**
Land rent (Ksh/acre)	1,750.00	1,000.00
NET MARGINS		
Excl. family labor (Ksh/acre)	6,664.80	3,701.10
Incl. family labor (Ksh/acre)	**579.80**	**(2,328.90)**
Return to family labor (Ksh/manday)	**54.80**	**30.70**

1/ Excluding family labor costs

2/ Including family labor costs

** Cash costs are costs of ploughing, harrowing, planting, weeding, harvesting, shelling, and all other miscellaneous farm operations costs.

Sweet potatoes, which mainly serve the role of a 'food security' crop in most households' diets, are mostly cultivated in the lower potential areas of the Western and the Eastern Provinces. In the Western Province, gross margins for sweet potatoes average Ksh. 5,327 and Ksh. 1,962 (Table 11) before and after accounting for family labor, respectively, versus Ksh. 3,741 and Ksh. 136, in the Eastern Province, before and after accounting for family labor, respectively. Just like the other root tubers (irish potatoes and cassava) discussed above, sweet potato production also uses relatively more labor in proportion to capital.

Table 11. Gross Margins for Sweet Potatoes

Item	Western Province	Eastern Province
YIELD	**(n=39)**	**(n=18)**
Harvest (kg/acre)	2,390.50	1,370.60
Price (Ksh/kg)	3.00	3.50
REVENUE		
Sweet Potatoes (Ksh/acre)	**7,171.50**	**4,797.10**
PRODUCTION COSTS		
Seed/planting material		
Quantity (kg/acre)	1,153.00	889.20
Price (Ksh/kg)	1.00	1.00
Total cost (Ksh/kg)	**1,153.00**	**889.20**
Operations costs		
Cash costs (Ksh/acre)**	691.30	166.70
Family labor (mandays/acre)	67.30	72.10
Family labor (Ksh/acre)	3,365.00	3,605.00
Total cost (Ksh/acre)	**4,056.30**	**3,771.70**
Total Production Costs (Ksh/acre)[1/]	1,844.30	1,055.90
Total Production Costs (Ksh/acre)[2/]	**5,209.30**	**4,660.90**
GROSS MARGINS		
Excl. family labor (Ksh/acre)	5,327.20	3,741.20
Incl. family labor (Ksh/acre)	**1,962.20**	**136.20**
Land rent (Ksh/acre)	1,750.00	1,000.00
NET MARGINS		
Excl. family labor (Ksh/acre)	3,577.20	2,741.20
Incl. family labor (Ksh/acre)	**212.20**	**(863.80)**
Return to family labor (Ksh/manday)	**53.20**	**38.00**

1/ Excluding family labor costs

2/ Including family labor costs

** Cash costs are costs of ploughing, harrowing, planting, weeding, harvesting, shelling, and all other miscellaneous farm operations costs.

5.2 How profitable is maize?

The main focus of this study was to determine how profitable maize production is *vis-a-vis* that of alternative crop enterprises. The results on enterprise profitability that have been presented in the preceding section are summarized in Table 12, which reports a summary of the gross margins and Table 13, which reports the relative rankings of crop enterprises based on a relative profitability index. The gross margins from each enterprise is divided by that of the maize/bean (NBHI) (net buyer, high input user) enterprise to obtain a ratio that serves as a relative profitability index. NBHI was chosen because it was the most common among the sampled farmers. An index of less than, equal to or greater than unity indicates that the enterprise is less, equally or more profitable than the maize/beans inter-crop (NBHI). The results show that in the Rift valley province, maize/bean inter-crop (NBHI) is the most profitable enterprise excluding family labor costs but ranks third when family labor costs are included. Wheat followed by mono-crop maize are first and second respectively when family labor costs are included. Maize/beans inter-crop (NSHI) (net seller, high input user) is fourth followed irish potatoes. In the Western Province, maize/beans inter-crop (NBHI) is the most profitable both before and after including family labor costs. The second most profitable enterprise is also a maize/bean inter-crop (NSHI) followed by mono-crop maize (NBHI) with cassava and sweet potatoes being the least profitable. In the Eastern Province, the most profitable enterprise is irish potatoes after including family labor costs. The second most profitable enterprise is beans followed by maize/beans inter-crop (NBHI) and maize/beans inter-

crop(NBLI) (net buyer low input user). Sweet potatoes are only marginally profitable while cassava, mono-crop maize (NBLI) and mono-crop maize (NBHI) all have negative returns.

The inference we draw is that profitability of maize is low relative to alternative crops, but can be greatly improved if maize is inter-cropped with a legume, in this case, beans. Hence, profitability analysis that does not explicitly take into account maize inter-crops should indeed find that maize is less profitable than alternative crops; and that the continued cultivation of the crop by farmers can only be for: (1) subsistence reasons; or (2) at for other reasons that are not based on profitability. Earlier studies which have concluded that maize production is unprofitable, relative to other crops, may have been looking at maize profitability in Kenya from this 'narrow' lens. The results presented in this study suggest that maize production is relatively more profitable, or at least as profitable as other alternative enterprises, if maize is grown as an inter-crop with beans. The fact that the maize/bean inter-crop is the most common cropping pattern in Kenya, suggests that farmers have reached a similar conclusion.

Furthermore, depending on the market position of the farmer and the type of technology regime employed, the 'same' enterprise may seem profitable to one group of farmers while it is unprofitable to another group. For example in the Rift Valley Province, mono-crop maize is more profitable than maize/beans inter-crop for net-buying households while it is relatively unprofitable to net selling households. Hence, profitability analysis that involves the major food staple needs to be done within a context that recognizes the dual nature of the market position (*i.e.* either net maize buyers or net maize

sellers) of farmers as well as taking into account different input use regimes.

Table 12. Gross margins for different enterprises by Province (Ksh./acre)

Crop enterprise	Rift Valley Province		Western Province		Eastern Province	
	Ksh/acre		Ksh/acre		Ksh/acre	
	Return to Family labor	Gross Margins	Return to Family labor	Gross Margins	Return to Family labor	Gross Margins
Maize mono-crop (NBHI)/1	396	9,610	161	6,023	(28)	(3,182)
Maize mono-crop (NBLI)	-	-	-	-	(35)	(2,425)
Maize mono-crop (NSHI)	235	4,648	-	-	-	-
Maize/bean inter-crop (NBHI)	173	9,134	210	12,692	11	(2,063)
Maize/bean inter-crop (NBLI)	-	-	-	-	60	1,933
Maize/bean inter-crop (NSHI)	261	8,388	332	11,242	-	-
Beans	94	3,583	-	-	66	2,412
Wheat	2,396	11,053	-	-	-	-
Irish potatoes	107	5,956	-	-	107	2,777
Cassava		-	55	2,330	31	(1,329)
Sweet potatoes		-	53	1,962	38	136

/1 NBHI is net maize buyer, high input user

NBLI is net maize buyer, low input user

NSHI is net maize seller, high input user

Table 13. Ranking of enterprises according to relative profitability index by province

Crop enterprise	Rift Valley Province		Western Province		Eastern Province	
	Ksh/acre		Ksh/acre		Ksh/acre	
	Return to Family labor	Gross Margins	Return to Family labor	Gross Margins	Return to Family labor	Gross Margins
Maize mono-crop (NBHI)/1	2.29	1.05	0.77	0.47	(2.55)	(1.54)
Maize mono-crop (NBLI)	-	-	-	-	(3.18)	(1.18)
Maize mono-crop (NSHI)	1.36	0.51	-	-	-	-
Maize/bean inter-crop (NBHI)/2	1.00	1.00	1.00	1.00	1.00	1.00
Maize/bean inter-crop (NBLI)	-	-	-	-	5.45	0.94
Maize/bean inter-crop (NSHI)	1.51	0.92	1.58	0.89	-	-
Beans	0.54	0.39	-	-	6.00	1.17
Wheat	13.85	1.21	-	-	-	-
Irish potatoes	0.62	0.65	-	-	9.73	1.35
Cassava	-	-	0.26	0.18	2.82	(0.64)
Sweet potatoes	-	-	0.25	0.15	3.45	0.07

/1 NBHI is net maize buyer, high input user

NBLI is net maize buyer, low input user

NSHI is net maize seller, high input user

/2 Maize/bean inter-crop (NBHI) = 100%

5.3 What if farmers are net maize buyers?

In this section a slightly different argument is presented that incorporates the characteristic of the farming household. In section 1.3, a paper by Jayne *et al.* was cited, which reported that over 61% of the rural households in Kenya were net maize buyers. Also, Jayne *et al.* (2000) report that a high percent (52%) of the rural small holders in Kenya, are net maize buyers. Both of these papers argue that smallholders are hurt by high maize prices, since they are net buyers of maize. However, these papers do not address the implications of the farmers' net buying position on maize production. Since gross margins (farm profits) are the difference between revenue and production costs, their magnitude is directly related to the output price. When the crop of concern serves both the role of being a food crop as well as a cash crop, the output price affects the farming household in two ways. First, it is the price at which their produce is valued and therefore a high price would be preferred. Second, it is the price at which the household would buy the crop for consumption and would therefore prefer a low price. Maize in Kenya falls in this category of crops.

If the household is a *net maize seller*, then the selling price (farm gate price) of maize is the relevant price to use when computing the monetary value of that households's produce. In this case, the farmer looks at what price at which he/she can actually sell his/her surplus in the market place. However, if the household is a *net maize buyer*, then the selling price is not the appropriate price to use. Rather, the buying price should be used because this farmer, values his/her produce at the savings his/her own produce

accords the household in lieu of making purchases for consumption (Jayne 1994).

This study revealed that a great divergence exists between the buying prices and the selling prices of maize in all the study areas. Appendix Table A1 reports the 1998/1999 median maize buying and selling prices, by month for the province covered in this study. These data show significant differences between the prices at which farmers were able to sell their maize, versus the prices at which they were able to buy maize. In this study, we were unable to establish the reason(s) why this divergence exists.

The results on profitability presented earlier incorporate an illustration of the impact of using buying prices and selling prices, to estimate maize profitability for different categories of farmers. The maize from net buying households was valued at buying prices while maize from net selling households was valued at selling prices. The results showed that on average profitability was higher for net buying households than for net selling households. When buying prices are used to value maize, then the profitability figures represent what the profitability of maize production is from the standpoint of a net buying household. Now, looking at maize profitability through this 'lens' of the net buying households, it is hard to conclude that maize production is unprofitable, relative to alternative crops. The superiority of the maize/bean inter-crop gets greatly reinforced by these figures.

Given the foregoing discussion, it seems reasonable to conclude that farmers who are observed growing maize, rather than alternative 'high value' crops, are in fact rational. Thus, one can conclude that, what at first glance seems to be production decisions based on non-economic principles, are in fact based on the optimization principle. However,

these farmers incorporate their consumption requirement in their optimization constraint. This result is consistent with similar analysis and empirical findings from Zimbabwe (Jayne, 1994).

5.4 Farmers' characteristics and circumstances

In order to understand the factors (in addition to profitability) that influence farmers decisions regarding what crops to grow, the farmers' characteristics and their perceptions were examined. This section synthesizes some of the characteristics examined. The first, and most important factor in determining what crop and how much of it a farmer grows, is the amount of land that the farmer has available for crop production. Table 14 reports the land area owned by farmers in the whole sample and in the study provinces. Land sizes average 7 acres per household for the whole sample, compared to 11, 6, and 4 acres per household for the Rift Valley, the Western, and the Eastern Provinces, respectively. Although the actual acreage varied greatly, ranging from 0.10 acres to 81 acres, the median acreage indicates that at least 50 per cent of the sampled households owned 4 acres or less. The median acreage for the Rift Valley, the Western, and the Eastern Provinces are 5, 4, and 3 acres per household, respectively, indicating that most of the farmers in the sample are land constrained, hence, the reference to these farmers as 'small holders' or 'small-scale farmers. To supplement the family-owned land, approximately 22 percent of the farmers in the whole sample rented an average of 2 acres (per renting household) with the median acreage being 1 acre. The amount of land rented

also varied across renting households, ranging from a minimum size of 0.05 acres to a maximum of 9 acres.

Table 14. Land size (in acres) holdings in the Rift Valley, Western, and Eastern Provinces, Kenya.

Region	Number	Mean	Median	Std. Dev.	Min.	Max.
Rift Valley	**80**	**10.71**	**5.00**	**16.05**	**0.10**	**81.00**
Western	**80**	**6.04**	**4.00**	**7.52**	**0.25**	**48.00**
Eastern	**80**	**4.44**	**3.00**	**4.29**	**0.50**	**30.00**
Whole sample	**240**	**7.07**	**4.00**	**10.83**	**0.10**	**81.00**

Source: Survey data, 1999

The second factor that influences household decisions regarding what crops to grow is the number of people that depend on family-owned land for their provisions. Farmers use their land to provide their family members with the basic needs of life - food, shelter, and clothing. For agrarian communities like the ones from which the sample was drawn, their most important concern is to have enough food for the family members. The fact that the households depend mostly on land for their livelihood, rather on other sources of livelihoods (incomes), is evidenced by the low percent of people involved in off-farm income-generating activities. Of the over 1,600 members of the 240 sampled households, 48 percent were students and 39 percent were engaged in farming as their primary occupation (Table 15). Hence, only 17 percent of all the members in the sampled households depend, in part, on non-farm sources of income. This fact underscores the

importance of land as a source of livelihood for majority of the rural small holders in Kenya.

The third factor that influences household decisions regarding what crops to grow is an interaction between the number of family members that depend on the family land for food and the ability of alternative crops to generate sufficient revenue necessary for meeting the household's food needs. Although the process by which farming households make decisions on cropping patterns is complex, I hypothesize that they do so in a step-wise fashion. First, I hypothesize that they consider crops that will provide them with food, usually their staple. Second, they consider alternative crops that could potentially be grown to provide them with income, which they can use to purchase their staple food. Third, they consider the relative profitability of the alternative crops, compared to that of the staple food crops. If the alternative crops are more profitable then they are, *ceteris paribus*, considered potential challengers for the land grown to the staple food crop. Finally, farmers determine if the revenue from the more profitable alternative crops will in fact be sufficient to purchase the staple food. If the revenue from the alternative crops is not sufficient to pay for the food staple, farmers would choose to grow the staple food themselves.

Table 15. Primary occupation of household members of the sample households.

Primary occupation	Frequency	Percent	Cumulative Percent
farmer	559	34.8	34.8
farm labourer	62	3.9	38.7
teacher	40	2.5	41.2
civil servant	15	0.9	42.1
other employment on salary	79	4.9	47.0
artisan	20	1.2	48.3
trader	27	1.7	49.9
student	766	47.7	97.6
butcher	2	0.1	97.8
religious activities	9	0.6	98.3
unskilled non-agric. worker	19	1.2	99.5
homemaking	8	0.5	100.0
Total	1,606	100.0	

Source: Survey data, 1999

For the whole sample, each household had an average of 8 members that were supported by the family farm (Table 16). In the Rift Valley Province, the average family size is 8.5 members while in the Western and the Eastern Provinces, average family sizes are 8 and 7.2 members, respectively. The median number of members per household is 8 members for the whole sample, implying that at least 50 percent of all the households have a family size of 8 or more members to feed, house, and clothe. In addition, on average these 8 members per household, depend on 7 acres (Table 14) of land with at least 50 percent of the households depending on less than 4 acres of land.

Table 16. Number of family members per household in the Rift Valley, Western, and Eastern Provinces, Kenya.

Region	Number of household family members			
	Number	Mean	Median	Std. Dev.
Rift Valley	80	8.49	9.00	2.83
Western	80	8.01	8.00	2.71
Eastern	80	7.23	7.00	2.08
Whole sample	240	7.91	8.00	2.61

Source: Survey data, 1999

In order to determine whether the revenues from alternative crops are sufficient to pay for household food needs, a detailed analysis of consumption is necessary. However, while this is beyond the scope of this study, by studying the cropping choices that farmers made in 1999 (Table 17), one can hypothesize on what the reality faced by farmers could be.

In the Rift Valley Province, farmers that are net maize buyers allocate an about 40% of their land to maize/beans inter-crop and 16% to mono-crop maize while about 38% of the land was allocated to wheat. All other crops, such as, irish potatoes, pyrethrum, bananas, and sweet potatoes are allocated less than 5% of the total land. In the Western and the Eastern Provinces, a similar pattern of cropping choices are evident. Farmers allocate the largest share of their crop land to maize and maize/bean inter-crops while they allocate less than 5% of total area to most of the alternative crops. This land allocation pattern suggests that farmers believe that alterative crops can not generate sufficient revenue to pay for their food. Nevertheless, further analysis that looks at the

consumption patterns of households and how these affect cropping decisions need to be done. In addition, it should be noted that during the survey period, there was a tariff of 25% on maize imports which may have influenced the cropping choices that farmers made.

Table 17. Acreage planted to different crops in the Rift Valley, Western, and Eastern Provinces, Kenya, 1999.

Region	Market position	Input use	Crop enterprise	Percent of total area
Rift Valley	Net maize buyer	High input user	Maize/beans inter-crop	39.73
			Wheat	37.72
			Mono-crop maize	15.88
			Irish potatoes	1.54
	Net maize seller	High input user	Maize/beans inter-crop	44.96
			Wheat	23.84
			Mono-crop maize	22.33
			Pyrethrum	4.53
Western	Net maize buyer	High input user	Maize/beans inter-crop	55.05
			Sugarcane	20.48
			Mono-crop maize	6.30
			Sweet potatoes	2.44
	Net maize seller	High input user	Maize/beans inter-crop	60.35
			Mono-crop maize	19.84
			Sugarcane	8.49
			Millet	2.97
Eastern	Net maize buyer	High input user	Maize/beans inter-crop	47.26
			Mono-crop maize	8.67
			Coffee	8.32
			Beans	5.72
		Low input user	Maize/beans inter-crop	56.57
			Mono-crop maize	13.69
			Maize/pigeon peas	6.08
			Maize/beans/cassava	4.56

Source: Survey data, 1999

5.5 Simulated effect of the removal of maize import tariff on relative profitability

During the study period, a 25% maize import tariff was in place that is thought to have affected maize prices and therefore affected the profitability of maize and hence the relative profitability of other crop enterprises. The price of maize was reduced by 25% and used to compute gross margins for the mono-crop maize and maize/beans inter-crop in order to see what happens to relative profitability in without-tariff setting. The simulation results were then used to compute a relative profitability index for each enterprise and the results are presented in Table 18.

The results show that in general the profitability of alternative crops increases in the without-tariff setting compared to when there was the tariff. For example the relative profitability index for cassava in the Western province increases from 0.52 with the tariff to 0.74 without the tariff. In terms of ranking ordering of enterprises according to relative profitability index, some changes also occur. In the Rift Valley Province, wheat is still the most profitable enterprise but irish potatoes now become the second most profitable instead of mono-crop maize (NBHI). Maize/beans inter-crop (NBHI) is third followed by Maize/beans inter-crop (NBSI) and then mono-crop maize (NBHI). In the Western Province, maize/beans inter-crop (NSHI) becomes the most profitable taking the place of maize/beans inter-crop (NBHI) with the least profitable being the mono-crop maize (NBHI). In the Eastern Province, irish potatoes are still the most profitable and, again, is followed by beans just like in the situation with tariff. Maize/bean inter-crop (NBLI) is third and sweet potatoes are fourth with the other remaining enterprises having negative

indices reflecting the negative returns from these enterprises.

These results show that even with the removal of the import tariff, wheat and irish potatoes are still the most profitable enterprises in the Rift Valley and Eastern Provinces respectively. In the Western Province, the most profitable enterprise is maize/beans inter-crop (NSHI) in place of the maize/bean inter-crop for net buyers, high input users. The inference that can be drawn from these simulation results is that the removal of the import tariff, does not substantially alter the ranking of crop enterprises based on relative profitability.

Table 18. Ranking of enterprises according to simulated relative profitability index by province

Crop enterprise	Rift Valley Province		Western Province		Eastern Province	
	Ksh/acre		Ksh/acre		Ksh/acre	
	Return to Family labor	Gross Margins	Return to Family labor	Gross Margins	Return to Family labor	Gross Margins
Maize mono-crop (NBHI)[1]	1.91	0.92	0.63	0.21	(1.16)	(1.51)
Maize mono-crop (NBLI)	-	-	-	-	(1.01)	(1.12)
Maize mono-crop (NSHI)	0.74	0.12	-	-	-	-
Maize/bean inter-crop (NBHI)[2]	1.00	1.00	1.00	1.00	1.00	(1.00)
Maize/bean inter-crop (NBLI)	-	-	-	-	4.24	0.44
Maize/bean inter-crop (NSHI)	1.49	0.94	1.75	1.01	-	-
Beans	0.80	0.65	-	-	4.16	0.85
Wheat	19.39	2.01	-	-	-	-
Irish potatoes	0.84	1.09	-	-	6.81	0.98
Cassava	-	-	0.41	0.29	2.08	(0.47)
Sweet potatoes	-	-	0.47	0.25	2.77	0.05

/1 NBHI is net maize buyer, high input user

/2 Maize/bean inter-crop (NBHI) = 100%

NBLI is net maize buyer, low input user

NSHI is net maize seller, high input user

Source: Survey data 1999

5.6 Farmers' Perceptions

To corroborate some of the conclusions drawn from the results presented in this study, farmers were asked questions to express their perceptions on several issues about which analysts are concerned. To determine if land owned was perceived as a constraint, farmers were asked if they rented land and, if so, how much. The results reveal that 23 percent of the whole sample rented land in 1999. Farmers were then asked what crops they grew on the rented land. The results reveal that 64 percent of the farmers' rented land was planted to maize. Wheat was grown on 11 percent of the rented land, followed by sugar cane (5 percent), and cassava (5 percent), among others. These results reinforce the conclusions above that as they make cropping decisions the main concern for households is to ensure a sufficient supply of the staple food (maize) for their households.

Farmers were also asked to identify their most important food crop. An overwhelming majority (91 percent) said that it was maize while, the others said beans (3 percent), bananas (3 percent), sweet potatoes (1 percent), and cassava (1 percent) (Table 19). When farmers were asked what crop served as their most important source of (cash) income, the results were less overwhelming (Table 20). However, maize was ranked as the most important source of income by 22 percent of the households, followed by sugarcane (15 percent), wheat (12 percent), bananas (10 percent), coffee (8 percent), and beans (5 percent). These results are consistent with the conclusions drawn in this study – that maize is profitable and that households use maize both as a cash crop and food crop. However, some other studies on Kenyan agriculture have arrived at different conclusions. For

example, Jayne *et al.* (2000) argue that, "*the idea of small rural farms relying mostly on grain crops for their incomes is an outdated perception*". They suggest that the most important sources of farm income are horticulture, sugarcane, tea, and coffee. However, the paper acknowledges that in Trans Nzoia and Uasin Gishu districts of the Rift Valley Province, maize appears to be the most lucrative cash crop. This is consistent with the findings of this study. Nonetheless, in the Western Province which is the area most suitable for growing sugarcane, the data from this study do not show that sugarcane is the most important source of cash income (see Table 20).

Table 19. The most important crop used as a source of food for households in Kenya.

Most important source of food	REGION			OVERALL
	RIFT VALLEY	WESTERN	EASTERN	
maize	90.0%	92.4%	90.0%	90.8%
maize/beans	1.3%	-	-	.4%
beans	7.5%	1.3%	1.3%	3.3%
sorghum	-	1.3%	-	.4%
bananas	-	2.5%	6.3%	2.9%
cassava	-	-	2.5%	.8%
sweet potatoes	1.3%	2.5%	-	1.3%

Source: Survey data, 1999

Table 20 The most important crop used as a source of farm cash income for households in Kenya

Most important source of income	REGION			OVERALL
	RIFT VALLEY	WESTERN	EASTERN	
maize	48.6%	14.3%	4.1%	22.2%
maize/beans		1.4%		.5%
beans	2.8%	4.3%	8.1%	5.1%
millet		1.4%		.5%
bananas		1.4%	27.0%	9.7%
coffee		10.0%	13.5%	7.9%
tea		10.0%		3.2%
wheat	36.1%			12.0%
sugarcane	1.4%	41.4%	4.1%	15.3%
pyrethrum	8.3%			2.8%
cowpeas			1.4%	.5%
french beans		7.1%	8.1%	5.1%
cassava		2.9%	5.4%	2.8%
tobacco			1.4%	.5%
tomatoes			4.1%	1.4%
kales	1.4%	2.9%	4.1%	2.8%
oranges			1.4%	.5%
onions			4.1%	1.4%
cabbages			2.7%	.9%
pigeon peas			8.1%	2.8%
sweet potatoes	1.4%	1.4%	1.4%	1.4%
avocado			1.4%	.5%
napier grass		1.4%		.5%

Source: Survey data

To examine the perceptions of farmers regarding maize price policy and how they perceive maize prices to affect their cropping decisions, farmers were asked an open ended question, '*If the price of maize went down, what would you do with the land that is under maize production?*' A majority (73 percent) of the respondents said that they would continue growing the same quantity of maize while, 14 percent said that they would consider reducing maize acreage for another crop, 10 percent said that they would consider changing to another crop altogether, and 3 percent said they would consider changing to dairy farming. A follow-up question was asked to those who said that they would continue growing the same quantity of maize as they did before the price decline, asking why they would do so. The majority (73 percent) of the respondents answered, because "maize is their main food staple". Others said that they would continue to grow maize because, "they produce maize strictly for home consumption and not for sale" (8 percent), that instead of switching crops they, "would rather speculate, hoping to sell maize later at a higher price" (6 percent), that "there is no alternative food crop and that maize is the only viable option" (5 percent), and that "the next best alternative crop is capital intensive" (2 percent). These results suggest that it is indeterminate whether lower maize prices would lead to a substantial shift in cropping patterns from maize to alternative crops.

5.7 Constraints to agricultural commercialization

One objective of this study is to identify the factors that explain why the structural transformation process seems to be slow in stimulating agricultural commercialization in Kenya (*i.e.* increasing the share of total production that farmers market). Further, a higher degree of commercialization is thought to enhance the process of structural transformation by encouraging changes in cropping patterns in favor of crops with high (cash) value. A factor is considered a constraint to agricultural commercialization if :

1. it hinders shifts in cropping patterns from production of low-value to high value crops;
2. it hinders an increase in the share of marketed crop output ; and
3. if it encourages 'subsistence' type of agricultural production system.

The following summary of the factors thought to be constraining agricultural commercialization is based on the results discussed above and information gathered through observation and interviews with subject matter specialists in Kenya.

5.7.1 Land size holding and productivity potential

Access to arable land was the most constraining factor to commercialization for most of the household studied. Over 30 percent the respondents owned 2 acres, or less

with 10 percent owning less than 1 acre. Considering that the average family with 8 members depend on family land for their livelihood, then it is clear that land is a constraint to agricultural production, given the technology currently in use. For some districts, such as Vihiga District (in the Western Province), the largest parcel of land owned by a single household is 3 acres. Moreover, it is on the same land that the homestead is built. Most households visited had three to four houses built on their land to provide shelter for family members. With land sizes this small, and family sizes this large, surpluses for the market are seldom achieved. In fact, sufficient food for the household members is seldom produced. Thus, the size of land holding is one of the constraints to agricultural commercialization. This argument is however based on the assumption that the main objective for the farmers is to feed their family.

5.7.2 Water availability

Land availability is more of a constraint in the Rift Valley and the Western Provinces than it is in the Eastern Province. In the Eastern Province, low land productivity is the issue of most concern. Most of the land in Eastern Province is regarded as 'unproductive' simply because of poor rainfall, hence, the classification of this region as a low potential area. In the study areas of the Eastern Province, most of the land was left fallow and covered by acacia trees, savanna shrubs, and grass. Farmers cleared small sections of their land, planted crops on these cleared sections, but left most of the land fallow. However, some farmers whose lands are served by seasonal rivers, used water

from the seasonal streams to grow a variety of crops such as onions, cabbages, and tomatoes which they sell in the local markets and to traders from outside their districts. During interviews, farmers frequently asked, "where is the water to grow those crops you are talking about ?" Hence, the issue of concern in the Eastern Province is not whether they can produce for the market, but rather whether they can produce at all. As articulated by Owuor (1999), the alternative high value crops such as horticulture can only become viable options if substantial investments are made to develop water infrastructure. Thus, access to water is a major constraint to agricultural production and commercialization, especially in the low potential areas of the Eastern Province.

5.7.3 Relative profitability

In order for farmers to shift from growing one crop, such as maize, to an alternative crop, the profitability of the alternative crop needs to be convincingly higher than the profitability of the original crop. In this study, the analysis of the relative profitability of maize versus alternative crops, yielded mixed results in the three provinces studied. In the Rift Valley Province, wheat is more profitable than maize and in the Eastern Province, irish potatoes and beans were more profitable than maize with the gross margins for maize being negative. However, in the Western Province, maize/beans inter-crop was the most profitable enterprise. Thus, based on profitability, one would expect that farmers in the Rift Valley would allocate more land to wheat and irish potatoes than to maize, and that farmers in the Eastern Province would allocate more land to growing

irish potatoes and beans than maize. However, this study revealed that farmers allocate more land to maize than any other crop in all the three Provinces, in spite of some alternative crops yielding higher gross margins.

The explanation for this apparent discrepancy is twofold. First, while alternative crops such as wheat may be more profitable than maize, because they are highly capital intensive, they are not viable options for cash-strapped households. This explanation is consistent with conclusions drawn by other scholars who have analyzed the cultivation of highly capital intensive crops. For example, Kodhek (1995) states that a lot of small-scale farmers are reluctant to adopt crops like tea and coffee because of their inability to self-finance the establishment of such crops. Similar conclusions are drawn by Owuor (1999).

Second, some alternative crops which seem more profitable than maize (and are therefore commonly referred to as 'high value' crops), are only more profitable when maize is valued at its selling (farm gate) prices. But, as discussed in section 5.4 above, to accurately assess its profitability, maize should be valued at its buying prices because it serves the dual role of a cash and food crop. This is because poor households who depend mostly on their family land for their food and other provisions, value maize in terms of the saving to their households, (*i.e.* money saved by not having to purchase maize) rather than in terms of the cash income they could potentially earn from selling maize. When maize is valued at the buying prices, maize is a profitable enterprise.

5.7.4 Thin and troubled markets for alternative crops

The key to agricultural commercialization is the existence of a reliable market for farm produce. In Kenya, the strategy put forth for transforming smallholder agriculture into a more commercial orientation is based on encouraging farmers to shift from production of maize, sorghum, millet, and cassava towards the production of horticulture, coffee, tea, sugarcane, cotton, and dairy farming (World Bank, 1997). However, some of these crops are not straight forward alternatives because of, among other reasons, the absence of a stable market.

The markets for sugarcane, cotton, and milk (dairy farming) have many problems. Due to lack of enforcement of the sugar import duty, imported sugar has flooded the supermarkets and left local industries burdened with excessive inventory. As a result, farmers are unable to sell their sugarcane harvested on time, leading to tremendous losses. During the survey period, most sugarcane farmers' cane had been in their fields for over 24 months, when the optimum harvesting age is 18 months. This is a disincentive to current and potential sugarcane farmers. As for cotton, massive imports of duty free used clothes have flooded the market with cheap garments, resulting in a decline in demand for domestic textile products. By the time of the research, three textile industries had closed and the last surviving one was struggling. As a result, growing of cotton has declined tremendously. Thus, cotton is no longer a viable alternative for farmers. Similar observation concerning the cotton and sugarcane industry are made by Owuor (1997).

Horticulture provides a lucrative alternative to growing maize, but its market is too

thin to benefit majority of the farmers. The main horticultural crops produced for export are cut flowers, french beans, and Asian vegetables. These crops are grown under contract from exporting companies, which in turn sell these crops in very competitive export markets in Europe. Depending on seasonal supply and demand, these companies purchase varying quantities of horticultural crops from farmers and sometimes, when the European market is flooded, fail to buy at all. The following account, even though anecdotal, is illustrative of the challenges of relying on horticulture as a source of a family's livelihood.

> In 1998, a horticultural export company contracted farmers in Mutuyu Village, Makueni District, to grow french beans and provided them with the inputs to do so. The experience was good and farmers got good returns for their land and labor. In the next season, many additional farmers in the village shifted to the production of french beans and were also provided with seed by the exporting company. However, this next season coincided with a period of heavy rainfall throughout the country as a result of the El-Nino phenomenon. French beans in locations nearer to Nairobi than Mutuyu, performed well and exporters were able to procure them cheaply-- including the exporter in question. The company failed to show up in Mutuyu Village to collect the french beans produced by Mutuyu farmers on its behalf. These farmers lost. They lost an opportunity to grow their own food and there was hunger in Mutuyu Village that season. However, a few farmers who had grown cabbages instead of french beans, made money as the demand within the village was high since most farmers did not grow their own. In 1999, farmers in Mutuyu planted cabbages and abandoned planting of french beans. To use the words of one farmer, "...cabbages were so many that you could get a bag free of charge ... even the cows could no longer eat any more cabbages"[15].

The above account is indicative of the uncertainties that are prevalent in the horticultural industry. When farmers have such experiences, it is hard to convince them to make the shift to relying on horticultural crops for their livelihoods because of the potential danger of not having any food for the family.

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[15] Quote from Jacob Kimanthi, a primary school teacher and farmer in Mutuyu Village, Makueni District.

5.7.5 Lack of enabling environment

In Chapter One, four conditions are listed that must be met for the structural transformation process to occur. These are: low food prices, relative to wages in off-farm activities; assurance of a sufficient food supply to consumers; existence of a low-cost exchange system; and existence of an effective information system. As discussed above, the buying price of maize is sometimes substantially higher than the selling price. The great divergence of the buying and selling prices is in part due to high marketing costs. At the time of the research, the road network in Kenya was in very poor condition. The tarmac roads were ridden with potholes that made communication very difficult and expensive. Also the rural roads were in poor condition and most of them were unmotorable.

Also, inherent in the structural transformation process, is the need for a vibrant non-farm sector to absorb the labor released from agriculture and hence lead to high productivity per agricultural worker. Unfortunately, Kenya's non-farm sector is not vibrant. The public service commission stopped employing new workers in 1993 and there are thousands of university graduates that are unemployed, among other potential workers. The pool of unemployed workers continues to grow each year. Because of the high rate of unemployment, household members find themselves dependent on the family farm for their provisions.

Therefore, given the foregoing, it is not surprising that structural transformation has not occurred very rapidly in Kenya. Liberalization and other structural changes that the government has implemented notwithstanding, there is lack of an enabling environment

for structural transformation to occur. Unless the above bottlenecks are removed or at least mitigated, agricultural commercialization is likely to remain low and the process of structural transformation will continue to remain elusive.

CHAPTER SIX

CONCLUSION

The goal of this study was to determine the relative profitability of maize *vis-a-vis* that of alternative annual crops in Kenya. A main contribution of the study was to provide an empirically determined list of constraints to agricultural commercialization in Kenya. This study also provides information that helps in understanding the constraints faced by farming households. A more general contribution of this study is that it adds to the pool of information regarding on-going debate on why the structural transformation process has been slow in developing countries.

The results show that profitability varies by region, by type of crop enterprise, and by type of technology employed. Crop enterprises are generally most profitable in the high potential districts of the Rift Valley Province followed by the middle potential districts of the Western Province and finally by the low potential districts of the Eastern Province. The results also show that family labor constitutes a significant share of the production costs of most crops, suggesting that profitability results need to be interpreted with caution– taking into account whether or not family labor costs are explicitly considered.

Analysis of profitability for the mono-crop maize and for the maize/bean inter-crop was carried out for three contiguous groups each– net maize buying high input using households (NBHI), net maize buying low input using households (NBLI), and net maize selling high input using households. The results reveal that on average, the high input using households were able to generate net surpluses that could be sold. The advantage of

this classification of households according to their market position is that it makes it possible to take into account the fact that maize farmers are not a monolithic group, an assumption that is inherent in most of the previous studies. Hence, maize profitability is different, even within the same geographic area, depending on the level of input use by farming households, and also depending on whether a household is a net maize buyer or net maize seller.

Relative to the maize/beans inter-crop, wheat was more profitable in the Rift Valley Province followed by mono-crop maize. In the Eastern Province, Irish potatoes were the most profitable followed by beans while in the Western Province, maize/beans inter-crop was the most profitable enterprise. These results show that relative to maize, there are enterprises that are more profitable in two of the three provinces studied. However, maize/beans inter-crop was still the most common enterprise grown by farmers because some of the more profitable alternative crops are capital intensive while others do not have a stable market.

This study also found that although the majority of farmers said that they would prefer to grow maize, there were some who said that they would be willing to consider alternative ventures if the price of maize were lowered. However, since this study found that maize was still cultivated even in regions where it was clearly unprofitable to do so, it remains unclear whether in reality farmers would shift from maize cultivation in the face of lower maize prices. In addition, this study found that the main concern for households is to ensure a sufficient supply of maize, the main staple, and as a result a high percent (73%) of the interviewees said that they would continue to grow it even if prices declined. This

suggests that policies that lead to reduced maize prices such as, removal of import tariff may not substantially affect maize acreage and the expected subsequent shift to cultivation of alternative crops.

Several factors were found as the main constraints to agricultural commercialization in Kenya. First, profitability of alternative crops is not significantly higher than that of maize or maize/bean inter-crop. Hence, to the extent that maize is regarded as a subsistence crop, relative profitability results suggest that alternative crops do not offer much opportunity for farming households to shift from maize and depend on alternative for food provision.

The second constraint is small land size holding and low productivity potential. Over 30 percent of the respondents owned two acres or less of land and a whole family, often a large one, depended solely on this piece of land for its livelihood. Such a small parcel of land is often insufficient for the production of food for home use and generate surpluses for sale.

The third constraint is the unavailability of sufficient water necessary for crop production. Although farmers in the Eastern Province owned relatively large pieces of land, they usually leave their farms fallow because most of the Province is semi-arid. The Province does not receive sufficient rainfall to grow crops in most years and the limited irrigation that is currently being done using water from seasonal streams is inadequate for substantial crop production.

The fourth constraint identified was the lack of adequate market openings for alternative crops such as cotton, sugarcane, and horticultural crops. In part, due to laxity

in the enforcement of import duty policies on sugar and textile products, Kenyan markets are flooded with these products. Most of the cotton and sugar industries have closed down and those that still remain continue to be faced with difficulties of tied up capital in unsold inventories. The horticultural produce market for most of the exported crops such as french beans and cut flowers is highly volatile and unpredictable.

The fifth constraint identified was the lack of an enabling environment for commercial agriculture. For commercialization of agriculture to be a realizable objective, a vibrant non-farm sector that absorbs the labor force released from agriculture is necessary. Poor transport and communication to most parts of the country raise the marketing costs of agricultural produce hence hindering agricultural commercialization.

APPENDIX

Table A1. Maize grain buying and selling median prices, by Region and by month for 1998/1999 crop production period.

Province	Maize price - Ksh/kg	1998						1999					
		Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	Jun.
Eastern	Selling	7.80	-	11.10	-	-	-	-	-	13.30	17.80	-	-
	Buying	14.00	12.00	13.50	10.00	12.00	12.00	10.00	15.00	12.00	16.00	-	-
Western	Selling	-	10.80	10.70	12.20	8.90	11.20	9.40	8.90	-	-	-	-
	Buying	10.00	10.00	12.50	10.00	12.75	10.00	10.00	12.50	15.00	14.50	-	-
Rift Valley	Selling	-	-	-	8.30	5.60	7.80	8.90	8.90	9.00	10.30	-	-
	Buying	13.30	15.00	-	-	-	11.60	12.90	11.60	10.30	12.50	13.30	10.60

1/ - means that there was no price data for that month

Source: Survey data, 1999

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