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Comparative Economic Advantage of Alternative Agricultural Production Activities in Zambia

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Foreword

Southern Africa was characterized by a heavily regulated agricultural market before the late 1980s. Since then, countries in the region have followed a strategy to remove restrictive measures from the agriculture sector. The deregulation process has taken place within the context of worldwide liberalization of agriculture. These changes have meant that Zambia, and the entire southern African region, has to compete internationally in a more open agricultural market. In order to be competitive, southern African countries have to use resources more efficiently by exploiting their comparative advantages. Policy decision-makers should be guided so as to implement policies and strategies that will enhance the competitiveness of agricultural producers.

Various studies have shown that countries can improve their welfare by opening up their borders to freer trade. Furthermore, there is a worldwide move toward economic integration, the European Union being the most prominent example. Southern Africa is no exception, with the region's move toward a Free Trade Area under the auspices of the Southern African Development Community (SADC). Not only is it foreseen that this movement will improve welfare in the whole region, but the region's competitiveness could also improve. Within the framework of economic integration in southern Africa, countries will only reap the benefits by exploiting comparative advantages that exist within the region.

Zambia is one of seven countries in SADC participating in the Research Program on Regional Agricultural Trade and Changing Comparative Advantage in Southern Africa. The comparative economic analysis (CEA) study in Zambia, therefore, forms part of a larger activity to determine comparative advantages in the region. These studies not only examine the existing comparative advantages, but also provide a means to evaluate the impact of different agricultural policies on comparative advantage. This proves to be an especially valuable tool to guide policymakers in the region.

Comparative economic analysis found that Zambia has comparative advantage in all crops analyzed, with the exception of rice. Non-traditional export crops are the most profitable and efficient, but logistical and capital constraints have limited production of these crops across all agroecological zones and categories of farmers. Small-scale farmers in Zambia were found to be more efficient maize producers, but their advantage disappears when they attain potential yields. In terms of policy implications, the study's findings recommend efforts to diversify away from maize, to produce wheat (due to the high transport costs for imports), to expand the production of some export crops such as cotton and tobacco, and to rehabilitate roads in order to improve the comparative advantage of remote regions.

This study is one in a series of studies on Africa's regional trade and comparative advantage, a joint activity of USAID, Africa Bureau, Office of Sustainable Development's Agriculture, Natural Resources and Rural Enterprise (ANRE) Division and the Regional Economic Development Services Office for Eastern and Southern Africa (REDSO/ESA).

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Lastly, I would like to pay tribute to my colleagues in the Zambian team whose respective inputs during the course of this Study collectively constitute this technical paper. These are Dr. Denis Chiwele, Assistant Director, Institute of Economic and Social Research (INESOR), University of Zambia; Dr. Faustin Mwape, Dean, School of Agricultural Sciences, University of Zambia; and Mr. John Keyser, Research Affiliate at the Institute of Economic and Social Research, who was co-opted to guide the team on methodological issues and who, in the process, assisted in the establishment of a database at this Institute for the calculation of Zambia's comparative advantage in agricultural commodities. I would also wish to acknowledge the valuable input of the study's research assistant, Mr. Mutaziwa Kumwenda, and that of Mr. Oliver Moono (senior accounting officer at INESOR) for handling the financial matters related to the study.

Dedication

Dedicated to the memory of the late Professor Glenn Themba Magagula, formerly Deputy Vice Chancellor of the University of Swaziland, whose vision, foresight and leadership led to the development and implementation of the "Regional Trade and Comparative Economic Advantage in Southern Africa" activity.

Executive Summary

Most countries in Southern Africa are going through the process of liberalization mainly under structural adjustment programs. The attendant macroeconomic changes include the liberalization of the agricultural sector. The changes entail mainly the departure from import-substitution strategies to trade liberalization (both domestically in terms of internal market decontrols and externally with respect to the effort to remove barriers to external trade flows). To the extent that the on-going liberalization measures are expected to result in crop diversification, there is the possibility that countries in the region would diversify into similar commodities.

Another important consideration is that there is a new economic and political dispensation in southern Africa particularly following the major political change in South Africa. This has opened the region in a way that has resulted in a number of bilateral and regional initiatives being put underway towards the promotion of closer economic integration and co-operation in the region.

Against the above background, USAID missions in the Southern African region, in collaboration with the University of Swaziland's Center for Agricultural Research and Policy Analysis (CARPA) and national institutions and researchers in selected countries of the region, decided to facilitate the analysis of the impact of evolving trade and agricultural policies on agricultural productivity and food security in the region. The aim is to generate policy-relevant data that would facilitate appropriate policy responses in the fields of regional trade, agricultural productivity and food security. The Institute of Economic and Social Research at the University of Zambia is one institutions in the region conducting the studies, and this technical paper is part of this regional initiative.

In the overall context of the Regional Agricultural Trade and Changing Comparative Advantage in Southern Africa project, this regional initiative aims to realize the following objectives:

- Evaluate the comparative economic advantage (CEA) of alternative agricultural production activities in the various agroecological zones and under the different technology levels and land tenure systems in southern Africa.
- Analyze the potential impacts of removing existing price and policy distortions in the structure of economic incentives on the economic efficiency of alternative productive uses of the region's resources.
- Identify points of policy, technology, and institutional interventions to enhance economic efficiency and direct agricultural resources to their most productive uses.
- Build country data components needed for conducting the regional analysis of CEA and trade in agricultural commodities for southern Africa.

In the Zambian context, this regional initiative is especially relevant given the broad consensus that the country's agriculture has not lived up to its full potential and that there is considerable room for growth. In 1995, for example, the sector accounted for only about 5% of total export earnings and just 18% of Gross Domestic Product (GDP).[1] This was despite a rich abundance of natural resources and the fact that approximately 60% of the population depend directly on agriculture for their livelihood. With the rapid depletion of profitable copper reserves, it is generally agreed that the development of agriculture is critical to Zambia's economic survival.

But for which crops and livestock products does Zambia enjoy a comparative advantage? Which farming activities are the most, and least, profitable and how do different enterprises compare with regard to labor requirements, production costs and other characteristics of private and social importance?

This study has been prepared to help answer some of these questions and to provide agricultural administrators, policymakers, farmers, agribusiness firms,

donors, and others with an improved basis upon which to judge current agricultural sector performance and to anticipate areas of potential growth.

Generally speaking, CEA evaluates the economic efficiency of alternative productive uses of the country's scarce land, labor, capital and water resources. The option that generates the highest social gains from the use of domestic resources is considered the most efficient user of those resources, and Domestic Resource Cost (DRC) analysis techniques are currently among the most commonly used tools for measuring CEA. It is general maintained that for any production option to be the most efficient user of the country's resources, two conditions need to be met:

- the foreign exchange cost of the domestically generated product must be less than its import price, i.e., costs less to produce it locally; and
- the net foreign exchange gain from producing that product must exceed the net economic gain foregone from using the same amount of domestic resources to produce alternative products (or the same product under a different technology or production system), which is referred to as the opportunity cost of domestic productive resources.

DRC measures of economic efficiency include net social profitability, value added, DRC and resource cost ratios (RCR).

The following factors are assumed to be among the major determinants of CEA in agriculture:

- *Biophysical conditions*: these include the physical climate (rainfall, temperature, number and length of sunny days, etc.); physical and chemical soils characteristics; terrain; etc.
- *Level of technology and production systems*: all farming activities are practiced under modern and traditional methods and various scale, land tenure, and cropping systems. These method also define, to a large measure, the yield potential and net economic gains from farming activity.
- *Markets and infrastructure:* proximity to major consuming centers (market) may be a key determinant of CEA, especially in countries where transportation costs are high or the road infrastructure is poor.
- *Resource endowments:* the relative abundance or scarcity of productive resources such as land, water, labor, etc. determine their availability and hence their relative costs or value.
- *Economic policy:* liberalized economic systems promote competitive economic advantage by attracting productive resources to their most profitable uses.

To achieve the main aims of this study, the quantitative analysis is based on a set of indicative crop budgets to reflect actual farm conditions to the best extent possible. Twenty-five distinct crop and livestock activities are covered by these budgets including several levels of small-scale, emergent and commercial management in various regions of the country. Drawing on these budgets, the Policy Analysis Matrix (PAM) was used to analyze the social efficiency of agricultural production as well as the effects of government policy. Trade-offs are involved in all production decisions, and several financial measurement of farm profits and production costs are also provided to help evaluate each activity.

Ultimately, this analysis suggests which farm enterprises make the best use of Zambia's domestic resources from a variety of perspectives. The study identifies which types of farmers are best at certain activities and which regions are the most efficient in the production of different commodities. By analyzing several levels of farm management, an indication is also provided of areas where to realize the greatest potential benefits from targeted programs aimed at improving production. This information is important for the design of effective agricultural policies, farm strategies, and research programs.

In order to establish the agricultural comparative advantage for Zambia within the country's agroecological framework, this technical paper attempts to do the following:

- analyze the degree to which the existing macroeconomic policies have an effect on the economic efficiency of alternative productive uses of the country's resources;
- identify the different types of agroecological zones of Zambia and use these as the main criteria/focus

of the study. In this respect, the comparative Domestic Resource Costs (DRC) data that are based on the country's agroecological zonation are used in the analysis;

- analyze information on crops and livestock production systems. To the degree that agroecological approach is used, an attempt is made to analyze the influence of the physical environment on farming systems in different ecological regions; and
- using the 1995/96 agricultural season as the base year, the technical paper attempts to establish the relative comparative advantage of a number of major agricultural commodities across agroecological zones in Zambia. These include grains, oilseed, cash crops, non-traditional exports, and livestock.

The technical paper is divided into two volumes. Volume One (the main report) begins with Chapter One that presents Zambia's macroeconomic environment. The country's policy shifts are catalogued and the present macro and sectoral policies briefly highlighted. Chapter Two, in turn, presents and analyzes Zambia's agroecological zones, farming systems, and production trends. This is followed by Chapter Three, which presents this study's methodological framework. In particular, the chapter describes the methodology underlying the assumptions used for the analysis of Zambia's agricultural comparative advantage. It is here where the PAM and the key assumptions and procedures are described and analyzed.

Chapter Four presents the results of the study, focusing on Zambia's agricultural comparative advantage. Chapter Five is devoted to sensitivity analysis, presenting three types of sensitivity tests that were conducted during the study in order to illustrate the degree to which new economic parameters affect Zambia's comparative advantage in agriculture. The three tests are (1) measuring the impact of individual price distortions to establish which policy reform could be of most benefit to farm productivity; (2) modeling alternative road freight costs to reveal how social efficiency and farm productivity could improve through investments in rural infrastructure; and (3) upgrading the analysis of the 1995/96 season using prices for 1996/97. Lastly, Chapter Six presents an overview of the study's main conclusions and recommendations. Volume Two, constituting of the appendices, gives the yield, transportation, and cost assumptions. It also presents the 1995/96 and 1996/97 data tables upon which the study's analysis is based.

Glossary of Acronyms and Abbreviations

ASIP	Agricultural Sector Investment Program
CARPA	Centre for Agricultural Research and Policy Analysis
CDC	Commonwealth Development Corporation
CEA	Comparative Economic Advantage
COMESA	Common Market for Eastern and Southern African Countries
DPB	Dairy Produce Board
DRC	Domestic Resource Cost
ECF	Export Credit Fund
EPC	Effective Protection Coefficient
EPRF	Export Pre-financing Revolving Fund
EU	European Union
FAO	Food and Agricultural Organization
FSR	Farming Systems Research
GDP	Gross Domestic Product
GRZ	Government of the Republic of Zambia
IBRD	International Bank for Reconstruction and Development
INESOR	Institute of Economic and Social Research (University of Zambia)
NCDP	National Commission for Development Planning
NPC	Nominal Protection Coefficient
PAM	Policy Analysis Matrix
PTA	Preferential Trade Area
RCR	Resource Cost Ratio
SADC	Southern African Development Community
SAP	Structural Adjustment Program
TAZARA	Tanzania Zambia Railways Ltd.
TAZ	Tobacco Association of Zambia
UAPTA	Unit of Account of the Preferential Trade Area
UNCTAD	United Nations Conference on Trade and Development
UNECA	United Nations Economic Commission for Africa

USAID	United States Agency for International Development
UNDP	United Nations Development Program
UNZA	University of Zambia
VAT	Value Added Tax
VEG	Village Extension Group
WBLR	Weighted Base Lending Rate
ZNFU	Zambia National Farmers Union
ZSC	Zambia Sugar Company

1. Macroeconomic Background

1.1 GENERAL ECONOMIC OVERVIEW

Zambia has gone through a series of significant policy shifts since it attained political independence in 1964. At independence, the country's mineral resources were well developed and its expenditure levels reflected the steady and considerable export receipts mainly from copper. The country's economic performance declined after 1974 largely due to the fall in world copper prices. Between 1974 and 1988, for example, Zambia's external receipts from metal products declined by 23%. This condition compromised the needed re-investments in both the mining and other sectors of the economy. Consequently, the economy declined since then.

It is observable that in spite of the mining sector being the main foreign exchange earner in terms of GDP contribution, the economy is dominated by the services sector. In 1991, the services sector accounted for around 44% of total GDP. It was followed by manufacturing industry with 30%, agriculture with 18% and mining with around 7.5%.[2] Thus, the "productive" sectors accounted for around 55% of total GDP.

The economy has suffered from high inflation; huge budget deficits; and a distorted price structure. By 1992, the inflation growth rate reached 191.2% as opposed to 111.1% the previous year. The situation improved in 1993 when the inflation rate was recorded to be 138.3%. Largely due to the government's adherence to the cash budget, the average inflation in 1996 dropped to 35.1% and in the same year, the government managed to eliminate the budget deficit.

It is worth observing that growth rates have been sluggish and erratic for all sectors. The manufacturing sector, for example, continued to slide and recorded a growth rate of -.2% in 1992. This was largely explained by high inflation; the squeeze in the financial markets; increasing import prices; rising interest rates; and competition from imported consumer goods. The mining sector did not fare better either. The sector's output declined by as much as 33% over the 1974-85 period. Hence, mineral revenue as a proportion of GDP declined from 3.8% in 1975 to well below 2% over the 1975-85 period.

Against the above background, Zambia's economic decline has evidently been one of the worst in sub-Saharan Africa. This has been coupled with an increase in unemployment; a decline in real wages; and a reduction in transfers from the state to the average household. Taken together, this suggested a worsening poverty situation as confirmed by the average standard of living that has been on the decline since the 1970s. It has been estimated, for example, that in 1991 67% of all households were poor and 58% extremely poor. Moreover, 75% of rural and 36% of urban households were recorded as extremely poor.[3] Preliminary data for 1993 suggests that the evidence of poverty continues to grow.

With respect to the area of this technical paper's main concerns, it is noteworthy that there is great potential to achieve higher levels of agricultural production under the above-discussed policy environment, a number of obstacles still continue to constrain this. Some of these are transitional, arising from the adjustment taking place in the sector as a result of the implementation of a radical reform program. Others are institutional and structural in nature and, despite interventions, they are not likely to disappear within a short time. There are, thus, non-agronomic constraints that need to be addressed in order to promote agricultural growth. These constraints need to be kept in mind in analyzing Zambia's comparative advantage in agricultural growth. During the pre-reforms period, constraints to agricultural production included the following:

- *Government Interventions:* The marketing of most agricultural commodities was monopolized by the parastatal sector and government-instituted co-operatives. Moreover, for all the controlled agricultural commodities, the government regulated both

the procurement and sale prices. Transport rates were also determined by the government. Hence, in order to maintain uniform prices of controlled goods and services, the government had to extend subsidies.

- *Producer Price Policies:* The producer price for the country's staple crop (maize) continued to be set by the government so that it remained the same throughout the country (pan-territorial) and throughout the year (pan-seasonal). Started in the 1974/75 crop season, uniform farmgate floor prices were set for producers, according to the government then, to ensure a "fair" and "equitable" compensation to all farmers. Such uniform prices failed to recognize variations in transport costs. Consequently, by trying hard to keep the consumer prices low, the government actually succeeded in making producer prices remain well below both import parity and free market prices.[4]
- *Marketing Subsidies:* The marketing of maize was also subsidized. Under the system, millers were able to procure maize at prices that were closer to producer prices. It is equally noteworthy that the government also used to set into-mill price for maize and ensured that the price was uniform throughout the country. The budgetary implications of the pre-reforms heavy maize subsidies were significant. In particular, between 1980 and 1990, maize subsidies ranged between 21% and 145% of the total budget deficit.[5]
- *Weak Support:* This included the following:
    - Maize Bias: Because of the policy bias in favor of maize, infrastructure and service support to the agricultural sector discriminated against other equally rewarding crops in this sector. Consequently, a distorted and lopsided agricultural sector emerged that was dominated by a single crop, maize, that was encouraged even in areas that were not suited for its production.
    - Inadequate Financial Resources: During the 1980s, the agricultural sector's share of total government expenditure ranged between 11% and 16%. Capital expenditure, in particular, suffered considerably and any noticeable improvements in resource allocations (e.g., in 1986 and 1987) were largely a function of donor support under SAP.

1.2 POLICY RESPONSE TO THE CRISIS

In order to cope with the above problems, the government began in 1983 to work towards economic stabilization. In spite of the characteristic 'stop-go' experience with structural adjustment program (SAP) in Zambia, the basic components of the reforms remained basically the same. Zambia's rather rocky position on structural adjustment can be categorized into five phases: (1) 1980 to 1983 being the period before SAP proper; (2) 1983-1987 when SAP was adopted; (3) mid-1987 to 1989 when the government abandoned SAP; (4) 1990-1991 when liberalization was re-introduced; and (5) late 1991 to the present day (1997) when a new government came into power and a full-scale and accelerated SAP has been adopted.

Zambia's fiscal policies under SAP revolve around fiscal management that aims at balancing the budget by way of gradual reduction and eventual elimination of the large budget deficit. A number of strategies have been adopted to realize this. First and foremost, the government decided to eliminate subsidies on maize and fertilizer. By 1994, all consumer subsidies on maize and maize products were eliminated and the price of mealie meal liberalized. Complementary to this decision was the government's policy to totally withdraw from the marketing and distribution of maize meal.

Another SAP fiscal policy decision in Zambia that has far reaching implications for this study is *privatization*. Given the background of the poor performance of these state enterprises, the decision to privatize them constituted the heart of the country's economic restructuring exercise. The Privatization Act was passed in July 1992 and aims to promote private sector activity in order to stimulate competition and greater economic activity in the economy. Secondly, it intends to free the government from the heavy burden of subsidizing loss-making parastatals.

Table 1.1. Economic Performance Indicators, 1991 – 1995

	1991	1992	1993	1994	1995
Real GDP Growth Rate (%)	(0.04)	(2.5)	6.5	(3.1)	(3.9)
Inflation Rate (%)	111	191.3	187.3	53.3	45.5
Current Account Balance (US$ million)	-447.7	-94	-255	-243	-84.1
Formal Employment	544.2	545.9	520	502.9	n.a.

Source: *Central Statistical Office, Ministry of Finance,* Budget Addresses, *1992 to 1996.*

In an effort to promote prudent fiscal management, the government also adopted a cash-based budget system in January 1993. Under this system, the government has made a policy decision to curb inflation by reducing money supply. Hence, the government is expected not to incur any expenditure that is not covered by existing revenue. A number of other monetary and financial policies have accompanied Zambia's structural adjustment reforms. These include (a) interest rate liberalization; (b) exchange rate liberalization; and (c) tight money supply.

The collective economic impact of the macroeconomic regime in Zambia as presented above is generally positive as can be gauged from the statistics for the last five years on several key economic indicators. These are provided in Table 1.1.

The trends in the four variables included in Table 1.1 show that the government achieved success in stabilization. The average annual rate of inflation has been substantially reduced as was the deficit in the current account balance (although there is some fuzziness in the data here). But growth of output and employment has not fared well. The only year when there has been a significant positive growth rate was 1993. But this was almost wholly due to a bumper harvest growth in the agricultural sector in comparison to the drought output of the previous year. In 1992, agriculture fell drastically with its contribution to GDP coming down from 18.4% to 12.7% thereby bringing down the GDP as well. In 1993, agriculture grew by 79.6%, raising its contribution to GDP to 21.3%, thus, also boosting the growth rate of the GDP. Most of the other sectors had recorded a decline.

Again, the figures for 1995 cast doubt on the continuity of stabilization. The positive trend whereby inflation steadily came down was reversed after the first half of 1995. The inflation target for 1996 has been set at 10%, but if one considers the recent rapid deterioration in the external value of the Kwacha, the actual rate of inflation could turn out to be significantly higher than the projected rate. Such an eventuality may, in turn, reduce the feasibility of achieving the 6% target for the real growth rate.

1.3 TRADE

An appreciation of the trade regime in Zambia is important in the analysis of the country's comparative advantage in the southern African region. Zambia's trade interaction with the world has been liberalized under SAP. Access to foreign exchange for exporters and importers has been freed while administrative and other non-tariff barriers to trade have been substantially eliminated. The protection of local firms no longer exists and local manufacturers now have to compete with imported products. The objective in opening up the economy is to remove the inefficiencies and distortions promoted by the old protective regime.

A number of other monetary and financial policies that have far-reaching implications for Zambia's international trade activity have accompanied Zambia's structural adjustment reforms. These include interest rate liberalization; exchange rate liberalization; and the removal of exchange controls. The playing field is being leveled for all competitors, domestic and foreign.

Notwithstanding the above, there still exist disincentives to the southern African region's exporters and importers. First, the demand and supply structures

in the southern African region are such that there is very little scope for intra-state trade. Most of the regional countries (excluding South Africa) produce more or less the same products. The existing export commodities are mainly raw materials whose destination is usually the West.

Second, importers and exporters in the southern African region suffer from poor knowledge of existing and potential market opportunities. This is principally a function of the generally poor marketing strategies and weak communications systems. The information gap in the region regarding the countries' existing and potential export opportunities is, in turn, explained mainly by the absence of efficient and well-conceived export support institutions that provide production and trade information. The average exporter in Zambia is unable to benefit from a well-targeted and properly conceived and sophisticated marketing and trade support programs similar to what obtains in his/her overseas competitors' markets. This is largely explained by the absence in Zambia of serious and well-conceived export-dedicated information-support arrangements that are complemented by an aggressive export promotion drive. The existing export promotion institutions are either poorly funded and/or operated or too ill-equipped to meaningfully meet the emerging challenges in the region. Put crudely, Zambia should begin to address the question of export promotion and diversification from the premise that it simply lacks an export-friendly environment.

Another factor worth noting in Zambia is the continued heavy reliance on foreign aid for commercial trade settlements. This has had a negative effect on enhanced intra-regional trade since the donors have generally tied the sourcing of the imports (when their money is used) to extra-regional suppliers, usually domiciled in the donor's country. Such procurement restrictions have rendered inoperational the more traditional systems of import sourcing. For example, normal trade finance mechanisms such as letters of credit through the region's banking system have almost ceased as more and more imports are financed by the donor community. The absence of convergence of basic macro-economic parameters in southern Africa (e.g., investment policies and incentives; fiscal and monetary regimes; exchange rate stability; etc.) has also tended to check the pace and magnitude of intra-regional trade expansion.

External trade performance in Zambia has been closely linked to the country's exchange rate policies. The experience of the country over the 1980 to 1994 period confirms the strong correlation between export volumes and the real exchange rate, and the government's decision to liberalize the latter is in recognition of this reality. Non-traditional exports increased by close to 80% in the two years following the introduction of reforms in 1983. When Zambia abandoned SAP in mid-1987, which resulted in a considerable appreciation of the real exchange rate, export growth in the non-traditional sector reversed so dramatically that by 1990 the export levels were similar to the 1983 ones. Expectedly, when the government returned to the policy of liberalization around 1990, an appreciable degree of non-traditional export growth was registered. After 1991 Zambia registered a relatively stable, albeit slightly appreciating, real exchange rate which was accompanied by the weakening of the non-traditional export sector. Copper exports are rather insensitive to the real exchange rate since the sector's revenue and a significant part of its costs are denominated in US dollars. Nevertheless, the Kwacha devaluation does positively affect the sector's profitability to the extent that there are local costs such as personnel remuneration.

Notwithstanding the above considerations, the most crucial challenge for Zambia *vis-à-vis* increased external trade flows is fundamentally bordering on enhanced production of tradable commodities (both agricultural and industrial) and services. However, considering the speed with which Zambia has liberalized its economy relative to what other regional economies have done, many producers in the country complain that they are exposed to an unleveled playing field in their regional trade interaction. Hence, it is generally argued that Zambian exporters are being subjected to unfair competition. In late August 1996 when he attended the Southern African Development Community (SADC) meeting in Lesotho where the Organization's Trade Protocol was signed, the Zambian President lamented over South African trade dominance over his country (presently

standing at the ratio of 15:1) and appealed to SADC to consider mechanisms to correct the situation. As of November 1997, the Zambian government was in the process of concluding a preferential trade arrangement with South Africa (including its SACU partners), largely the latter's response to Zambia's complaints.

Fundamentally, Zambian exporters' complaints are founded on the existing inter-relationship of (a) the Preferential Trade Area/Common Market for Eastern and Southern African Countries (PTA/COMESA) preferential tariffs; (b) lower duty and duty drawbacks on inputs that are being enjoyed by the country's neighbors, particularly Zimbabwe; and (c) weak capacity to collect import duty,[6] allowing for duty evasion. Zimbabwean producers do not pay duty on their imported inputs (or when they do, these are reimbursed once the finished good is exported). This aspect had, for a long time, given Zimbabwean exporters an 'unfair' comparative advantage over their Zambian counterparts that operate under liberalized external trade policies. Nevertheless, faced with considerable pressure from producers, the Zambian government decided to partially level the playing field and announced in the 1995 budget the suspension of duty on raw material imports which were previously subjected to a 20% duty rate. However, the main threat to Zambian goods' competitiveness is no longer tariffs but duty evasion whereby Zambia-bound exports enter the country without proper documentation and/or are subjected to 'under-the-table' deals with customs officials in spite of the improved vigilance of the newly-established Zambia Revenue Authority that replaced the Department of Customs and Excise.

Additionally, South Africa's export subsidies to its exporters are also said to place Zambian non-traditional exports at a comparative disadvantage. It is against this background that a recent study[7] recommended that in its industrial policy, the Zambian government should include the following measures:

- review of the present tariff structure before an effort is made to further change/liberalize it;
- explore possibilities, allowable under PTA/COMESA, to eliminate preferential access to the Zambian market by those countries that operate a drawback system that places Zambia into a disadvantaged position; and
- synchronize further tariff reductions with those that prevail in the country's PTA/COMESA partners, including negotiating a common external tariff among regional members.

Notwithstanding the above, another important challenge for Zambia and the region as a whole is that while a common external tariff may be desirable, the tariff levels should not be too high. It is evident that an integrated southern Africa would constitute a small economic unit by global standards. Integration of the region should not, therefore, be seen as a basis for inward-looking policies but rather should aim at enhancing the regional capacity to become more competitive in an outward-looking growth and development strategy.

1.4 FINANCE

It is noteworthy that southern Africa generally has no effective trade payments systems that are essential for smooth trade transactions. The existing systems such as the COMESA Clearing House in Harare and the Unit of Account of the Preferential Trade Area (UAPTA) Travellers Cheques have provided only a limited relief since these are being under-utilized. Generally speaking, the southern African region lacks adequate capital and appropriate institutional arrangements that support viable export financing. To circumvent this problem, Export Credit Funds (ECFs) should be seen by Zambia and the entire southern African region to be important. Complementary to the need for ECF in export promotion initiatives is the importance of creating export guarantee and insurance schemes which are designed to protect the exporter from the risks associated with trading abroad on credit terms. Such schemes are essential against the background of the general uncertainties that often prevail when one sells abroad (as opposed to selling domestically) on credit terms.

In addition, there is need to develop an Export Prefinancing Revolving Fund (EPRFs) in Zambia that would provide pre-shipment export finance on realistic terms.

EPRF's main function is to provide, on a revolving basis, foreign exchange to exporters in the country in order to facilitate meeting the costs of imported inputs and services that are needed in export production (for both the regional and international markets) in order to guarantee speedy execution of export orders in a self-sustainable manner. This is expected to improve and diversify the country's export base.

At the domestic level, it is the Zambian government policy to create capital markets by facilitating the growth of the banking sector so as to allow for a diversified system of financial intermediation. The government expects that this would allow for the creation of sophisticated money and capital market instruments through which borrowers can source the needed productive investment capital. The opening up of the financial sector resulted in the entry of several new institutions. By 1995, there were 32 registered commercial banks of which over two thirds were operational. In addition to the commercial banks, there were also various non-bank financial institutions ranging from insurance companies to pension funds. The repeal of the monopolistic Insurance Companies (Cessation and Transfer of Business) Act in December 1991 led to the emergence of four new insurance companies by March 1992. All these developments should have important positive implications for Zambia's export financing, in general since they have resulted in a diversified money market open to the average importer and exporter.

1.5 INFRASTRUCTURE CONSTRAINTS

The agricultural sector in Zambia has been affected by severe physical constraints. Such infrastructural provisions as roads, rail systems and transportation (vehicles) had tended to favor farmers based in urban areas while rural areas have generally been neglected. Thus, surplus produce from the majority of farmers can not easily reach the market. Agricultural storage facilities have also been inadequate, a state of affairs that demands that grain must be transported to safe centralized storage facilities before the onset of the rainy season to prevent it from going to waste. A closer look at the transport constraint would shade more light on the degree to which crops that possess comparative advantage on purely economic grounds fare badly because of their geographical location.

2. Agroecological Zones, Farming Systems, and Production Trends

2.1 DESCRIPTION OF AGROECOLOGICAL ZONES

Zambia's natural resources make the country reasonably well-suited to agricultural production. Although there is only one growing season each year, most parts of the country receive adequate rainfall for the production of arable crops. Approximately 48 million hectares could be considered suitable for agricultural purposes. Large parts of this, while subject to some limitations, have the capacity to produce a variety of arable crops on a sustainable basis. The rest, although not well-suited to crop production, is quite suitable for grazing. Also, water supplies are sufficient to permit irrigation during the dry season in some of those areas that are suitable for crop production.

A significant part of the country's total land area is not available for agriculture. Out of the total 75.3 million hectares, 25.7 million are utilized by national parks, game management areas, and open water. Stateland (i.e., land with title deeds) currently occupies only 3.7 million hectares, including urban areas, and is mostly located in Central, Copperbelt, Lusaka, Northwestern, and Southern Provinces. Traditional lands, which are under the control of the local chiefs, account for 47.9 million hectares but only about half of this is both available and suitable for agriculture (see Table 2.1). Large areas of traditional land are located in Northern, Northwestern, Western, and Central Provinces.

Zambia is divided into 36 agroecological zones[8] which are further grouped into three main zones, mainly on the basis of rainfall (see Table 2.2). Zone I is characterized by low rainfall, short growing season, high temperatures during the growing season, and a high risk of drought. Zone III is characterized by high rainfall, long growing season, low probability of drought, and cooler temperatures during the growing season. Zone II falls in between Zone I and III for most climatic variables. There is great variation in the agronomic features (rainfall, elevation, mean temperatures, vegetation, and soils) of the three zones and within zones themselves. The varied nature of these environmental variables makes it possible to grow a wide range of crops throughout the country.

Table 2.1. Estimated Allocation of Total Land (million ha) by Province, 1994

Province	Open Water	National Park	Game Management Area	Stateland	Traditional Land Area	Total Area
Central	0.02	1.88	1.03	0.55	5.96	9.44
Copperbelt	0.00	0.46	0.00	0.78	1.90	3.13
Eastern	0.00	3.24	0.41	0.29	2.98	6.91
Luapula	0.44	0.27	0.15	0.01	4.18	5.06
Lusaka	0.00	1.13	0.41	0.39	0.26	2.19
Northern	0.31	1.44	1.77	0.10	11.16	14.78
Northwestern	0.00	2.47	0.63	0.49	8.99	12.58
Southern	0.25	1.69	0.94	1.10	4.56	8.53
Western	1.03	3.81	0.89	0.00	7.94	12.67
Total	1.05	16.38	6.23	3.70	47.92	75.29

Source: Government Republic of Zambia, 1994: Agricultural Sector Investment Program, Land Use and Administration Sub-Program, Ministry of Agriculture, Food and Fisheries, Lusaka

Table 2.2. Climatic Characteristics of Zambia's Three Major Agroecological Zones

Zone	Average Rainfall (mm/year)	Elevation (meters)	Growing Season (days)	Risk of Drought	Occurrence of Frost in Dry Season	Min. Monthly Temperature (Dec-Feb)
I	less than 800mm	300 - 900; 900-1,200	80 - 129	Medium to High	Risk on Plateau Areas	19 - 21
II	800 - 1,000 mm	900 - 1,300	100 - 140	Medium to Low	Risk on the Central Plateau	17 - 18
III	more than 1,000 mm	1,100 - 1,700 (less than 1,000 in Lapula)	120 - 150	Almost nil	Some risk in the South-West	14 - 16

Source: Institute for African Studies (1996). Agricultural Sector Performance Analysis, IAS, University of Zambia, Lusaka, Table 3.2.

Zone I is found in the main valleys of Zambia such as the Luangwa Valley in eastern Zambia and the Gwembe Valley in the south. It also encompasses parts of Western and Southern Provinces. Zone II is mainly found in the central parts of the country, i.e., Central, Eastern, Lusaka, and Southern Provinces and some parts of Western Province. The northern parts of the country consisting of Northern, Luapula, Copperbelt and Northwestern Provinces lie in Region III. Zone I, with 17.3 million hectares of total land area, is the smallest of the three zones. The proportion of arable land is low (20%) and even some of that has been reserved for national parks and game management areas (e.g., the Luangwa National Park). Zone II, with a total area of 27.4 million hectares, is the second largest of the three zones. Furthermore, 23.8 million hectares, or 87% of the total are suitable for agriculture. Large areas of Zone II have been set aside for national parks (e.g., the Kafue National Park), forests, and game management areas, and this significantly reduces the amount available for agriculture. Zone III has almost as large an area suitable for agriculture (21.4 million hectares), and much of this has not been claimed for other uses. This means that the potential to utilize further land for agriculture exists much more in Zone III than in the other two regions. Table 2.3 and Map 2.1 gives the locations of Zambia's agroecological zones.

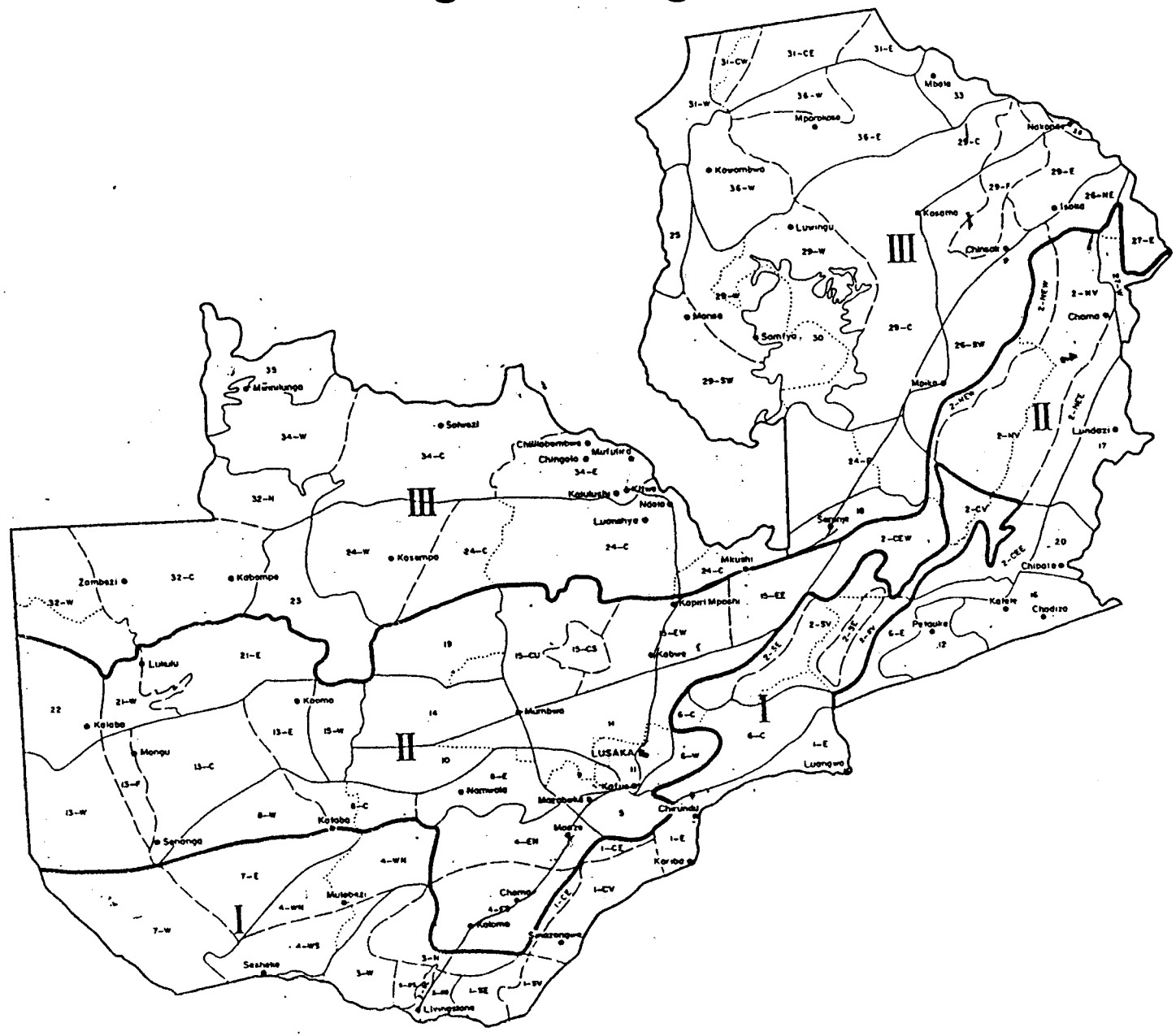
In their natural state, most Zambian soils were covered by woodland, but some were heavily forested and some, especially in the Western plains, were grasslands. In general, Zone III had a higher coverage of forest because of the higher rainfall. While this necessitated a large

Table 2.3. Locations of Zambia's Agroecological Zones

Zone	Locations
I	Major valleys, e.g., Gwembe, Lusemfwa, and Luangwa. Also southern parts of Western and Southern Provinces.
II	Sandveld plateau of Central, Eastern, Lusaka, and Southern Provinces. Also, Kalahari sand plateau and Zambezi flood plains of Western Province.
III	Part of the Central African Plateau covering Northern, Luapula, Copperbelt, and Northwestern Provinces and the northern parts of Serenje and Mkushi Districts.

Source: Compiled from A. Bunyolo, B. Chirwa and M. Muchinda, "Agro-ecological and Climatic Conditions" in Stephen W. Muliokela (ed.) (1995), Zambia Seed Technology Handbook, Ministry of Agriculture, Food and Fisheries, Lusaka.

Map 2.1
Zambia's Agro-Ecological Zones

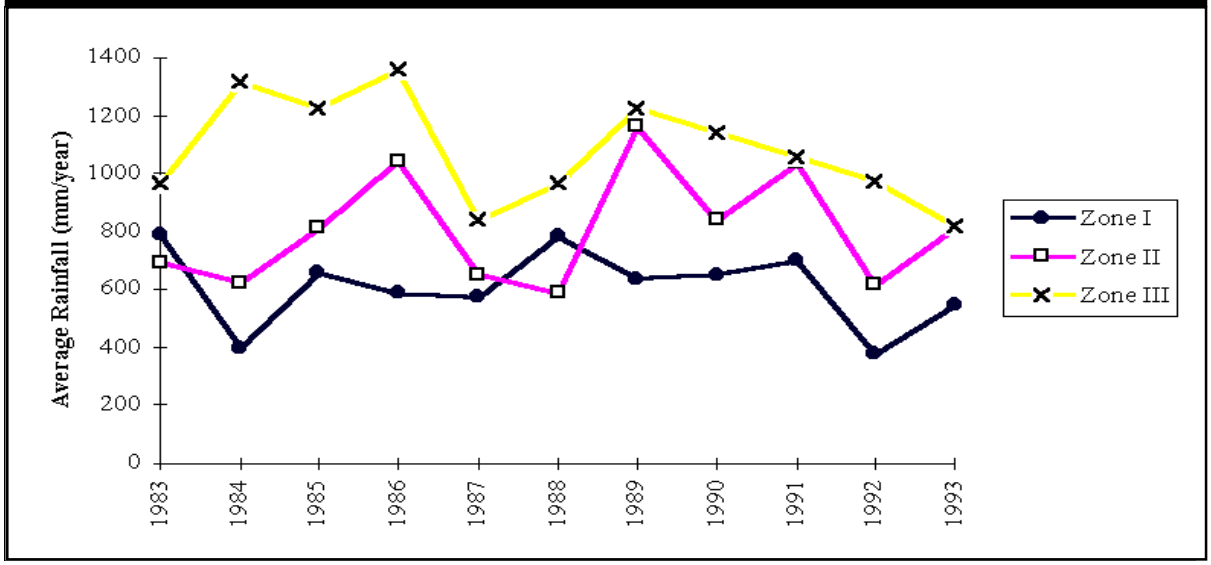


investment in land clearing, the gently undulating topography made much of the land suitable to farming. However, high levels of acidity due to leaching constrain crop production in Zone III and parts of Zone II. Even within the three major climatic zones, there is enough variability in soils and climate to make some areas much better suited to certain crops than to others. For example, tobacco and cotton do well in the southern part of Zone II while maize is better-suited to those northerly parts of Zone II with loam and clay-loam soils. In the western regions, Kalahari sands cover the degraded, more heavily textured soils. This, in combination with rainfall patterns, substantially reduces the capacity for arable crops. Here, Zones I and II are largely grasslands in their natural state and mainly suitable for cattle production.[9]

Year-to-year variability in rainfall has been important in determining crop output in most parts of the country. Perhaps the biggest constraint to smallholder production that has been all too obvious in the 1990s is the vulnerability of production to variations in the climatic conditions. Disastrous yields have been obtained from the 1990s droughts, particularly in the southern parts of the country. Added to this is the decline in the soil fertility in the areas that have been historically the most productive, due to constant cultivation and over-application of fertilizer. This is mostly pronounced in Zones I and II which in recent years have been severely affected by persistent droughts. In the 1991/92 drought, the worst in many decades, rainfall averaged 375.5 millimeters and 615.3 millimeters in Zone I and II respectively. Zone III recorded 971.5 millimeters (see Figure 2.1). Poor rainfall in Zone I and II has meant that Zone III has increasingly become relatively more reliable in agricultural production.

The recent droughts may be part of long-term climatic change associated with global warming which may result in more frequent droughts and lower average rainfall in the southern parts of the country. It will also result in slightly higher temperatures and evaporation rates throughout the country. Even if climatic changes were not occurring, Zones I and II are higher risk areas than Zone III for the production of some crops, especially maize. If the recent trends in climate persist, it will be virtually impossible to sustain any maize production in Zone I and the risk of a poor maize crop will go up in Zone II, especially on the Central Plateau. Climatic change is unlikely to affect crop production in Zone III very much. Even when rainfall is slightly reduced, Zone III has a surplus rainfall for maize in most years. Ensuring rural cereal supply in Zone I and part of Zone II in poor rainfall years, especially if recent weather conditions persist, would require a radical change in practices, e.g., increased emphasis on crops like sorghum, millet, and cassava

Figure 2.1. Average Rainfall by Agro-ecological Zone.



Source: Meteorological Department, Lusaka.

Table 2.4. Soils in Agroecological Zones and Their Limitations to Crop Production

Zone	General Description of Soils	Limitations to Crop Production
Zone I	Loamy and clay with course to fine tops	Slightly acidic to alkaline. Minor fertility limitations
	Reddish coarse sandy soils	Low pH, available water & nutrient capacity reserve
	Poorly drained sandy soils	Severe wetness, acidic & low fertility
	Shallow & gravel soils in rolling to hilly areas including escarpment zones	Limited depth & unsuitable for cultivation
Zone II	Moderately leached clayey to loamy soils	Low nutrient reserves & water holding capacity
	Slightly leached clayey soils	Slight to moderate acidity. Difficult to work due to heavy textured soil
	Coarse sandy loams in large valley dambos	Imperfectly to poorly drained. Limitations due to wetness
	Sandy soils on Kalahari sand	Medium to strong acidity, course textured top soil, low water holding capacity and nutrient reserves
Zone III	Red to brown clayey loamy soils	Very strong acidity and strongly leached
	Shallow and gravel soils in rolling hilly areas	Limited depth
	Clayey soils, red in color	Moderately to strongly leached. Fewer limitations
	Poorly to very poorly drained flood plain soils	Variable texture and acidity
	Course sandy soils in pan dambos on Kalahari sand	Very strong acidity

Source: Compiled from A. Bunyolo, B. Chirwa and M. Muchinda "Agro-ecological and Climatic Conditions" in Stephen W. Muliokela (ed.), 1995: Zambia Seed Technology Handbook, Ministry of Agriculture, Food and Fisheries, Lusaka.

combined with different livestock management practices. Table 2.4 gives soils in Zambia's agroecological zones and their limitations to crop production.

2.2 TECHNOLOGY AND PRODUCTION SYSTEMS

2.2.1 Introduction

Official statistics divide Zambia's agriculture into two main sub-sectors: the commercial and smallholder sub-sectors. The latter is further split into small-scale farmers and medium-scale or emergent farmers. Medium-scale farmers cultivate between 5 and 20 hectares while commercial farmers cultivate above 20 hectares. Small-scale farmers' area of cultivation is below 5 hectares. It is controversial to classify farmers using area under cultivation. Farming technologies are preferred although in reality they do not provide watertight classifications. According to the Central Statistical Office (GRZ, 1990), commercial farmers are characterized by extensive mechanization, use high-level technology and management, rear mostly exotic breeds, and rely heavily on hired labor. Small-scale farmers depend on hand-hoe cultivation and infrequent use of draft animals while depending mainly on unpaid family labor. Further, small-scale farmers are characterized by low use of modern inputs. Where these are adopted,

it is usually the use of hybrid maize and fertilizer that were over-promoted by past policies.[10]

The smallholder sub-sector contributes on average about 60% to agricultural output. Crops contributed about 80% to smallholder production in the 1990s. Livestock had contributed over 30% in the mid-1980s. This has declined in the 1990s because of animal losses and sales as a result of droughts. Nevertheless, it is the possession of cattle, and particularly oxen, which makes the difference between a small-scale and an emergent farmer. The smallholder sub-sector produces most of the food maize, crops, sorghum, millet, cassava, groundnuts, and mixed beans. The major crop grown is white maize, partly from improved hybrids and varieties, and partly from traditional seed. The commercial sub-sector produces most of the wheat, 80% to 85% of the soya beans, up to 75% of the Virginia tobacco, 30% to 35% of the maize, all of the sugar cane, most of the coffee, and most of the horticultural crops for export. The crop yield in traditional agriculture is low and is usually half that in the commercial sub-sector. For example, whereas average yield per hectare for 90 kilograms of maize was 19.7 between the 1982/83 and 1993/94 seasons, in the commercial sub-sector it was 37.5 kilograms.

In terms of numbers, commercial farmers are estimated at less than 1,500 and farm mostly along the narrow corridor of land following the line of rail and in some parts of Eastern Province. Emergent farmers are estimated to number about 100,000 farm households. These are usually found in Southern, Eastern, and Central Provinces. Small-scale farmers number about 600,000 farm households and are naturally more widespread than the other two categories. The farming systems applied vary from location to location and have been historically shaped by agroecological conditions of which three main ones have been recognized. It follows that any sustainable growth in agricultural development with important equity and food security implications can never occur in Zambia without the uplifting of the status of the smallholder sub-sector.

2.2.2 Farming Systems

The physical environment has had an important effect on the nature of the farming systems practiced throughout the country. Soil types and rainfall are the most important factors. Rainfall apart from having an effect on the soil types is also an important determinant on the types of crops that could be grown in an area. The most suitable areas for crop production appear to fall in the range of 800 mm to 1,000mm mean annual rainfall. Over the 1,000mm mean annual rainfall, "the soils tend to be highly leached and are ferrallitic. Natural vegetation grows very well in these areas. From the traditional farming systems, only those practices that hinge on soil fertility improvement and soil utilization can thrive. The areas with less than 1,000mm annual rainfall are less leached and have ferrisols being dominant. These cover the southern parts of the country where more semi-permanent cropping and livestock rearing are important." (Chiti et al, 1989, p. 23)

Following the delimitations of rainfall patterns and soil types, Chiti et al . (1989) identify six broadly defined cultivation systems practiced in Zambia. These are summarized below. The first four correspond with the farming systems used by small-scale farmers as defined above. The fifth system is practiced by emergent farmers while the sixth are utilized by commercial farmers.

- *The Shifting Axe and Hoe Systems*: These systems include the Chitemene shifting cultivation systems and have been the mostly widely practiced agricultural production systems. They involve about 40% of the country and about 20% of the rural population. They are mostly practiced in Zone III and have been adopted as a counter to highly leached and low inherent fertility soils. Shifting axe and hoe systems involve cutting or lopping trees that are heaped in a single place and then burnt. The ash patches of the field are then cultivated as a means of soil fertility improvement and weed control. The systems are known to be very good at preserving the soil structures and fertility. However, because land is left to fallow after three to six years of continuous cultivation, they tend to have very high land requirement. They have been increasingly abandoned due to population pressures.

- *Fishing and Semi-Permanent Hoe Systems*: These systems are practiced mostly along the main rivers and swamps such as Lake Mweru, Lake Mweru Wantipa and Lake Tanganyika in Zone III and flood plains in Western Province in Zone II. The systems cover 7% of the rural population. The dominant crops are maize, cassava, and groundnuts but fishing is the dominant agricultural activity.
- *Semi-Permanent Hoe Systems*: These systems are mostly practiced in Zone I. There is little crop production due to harsh climatic conditions although some significant livestock rearing takes place. The limited land for agricultural expansion is another constraint and hence the continuous cultivation of the same pieces of land. Shifting cultivation is unsuitable under these agronomic conditions.
- *Semi-Permanent Hoe and Ox Plow*: These systems are practiced in Zone II with maize, finger millet, sorghum, groundnuts, and beans as the dominant crops. Some cassava, although not very significant, is also grown in certain areas. Livestock plays an important role in these systems. About 25% of the rural population use these farming systems.
- *Semi-Commercial Ox and Tractor Plow Systems*: Going by the three categorizations of the farmers provided above, this group consists mainly of emergent farmers. The land areas cultivated are usually above five hectares employing both draft and tractor plowing. About 28% of the rural population is involved. Cash crops, particularly maize and groundnuts, are dominant. These are mostly found in Zone II although widespread throughout the country.
- *Commercial Systems*: As described above these are highly specialized farming systems with big variations. Their characteristics are extensive mechanization, high level technology and management and rearing mostly exotic breeds. Although both in Zone II and III they are mostly concentrated along the line of rail with a much higher concentration in Zone II.

2.2.3 Production Trends

Overview

The percentage of the Zambian population that derives its livelihood from agriculture is more than 60%. Farm labor in smallholder agriculture, accounting for 51% of the economically active rural population, peaked at 2.6 million in 1987/88 but declined to 2 million in 1993/94 because of disappointing performance in the 1990s.[11] The significance of the smallholder sector's contribution to the national economy is not, however, easily reflected because the labor and land productivity of small-scale farming is low. Agriculture's contribution to total GDP for most years was only about 12% and was nearly 20% by the late 1980s.[12]

The agricultural share of total exports is less than 3% for most years. Agricultural exports, however, increased from US$9.7 million in 1987 to US$33.7 million in 1994; the agricultural share of non-traditional exports improved from 11th to 4th position. The scheme introduced in the mid-1980s under which income earned from exports was retained in foreign currency by the exporter aided increase in non-traditional exports, in general, and agricultural exports, in particular. The growth in agricultural exports in the 1990s appears to have resulted mainly from trade liberalization.

Food imports were 8.1% of total imports in 1979, but increased to 11% in 1992 because of the severe drought of that year. The amount spent on importing agricultural inputs, particularly fertilizer, is substantial. Thus, agriculture's contribution to foreign trade has been largely negative. The share of cereals in total food imports increased over time reflecting worsening food deficit. Internal sufficiency in the case of maize was achieved in only six out of the 16 years from 1978 to 1994. The sufficiency attained at the national level in some years does not always go hand in hand with household food sufficiency. At least 25% of the small-scale farm households are food (maize) deficient even in the good years. The proportion under deficit increases to about 66% in the extreme cases (Kalinda, 1993). Household food security in rural areas may have deteriorated in the 1990s, particularly during the rainy season when much of the agricultural activity takes place. Consequently, some households have

Table 2.5. Percentage Share of Crops in Total Hectarage for Various Farm Categories, 1993/94 & 1994/95										
	Maize		Drought Resistant Crops		Cash Crops		Legumes & Oilseeds		Other Crops	
	1993/4	1994/5	1993/4	1994/5	1993/4	1994/5	1993/4	1994/5	1993/4	1994/5
All Smallholders	59.03	57.81	22.98	23.53	6.51	6.81	10.28	11.04	1.20	0.82
Male Headed	59.76	57.50	21.95	23.51	7.19	7.29	10.00	10.91	1.10	0.79
Female Headed	54.75	59.22	29.03	23.62	2.53	4.57	10.94	11.64	1.75	0.98
Small-scale	57.05	56.16	26.14	25.91	5.09	5.99	10.39	11.10	1.33	0.84
Medium	68.98	69.02	7.07	7.27	13.69	12.40	9.72	10.64	0.54	0.67
Zone I	49.87	53.35	40.62	45.53	7.07	0.73	2.43	0.39	0.00	0.00
Zone II	71.14	69.75	8.00	7.62	9.71	13.11	11.93	10.15	0.61	0.63
Zone III	33.94	40.99	47.77	50.75	0.86	0.62	8.04	13.46	2.33	1.23

descended into a poverty trap as members work for food at a time their own fields should be prepared.

Changes in Agricultural Production

Total agricultural production has varied from year to year mainly because of variations in the climatic conditions. This has particularly been the case in the 1990s. Taking the 1989/90 season as the base year, agricultural production for maize only rose in the 1992/93 and 1995/96 seasons and registered declines in all other years due to drought in all other years (see Table 2.5).

All other crops do not appear to have performed better with the exception of sorghum, mixed beans, and groundnuts. This development is important as it shows a trend towards the production of food crops rather than cash crops. Persistent droughts in the 1990s have revealed the vulnerability of most rural households to food insecurity.

The total area cultivated under traditional farming increased from 704,000 hectares in 1982/83 to 1,241,000 hectares in 1990/91 and then declined to 735,345 hectares in 1994/1995. The proportion of cultivated area devoted to different crops over this period was stable. Maize has continued to account for the major part of smallholder farmers' total hectarage with a proportion of 57.8% in 1994/95, a slight drop from 59.1% recorded in 1993/94. This was followed by drought resistant crops that accounted for 23.5%. Cash crops accounted for only 6.8% of total hectarage. The main cause is that previous policy promoted the growth of maize at the expense of other crops. Despite the development of high yielding varieties by the Research Branch, maize technologies are the only modern crop technologies that have been widely adopted by smallholder farmers. However, the total area planted under maize declined by at least 30% since 1989 because commercial farmers turned away from growing maize to cultivating the high-value and export-oriented crops, such as soya beans, sunflower, cotton, and horticultural products. The production and export of horticultural products by commercial farmers have grown steadily.

There are, however, important differences between the different categories of smallholders. In terms of the share in total hectarage, maize is a much more important crop for medium-scale farmers accounting for 69.0% for their cultivated land but only 56.2% in the case of small-scale farmers. Medium-scale farmers also grow more of cash crops but little of drought resistant crops unlike small-scale farmers. One notices some drought adjustment in Zone I where droughts are severest and more persistent. The share of drought resistant crops in total hectarage rose from 37.1% in 1990/91 to 45.6% in 1994/95 in Zone I.

The number of hectares cultivated per person in the 1989/90 cropping season was 0.43 hectares but dropped to 0.37 hectares in the 1995/96 agricultural season. This represents a deterioration in the already low labor productivity that characterizes the smallholder sector. The reasons for low hectarage per

Table 2.6. Percentage of Farm Households Owning Cattle and Oxen, 1990/91, 1993/94, & 1994/95 Seasons							
		Percent of Households with Cattle			Percent of Households with more than 2 Oxen		
		1990/91	1993/94	1994/95	1990/91	1993/94	1994/95
All Smallholders	Small-Scale	15.88	11.83	11.79	9.49	7.08	7.22
	Medium-Scale	65.39	57.71	48.89	43.57	46.45	36.89
	Average	18.10	13.69	13.30	11.08	8.68	8.43
Male Headed Households	Small-Scale	18.49	13.47	12.55	11.21	8.38	8.02
	Medium-Scale	66.23	58.09	49.58	44.40	47.81	37.63
	Average	21.22	15.65	14.22	13.09	10.31	9.36
Female Headed Households	Small-Scale	7.40	6.31	9.03	3.89	2.70	4.30
	Medium-Scale	45.74	51.83	44.04	30.41	25.23	31.73
	Average	7.87	6.81	9.86	4.22	2.94	4.95
Agroecological Zones	Zone I	38.29	27.44	24.78	19.75	18.01	16.90
	Zone II	27.83	20.92	19.79	18.58	14.60	13.49
	Zone III	5.44	4.80	4.36	1.77	1.50	1.48

person are mainly labor shortages during the critical time of land preparation because most small farmers depend only on hand hoe cultivation. It has therefore been recommended that increased farm power mechanization, such as oxenization and tractisation, would have great impact in raising the area brought under cultivation and would enable Zambia to take advantage of its surplus land status. Only 7.2% of households owned more than two oxen in 1994/95, which was even a drop from 9.5% in 1990/91 (see Table 2.6). Regression analysis on the 1994/95 Post-Harvest Survey data suggests that the highest marginal increase in the area cultivated arising from a unit increase in draft power will be experienced in Zone III followed by Zones II and I respectively (Institute of Economic and Social Research, 1997). This finding is significant as Zone III, a high rainfall area, offers at the same time the greatest potential for expanding area brought under cultivation. The marginal increase in the cultivated area resulting from an increase in draft animal power could be lower in Zone I because of land limitations and the higher oxen/hectare ratio.

Increasing the use of draft animals (and mechanical power) alone will not optimize Zambia's advantage as a land surplus country. The current coefficients of both oxen and labor although significant are still very low and technological improvements to change these coefficients are required so that the amount of labor required to produce a crop by hoe or oxen is reduced. Therefore some studies apart from the need to intensify oxenization also recommend the promotion of reduced tillage techniques. Figures show some improvements in the variables that determine oxenization such as calving and mortality rate in 1994/95 (Institute of Economic and Social Research, 1997, Table 4.7, and J. Keyser and H. Mwanza, 1996). There are indications that this trend continued in 1995/96. However, the rate at which these variables are changing is too low to have any significant impact on area under cultivation for some time to come. An intensified utilization of minimum tillage techniques seems to offer greater potential in achieving this goal in the short term. However, much research is needed to be carried in order to overcome some of the problems associated with them particularly increased weed infestation. In terms of targeting, oxenization should be intensified much more in Zones II and III.

Table 2.7. Yield Rates (kg/ha) for Selected Crops by Ecological Zone, 1990/91, 1993/94, & 1994/95									
CROP	ZONE I			ZONE II			ZONE III		
	1990/91	1993/94	1994/95	1990/91	1993/94	1994/95	1990/91	1993/94	1994/95
Cassava	1,153	1,540	1,000	1,020	884	958	2,009	1,746	1,464
Groundnuts	448	233	514	643	392	238	585	523	512
Maize	1,198	867	689	1,788	1,418	1,332	2,134	1,898	1,990
Millet	540	885	438	792	696	651	891	872	1,266
Mixed Beans	111	155	100	544	202	634	634	363	582
Seed Cotton	1,041	197		1,403	899	609	609	1,051	549
Sorghum	635	748	395	899	705	1,044	1,044	742	1,050
Soybeans		540	553	607	427	762	762	509	529
Sunflower	415	268		469	312	716	716	260	738

2.2.4 Changes In Yields

Previous studies have found no evidence of any increase in the yield rates of crops cultivated in the smallholder sub-sector over time (Institute for African Studies, 1996). Instead, yields tended to fluctuate from one year to another depending on the amount of rainfall. Vulnerability to climatic fluctuations is the major constraint to raising yields.

Yield rates in general are highest in Zone III and lowest in Zone I that shows the significant impact of rainfall on crop yields. There was a drop in the yield rate of all crops recorded in Table 2.7 in Zone I except for groundnuts and soya beans in the 1994/95 season. A worrying observation for Zone I is that even for drought resistant crops (cassava, millet, and sorghum) the yield rate drastically fell. Observations that Zone III is becoming a more reliable producer of cereal is seen from the fact that whereas the yield rate for maize dropped in Zones I and II, it rose by 4.9% in Zone III. On account of these figures it is tempting to recommend that strategies be adopted to shift production of cereals to Zone III away from other Zones. However, in the long run, the yield rate for maize in Zone III is likely to drastically fall as virgin land gets exhausted. Soils in Zone III have a low nutrient-retention and are highly acidic. Soil acidity can be redressed through liming but the expenditure tends to be prohibitive to small-scale farmers. Any strategy to encourage cereal production in Zone III will have to be implemented hand in hand with a liming program.

Apart from environmental factors such as rainfall and soil fertility, extension advice (both direct and through radio), fertilizer application, draft power and education all have a significant impact on the yield rate. One of the biggest constraints on raising yields for most crops, and particularly for maize, is late planting. By enabling farmers to finish land preparation early and plant in good time, draft power significantly affects the yield rate. The significant animal loss that occurred in the 1990s not only constrained the increase in the area cultivated but affected yield rates adversely as well. Technologies that improve the time spent on land preparation for each animal are likely to positively affect the yield rate apart from raising the area cultivated. It is therefore important to recognize this cross-relationship between livestock and crop enterprises and integrate it in the design of agricultural services aimed at improving both crop and livestock production.

Education and literacy levels of farmers play an important role in empowering them to receive and learn new farming practices imparted by extension. Although most of the rural population have had some primary education, lack of opportunities to consolidate this education make it easy for most rural dwellers to quickly relapse into illiteracy. The poor health status of the rural population, particularly during the rainy season when demand for labor is highest, further undermines the already weak

Table 2.8. Average Expenditures (Kwacha per hectare, 1985=100) on Crop Inputs in the Smallholder Sub-Sector)					
Year	Labor	Seed	Fertilizer	Machine Hire & Repair	Total
1982/83	21.0	11.4	63.1	7.1	102.6
1983/84	24.7	11.2	73.2	9.5	118.7
1984/85	21.3	8.7	46.4	9.5	86.0
1985/86	29.9	7.9	47.4	7.3	92.5
1987/88	17.6	10.3	50.8	18.7	97.4
1991/92	5.7	3.7	13.1	2.9	25.3
1992/93	6.6	5.7	31.5	3.2	47.0
1993/94	7.2	7.9	23.7	3.6	42.4

Source: Institute for African Studies, Table 5.3.

human capital accumulation necessary for increased agricultural production.

Low and declining use of modern inputs has been identified as a major constraint to raising yield rates among smallholders. Farmers tend to use less than the recommended amounts of improved seed and fertilizer as the area cultivated increases. This outcome may be the result from small-scale farmers' lack of access to inputs arising from poor input supply and high prices of inputs, particularly after official subsidies were removed. This result represents a rational decision because land, as opposed to purchased inputs, does not constrain most smallholders from increasing production. The collapse of the maize-credit schemes has worsened that tendency. Rural credit may not be revamped easily but encouraging private firms to provide rural credit, such as in the outgrowers schemes, may be workable.

Crop yields have tended to increase in the long term in most parts of the world largely as a result of the increased use of modern inputs, especially new varieties, improved fertilizers, and improved pest control. The trend in Zambia, however, has been the opposite. Input usage per hectare has declined since the early 1980s and the decline was particularly marked in the early 1990s (see Table 2.8). Decline has not been confined to fertilizer use only; it is also evident in the amount of labor hired and in the expenditures on seed, machinery hire and machinery repairs. The low yield per hectare in the early 1990s thus appears attributable to a combination of low input usage and environmental conditions.

Purchased inputs are rarely used for crops mainly grown for home consumption (i.e., sorghum, millet, cassava, groundnuts, and mixed beans) because farmers have no direct means of obtaining the cash needed to pay for the purchased inputs. It is to the cash crops, such as maize, rice, cotton, sunflowers, and soya beans, that the purchased inputs are applied. Reversing the declining use of purchased inputs even in the case of cash crops is, however, difficult because farm profitability has declined continually in the 1990s. Increasing the national average yields for both cash and food crops must, therefore, derive from technologies in which the amount of purchased inputs required is minimal.

2.2.5 Extension and Research

By developing improved technologies and imparting better farm management practices, research and extension are critical in helping farmers raise their yield levels. In Zambia, the extension "train and visit" method, adopted in 1982, has been supplemented by other techniques of disseminating information. The Village Extension Groups (VEGs), adopted in the 1990s, were a further modification to the traditional train and visit. Participatory extension methods have been used to improve the delivery of extension messages in recent years and may soon lead to major changes in train and visit practices. Accounting for 20% of the Ministry of Agriculture budget in 1990 to 1994, agricultural extension engaged about 1,450 camp officers and operated under a ratio of 415 farm households per camp extension worker.

Table 2.9. Percentage of Households Covered by Direct and Radio Extension, 1990/91, 1993/94, & 1994/95

		Percent of households with access to direct extension			Percent of households with access to radio extension		
		1990/91	1993/94	1994/95	1990/91	1993/94	1994/95
All Smallholders	Small-Scale	22.69	24.27	30.51	39.17	38.52	38.62
	Medium-Scale	31.18	38.00	45.02	63.50	62.91	66.35
	Average	24.05	24.83	32.92	40.72	39.50	40.03
Male-Headed Households	Small-Scale	24.13	25.73	31.56	43.53	44.18	40.70
	Medium-Scale	31.39	38.57	45.04	65.03	63.90	66.50
	Average	25.47	26.35	33.99	45.14	45.14	42.16
Female-Headed Households	Small-Scale	17.18	19.37	26.54	22.91	19.36	30.72
	Medium-Scale	28.12	29.02	44.87	37.62	47.39	65.31
	Average	17.78	19.47	28.55	23.17	19.67	31.79
Agroecological Zones	Zone I	24.57	10.99	23.78	23.04	34.03	31.29
	Zone II	23.62	26.41	28.97	42.53	41.93	41.78
	Zone III	24.44	23.91	38.33	39.84	37.13	38.20

The proportion of farm households reported to receive extension advice either directly (as individual units or through VEGs) or through radio is given in Table 2.9. It shows that coverage of direct extension rose from 22.7% in 1990/91 to 30.5% in 1994/95. Radio extension is a much more important avenue that remained at almost 40% in the two respective years. It is government policy to raise extension coverage significantly but this has been difficult due to the following reasons:

- The low staffing levels of the extension service. As stated above, each camp extension officer covered on average 415 farm households in the 1990s.
- The geographical radius handled by extension workers is too big and is often twice the recommended 15km radius.
- Camp officers have insufficient transport. The bicycles given to camp officers are notably inappropriate in most cases because of the terrain or long distances.
- The number of visits required under the train-and-visit system is too high given the inadequate transport.
- Only about 30% of farmers covered find extension advice relevant (Institute for African Studies, 1996).

2.2.6 Research and Extension Linkage

Technologies suitable for smallholder farmers were produced by the Research Branch. The new technologies include the high-yielding varieties of maize, sorghum, soya beans, and other crops designed to suit the various agroecological zones. By promoting extension, subsidies, and favorable prices (to small-scale farmers in outlying areas), the use of hybrid maize seeds increased from 30% in 1985 to 57% in 1990. Zambia has one of the highest adoption rates of hybrid varieties in east and southern Africa (IBRD, 1995). The use of hybrid varieties other than maize by the smallholders has been less widespread. The value of improved seed for all crops, not just maize, is well understood and appreciated by farmers. Thus lack of adoption may point to technology being developed with little knowledge of farmers' constraints. This particular difficulty could be avoided if the researchers obtained feedback from the farmers. The role of extension officers in the diffusion of technology is pivotal.

The Farming Systems Research (FSR) was established to help bridge the gap between research and the farmers. It is up to the researchers to be able to identify the most important problems of the farmers

and the technology appropriate to solving those problems. Extension officers have always been recognized as an important part in the chain linking the farmers and the researchers. After nearly two decades since establishment, however, the Farming Systems Research has yet to improve the link between research and extension. This is mainly due to the fact that research/extension liaison still remains weak as little resources are available for joint activities. In some areas FSR teams still remain weak.

2.3 CONCLUSIONS

The agronomic characteristics considered in the chapter make it obvious that Zambia is well-suited to a variety of agricultural enterprises. It is clear that the physical environment has affected the farming systems adopted by farmers in different regions as they try to take advantage of the potential and overcome constraints posed by different regions. These differences need to be taken into account in the country's research and extension strategies.

Highest potential for agriculture is found in Zone III, which is a high rainfall area and recorded the highest yield rates in the 1990s. This is fortunate because Zone III has the largest arable land that remains unexploited. Here a combination of strategies to open up unexploited land through the provision of infrastructure such as roads, electrical power, and telecommunication facilities and technologies would have very important positive implications for agricultural production in the region. An aggressive oxenization program would yield important results. Although Zone II has traditionally been Zambia's breadbasket, recent climatic changes have made agricultural production vulnerable to weather conditions, particularly in the southern parts of the region. Constant over-application of fertilizer has also made the quality of the soils to decline. Zone I is unsuitable for most agricultural activities and this has been worsened in recent years by persistent droughts.

The weak human and capital resources available to agriculture have constrained the attainment of Zambia's agricultural potential. The ability of farmers to receive and process information on new farming practices is limited by the low skills and poor health of the rural population. This should be addressed by investing more in the social sectors (i.e., education, health, water, and sanitation) in order to improve the quality of the human resources.

The low levels of technology are not improving the resource productivity to the level required in order to raise incomes and accumulate capital. Most farmers continue to rely on simple farm implements, such as hand-hoes, and few have access to draft animals. While Zambia's resource base thus seems vast, unless new technologies are adopted, not only will growth of the rural population increase pressure on the land but rural poverty will also continue to prevail in the smallholder sub-sector. Technologies enabling people to take advantage of Zambia's abundant land should therefore be introduced urgently. Such technologies should be introduced as to be usable with the existing simple farm implements because current low farm profitability might preclude most farmers from adopting the new technologies.

3. Methodological Framework

This section of the technical paper describes the methodology and underlying assumptions used for the analysis of Zambia's agricultural comparative advantage.

3.1 ANALYSIS OF FARM ENTERPRISES

3.1.1 Overview

The quantitative analysis began with and is based largely on a data collection exercise carried out over the last several months of 1995 where the primary objective was to prepare a set of indicative enterprise budgets believed to reflect actual farm conditions to the best extent possible.[13] Farmers, input dealers, agricultural processors, private traders, transport agents, and others working in Zambian agriculture were all consulted for the primary and secondary information used to prepare these crop models. Throughout this process, great care was taken to ensure that the data entered in these budgets should reflect the actual management practices of typical farmers in each agroecological zone. Although it was certainly not possible to capture all aspects of the rural economy in these models, the farm budgets used for this study are believed to provide a reasonably accurate picture of resource use and the returns to agricultural production in Zambia.

To help ensure that these models reflect actual farm practices, two management levels are analyzed for most crops covering the small-scale (hand hoe), emergent (ox plow) and commercial (tractor power) sectors respectively. Specifically, the first or "average" management level is intended to reflect the typical practices of each sub-sector and, especially for small-scale and emergent farmers, is characterized by a relatively light use of purchased inputs (including fertilizer and chemicals) and fairly modest yield results. The second, or "potential" level, on the other hand, is intended to represent a point where Zambian farmers could produce with only a modest improvement in management (including more timely planting and a greater attention to weed control) and a slightly more intensive use of purchased inputs than at the average level.[14] Importantly, as used here, the term "potential" is not intended to refer to a research station potential, but only to the output a very good farmer might realistically expect to achieve in a year with "normal" rainfall. All crop models have been reviewed by Zambia National Farmers Union (ZNFU) representatives and other crop experts to help ensure that the yield expectations are realistic given the inputs that are costed.

In addition to covering two management levels and three farm sectors, two time periods have also been analyzed. As noted, the original data set was prepared in 1995 so that the prices used in these budgets cover the 1995/96 farm season roughly midway into the process of market liberalization and structural adjustment. By this season, all price controls and input subsidies had been abolished and government policy was generally guided by the desire pursue a hands-off policy with respect to agricultural markets. This season is taken as the base year for analysis and, unless noted, all financial and economic indicators are for the 1995/96 season. However, because inflation and other price developments have an important bearing on the returns to agricultural production, a database system using linked spreadsheet files was developed drawing on the original crop models to allow the analysis to be updated each year. Towards this end, a separate data collection exercise was carried out in late 1996 to gather new price information covering the 1996/97 farm season. Importantly, all other technical coefficients, including yield and input use, were held constant so that the updated results only show the impact of price developments. Results from this updating exercise are included in Chapter Five as part of the sensitivity analysis.

By continuing to update and refine the crop models each year, the quantitative methodology could be used to build a picture of the structural adjustment

process showing the effects on the costs of production as well as the competitiveness of each farm sector. The development of similar monitoring systems in other countries could be an important step towards an improved understanding of regional trade patterns and comparative advantage.

3.1.2 The Policy Analysis Matrix (PAM)

Based the production models developed during field research, the next step of the analysis was to construct a set of policy analysis matrices (PAMs). The PAM is a product of two accounting identities. The first defines "profitability" as the difference between revenues and costs. The other measures the effects of government interventions or divergences (market failures) as the difference between observed parameters and parameters that would exist if the divergences were removed. By filling in the elements of the PAM for agricultural activities, it is possible to measure both the extent of policy effects and the inherent economic efficiency (or comparative advantage) of the activity.[15]

The PAM is based on a familiar equation:

$$\text{Profit} = \text{Revenue} - \text{Cost} \qquad [1]$$

The PAM, as presented in Table 3.1, has four columns. The first is for revenue, the second and third for costs, and the last one for profitability. Each PAM contains two cost columns, one for tradable inputs and the other for domestic factors. It distinguishes between tradable inputs and domestic resources because exchange rate policies have a direct bearing on the former and because certain measures of efficiency require the distinction. Intermediate inputs–including fertilizer, pesticides, purchased seeds, electricity, transportation services and fuel–are divided into their tradable input and domestic factor components. Revenue and tradable input values are measured with reference to an import or export parity price which is the amount a country either saves or earns from the production system being analyzed.

The PAM has three rows. The first two represent the two different versions of equation [1], with the first row evaluated using the actual (market) prices encountered by the production system and the row below it evaluated at shadow or social prices. The effects of government policy (or market failure) are measured in the third row, for which each entry is simply the difference between its value in the first row and the second row.

3.1.3 Private Profitability (D)

The data entered in the first row of Table 3.1 measure a production system's private profitability. The term "private" refers to observed revenues and costs reflecting actual market prices received or paid by farmers, traders, and processors in the agricultural commodity system. These private, or actual, market prices thus incorporate the underlying economic costs and valuation plus the effects of all policies and market failures. In Table 3.1, private profits (D) are the difference between revenues (A) and costs (B + C); and all four entries in the top row are measured in observed prices. The components of these budgets are usually

Table 3.1. The Policy Analysis Matrix (PAM)

	Revenues	Tradable Input	Domestic Factor	Profits
Private Prices	A	B	C	D
Social Prices	E	F	G	H
Policy Effects (Transfers)	I	J	K	L

Where: D = A - B - C; H = H - F - G; L = I - J - K = D - H; I = A - E; J = B - F; K = C - G

entered in the PAM as local currency units per physical area of land (ZK/hectare).

Because the PAM looks at an entire production system and bases these calculations on a commodity's import or export parity price (which is necessary for measuring the relative efficiency of agricultural production), private profits (D) do not necessarily equal the income that accrues to individual farmers. Limited access to markets, lack of knowledge about world prices, and profit margins taken by traders and intermediary processors mean that farmers are rarely paid import or export parity.

Since agricultural production begins with farm-level decision-making, several additional measurements of financial profits and production costs are provided for each activity. These indicators include net profit, gross margin, variable costs, days worked and labor as a percent of variable costs. The rate of financial return to each activity is measured by a gross margin/variable cost ratio where crops with a high score provide a better return to the expenditure on inputs than those with a low score. Gross margin is defined as a farmer's total revenue less the variable costs of production; net profit is the gross margin less the annualized depreciation cost of any long-term investment items needed to produce the crop being analyzed. These measurements are important because it is possible than an agricultural activity may be an efficient user of domestic resources, but that it is unprofitable, or too expensive, from the farmer's private perspective.[16]

3.1.4 Social Profitability (H)

The second row of the PAM uses social prices, as indicated in Table 3.1. These valuations measure comparative advantage or efficiency in the agricultural commodity system. Efficient outcomes are achieved when an economy's resources are used in activities that create the highest levels of output and income. Social profits (H) are an efficiency measure because outputs (E) and inputs (F + G) are revalued in prices that reflect scarcity values or social opportunity costs. Social profits, like private profits, are the difference between revenues and costs, all measured in social prices: H = (E - F - G).

For outputs (E) and inputs (F) that are traded internationally, the appropriate social valuations are given by world prices. These are c.i.f. import prices for goods or services that are imported or f.o.b. export prices for exportables. World prices represent the government's choice to permit consumers and producers to import, export, or produce goods or services domestically. The social value of additional domestic output is thus the foreign exchange saved by reducing imports or earned by expanding exports.

The services provided by domestic factors of production (labor, land, and capital) do not have world prices because the markets for these services are considered to be domestic. The social valuation of each factor service is therefore found by estimating the net income foregone because the factor is not employed in its best alternative use. A distinction is made between mobile and fixed factors of production. Mobile factors, usually capital and labor, are factors that can move from agriculture to other sectors of the economy, such as industry, services, and energy. For mobile factors, prices are determined by aggregate supply and demand forces. Because alternative uses for these factors are available throughout the economy, the social values of capital and labor are determined at a national level, not solely within the agricultural sector.

Fixed, or immobile, factors of production are the factors whose private or social opportunity costs are determined within a particular sector of the economy. The value of agricultural land, for example, is usually determined only by the land's worth in growing alternative crops. Because land is immobile, its value is not directly affected by events in the industrial and service sectors of the economy. But the social opportunity cost of farmland is sometimes difficult to estimate. For this reason, it is often convenient in assessing agricultural activities to re-interpret crop profits as rents to land and other fixed factors (for example, management and the ability to bear risk) per hectare of land used. This re-interpretation includes private (and social) returns to land as part of D. Profitability per hectare is then interpreted as the ability of an agricultural activity to cover its long-run variable costs, in either private or social prices, or as a return to fixed factors such as land and management skill.

3.1.5 Policy Effects (I, J, K, and L)

The second identity of the PAM concerns the differences between private and social valuations of revenues, costs and profits. For each entry in the matrix–measured vertically–any divergence between the observed private (actual market) price and the estimated social (efficiency) price must be explained by the effects of policy or by the existence of market failures. This follows directly from the definition of social prices. Social prices correct for the effects of distorting policies that lead to an inefficient use of resources. These policies often are introduced because decision makers are willing to accept some inefficiencies (and thus lower total income) in order to further non-efficiency objectives, such as the redistribution of income or the improvement of domestic food security.

Only government policy or market imperfections can cause a divergence between private and social prices. Unless the government enacts a protection policy, for example, each importable output and input will be available at its c.i.f. import price, which in turn becomes the domestic price, so that A will equal E and B will be the same as F in Table 3.1. Consequently, any difference between A and E or between B and F is caused by some combination of trade restrictions, price control, tax/subsidy or exchange rate policies. If A exceeds E, either domestic consumers are forced to pay higher than world prices or the government treasury is directly subsidizing production, causing an output transfer (I) equal to (A - E). Similarly, if B is greater than F, tradable inputs are taxed resulting in an input transfer (J) of (B - F). For domestic factors, the transfer (K) amounts to (C - G).

The net effects caused by policy and market failures (L in the matrix) is the difference between effects on outputs (I) and on costs (J and K), thus L = (I - J - K). The net effect can also be found by a comparison of private and social profits. These measures of the net effects must, by definition, be identical in the double-entry matrix: L = (I - J - K) = (D - H). Table 3.2 summarizes and defines these policy effect measurements.

3.1.6 Comparison of Agricultural Activities Producing Different Outputs

The entries in the PAM allow comparison among agricultural activities that produce identical outputs. If interest focuses solely on a comparison of one maize operation with another, for example, the matrix entries provide all the information necessary for the analyst. Comparisons can be drawn readily by construction of PAM entries for two or more different systems that produce the same quality of maize.

Comparisons between maize and cotton, however, are another matter. To permit the comparison of systems that produce different outputs, some common measure of value must be generated. One technique involves the expression of all values relative to a constraining domestic resource, such as labor. Another method uses ratios. Both the numerator and the denominator of each ratio are PAM entries defined in domestic currency units per physical unit of the commodity. Thus, the ratio is a pure number free of any commodity-specific or monetary designation. Table

Table 3.2. Policy Effect Measurements

Indicator	Formula	Description
Net Effect	L = D - H; or L = I - J - K	Net effects of government policies.
Output Effect	I = A - E	Effects generated by domestic price/border price differences
Tradable Input Cost Effect	J = B - F	Effects generated by domestic price/border price differences
Domestic Factor Cost Effect	K = C - G	Effects generated by actual price/shadow price differences.

Table 3.3. Ratio Indicators for Comparison of Unlike Outputs

Ratio	Abbreviation	Definition
1. Domestic Resource Cost Ratio	DRC	G/(E-F)
2. Nominal Protection Coefficient	NPC	[A/E] - 1
3. Effective Protection Coefficient	EPC	[(A-B)/(E-F)] - 1

3.3 summarizes these ratios or coefficients useful for cross-commodity analysis.

3.1.7 Domestic Resource Cost Ratio (DRC)

Social profits (H) measure efficiency or comparative advantage. When systems producing different outputs are compared for relative efficiency, the Domestic Resource Cost (DRC) Ratio, defined as G/(E-F), serves as a proxy measure for social profits. By elementary algebra it follows that the ratio equals 1 if social profitability (H) is 0, is greater than 1 if H is negative, and is less than one if, and only if, H is positive. Minimizing the DRC is thus equivalent to maximizing social profits and, the lower the DRC, the greater the system's comparative advantage. In cross-commodity comparisons, DRC ratios replace social profit measures as indicators of relative degrees of efficiency. Efficient activities can be defined equivalently as those for which social profitability is positive or for which the DRC is less than 1.

3.1.8 Nominal Protection Coefficient (NPC)

The Nominal Protection Coefficient (NPC) is a ratio that contrasts the observed (private) commodity price with a comparable world (social) price. This ratio indicates the impact of policy (and of any market failures not corrected by efficient policy) that causes a divergence between the two prices. The NPC on tradable outputs, defined as (A/E)-1, indicates the degree of output transfer. An NPC greater than zero shows that policies are increasing the market price above the world price, thus providing a positive incentive to the producer. Likewise, an NPC less than zero indicates a negative incentive (or disincentive) to the producer.

3.1.9 Effective Protection Coefficient (EPC)

The Effective Protection Coefficient (EPC) is another indicator of incentives and is the ratio of value added in private prices (A-B) to value added in world prices (E-F), or EPC=[(A-B)/(E-F)]-1. This coefficient measures the net policy effect resulting from product market-output and tradable-input policies. But, like the NPC, the EPC ignores the transfer effects of factor market policies. Hence, it is not a complete indicator of incentives.

3.2 LIMITATIONS OF PAM ANALYSIS

While the PAM provides a great deal of information about agricultural production systems, it is important to note some of the things it does not tell the analyst as well as a few of the complications associated with its use.

3.2.1 Price Response and Elasticities

First, it is important to recognize that the PAM is not a behavioral model and cannot be used to calculate the new quantities of outputs and inputs that would follow from changes in national opportunity cost prices or from any other alternative prices (such as those resulting from sector development projects). The input-output physical budget is itself the product of past adjustments to actual market prices. At new national opportunity costs, the use of inputs and outputs would be further adjusted. The PAM tells only the relative incentive for change, without measuring the magnitude of change. Estimation of new input and output quantities requires more detailed behavioral models of supply and demand, specifying elasticities and resource constraints.

3.2.2 Dynamic Comparative Advantage

In this respect, the PAM is frequently criticized as being static, whereas efficiency and comparative advantage are dynamic concepts. Dynamic comparative advantage refers to shifts in a system's competitiveness that occur over time because of changes in three categories of economic parameters: long-run world prices of tradable outputs and inputs;

social opportunity costs of domestic factors of production (labor, capital, and land); and production technologies used in farming or marketing.

This weakness can be partially overcome through the construction of additional PAMs that utilize social prices for outputs and costs that approximate best guesses of expected future prices, and thus serve as proxies for long-run equilibrium levels. If the country's decision to buy or sell on the world markets will not have any measurable effect on world prices (as is generally the case with Zambian agriculture) those prices can be considered exogenous and, once arrived at, taken as given for domestic agricultural activities. Likewise, with regard to technology, alternative production systems can be modeled to provide an indication of how competitiveness might change over time as a result of adopting improved farming practices. Finally, with the use of spreadsheet software, PAMs can be easily subjected to sensitivity analysis as a way of testing the effect of new prices assuming that input use remains constant.

As noted earlier, PAMs have been estimated for this study to cover two levels of small-scale, emergent and commercial farm production. This focus on the technical aspects of dynamic comparative advantage is justified by the enormous variations in yield and input use that characterize Zambian agriculture. A limited number of sensitivity tests have also been carried out that examine the effects of alternative transportation costs and the elimination of policy transfers. Lastly, for each activity, the amount by which yield and price could decline before the farmer's gross margin would equal zero and the DRC would equal one have also been determined.

3.2.3 Data Requirements

Finally, it is important to note than an inherent problem with the PAM is its intensive use of data. Detailed information is needed on farm -level costs of production (including the value of family and hired labor), transportation costs, economic distortions, and international commodity prices. This means that the analyst is presented with many opportunities to utilize inaccurate price data and to make mistakes. Although great care has gone to ensure that the calculations and prices used for this study are as accurate as possible (or at least that best estimates of prices are applied consistently to the analysis of all crops), it is important for the reader to treat the conclusions that follow with some caution. At two decimal points, for example, the DRC results may look accurate and convincing, but they are only as good as the many other numbers used for their derivation.

3.3 KEY ASSUMPTIONS AND PROCEDURES

Before proceeding to the discussion of the indicative results for all activities analyzed, the key assumptions and methodological procedures underlying the estimation of social prices are briefly explained.

3.3.1 Farm Sub-Sectors

As noted, small-scale, emergent, and commercial farm enterprises are analyzed in this report. For indicative purposes, small-scale farmers are assumed to utilize only hand hoe cultivation technology and family labor. Farm size is less than five hectares and an average delivery distance of 40km to the market depot or town center where the farm product is sold has been assumed. Emergent farmers are assumed to cultivate ten hectares and to own their own team of oxen and ox-driven cultivation equipment. They may hire additional labor when needed and generally experience better yields than small-scale farmers due to improved crop management. These farms are assumed to be 20km from the market depot or town center where the product is sold. Finally, commercial farmers are assumed to cultivate an average of 200 hectares with tractor-powered equipment and may irrigate their crops where appropriate. Transportation costs from farm to market for this sector are based on a delivery distance of 40km.

3.3.2 Location

Where appropriate, each farm activity is analyzed for more than one location to indicate which area enjoys the greatest comparative advantage. Agroecological conditions, transportation costs and farmgate input and output prices all vary greatly from one location to another and have an important bearing on the returns to agricultural production. Although it was not possible to cover all important farm areas, these locations were chosen

to represent major areas of production for each commodity.

3.3.3 Yield

To help ensure that the results presented here are as realistic as possible, yield assumptions are based on ten year averages for each location studied plus field observations and discussions with extension officers and farmers about current conditions. Importantly, these yield estimates assume "normal" rainfall, and actual production would be much lower in a drought year. All crop budgets used for the analysis have been carefully reviewed by team members and other crop experts to help ensure that the estimated output is realistic given the inputs that are costed and the assumption of normal rainfall. A complete summary of these yield assumptions is presented in Appendix 1.

3.3.4 Exchange Rate

In order to convert foreign currencies into their Zambian Kwacha equivalent, an economic price of ZK850 per U.S. dollar was assumed for the analysis of the 1995/96 season. For the updated analysis covering 1996/97, a price of ZK1,250 per U.S. dollar was assumed. These values are based on the average exchange rate that prevailed over each farm season. Because Zambia imposes no restrictions on the conversion of foreign exchange, it is further assumed that the financial and economic exchange rates are equivalent. Further analysis could simulate both a possible overvaluation of the currency as well as its continued depreciation in real terms. To facilitate comparisons with data from other countries and across time periods, most monetary values are expressed both in local and foreign currency terms.

3.3.5 Land

No specific cost has been entered in the crop budgets to account for the use of farmland. As noted above, this approach means that crop profits may be re-interpreted as rents to land and therefore indicate the ability of each activity to cover its long-run variable costs. This approach is especially appropriate in Zambia due to the abundance of idle farmland in most locations. Indeed, farmers in Zambia rarely make a formal payment in exchange for the use of land and only need to seek the permission of the local chief to farm in a particular area. Importantly, all crops are treated the same with respect to this omission of a specific land cost so that the results for each activity may be compared directly. In circumstances where improvements to land are required, including bore hole development and electrification, these costs have been depreciated on an annual basis and are included in the crop models as an investment expenditure. Clearing costs, however, are not included since these will tend towards zero over the long run and cannot be charged as an expense in any one year.

3.3.6 Parity Prices

For the purpose of efficiency calculations, all activities are assumed to produce tradable outputs–either commodities that substitute for imports or commodities that are exported. If increased production substitutes for imports, then an import parity price was used. This is determined by first finding the price Zambia is most likely to pay in order to import the commodity and then by adding transportation costs to this price to obtain the landed c.i.f. price, Lusaka or Ndola. Finally, to convert this price to a farmgate import parity price, the cost of transportation from the urban area (where the commodity is consumed) to the area where it is produced is subtracted from the c.i.f. price. This gives the price at which Zambia's farmers must compete with imports. If it was assumed that increased production would be exported, then an export parity price was used (usually quoted as a f.o.b. Lusaka price with the costs of transportation from the farmgate subtracted).

For some commodities, including maize and cotton, both import and export parity prices have been analyzed. This is because in some years Zambia produces a deficit of these commodities and in other years a surplus. Furthermore, for maize, both an Argentina and a regional import parity price have been analyzed. This is because in severe drought years the entire Southern Africa region becomes deficient in white maize and Argentina is normally one of the nearest reliable sources of supply.

3.3.7 Transportation Costs

Transportation cost estimates are based on information obtained from the principal trucking companies and ocean freight agents that serve Zambia. Domestic road rates are believed to be an average price paid per kilometer by most people seeking to move goods along

Zambia's main roads. Lower back-load rates may be available for these routes and no specific premium has been added to reflect the higher costs of transportation over secondary or unsealed roads. For international freight, fixed rates are used for each specific route including back-load rates for journeys from Zambia as appropriate. Chapter Five presents results from a quick sensitivity test that looks at the effects of different transportation costs on social efficiency and farm profitability. Appendix 2 summarizes the transportation cost assumptions used for this study.

3.3.8 Conversion Factors for Crop Inputs

From 1991, Zambia embarked on an ambitious program of economic liberalization where many price distortions have been eliminated from the domestic economy. Agricultural subsidies and price controls have all been abolished and many farm inputs (including seed, fertilizer and veterinary medicines) are now sold tax-free. Likewise, some non-traditional exports, including roses and coffee, are entitled to special export incentives so that all inputs used specifically for these crops are exempt from both Value Added Tax (VAT) and import duty.

Still, certain inputs including fuel, machinery, grain bags and agricultural chemicals remain subject to heavy price transfers. For these items, the shadow price (or social value) is derived by multiplying the observed financial price by a conversion factor equal to the untaxed portion of that input's value.[17]

3.3.9 Foreign Exchange Percentages

Because the PAM requires the separation of costs according to their domestic and tradable components, the foreign exchange content of each input has been estimated. In most cases, these estimates are based on discussions with private traders, manufactures and economic planners. For example, the foreign exchange component of agricultural chemicals (which are all imported) has been estimated at 77% because importers report that the price they sell at locally includes a mark-up of 30%. The foreign exchange component for fertilizer, on the other hand, is estimated at 85% because the domestic price includes less of a mark-up than for chemicals. Similarly, while Zambia produces most of its own seed, the foreign exchange content of this input has been estimated at 10% to reflect the cost of imported seed dressing. Although these estimates are not perfect, DRC analysis is very insensitive to different foreign exchange assumptions so that these best guesses — which are applied consistently to the analysis of all crops — are adequate for present purposes.

3.3.10 Interest Rates

In recent years, Zambia has experienced interest rates that are extremely high by historical standards coupled with wildly fluctuating monthly rates of inflation. The reason for this phenomenon is the monetary regime that has been adopted as part of the Structural Adjustment Program in an attempt to stabilize the domestic currency. While this means that the selection of any rate involves some degree of arbitrary decision making, this paper has chosen to use 19% and 17% as the real interest rates on borrowing for the 1995/96 and 1996/97 farm seasons respectively. These rates were derived by looking at the monthly inflation rate (CPI) and the Weighted Base Lending Rate (WBLR) charged by the Bank of Zambia to other financial institutions and have been adjusted for a nine-month loan period. A factor of 0.5 is used to convert these rates to their economic equivalents. For savings, the real rate

Table 3.4. Summary of Labor Cost Assumptions

	Financial Prices (ZK/day)		Conversion Factor	Economic Prices (ZK/day)	
	1995/96 Season	1996/97 Season		1995/96 Season	1996/97 Season
Smallholder & Emergent					
Remote	300	500	1	300	500
Non-Remote	400	600	1	400	600
Commercial Farms					
Casual	800	1,200	0.50	400	600
Permanent Staff	1,200	1,800	0.3333	400	600

of interest paid by banks has been estimated at 6% and 4% for the two growing seasons respectively.

3.3.11 Labor

After considerable debate, a consensus was reached among the parties working on this report that the wage rates shown in Table 3.4 would be used for analysis. For smallholder and emergent farmers a distinction is made between the value of labor in remote and not-so-remote areas to reflect the different wage opportunities that exist across Zambia. These values were derived using a combination of methods that looked at both the cost of rural subsistence and the returns per day worked on a typical farm enterprise. For this analysis, remote areas include Chipata, Katete, Mongu, Solwezi, and Kasama.

For commercial farmers, a distinction is made between casual wage rates and the cost of hiring the permanent staff needed to maintain farm operations throughout the year. For casual workers, the market price is based on the commercial farm daily minimum wage plus an allowance to include other costs (such as transportation) associated with the use of casual labor. The rate for permanent staff, on the other hand, is based on a typical annual wage bill for a 200 hectare farm where 50 laborers work an average of 25 days per month. This amount includes housing costs, bonuses, medical expenses and other items. Because each worker on this farm will cover four hectares, every commercial activity is billed for 75 days of waged labor which is the per hectare share of the total wage bill. The shadow cost for both types of commercial labor is based on the rate for non-remote smallholder and emergent labor since it is assumed that the workers' forgone opportunity is to farm on their own.

3.3.12 Derivation of Investment Costs

Briefly, the approach used to estimate the annual per hectare cost of such long-term investments as ox plows, tractors, and irrigation equipment was to determine the so-called "capital recovery cost" of each input, which is the annual payment that will repay the cost of a fixed input over its useful life and provide an economic rate of return on the investment.[18] This approach has the advantage over the simple division of a fixed input's value by its useful life since it accounts for the fact that if the farmer did not purchase that input, the money could have been invested in some other on- or off-farm activity.

4. Agricultural Comparative Advantage

Analysis of Results

4.1 INTRODUCTION

This chapter presents the quantitative comparative advantage results from 1995/96 for all activities analyzed by major crop grouping. For each activity, a brief description of production trends, marketing issues and crop characteristics is followed by a discussion of the detailed comparative advantage indicators. Throughout this chapter, concise summary tables accompany the discussion of each crop. For more detailed information, and rankings of each activity by individual indicators, the reader should refer to Appendix 2 where the complete data set is presented. Updated results covering 1996/97 are presented in Chapter Five as part of the sensitivity analysis.

A total of 161 production models for 1995/96 were estimated for this study covering 25 distinct crop/livestock activities and several variations by production level, location and parity basis. For small-scale and emergent farmers, there are 119 production models covering 14 distinct crop/livestock activities. For the commercial sector, there are 42 production models covering 16 crop/livestock activities. Table 4.1 provides a complete summary of all activities, locations and production levels analyzed for 1995/96 while Map 4.1 shows the physical location of the study area.

From the social perspective, the results of this analysis are extremely good and show that Zambia enjoys a strong comparative advantage in the production of most agricultural commodities. Referring to the summary tables in Appendix 2, only 48 of the 161 production scenarios yield a DRC greater than 0.50 and just 5 scores are greater than one. The average DRC for all activities is just 0.41. These are excellent results and imply a very good potential for broad-based agricultural growth and development.

Importantly, however, from the private perspective, the results are much less encouraging, since 55 of the production scenarios analyzed return less than ZK85 thousand/ha (US$100) and 15 scenarios actually lose money. Rather surprisingly, many of these loss-making models cover the commercial sector and the data clearly show that these farmers do not always enjoy better profits than small-scale and emergent growers on a per hectare basis.[19] One significant reason for this is that many agricultural inputs, including chemicals, fuel, grain bags and machinery, are subject to heavy taxes and import duties. Capital and labor market distortions also detract from farm profitability. Although all sectors are affected by these transfers, the greatest impact is felt by the commercial sector since these farmers make the most intensive use of taxable inputs, borrowed capital and hired labor.

It is also worth noting that, for all farm sectors, traditional grain and oilseed crops tend to be much less profitable than industrial cash crops such as cotton, paprika, sugar cane and tobacco. However, because these more lucrative activities also tend to be the most expensive, they are not always appropriate, especially for small-scale and emergent farmers with limited access to cash or other sources of crop finance. Success with cash crops also depends on farmers having fair and reliable access to market outlets which is certainly not always the case, especially in very remote locations. In these circumstances, subsistence food production clearly has an important role to play and will continue to be an integral part of most smallholder and emergent farm strategies.

4.2 GRAINS

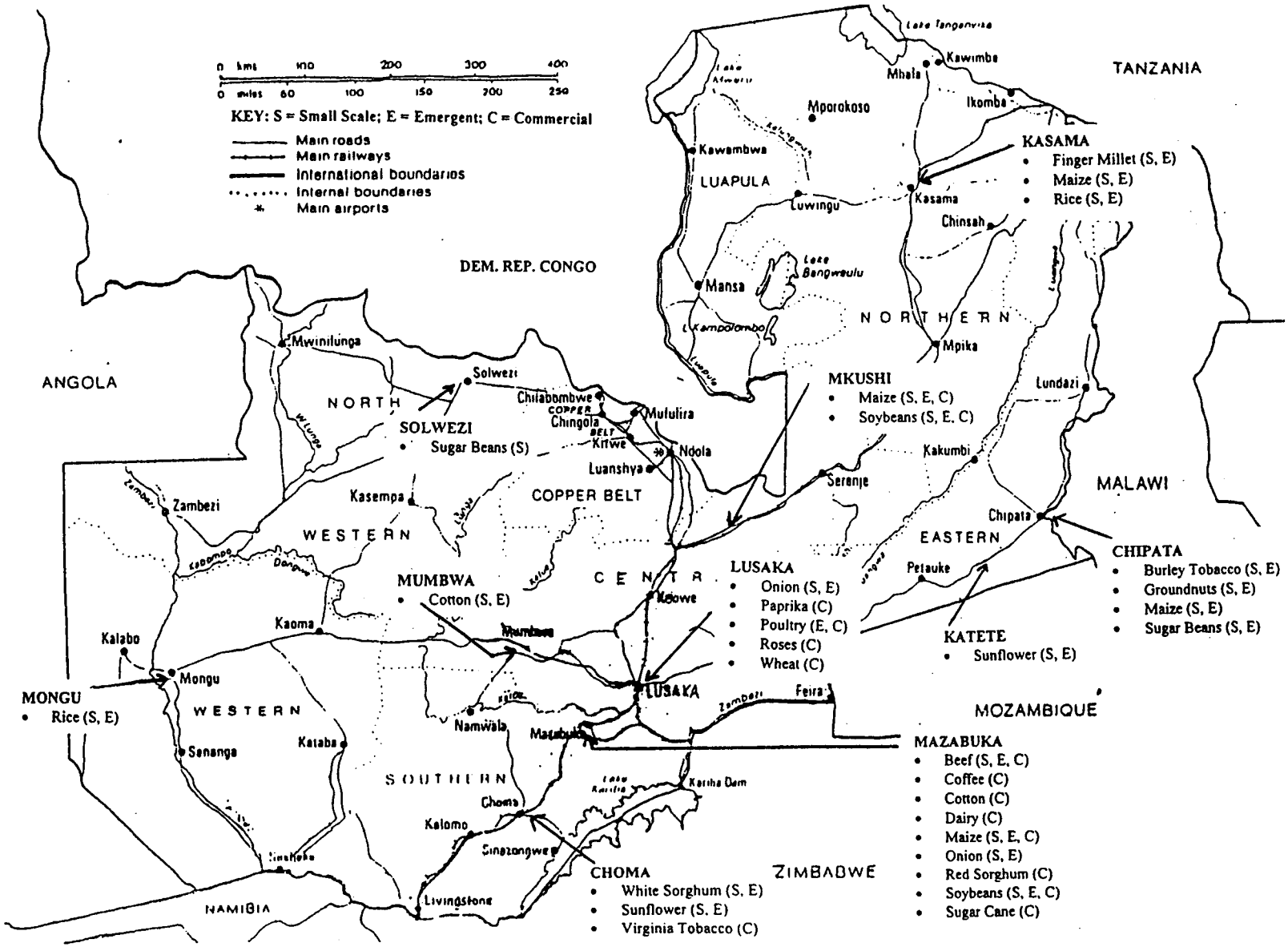
4.2.1 Introduction

This section looks in detail at Zambia's main grain crops. Although a wide variety of grains are cultivated throughout the country, the majority of production is accounted for by maize which is the main subsistence crop and an important wage good for urban residents.

Table 4.1. List of Agricultural Activities Analyzed (1995/96 Season)							
	Location	Small-Scale Average	Small-Scale Potential	Emergent Average	Emergent Potential	Commercial Average	Commercial Potential
ZONE II (Low Rainfall)							
Beef (ranch & feedlot)	Mazabuka (SP)	X		X		X	
Coffee	Mazabuka (SP)					X	
Cotton (irrigated)	Mazabuka (SP)					X	X
Dairy	Mazabuka (SP)					X	X
Irish Potato	Mazabuka (SP)	X		X		X	
Maize	Mazabuka (SP)	X	X	X	X	X	X
Onion	Mazabuka (SP)	X		X			
Rice	Mongu (WP)	X	X	X	X		
Sorghum - White	Choma (SP)	X	X	X	X		
Sorghum - Red	Mazabuka (SP)					X	
Soybeans	Mazabuka (SP)	X	X	X	X	X	X
Soybeans (irrigated)	Mazabuka (SP)					X	X
Sugar Cane	Mazabuka (SP)					X	X
Sunflower	Choma (SP)	X	X	X	X	X	X
Virginia Tobacco	Choma (SP)					X	X
ZONE II (Moderate Rainfall)							
Burley Tobacco	Chipata (EP)	X	X	X	X		
Cotton	Mumbwa (CP)	X	X	X	X		
Groundnuts	Chipata (EP)	X	X	X	X		
Maize	Chipata (EP)	X	X	X	X		
Onion	Lusaka (LP)	X		X			
Paprika	Lusaka (LP)					X	
Poultry (broilers)	Lusaka (LP)			X		X	
Roses	Lusaka (LP)					X	
Soybeans	Chipata (EP)	X	X	X	X		
Sugar Beans	Chipata (EP)	X	X	X	X		
Sunflower	Katete (EP)	X	X	X	X		
Wheat (irrigated)	Lusaka (LP)					X	X
ZONE III (High Rainfall)							
Finger Millet	Kasama (NP)	X	X	X	X		
Irish Potato	Mkushi (CP)	X		X		X	
Maize	Kasama (NP)	X	X	X	X		
Maize	Mkushi (CP)	X	X	X	X	X	X
Rice	Kasama (NP)	X	X	X	X		
Soybeans	Mkushi (CP)	X	X	X	X	X	X
Soybeans (irrigated)	Mkushi (CP)					X	X
Sugar Beans	Solwezi (NWP)	X	X				

Of the other grains, two unrelated types of millet are traditionally grown. Pearl millet is typically produced in the relatively dry southwestern part of the country and finger millet is grown in the wetter north. Finger millet (commonly known as *ropoko*) is the type of millet analyzed in this report. Sorghum is mainly produced in the dry southern parts of the country with some production also taking place in the Northwest. Both of the millets and sorghum have been targets of SADC-wide seed selection and breeding programs. There are many seasonal flood plains in Zambia and

Map 4.1
Locations Selected for Analysis



several of these have been developed for rice production as part of donor-sponsored aid projects.

All types of grain, with the exception of irrigated wheat and small amounts of irrigated maize, are planted at the beginning of the rainy season (generally from October to December) and are harvested once the rains have stopped and the grains have dried out (sometime between May and July). Zambia typically utilizes only about 40% of its grain milling capacity. There is very little artificial drying of grain except on a few commercial farms when a premium can be obtained from an early harvest.

4.2.2 Maize

Maize is the principal staple food in Zambia and is without doubt the country's dominant agricultural activity. Reasons for this dominance include the expansion of maize-only credit facilities in the mid-1980s, the "one crop" message propagated through the extension services, and previous policies that enforced pan-territorial maize pricing and subsidies on transportation, seed and fertilizer. As a result of these developments, many Zambian farmers became near mono-culturalists by the early 1990s and an aerial survey of Southern Province conducted in 1992 found that only about 2% of smallholder lands were planted to crops other than maize. The situation is gradually beginning to change with many farmers now pursuing a more diversified strategy although maize is still, by far, the dominant activity of most small-scale and emergent farmers.

One of the most notable features of Zambia's maize sector is the very wide range of yields attained by farmers across the country and within individual villages. Since the introduction of high - yielding varieties in the late 1950s, maize has effectively fragmented into two different crops — one which is grown at low cost and low yield for subsistence and one that is grown at high cost for sale. Traditional varieties are relatively hardy and of good storage quality but generally yield less than one metric ton per hectare. In non-drought years, Zambia's climatic conditions are ideally suited to maize and individual yields of nine to ten metric tons per hectare are sometimes achieved by the best commercial farmers. On village lands, yields frequently drop to less than one ton per hectare even with the use of fertilizer and hybrid varieties. Map 4.2 shows geographical areas where maize is suitable.

Many variables, including drought and changing monetary policies, have together caused deep oscillations in Zambia's overall maize production. For the country as a whole, production has been in surplus only four times over the past ten years and in deficit six times (only three of these by reason of drought). Since the value to weight ratio for maize is generally low compared to other commodities, transport costs are significant and the spread between export and import parity prices is accordingly very large. In times of surplus, local prices can fall as low as US$70 per metric ton, while import parity can lie anywhere between US$150 and US$300 per ton depending the source of supply.

Given the importance of maize in Zambia, 60 PAMs have been estimated to include a large number of production variants — more than for any other crop or crop grouping. Because in some years Zambia produces a surplus of maize and in other years a deficit, both export parity and two import parity scenarios have been analyzed. Export parity prices are based on the nearest likely export destination for each location studied. For imports, both Zimbabwe and Argentina import parity prices are analyzed. This is because in severe drought years, the entire Southern Africa region becomes a deficit producer of white maize and Argentina is normally one of the nearest reliable sources of supply. Efficiency results from the analysis of Zambia's maize options are summarized in the Table 4.2.

Most clearly, the above DRC scores show that Zambia is a very efficient producer of maize where individual results range from just 0.06 to 0.97 and only four DRCs are greater than 0.60. The fact that these scores span a very broad range is mostly explained by transportation cost differences between each parity price scenario analyzed. Unsurprisingly, Zambia is a remarkably efficient producer of maize when the alternative is to import grain from Argentina (average DRC for all sectors = 0.11). The country is significantly less efficient when the alternative is to import grain from Zimbabwe (average DRC

Map 4.2
Maize Suitability Map

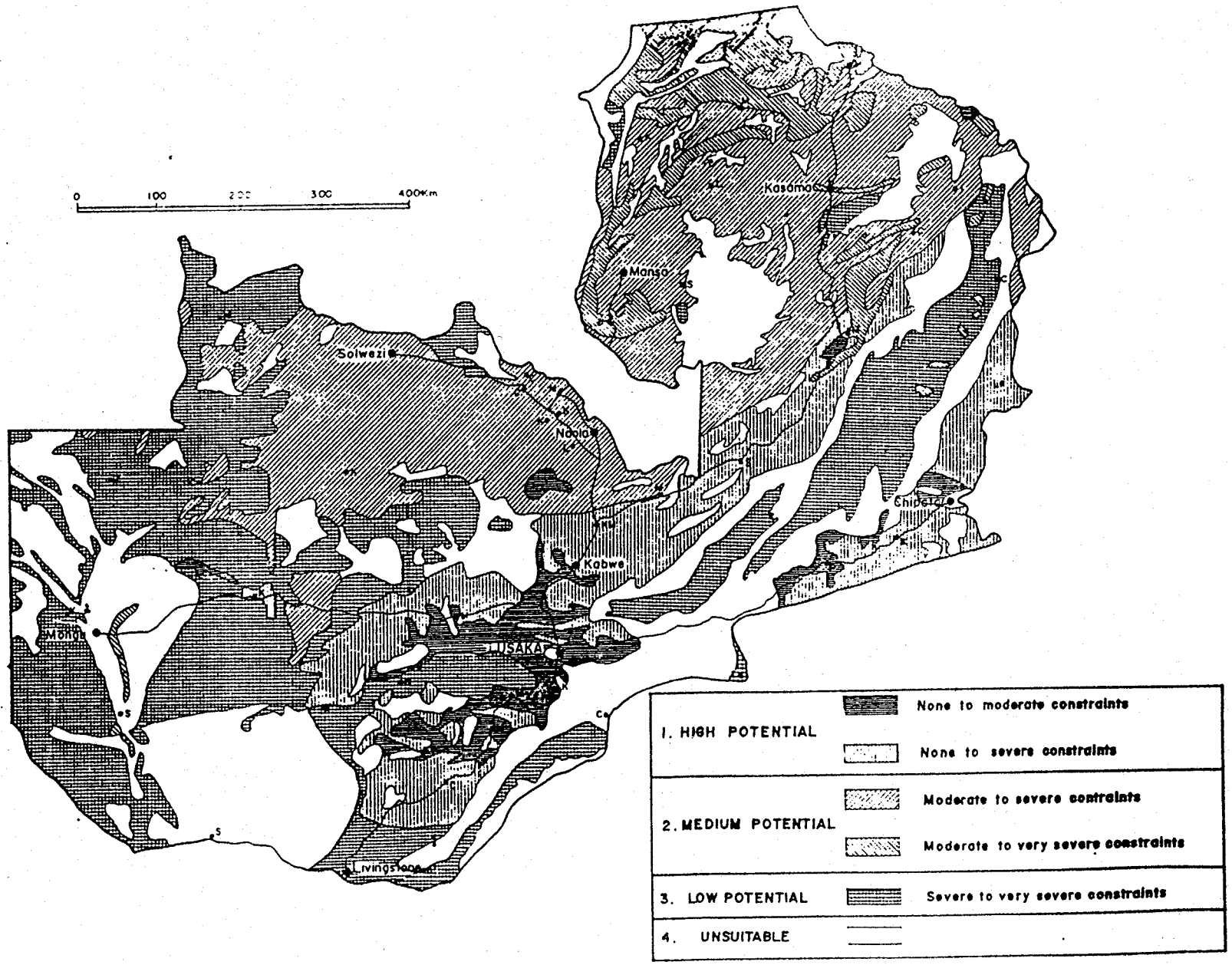


Table 4.2. DRC Results for Maize						
	AVERAGE MANAGEMENT			POTENTIAL MANAGEMENT		
	Argentina Import Parity	Zimbabwe Import Parity	Regional Export Parity	Argentina Import Parity	Zimbabwe Import Parity	Regional Export Parity
Small-scale						
Chipata (EP)	0.14	0.56	0.35	0.14	0.62	0.37
Kasama (NP)	0.10	0.42	0.55	0.13	0.55	0.66
Mazabuka (SP)	0.10	0.32	0.48	0.06	0.23	0.40
Mkushi (CP)	0.06	0.27	0.31	0.07	0.30	0.34
Emergent						
Chipata (EP)	0.14	0.52	0.34	0.14	0.57	0.35
Kasama (NP)	0.10	0.40	0.51	0.12	0.49	0.60
Mazabuka (SP)	0.10	0.30	0.45	0.06	0.23	0.38
Mkushi (CP)	0.06	0.26	0.30	0.07	0.28	0.33
Commercial						
Mazabuka (SP)	0.16	0.68	0.97	0.05	0.25	0.44
Mkushi (CP)	0.13	0.52	0.49	0.05	0.28	0.33

= 0.42), and still marginally less efficient when it exports maize (average DRC = 0.47). In this respect, the findings suggest that Zambia may do best to focus on producing enough maize to meet domestic demand and not look to grow surpluses for export.[20] Although all export DRCs are less than one, indicating that Zambia is an efficient producer of export maize, many other agricultural activities make considerably better use of scarce domestic resources.

Regionally, the data in Table 4.2 show that Central Province is the most efficient area for maize production followed by Southern and then Eastern Provinces. Northern Province is the least efficient. While Central Province is commonly regarded as a good maize area, the finding that the north is not somewhat contradicts conventional wisdom. Indeed, there is a widespread perception that because rainfall is normally very reliable in northern Zambia, that this region is endowed with a "natural comparative advantage" in maize over other parts of the country. The above data, however, show that this is not necessarily the case since most of the DRCs for Kasama are higher than for other parts of Zambia despite relatively good yields. The primary reason for this outcome is that the costs of transportation from Kasama to the urban centers where maize is consumed tend to offset the benefits of higher rainfall, if not necessarily the benefits of more "reliable" rainfall. Whether the far north is really a better region for maize than the south depends on if the repeated incidence of drought is a permanent or temporary phenomenon.

Next, because agricultural production begins with farm-level decision making, Table 4.3 presents a set of financial indicators for maize covering each sector, location and production level analyzed.

With regard to crop profitability, the above data show that emergent farmers earn the best income with average yields followed by small-scale farmers. For the commercial sector, maize returns a very large net loss with average management and does not appear attractive. With improvement to the potential level of output, commercial maize becomes much more profitable but still only returns about the same income as small-scale and emergent farmers appear to enjoy. This outcome is partly explained by an examination of the net effects of government policy (L from the PAM) which reveals that commercial maize systems are subject to much larger policy transfers than either small-scale or emergent systems. Specifically, in every case, the transfers away from commercial maize are in excess of US$118/ha whereas the transfer from small-scale and emergent farm systems is rarely worse than US$35/ha (ZK30,000).

Importantly, Table 4.3 also shows that maize is an expensive crop to grow where a large cash expenditure is required at each level due to the intensive

Table 4.3. Financial Indicators for Maize										
	Net Profit (US$/ha)		Variable Costs (US$/ha)		Gross Margin/ Variable Cost Ratio		Labor as % of Variable Costs		Change in Yield to Gross (%) Margin = 0	
	Avg.	Pot.	Avg.	Pot.	Avg.	Pot.	Avg.	Pot.	Avg.	Pot.
SMALL-SCALE SECTOR										
Chipata (EP)	122.66	152.83	159.41	258.52	0.77	0.59	14	10	-46	-39
Kasama (NP)	82.28	87.96	163.35	302.82	0.50	0.29	14	9	-35	-24
Mazabuka (SP)	113.19	144.06	158.99	269.29	0.77	0.54	19	13	-46	-37
Mkushi (CP)	123.08	217.40	145.38	235.08	0.78	0.92	21	15	-46	-50
EMERGENT SECTOR										
Chipata (EP)	164.42	198.43	172.74	268.01	0.97	0.75	13	10	-51	-44
Kasama (NP)	120.52	136.27	177.27	311.67	0.70	0.43	13	8	-42	-31
Mazabuka (SP)	159.66	268.88	159.87	244.58	1.02	1.11	19	14	-52	-54
Mkushi (CP)	164.84	190.30	172.32	276.14	0.98	0.70	18	13	-51	-42
COMMERCIAL SECTOR										
Mazabuka (SP)	(121.26)	286.49	618.95	729.77	0.04	0.60	20	18	-4	-39
Mkushi (CP)	(107.38)	142.27	665.15	768.08	0.06	0.38	19	17	-6	-29

use of fertilizer and other purchased inputs. Indeed, for the small-scale and emergent sectors, maize costs at least US$145/ha to grow with just average management — a figure equal to more half of most Zambians' annual income. With potential management, the required expenditure for maize increases substantially to a minimum of US$235/ha (ZK200,000) so that many poor farmers simply cannot afford this level of input use.

In this respect, the data clearly indicate that efforts to improve maize production to the potential level may not be the best way forward for the small-scale and emergent sectors. Indeed, Table 4.3 shows that variable costs at this level increase by substantially more than net profits, while much smaller losses of yield are generally sufficient to erode all financial profits compared with average management. Likewise, from the social perspective, the DRC scores in Table 4.2 show that potential management is less efficient that current average practices in most locations so that the additional use of resources cannot be justified in economic terms. Because the potential maize models are based largely on Zamseed and MAFF recommendations, these findings suggest a need to re-evaluate the extension advice Zambian farmers are provided.[21]

4.2.3 Wheat

Over 99% of the wheat produced in Zambia is grown in the winter, entirely under irrigation. The balance, amounting to only some 500 metric tons, is produced by rain-fed crops grown in the northern part of the country during summer. While irrigated wheat is of good bread-making quality, bread from rain-fed wheat is exceptional. Protein levels for this crop exceed 15% and gluten content is higher than 40%. Unfortunately, there is no local market for wheat of this high quality and the volumes produced are too small to generate any interest in overseas markets.

The amount of wheat produced in Zambia increased over the last seven years to a peak of 75,000 metric tons in 1993. Until then, all wheat produced was sold on the local market at a price roughly equivalent to import parity. The local market was estimated to consume some 90,000 metric tons in 1992 and the quantity demanded has always exceeded local supply. Prior to market liberalization, the guaranteed floor price offered by government resulted in a consistent increase in the area sown to wheat and a concomitant increase in total production. Recently, lack of water resources and the diminished producer confidence in Zambia's newly liberalized markets, have resulted in decreased production.

Table 4.4. Comparative Advantage Indicators for Irrigated Wheat							
	DRC	Net Profit (US$/ha)	Variable Costs (US$/ha)	GM/VC Ratio	Days Worked	Labor as % of Variable Costs	Change in Yield to Gross Margin=0
Lusaka Province						19%	
Average	0.17	395.07	659.31	0.98	95	18%	-51%
Potential	0.10	834.65	742.08	1.46	105		-61%

Note: *Production analyzed for Lusaka (Zone II); DRC calculations based on USA import parity.*

Due to the high costs of transportation, there is little export market for Zambian wheat.

Costs of production for wheat have risen markedly since the removal of subsidies from fertilizer and an increase in the cost of electricity. In 1988 the costs per hectare of fertilizers and electricity quoted by the Commercial Farmers Bureau were K965 and K516, corresponding, at a shadow exchange rate of K25:US$1, to US$38.60 and US$20.60, respectively. By 1993 these costs had risen to US$227 and US$136. Despite such increases, wheat production in 1993 was the highest ever achieved.

Current milling capacity is in excess of 140,000 metric tons per year. In Lusaka, a mill of 7,000 metric tons annual capacity has been purchased and at least one other comparable facility is under consideration. All indications are that existing and future milling capacities will not be a constraint to increased wheat production.

The potential for increased wheat production depends mainly on the availability of water. There is a considerable area of cleared land that could be put under irrigation so as to allow the production of wheat to increase more than 30 fold. Much of this area, however, lacks adequate infrastructure (power, access and water) and would require considerable investment to be put into production. Although there are considerable reserves of water in some rural areas, these have become increasingly restricted under current climatic conditions. It is already apparent that wheat produced using water pumped from the limestone aquifers near Lusaka and Kafue is competing increasingly with domestic and industrial demand. This will undoubtedly affect wheat production in the future.

The quantitative results for irrigated wheat grown near Lusaka by commercial farmers are given in Table 4.4.

Clearly, these results show that wheat makes extremely efficient use of Zambia's domestic resources where the estimated DRC is just 0.17 with average management and 0.10 at the potential level. Both of these results are excellent and indicate that Zambia enjoys a very strong comparative advantage as a grower of import-substitute wheat. The data also show that wheat is a very profitable activity and provides significantly more income than any other commercial grain crop. This is especially true at the potential level where net profits more than double compared with average management and variable costs increase by less than US$100/ha (ZK85 thousand). The EPCs for wheat at the average and potential levels equal just (0.03) and (0.00) respectively and indicate a very modest level of price transfer despite a relatively intensive use of taxed farm machinery, irrigation equipment and electricity for pumping.

Although the economic and financial results for wheat are very good, it is important to note that many other non-grain activities can provide significantly more income. Virginia tobacco, sugar cane, paprika, coffee, and roses all provide commercial farmers higher net profits than wheat and so may be preferred by those that can afford the additional investment and operating costs demanded by these other activities. Of these other crops, however, only roses return a lower DRC.

Table 4.5. Comparative Advantage Indicators for Red and White Sorghum							
	DRC	Net Profit (US$/ha)	Variable Costs (US$/ha)	GM/VC Ratio	Days Worked	Labor as % of Variable Costs	Change in Yield to Gross Margin=0
WHITE SORGHUM							
CHOMA — Southern Province (Zone II) (Low Rainfall)							
Small-scale							
Average	0.70	47.06	54.80	0.86	88	68%	-48%
Potential	0.35	219.81	119.72	1.84	103	37%	-67%
Emergent							
Average	0.46	151.29	99.68	1.55	88	37%	-62%
Potential	0.25	444.35	146.15	3.07	103	30%	-77%
RED SORGHUM							
MAZABUKA — Southern Province (Zone II) (Low Rainfall)							
Commercial							
Average	0.55	54.87	501.59	0.41	155	36%	-30%

Note: *DRC calculations based on export to Botswana.*

4.2.4 Red and White Sorghum

Even though white sorghum is produced by small-scale and emergent farmers throughout the country, it is produced especially in Southern Province where it is well suited to prevailing agro-climatic conditions due to the crop's drought resistant characteristics.

Local varieties are late maturing and prone to fail if the rains end early. This is partly because local seeds have been retained over the years from the last ears to mature. Modern seed breeding has resulted in a dwarf, early maturing variety known as *Kuyuma* which has proved remarkably tolerant of moisture stress in field trials. Sorghum yields improve substantially with just small applications of basal fertilizer, but because sorghum is typically viewed as a less important crop than maize, fertilization is rarely a priority.

Efforts to promote the growing of *Kuyuma* in the South have been hampered in recent years by seed shortage. Each year, Zambia's stock of *Kuyuma* seed is largely taken up by exports to Mozambique so that only maize seed is commonly available in many locations. The situation is, however, beginning to change where the occurrence of three major droughts at the start of the 1990s has added impetus to the diversification effort. The Lonrho Cotton outgrower scheme in Central Province is also moving into the promotion of Kuyuma as an excellent rotation crop with cotton. There are good export markets for both red and white sorghum in Botswana but domestic demand for these crops is normally very thin so that farmgate prices are often not very attractive.

Grain-eating birds are a major problem in growing white sorghum. Much of the labor invested by small-scale and emergent farmers for the production of this crop is devoted to bird scaring and trapping that is normally done by children. Commercial farmers therefore tend to find that white sorghum is almost impossible to manage and prefer to grow red sorghum that is bitter and distasteful to birds. Red sorghum is mainly used for beer brewing and must be polished to remove the hard seed coat before eating. This results in a weight loss that renders red sorghum less valuable than white sorghum when transported over long distances. Quantitative results from the analysis of red and white sorghum are given in Table 4.5.

Overall, these data show that white sorghum is a very promising activity for small-scale and emergent farmers, especially at the potential levels of output. Although the normal level DRC of 0.70 for small-scale farmers is higher than for many other activities, the improved value of 0.35 at the potential level is excellent and shows that Zambia enjoys a strong comparative advantage in this drought resistant grain crop. Emergent farmers are significantly more efficient than small-scale grow-

Table 4.6. Comparative Advantage Indicators for Finger Millet							
	DRC	Net Profit (US$/ha)	Variable Costs (US$/ha)	GM/VC Ratio	Days Worked	Labor as % of Variable Costs	Change in Yield to Gross Margin=0
Small-scale							
Average	0.18	118.49	38.22	3.10	60	55%	-78%
Potential	0.14	270.04	121.73	2.22	75	22%	-71%
Emergent							
Average	0.23	137.42	54.78	2.58	60	39%	-73%
Potential	0.14	377.94	140.74	2.71	75	19%	-74%

Note: *Both small-scale and emergent farm systems are analyzed for Kasama (NP) — Zone III. DRC calculations based on local fob price.*

ers at both levels of production, since the average score of 0.46 is very good and the potential score of 0.25 ranks among the best compared with all other crop and livestock activities analyzed for this study.

From the financial perspective, the data likewise show that net profits improve significantly with potential management. Although production at this level requires two 50kg bags of fertilizer and is therefore much more expensive than average management, white sorghum still costs much less compared with average management maize and provides a much better income. Indeed, the potential level sorghum gross margin/variable cost ratios are among the best compared with all other results from this study and suggest that Zambia may do well to emphasize improved management through targeted extension programs in sorghum-growing areas. The DRC for commercial red sorghum equals 0.55 and is higher than for most white sorghum scenarios but still indicates a high level of social efficiency and is entirely acceptable. Compared with smallholder and emergent production, however, the financial returns from red sorghum are very poor and many other crops offer commercial growers a better net income.

Because white sorghum makes very little use of taxed inputs, this crop is only subject to small price distortions. The net policy transfer away from sorghum (negative L) is greater for small-scale producers than for emergent farmers but only totals about US$14/ha (ZK12 thousand) at the potential level of output. For the emergent sector, the net policy transfer is less than US$3.50/ha (ZK3 thousand) at both management levels. These transfers are due mainly to transportation taxes in parity price calculations and high interest rate charges resulting from imperfections in the capital market. Commercial red sorghum, on the other hand, is subject to a relatively large net policy transfer equal to about US$215/ha (ZK183 thousand) since these producers make more intensive use of borrowed capital, hired labor, chemicals, and other taxed inputs than small-scale and emergent growers.

4.2.5 Finger Millet

Finger millet is typically grown in the north of Zambia as the first (and sometimes second) crop in the *chitemene*, or slash and burn, system of rotation farming. In this system, branches are cut from trees and collected in a deep mat which is set on fire once sufficiently dry. This process results in some minerals being made available for plant growth. More importantly, it also sterilizes the soil by killing weed seeds and other organisms. This results in the release of further nutrients. Finger millet is then broadcast into the ash where it grows free from competition with weeds.

Alternative "conventional" methods of growing finger millet are also practiced but weed competition is a significant management problem. The major grass weed in Zambia is *eleusine indica*, a close relative of millet that is indistinguishable prior to flowering and against which selective weed killers cannot be applied. Therefore, any great expansion of finger millet will probably depend on developing cultivation methods that suppress *indica* in the season(s) before millet is planted. The most promising of these methods involves green manuring with long-season sunhemp in the previous season. This system is presently unknown to most millet growers.

Table 4.7 Comparative Advantage Indicators for Rice							
	DRC	Net Profit (US$/ha)	Variable Costs (US$/ha)	GM/VC Ratio	Days Worked	Labor as % of Variable Costs	Change in Yield to Gross Margin=0
MONGU — Western Province (ZONE II)							
Small-scale							
Average	1.13	26.23	114.94	0.23	130	40%	-19%
Potential	0.94	72.77	191.94	0.38	150	28%	-29%
Emergent							
Average	1.03	42.23	130.57	0.35	130	35%	-26%
Potential	0.83	117.95	231.32	0.53	160	24%	-35%
KASAMA — Northern Province (ZONE III)							
Small-scale							
Average	1.12	5.36	118.17	0.05	130	39%	-5%
Potential	0.95	31.62	200.00	0.16	150	26%	-14%
Emergent							
Average	1.01	16.94	133.79	0.15	130	34%	-14%
Potential	0.83	64.15	241.00	0.28	160	23%	-22%

Note: *Import parity. Kasama DRCs based on c.i.f. price for Ndola; Mongu DRCs based on c.i.f. for Lusaka.*

Traditional strains of finger millet have excellent malting qualities and their main use is in the manufacture of a traditional alcoholic beverage called *katata*. Although some new selections have been made under a SADC breeding program, the recommended high-yielding "Lima" variety has poor malting quality and is grown only by farmers planning to pound the grain into meal.

There are some possibilities of finger millet being marketed as an organic health food in Europe and traditional varieties are commonly sold to Tanzania in informal cross border trade. Importantly, finger millet has a very good cash value and each 90kg bag typically sells for at a price more than double that received for maize.

The quantitative indicators from the comparative advantage analysis of finger millet are summarized in Table 4.6.

As with sorghum, these data suggest that finger millet is a very promising agricultural activity for Zambian farmers. At a range of just 0.23 to 0.18, the DRC scores for this crop are extremely low and indicate a very high level of social efficiency. The financial returns to finger millet are also very good, especially compared with other small-scale and emergent grain activities. Although it appears that net profits more than double at the potential level of output, the crop still provides a very good income with just average management where production costs are extremely low. Compared with maize, finger millet is both more profitable and costs considerably less to grow at each corresponding level of output. It is also worth noting that, for both sectors, finger millet offers good protection from yield loss in that the estimated output for all systems could fall by more than 70% before the farmers' gross margin would equal zero. NPCs and EPCs for this crop are never worse than (0.01).

4.2.6 Rice

Most Zambian rice is grown under natural flood conditions rather than in paddies. In particular, the flood plains near Kasama, the Bangweulu swamps, and Zambezi flood plain in Western Province are all well suited to the production of this grain. Because all of these areas are very remote, however, an important problem is that rice farmers generally face high input prices and correspondingly low output prices. Nearly all rice production in Zambia has been undertaken as part of donor-driven development projects. Combined with previous price controls, this has resulted in a very uncompetitive industry that is presently on the verge of collapse.

A major problem in the marketing of most Zambian rice is the poor quality of grain. This is mainly

the result of a failure to use pure seed of a single variety. Because four or five seed varieties have typically become mixed on many farms, it is virtually impossible to adjust the huskers to clean the paddy rice and also avoid breaking individual grains. The huskers themselves have been poorly managed by co-operatives that have generally failed to maintain the machines properly. At present, it is extremely difficult for Zambia to compete with imports from either Malawi or the Far East, which both produce a higher quality grain and can land rice in Zambia for roughly the same price as the costs of local production. The quantitative results are given in Table 4.7.

Importantly, the above analysis shows that rice makes extremely poor use of Zambia's domestic resources where the DRC scores compare unfavorably with every other activity analyzed at both levels of output. Indeed, at the average level, all DRC scores are above one and show that Zambia does not enjoy a comparative advantage in this activity. Although the scores do all improve to less than one with potential management, the DRCs are still very high (0.83 to 0.95) and most other activities make considerably better use of domestic agricultural resources. In most cases, rice production is slightly more efficient (or, more appropriately, less inefficient) in Kasama than Mongu due to differences in transportation costs.

Just as the social efficiency results for rice are poor, so too are the financial returns where farmers near Kasama earn between just US$5.36/ha and US$64.15/ha (ZK5 thousand and ZK55 thousand). In the West, profits are slightly better but still only range from US$26.23/ha to US$117.95/ha (ZK22 thousand and ZK100 thousand) and do not compare favorably with the earnings from many other crops. One reason that rice is more profitable in Mongu is that farmers in this location generally produce a higher quality grain than those in Kasama due to better seed selection and other management and processing practices. Rice is subject to stronger net policy transfers (negative L) than white sorghum or finger millet at a range of US$22.90/ha to US$74.20/ha (ZK20 thousand and ZK63 thousand) due to a relatively more intensive use of taxed inputs and high processing costs. Accordingly, the EPCs for rice range from (0.18) to (0.29) and indicate a rather considerable degree of policy transfer.

Taken together, these findings suggest a bleak future for rice production in Zambia. At the average levels of output, most DRCs are higher than 1 and, even with potential management, rice remains one of the least efficient activities analyzed. Private farm profits are also very poor and it seems unlikely that Zambia will be able to compete with imports from other countries.

4.2.7 Oilseeds (Sunflower; Soya beans; Groundnuts)

4.2.7.1 Introduction

This section presents the comparative advantage results for sunflower, soya beans and groundnuts as the main oilseed crops produced in Zambia. Oilseeds are an obvious focus for growth since, in a normal year, Zambia imports about 67% of its edible oil requirement but could become self-sufficient in this commodity. Most edible oil imports are as crude oil which is refined locally, although South African and other imported cooking oils are normally available in most shops. It is estimated that Zambia's annual per capita consumption of edible oil is six liters whereas the annual average consumption for the entire SADC region has been estimated at seven liters per person.

There are, however, a number of important constraints to increased oilseed production. Chief among these are limited rural processing capacity and, until recently, lack of liquidity in the largely parastatal processing sector. Processing in the rural areas is limited to a small number of hand-operated ram and screw presses of limited capacity (about ten liters per day) and a very few small-scale mechanical expellers. The total capacity of all these units is less than 4,500 metric tons of oil per year so that most of the rural population cannot realize the immediate benefits of an oilseed crop through on-site processing. Instead, the crops must be transported to urban processing units where problems of liquidity and management have restricted uptake and prevented a profitable price being paid to the grower.

Recently, as part of Zambia's privatization program, the situation has begun to change, since all parastatal processing companies have been sold to private companies. Indications are that this should allow much greater uptake of oilseeds and much higher prices to be offered to producers. In this respect, one company has already

begun to experiment with an outgrower program for sunflower through the provision of hybrid seed and other inputs on loan to smallholder farmers. Although these are indeed very positive steps, competition from cheap imported palm oil will continue to be a problem and may restrict development.

4.2.7.2 Sunflower

Sunflower is grown mainly by small-scale farmers (57%) and emergent farmers (30%). Only about 13 metric tons out of an average crop of 30,000 metric tons are produced by the commercial sector. Sunflower is not fastidious as to soil requirements and is an efficient user of soil nutrients. It will produce some yield even under the harshest conditions and is noted for its drought resistant characteristics during vegetable growth.

Nevertheless, sunflower yields in Zambia are very low, with many producers achieving less than half a ton per hectare. Reasons for this lie in the historic lack of a responsive market and the fact that sunflower is not a staple food crop. This means that sunflower is generally planted after food crops such as maize, sorghum, and cassava, which are grown on more fertile soils, weeded thoroughly and fertilized first when possible. A 1987 Baseline Survey on Crop and Livestock Production for the Strategic Extension Program in Southern Province noted that most sunflower is planted at least one month too late for optimum yields, that less than 10% of all sunflower crops are weeded even once and that less than 5% receive any fertilizer. Additionally, only 10% of the crop is planted to improved varieties of seed.[22] The potential for improved yield is therefore considerable. The use of improved seed has been shown to increase yield by around 20% while oil content can be raised by 20% - 40%. Similarly, weeding can increase yields by between 30% and 75% if carried out effectively and on time.

Quantitative analysis of sunflower was carried out for both small-scale and emergent farmers in Eastern Province (Katete) and Southern Province (Choma). Results are given below.

On the whole, these data show that sunflower makes efficient use of Zambia's domestic resources but that the private profits for farmers are very poor. Indeed, the DRC scores are all very good at a range of just 0.26 to 0.46 and show that Zambia enjoys a strong comparative advantage in this oilseed activity. At the average level, small-scale producers are somewhat more efficient than emergent farmers are but the situation is reversed when potential yields are achieved where emergent production becomes the most efficient. Interestingly, the DRC for small-scale farmers in Katete actually increases at the potential level indicating that the use of additional inputs

Table 4.8. Comparative Advantage Indicators for Sunflower

	DRC	Net Profit (US$/ha)	Variable Costs (US$/ha)	GM/VC Ratio	Days Worked	Labor as % of Variable Costs	Change in Yield to Gross Margin=0
CHOMA — Southern Province (ZONE II) (Low Rainfall)							
Small-scale							
Average	0.32	32.25	33.64	0.96	40	56%	-51%
Potential	0.29	80.05	84.66	0.95	45	25%	-51%
Emergent							
Average	0.46	25.47	53.21	0.55	40	35%	-36%
Potential	0.26	90.87	103.10	0.92	45	21%	-48%
KATETE — Eastern Province (ZONE II) (Moderate Rainfall)							
Small-scale							
Average	0.30	36.95	28.93	1.28	40	49%	-58%
Potential	0.37	82.45	82.25	1.00	45	19%	-52%
Emergent							
Average	0.46	30.17	48.50	0.70	40	29%	-42%
Potential	0.29	93.27	100.70	0.96	45	16%	-49%

Note: *DRC calculations based on Zimbabwe import parity (sunflower seed).*

(mainly fertilizer) cannot be justified from the social perspective in this case. Regionally, the differences between DRC scores are not significant where production in both Zones I and II appear to make very similar use of domestic resources. Table 4.8 gives comparative advantage indicators for sunflower. From the financial perspective, however, the data show that farmer profits are very poor, especially with current average management. At this level, the crop returns only about US$25/ha to US$37/ha (ZK21,250 - ZK31,450) which is less than for almost every other activity. With potential management, the profits from sunflower do improve significantly but are still less than for most other potential level scenarios. Importantly, sunflower is much more expensive to grow at this level of management so that these higher profits are likely to be beyond the reach of most poor farmers except where there is support from an outgrower program. Because sunflower uses very few purchased inputs (especially with average management) the NPCs and EPCs for this crop indicate only a very modest element of price transfer.

Taken together, these findings suggest that the prospects for increased sunflower production are mixed. The crop makes good use of Zambia's domestic resources but many other activities are significantly more profitable. Therefore, despite a potential for excellent returns to the expenditure on variable inputs and good protection from drought risks, it seem likely that sunflower will continue to remain a secondary activity on most farms.

4.2.7.3 Soya beans

Nearly 80% of Zambia's soya bean crop is produced by the commercial farm sector. Very little soya was grown by small-scale and emergent farmers until the introduction of the naturally nodulating varieties "Hernon 147" and *Magoye* in 1981. This removed the constraint of needing to keep the rhizobial inoculum at temperatures below 5°C before sowing which is beyond the capacity of most small-scale farmers. Once this constraint had been overcome, small-scale production increased, reaching a peak of 7,100 metric tons or 25.6% of total production in 1991. Approximately 40% of the total crop is grown on commercial farms under supplementary irrigation. The balance is produced under dryland conditions. All small-scale and emergent production is rain-fed.

Zambian soya is of above average quality. The protein content, particularly of the widely grown *Kaleya* variety, is substantially above the standard specification. This, however, is largely ignored by buyers who do not as yet pay any premium for Zambian soya. Fat levels are adequate and significantly higher than the Argentine soya with which Zambia must compete in regional markets.

Since liberalization of the oilseeds market in 1992, a regional demand for Zambian soya is becoming established. This is located primarily in Botswana and the Northern Transvaal which require in excess of 150,000 metric tons of imported soya annually. The extent of this market is determined by international market prices and by competition from Zimbabwe that is closer to these export destinations. Domestic marketing outlets for soya include use of the crop as (i) a high protein cake for stock feed; (ii) a high energy feed for livestock; (iii) a source of protein in corn-soya blends; (iv) a meat extender; and (v) a direct human food.

In recent years, Zambian farmers have exported soya placing the country in deficit and forcing themselves and other farmers to import soya cake at a price some 25% higher than the exported seed. This anomaly has been brought about by the severe liquidity crisis in the agricultural sector that has forced farmers to sell their crop for the best immediate price regardless of any expected future increase. Conversely, the processing industry has not been able to purchase more than its immediate requirements and has sourced those at as low a price as could be negotiated. In consequence, farmers have preferred to export seed rather than accept a depressed local price. Given increased processor liquidity resulting from the recent privatization of parastatal mills, the domestic market may be expected to improve and production levels should once again expand. Quantitative results from the analysis of soya grown in 1995/96 before privatization of the parastatal mills are given below. Table 4.9 gives the comparative advantage indictors for rain-fed and irrigated soya beans.

From the social perspective, the data show that soya beans make efficient use of domestic resources but that

many other crop options provide better economic returns. At a range of 0.50 to 0.78, average soya bean management is efficient but these scores do not compare favorably with those for most other activities including sunflower. With advancement to the potential level, however, soya bean DRCs improve to a more respectable range of 0.36 to 0.60. As discussed earlier, high transportation costs mean that the Mazabuka region is generally more efficient in the production of soya than either Mkushi or Chipata despite relatively poorer growing conditions. Both commercial and emergent farmers are more efficient than small-scale producers are and the rain-fed commercial crop makes marginally better use of domestic resources than the irrigated commercial crop.

Beyond the efficiency scores, the analysis also shows that soya provides farmers very small net returns. For small-scale producers, net profits range from break even

Table 4.9. Comparative Advantage Indictors for Rain-Fed and Irrigated Soybeans

	DRC	Net Profit (US$/ha)	Variable Costs (US$/ha)	GM/VC Ratio	Days Worked	Labor as % of Variable Costs	Change in Yield to Gross Margin=0
MAZABUKA — Southern Province (ZONE II) (Low Rainfall)							
Small-scale							
Average	0.78	0.00	114.26	0.00	80	33%	-0%
Potential	0.49	64.63	163.90	0.39	95	27%	-29%
Emergent							
Average	0.60	36.38	131.34	0.31	80	29%	-24%
Potential	0.46	91.68	178.88	0.53	95	25%	-35%
Commercial (rain-fed)							
Average	0.57	(130.56)	381.77	0.05	85	30%	-5%
Potential	0.36	8.20	414.40	0.38	90	29%	-28%
Commercial (irrig.)							
Average	0.50	(123.78)	420.74	0.30	85	27%	-24%
Potential	0.39	(33.65)	467.73	0.47	90	26%	-33%
CHIPATA — Eastern Province (ZONE II) (Moderate Rainfall)							
Small-scale							
Average	0.72	7.31	106.30	0.07	80	27%	-7%
Potential	0.60	28.56	160.79	0.18	95	21%	-16%
Emergent							
Average	0.65	23.71	124.10	0.22	80	23%	-18%
Potential	0.56	47.78	175.77	0.29	95	19%	-23%
MKUSHI — Central Province (ZONE III)							
Small-scale							
Average	0.71	17.49	115.71	0.15	80	33%	-14%
Potential	0.57	54.07	167.93	0.32	95	27%	-25%
Emergent							
Average	0.62	42.43	131.50	0.35	80	29%	-26%
Potential	0.53	79.81	182.91	0.46	95	24%	-32%
Commercial (rain-fed)							
Average	0.55	(93.75)	389.03	0.14	85	30%	-13%
Potential	0.44	(14.17)	420.45	0.32	90	29%	-25%
Commercial (irrig.)							
Average	0.61	(143.48)	424.77	0.25	85	27%	-21%
Potential	0.48	(61.30)	475.80	0.40	90	25%	-29%

Note: *DRC calculations based on export to South Africa.*

Table 4.10. Comparative Advantage Indicators for Groundnuts							
	DRC	Net Profit (US$/ha)	Variable Costs (US$/ha)	GM/VC Ratio	Days Worked	Labor as % of Variable Costs	Change in Yield to Gross Margin=0
Small-scale							
Average	0.50	67.98	110.48	0.62	100	32%	-39%
Potential	0.38	271.55	286.14	0.95	140	17%	-49%
Emergent							
Average	0.53	72.26	147.14	0.52	120	29%	-34%
Potential	0.36	344.08	321.48	1.08	160	18%	-52%

Note: *Both small-scale and emergent farm systems are analyzed for Chipata (EP) — Zone II (Moderate Rainfall). DRC calculations based on Lusaka f.o.b. price (export to South Africa).*

(zero net profit) to just US$64.63/ha (ZK55 thousand) depending on location and yield. In every instance, these profits are less than those from sunflower. For emergent farmers, the profits from soya are somewhat better and range from US$23.71/ha to US$91.68 (ZK20 thousand and ZK78 thousand). For commercial farmers, however, the cultivation of soya beans appears to be a very unprofitable activity. In all circumstances, except for rainfed production at the potential level in Southern Province, farmers actually lose money from this crop.

There are two important reasons for these commercial farm losses. First, commercial soya systems are subject to strong net policy transfers (negative L). These are in excess of US$176/ha (ZK150 thousand) in every instance due partly to the heavy reliance on imported machinery and other taxable inputs. Accordingly, irrigated soya systems are subject to greater price distortion than non-irrigated systems.

The second important reason for these losses is that a farmer's fixed investment costs must be subtracted from the gross margin to determine the overall profitability of each activity. For non-irrigated and irrigated commercial soya, these fixed costs have been estimated at US$148.72/ha and US$251.51/ha respectively (ZK126 thousand and ZK214 thousand). This means that a farmer may enjoy a positive gross margin, as is the case with all soya activities, but that the net income becomes negative once the costs of long-term fixed investments are accounted for. Because soya is an important rotation crop with both maize and wheat which (which is a highly profitable winter crop), it is not necessarily bad business sense to continue with soya production in summer. Since irrigation equipment is often shared throughout the year between crops, soya therefore plays an important role by helping to offset the depreciation costs of a farmer's fixed investments.

4.2.7.4 Groundnuts

Groundnuts are a crop of major importance in most parts of the country and are mainly grown by traditional farmers for home consumption with surpluses sold on the local market. Although insignificant quantities are currently used for oil extraction, groundnuts are the most important source of protein in rural diets. Women traditionally grow them for this purpose and to provide small cash income. Only in Eastern Province are groundnuts grown primarily as a cash crop where the variety *Chalimbana* is sold both locally and for export as a confectionery nut. It is the production of these confectionery nuts in which this paper is mainly interested.

In view of the informal nature of groundnut production, truly accurate figures as to production capacity and yield are not available. As a rough estimate, however, yields are figured to be around 350kg/ha with total national production varying between 20,000 and 40,000 metric tons. Less than 40% of this product reaches the market. Production of confectionery varieties is concentrated in the Eastern Province, which produces over 90% of the national output. Oilseed varieties are grown elsewhere, particularly in the lower rainfall areas. Imported seeds and fertilizer are seldom used for reasons of finance and availability; 80% of seed used is retained from the previous year's crop. Low productivity is attributed to high labor requirements and the restricted availability of improved seed.

Marketing of groundnuts is not well organized. No premium is paid for Zambian nuts, which have good market potential and were once regularly exported to Europe. Discontinuous supplies and poor quality control (especially with regard to aflatoxin) led to the collapse of this market. Nevertheless considerable potential exists for the development of new exports if a proper infrastructure for collection and marketing could be put in place.

Quantitative results from the analysis of *chalimbana* groundnuts grown near Chipata in Eastern Province (Zone II) are given in Table 4.10. Taken together, the above data show that groundnuts make very efficient use of Zambia's domestic resources and that the crop offers a potential for good producer profits. This is especially true at the potential level of output where the DRC, net profit and return to variable cost indicators are all much better than with current average management. Importantly, however, production is also much more expensive at this level due to the use of certified seed and some fertilizers so that it may be more difficult for poor farmers to use the potential technologies compared with other possible farm activities. At the average level, net profits are better than those for sunflower and soya beans but are still very low and do not compare favorably with the returns from other cash crops including cotton and burley tobacco. Both average and potential groundnut models are subject to very small net policy transfers and the EPCs for all systems at both levels of output equal just (0.04).

Finally, it should be noted that one important advantage of groundnuts is that this is a substantially easier crop to grow than many other cash crops (apart from sunflower). Groundnuts may also be eaten when marketing problems arise and therefore provide greater protection from marketing risks and food security benefits. Efforts to facilitate the use of improved seeds and fertilizer, however, appear to be important before this crop's full potential can be realized.

4.3 CASH CROPS

4.3.1 General Aspects

This section presents the detailed comparative advantage results for a selection of important traditional cash crops. Overall, these activities offer some of the greatest potential for increased volume and improved profitability. However, because success depends on farmers having fair access to reliable markets, cash crop production is generally more risky for small-scale and emergent farmers than cultivation of food crops.

Low yields and poor quality standards have been common problems associated with small-scale and emergent cash crop production. This situation has mainly resulted from the use of poor quality home-saved seeds, late planting, and inadequate fertilizer use. As a consequence, Zambia has lacked both the quantities and the consistency of quality necessary to develop and maintain viable export markets for most traditional cash crops. These problems do not apply to commercial production of sugar cane where very low field and factory costs by world standards have allowed Zambia to successfully penetrate both regional and European export markets.

Since liberalization of the maize market, the relative profitability of traditional cash crops has increased. The shift away from maize has been a conscious policy, based on the realization that subsidies and pan-territorial maize prices were unsustainable and causing uneven agricultural development. The corollary of such a shift is that farmers in remote rural areas have had to develop new crops (or expand traditional crop production into new markets) if they were to maintain the same living standards. In parts of Eastern, Northwestern, and Western Provinces this may be seen by the fact that many farmers have become increasingly reliant on crops like groundnuts, cotton and tobacco for a cash income.

For these reasons, the development of rural market facilities is an important prerequisite for the growth

Table 4.11. Comparative Advantage Indicators for Rain-Fed & Irrigated Cotton								
	DRC Import Parity	Export Parity	Net Profit (US$/ha)	Variable Costs (US$/ha)	GM/VC Ratio	Days Worked	Labor as % of Variable Costs	Change in Yield to Gross Margin=0
RAIN-FED COTTON								
MUMBWA — Central Province (Zone II) (Moderate Rainfall)								
Small-scale								
Average	0.10	0.24	145.28	84.51	1.78	125	70%	-64%
Potential	0.09	0.14	441.59	117.61	3.80	150	60%	-79%
Emergent								
Average	0.18	0.26	174.03	146.20	1.25	125	40%	-56%
Potential	0.10	0.15	503.23	193.48	2.65	150	36%	-73%
IRRIGATED COTTON								
MAZABUKA — Southern Province (Zone II) (Low Rainfall)								
Commercial								
Average	0.16	0.24	237.14	687.82	0.71	212	34%	-42%
Potential	0.13	0.19	623.35	772.21	1.13	240	34%	-58%

Note: *Parity calculations based on Liverpool reference price.*

of traditional cash crop activities and Zambian agriculture more generally. Specific interventions that could help promote the effective production of cash crops include the development of reliable input supply services and product collection facilities. Some privately operated outgrower schemes have recently begun to provide these services.

4.3.2 Cotton

For many years, cotton had been the almost exclusive domain of small-scale and emergent farmers. Prior to economic liberalization, cotton was marketed exclusively through the parastatal company, LINTCO, which was only privatized recently with its sale to Lonrho. Prior to privatization, the prices paid by LINTCO to growers were not attractive and most commercial farmers switched to other crops. Traditional farmers, who relied upon the input credit supplied by LINTCO, continued production that fluctuated between 25,000 and 80,000 metric tons of seed cotton per year. Although the Zambian climate is ideal for cotton growing, average yields on small-scale and emergent farms are low at around 600kg/ha, mainly as a result of poor management.

Since the privatization of LINTCO, a number of independent outgrower schemes have developed including those operated by Lonrho Cotton, Swarp Spinning, and Clarks. Increased world market prices have allowed these schemes to offer more attractive prices than the old LINTCO program while scheme managers have also developed improved mechanisms to ensure loan recovery. In addition to the crucial role these programs play in supporting small-scale and emergent growers, many commercial farmers have also been attracted back into cotton with the result that this sector now accounts for about 20% of total national output.

Zambian cotton falls into two categories. First category is the rain-fed cotton grown mainly by small-scale and emergent farmers. The short staple local variety these farmers produce is used for making rough cotton fabrics and for blending with longer staples in finer goods. Second category is the irrigated cotton grown exclusively by the commercial sector. This is of medium staple and is grown from imported varieties. Commercial cotton is capable of producing fine cotton fabrics and could be used to form the basis of a textile industry comparable with that of Zimbabwe.

Cotton production both at the small-scale and commercial levels is comparatively input- and management-intensive. Final yields are dependent upon good pest and weed control. This may require as many as five (small-scale/emergent) or ten (commercial) chemical applications to be effective. As a

consequence of the limited liquidity in Zambian agriculture, input costs are a constraint to increased cotton production. Credit schemes such as those managed by Lonrho and Swarp Spinning, which finance all or part of the input costs, have contributed significantly to recent increases in production. Given that the ginning capacity within Zambia is in excess of 100,000 tons of seed cotton per year, there is considerable scope for increased production to meet a growing world demand.

The quantitative comparative advantage indicators are presented above. Because Zambia produces a surplus of lint in some years and a deficit in others, both export and import parity conditions have been analyzed. Table 4.11 shows the comparative advantage indicators for rain-fed and irrigated cotton.

The results shown above are extremely favorable and indicate that cotton is a very promising activity for Zambia. Indeed, despite very low yields, cotton is one of the most efficient cash crops analyzed where the highest DRC is just 0.26 and the lowest score is an outstanding 0.09. Production is slightly more efficient when cotton is grown as an import substitute than as an export, although the results for both possible trade scenarios are excellent and show that Zambia has much to gain from production of this crop.

Another important advantage of cotton is that this crop provides farmers good financial returns. This is especially true at the potential levels of output where the profits for small-scale farmers improve by almost US$300/ha (ZK255 thousand) and variable costs only increase by US$33/ha (ZK28 thousand). Similarly, emergent farmer profits improve by roughly US$330/ha (ZK280 thousand) and commercial farm profits improve by US$386/ha (ZK328 thousand) at the potential levels of output while variable costs only increase by US$47/ha and US$84/ha (ZK40 thousand and ZK71 thousand) for the two sectors, respectively. These profits make cotton the second most profitable major crop activity for small-scale and emergent farmers at both levels of output, behind only burley tobacco. Onion and sugar beans also offer a potential for outstanding producer profits but are normally grown on very small plots so that the total income enjoyed by farmers is normally less than from cotton. On commercial farms, many other activities, including Virginia tobacco, coffee, wheat, and paprika all offer greater profits than cotton but are generally much more expensive to produce.

Net policy transfers (negative L) away from small-scale and emergent systems are relatively small and do not exceed 11% of total net profits. For commercial systems, however, the total transfer equals nearly 67% of total farm profit. For small-scale and emergent farmers, the output transfer (I) is larger than either the tradable input transfer (J) or the domestic factor transfer (K), indicating that most policy distortions occur subsequent to farm production and are associated with the transportation and ginning of seed cotton. For commercial production systems, J and K are considerably larger than I, indicating the majority of policy distortions occur during on-farm production. Most of these transfers are due to taxes on agricultural chemicals, imported machinery, fuel and irrigation equipment. Labor and capital market distortions also undermine the profitability of commercial cotton production in Zambia.

4.3.3 Burley & Virginia Tobacco

At independence, Zambia was the foremost producer of tobacco in the region. Since then, the industry has suffered a continual decline to the point where the country now produces less than one percent of the tobacco volume grown in Zimbabwe. This decline can be largely attributed to the nationalization of the tobacco marketing body that offered producers unattractive prices and drove many farmers away from this crop. Zambia's climate is, however, ideal for the production of both burley and Virginia tobacco, particularly in Southern and Eastern Provinces. Commercial farmers grow the bulk of Virginia tobacco to the west of the Luangwa River; small-scale and emergent farmers in Eastern Province grow most of the burley tobacco.

All Virginia tobacco is currently exported by the Tobacco Association of Zambia (TAZ), who recently acquired the privatized Tobacco Board. TAZ also exports a portion of Zambia's burley crop. The volumes currently traded by TAZ are, however, too small to interest international buyers to a regular auction floor, and growers only receive a price from a single buyer. This price is based on the quality of

their produce and the prices currently on offer at the Zimbabwe tobacco floor. The portion of the burley crop not handled by TAZ is marketed in a much less controlled fashion. Although the burley industry is served by its own association, this group is not well organized and has often been manipulated by buyers. As a result, burley growers have not been able to achieve the same margins as Virginia growers or been able to increase production in the same way. Most small-scale and emergent burley farmers are deeply in debt.

As an export crop, tobacco has been able to access finance for inputs in foreign exchange through a facility put in place by the European Union. This has provided a considerable incentive for increased production and allowed Virginia tobacco growers to avoid the problems associated with high interest rates and a weakening currency. Burley farmers have not been able to access this credit. Although world tobacco prices continue to fluctuate, this crop offers considerable potential, particularly for smaller scale farmers where, with careful management, tobacco can return exceptionally good net profits. This potential can be achieved if growers receive fair access to credit and support from outgrower schemes such as that put in place by the Tobacco Association. Quantitative results from the analysis of small-scale and emergent burley tobacco and commercially produced Virginia tobacco are given in Table 4.12.

Most clearly, data in Table 4.12 reveal that both burley and Virginia tobacco make very efficient use of Zambia's domestic resources where there are only small differences between the DRC scores for each sector and production level. Burley tobacco does appear slightly more efficient than the commercial Virginia tobacco crop but the differences are not significant and both activities offer a potential for excellent social returns.

From the private perspective, burley tobacco is one of the most profitable small-scale and emergent activities analyzed. This is especially true at the potential levels of output where net profits are substantially higher than with current average management. Importantly, however, the data also show that burley tobacco is a very expensive activity and so may not be feasible for most poor farmers except where there is access to credit facilities or some other form of input support. This point is made especially relevant when one considers that family labor only accounts for about 27% to 37% of small-scale and emergent production costs, indicating that a large cash expenditure is required for this activity. For commercial farmers, net profits are also much better with potential management due to improvements in both quality

Table 4.12. Comparative Advantage Indicators for Burley & Virginia Tobacco

	DRC	Net Profit (US$/ha)	Variable Costs (US$/ha)	GM/VC Ratio	Days Worked	Labor as % of Variable Costs	Change in Yield to Gross Margin=0
BURLEY TOBACCO							
CHIPATA — Eastern Province (Zone II) (Medium Rainfall)							
Small-scale							
Average	0.30	558.97	529.92	1.07	550	37%	-55%
Potential	0.24	935.42	700.68	1.34	600	30%	-61%
Emergent							
Average	0.34	612.64	746.18	0.83	600	28%	-48%
Potential	0.23	1,200.00	842.83	1.43	650	27%	-62%
VIRGINIA TOBACCO							
CHOMA — Southern Province (Zone II) (Low Rainfall)							
Commercial							
Average	0.43	159.85	1,723.10	0.23	775	44%	-19%
Potential	0.29	914.40	1,782.15	0.64	800	43%	-41%

Notes: *DRC calculations based on auction floor export parity.*

and yield. Importantly, for all farm sectors, net profits increase by much more at the potential level than variable costs so that improved management appears to make excellent financial sense for those that can afford this level of expenditure.

These very good net profit results are despite large net policy transfers (negative L) away from small-scale, emergent, and commercial production systems. For small-scale and emergent farmers the transfers amount to a maximum of US$92.72/ha and US$112.67/ha (ZK79 thousand and ZK96 thousand) respectively. For commercial farmers the maximum transfer is equivalent to US$669.31/ha (ZK569 thousand). These relatively large transfers are due to the fact that burley and Virginia tobacco both make very intensive use of agricultural chemicals and other taxed inputs. For commercial farmers, the casual labor minimum wage and finance charges are other important sources of price distortion.

4.3.4 Sugar Cane

The sugar cane industry in Zambia is favored by ideal climatic conditions that prevail in certain localized areas. These locations are among the northernmost areas suited to sugar production in Southern Africa and included the Kafue Flats, Zambezi Valley, Luangwa Valley and the Bangweulu Swamps. All of these locations enjoy a virtual frost-free winter, more than 2,800 hours of sunshine per year, and a mean summer temperature of 25°C. Due to the long dry winter, all cane in Zambia is grown under irrigation. In practice, this effectively restricts production to the Kafue Flats which is the only cane-suited area with adequate infrastructure. A new investment project is now being implemented on a pilot basis to develop cane production (albeit on a fairly small scale) in the Luena area near Kawambwa.

The Zambia Sugar Company (ZSC) dominates sugar production in Zambia at Nakambala on the Kafue Flats near Mazabuka. Zambia Sugar was until recently a parastatal company but has now been effectively privatized with the purchase of 51% of shares by Tate and Lyle and another 30% by the Commonwealth Development Corporation (CDC). ZSC not only grows and processes cane but also packages refined sugar and other finished products including molasses and jams for the domestic and export markets.

Cane production is centered on the Zambia Sugar Company Estate of 10,429 hectares near Mazabuka. Cane is also supplied to ZSC by commercial farmers (933 hectares) and through a local outgrowers scheme (1,889 hectares). These are all located within about 20 km of the company's processing plant since it is not economic to transport raw cane further than this distance. There is currently no other cane crushing facility in Zambia.

As a result of very high yields, per unit costs of production are extremely low and Zambian sugar is able to compete very effectively in both regional and world markets. One study found that Zambia's field costs of production are the fourth lowest out of 62 sugar cane, producing countries. Combined with factory costs, Zambia was shown to be the world's fifth least expensive producer of refined sugar.[23]

Sugar is Zambia's leading agricultural export and earned more than US$24 million in foreign revenue in 1995. In 1994/95, out of a total 145,000 metric tons of refined sugar produced, 78,000 tons were consumed locally and 67,000 tons were exported.[24] Much of this sugar is sold to African countries north of Zambia, which do not enjoy the climatic conditions required for sugar production. ZSC also enjoys a lucrative export quota into

Table 4.13. Comparative Advantage Indicators for Irrigated Sugar Cane

	DRC	Net Profit (US$/ha)	Variable Costs (US$/ha)	GM/VC Ratio	Days Worked	Labor as % of Variable Costs	Change in Yield to Gross Margin=0
Southern Province							
Average	0.32	478.29	2,204.18	0.36	171	13%	-26%
Potential	0.30	652.49	2,707.62	0.36	193	12%	-26%

Note: *Production analyzed for Mazabuka (Zone I); DRC calculations based on regional export parity.*

the European Union market. Both of these market opportunities make it economic to export as much sugar as possible while simultaneously importing sugar from countries further south to make up for any local deficit.

Quantitative results for sugar cane produced by commercial outgrowers adjacent to the Nakambala Estate are given in Table 4.13.

From the social perspective, the DRC results show that sugar cane is a very efficient activity where the scores of 0.32 and 0.30 compare favorably with those for most other commercial farm activities. Notably, however, the results are very similar for both levels of output so that there are only nominal efficiency gains from improved production in this case. The net profits from sugar cane are also very good despite relatively high production costs. With potential management, net profits improve by almost 36% to a very good US$652.49/ha (ZK554 thousand) compared with average output and the rate of return to the expenditure on variable inputs remains undiminished. These good net returns are despite very strong net policy transfers away from commercial sugar cane (negative L) in excess of US$1,183/ha at the average level of output and US$1,436 at the potential (ZK1 million and ZK1.22 million). These distortions are due mainly to taxes on imported irrigation equipment, farm machinery, and agricultural chemicals. As a labor intensive crop with relatively high variable costs, capital and labor market distortions are also important sources of these policy transfers. If these policy transfers were reduced or eliminated, sugar cane could be significantly more profitable.

4.3.5 Irish Potatoes

Potatoes are an important part of many diets, especially in urban areas where there is good demand from the middle classes and expatriate residents. Commercial farmers produce most potatoes under irrigation although some rain-fed production by small-scale and emergent growers also takes place. Since the early 1990s, potato prices have been falling due both to increased domestic production and competition with imports from Zimbabwe and South Africa. In 1994/95, for example, a 10kg pocket of potatoes sold for about US$5 whereas the price has now dropped to about US$3.50 per pocket. Results from the quantitative analysis of potatoes grown in 1995/96 based on a price of US$4.30/pocket are given in Table 4.14 for average level producers in both Mazabuka (Zone I) and Mkushi (Zone III).

Taken together, these data show that commercial farmers enjoy a distinct comparative advantage over small-scale and emergent growers in the production of Irish potatoes. This is true from both the private and social perspectives where the net profit and DRC scores for commercial growers are clearly much better compared with those for the small-scale and emergent sectors.

Although all DRCs are less than one, indicating that each sector is socially efficient, the results for

Table 4.14. Comparative Advantage Indicators for Irish Potato

	DRC	Net Profit (US$/ha)	Variable Costs (US$/ha)	GM/VC Ratio	Days Worked	Labor as % of Variable Costs	Change in Yield to Gross Margin=0
MAZABUKA — Southern Province (ZONE II) (Low Rainfall)							
Small-scale	0.87	(102.10)	2,249.16	(0.05)	264	6%	+5%
Emergent	0.78	102.77	2,470.03	0.04	240	5%	-4%
Commercial (irrig.)	0.45	2,334.94	5,142.97	0.50	205	5%	-34%
MKUSHI — Central Province (ZONE III)							
Small-scale	0.76	(17.90)	2,253.19	(0.01)	264	6%	+1%
Emergent	0.69	198.57	2,480.11	0.08	240	5%	-8%
Commercial (irrig.)	0.40	2,614.28	5,181.27	0.55	205	5%	-36%

Note: *DRC calculations based on Zimbabwe import parity; Mazabuka potatoes sold to Lusaka; Mkushi potatoes sold to Ndola.*

commercial farmers are clearly much better compared with all other potato scores and show that these farmers make considerably better use of Zambia's domestic resources. Production in Mkushi appears slightly more efficient than in Mazabuka due to the higher cost of landing imported potatoes in the Copperbelt compared with Lusaka. From the financial perspective, the superiority of commercial production is even clearer where the profits from potatoes are greater than for every other activity analyzed except roses, coffee, and poultry. Indeed, small-scale farmers appear to lose money from this crop and the returns for emergent growers are less than for many other activities.

Importantly, the data below also show that potatoes are an extremely expensive crop to grow. For small-scale and emergent farmers, a minimum expenditure of at least US$2,000/ha (ZK1.7 million) is required so that most farmers cannot afford this crop except on an extremely small-scale. For commercial farmers, the required expenditure for Irish potatoes is estimated at more than US$5,000/ha (ZK4.25 million) which is considerably more than for many other high value crops including Virginia tobacco, cotton and coffee. The main reason for these very high production costs is the price of seed which may account for as much as 73% of total variable costs for small-scale and emergent farmers and up to 50% of total costs for the commercial sector. On commercial farms, fertilizer and irrigation costs are also big budget items.

Despite these very high costs, potato systems are subject to only relatively minor price distortions where the NPCs and EPCs for this crop only range from (0.01) to (0.06). Partly, this is because potato seed, while expensive, is not subject to tax. As with other crops, commercial farm systems are subject to the greater price transfers than small-scale and emergent systems due to the increased use of agricultural chemicals, diesel fuel, electricity, and other such inputs.

4.3.6 Onion

Onions are an essential part of most Zambian diets and are widely prepared as relish in both rural and urban areas. Most production by small-scale and emergent farmers, however, is for home consumption and only about 85 hectares were grown by the commercial sector in 1995/96. Onion prices vary greatly by quality and change over the course of each season. Generally, prices peak around May and are at their lowest between September and October. Because of these price fluctuations, total output varies greatly from season to season as farmers are attracted to this crop in some years and discouraged in others. Quantitative results from the analysis of small-scale and emergent onion production based near Mazabuka (Zone II, low rainfall) and Lusaka (Zone II, medium rainfall) are given in Table 4.15.

Clearly, the indicators show that onions make very efficient use of domestic resources and that the crop offers a potential for very good farm profits. In fact, at a range of just 0.16 to 0.19, the DRC scores for onion are among the very best for the small-scale and emergent sectors and compare favorably with most other activities. The net profit results are also very good and show that onion can be very rewarding where the financial returns are better than for many other crops including cotton, groundnuts, maize and, in some

Table 4.15. Comparative Advantage Indicators for Onion

	DRC	Net Profit (US$/ha)	Variable Costs (US$/ha)	GM/VC Ratio	Days Worked	Labor as % of Variable Costs	Change in Yield to Gross Margin=0
MAZABUKA — Southern Province (ZONE II, Low Rainfall)							
Small-scale	0.19	464.35	720.94	0.64	225	15%	-41%
Emergent	0.17	612.20	842.95	0.73	250	14%	-43%
LUSAKA— Lusaka Province (ZONE II, medium rainfall)							
Small-scale	0.18	579.06	720.94	0.80	225	15%	-46%
Emergent	0.16	753.37	842.95	0.90	250	14%	-48%

Note: *DRC calculations based on Zimbabwe import parity.*

circumstances, even burley tobacco. Variable costs, however, are also high at an estimated US$721/ha and US$843/ha (ZK613 thousand and ZK717 thousand) for small-scale and emergent farmers respectively so that this crop may not be a practical option for many poor households. Net profits are a little more than US$100/ha (ZK85 thousand) better for farmers near Lusaka than in Mazabuka due to lower transportation costs and higher farmgate prices. Because onions are normally grown on very small plots, however, the actual returns enjoyed by farmers will, in most cases, be considerably less than shown above. EPCs for small-scale and emergent onion systems range from just (0.01) to (0.03) and indicate only a very modest element of price transfer.

4.3.7 Sugar Beans

Sugar beans, like onion, are commonly prepared as relish to accompany the staple food *nshima*. As with all legumes, one important advantage of sugar beans is that the crop is nitrogen fixing and so helps reduce the need for a cash expenditure on expensive inorganic fertilizers. Sugar beans enjoy especially good demand in urban and town centers where the crop may be easily sold for cash. Unlike other cash crops, however, sugar beans may be eaten when marketing problems arise and so generally involve less risk than cotton, tobacco and paprika. Quantitative analysis of sugar beans grown near Chipata (Zone II) and Solwezi (Zone III) are given in Table 4.16. Because oxen are rarely used for cultivation in the Solwezi area, production in this location is analyzed for the small-scale (hand hoe) sector only.

As with onion analyzed below, the results for sugar beans are very good where the DRC scores are excellent at a range of just 0.16 - 0.20 and net profits are also very attractive. Importantly, compared with onion, sugar beans are significantly less expensive to produce and so may be much easier to afford. Although this crop still costs more than average level maize, the returns to variable costs are extremely good as indicated by the excellent gross margin/variable cost ratios. Again, sugar beans may be eaten when marketing problems arise so that this crop involves less food security risks than many other cash crops. With a possible yield loss of 66% to 70% before all financial profits would be lost, sugar beans provide good protection from drought risks. NPCs and EPCs are never worse than (0.02) and this crop is subject only to very minor price transfers.

4.3.8 Non-traditional Export Crops

4.3.8.1 Introduction

A number of non-traditional export crops including coffee, roses, and paprika have been developed in Zambia with varying degrees of success. In general, this development has been concentrated in the commercial sector, although both paprika and coffee are

Table 4.16. Comparative Advantage Indicators for Sugar Beans

	DRC	Net Profit (US$/ha)	Variable Costs (US$/ha)	GM/VC Ratio	Days Worked	Labor as % of Variable Costs	Change in Yield to Gross Margin=0
CHIPATA — Eastern Province (ZONE II, Medium Rainfall)							
Small-scale							
Average	0.19	441.09	194.20	2.27	100	18%	-70%
Potential	0.18	518.32	244.04	2.12	120	17%	-69%
Emergent							
Average	0.20	481.02	221.19	2.19	100	16%	-69%
Potential	0.19	553.09	269.12	2.07	120	16%	-68%
SOLWEZI— Northwestern Province (ZONE III)							
Small-scale							
Average	0.17	388.15	194.20	2.00	100	18%	-67%
Potential	0.16	454.79	244.04	1.86	120	17%	-66%

Note: *DRC calculations based on Zimbabwe import parity.*

produced by a limited (but increasing) number of small growers and could be easily produced in large quantities through outgrower schemes.

The development of the non-traditional export sector was originally stimulated by the need to earn foreign exchange. With the liberalization of exchange controls, however, this need has been considerably reduced. Foreign exchange revenues are nevertheless still a significant advantage of this sector, particularly given the volatile rates of exchange for the Zambian Kwacha in recent years.

Growth of the non-traditional sector during the past six years has been considerable and in marked contrast to developments in other areas of agriculture. One of the main reasons for this has been the availability of finance, either through donor-supported schemes or through straightforward foreign exchange loans negotiated with commercial banks. In either case, the more constant and predictable revenues generated by a foreign exchange, as opposed to a Kwacha earning enterprise, have attracted farmers to this sector and contributed to very strong growth.

In every case, Zambia's non-traditional export crops enjoy country-specific advantages of climate and low labor costs. Thus roses grow particularly well during the Zambian summer, producing long stemmed blooms in profusion throughout the European winter when prices are high. Paprika is best suited to low altitudes where, at the prevailing higher temperatures, a high quality product can be attained with very good aster values. Zambian coffee is recognized to be of extremely high quality and has already moved into the gourmet market despite being produced in very small quantities.

4.3.8.2 Coffee

The Zambian Coffee industry has been enjoying a period of very high returns in recent years due to increased world demand and shortages caused by extensive frosts in the Southern Hemisphere that did not affect Zambia. Total Zambian output in 1995/96, however, was less than 1,500 tons with a gross value of roughly only about US$3.9 million. Areas well suited to coffee production include Mazabuka and Choma in Southern Province and the Mpongwe area in Copperbelt Province.

Importantly, Zambia enjoys a number advantages over other countries in the production of high quality coffee. First among these is the Zambian climate which is ideally suited to coffee, especially in the central and southern areas. Northern Province is another good area for coffee although very little development has so far taken place in this region. Second, the industry has been strictly regulated by the Coffee Board which permits only the growing of very high quality arabica varieties. Because a very high, uniform product standard has been consistently maintained, Zambian coffee regularly receives a premium of some 20% over comparable world prices. Thirdly, although Zambian coffee yields are low by world standards, production costs are also low. The extensive use of relatively inexpensive labor allows high quality standards to be maintained and ensures that Zambian coffee remains extremely competitive in the world market on a per unit cost basis.

Nearly all coffee in Zambia is currently grown on commercial farms although considerable potential exists for development within the emergent subsectors. This has been hindered by coffee's irrigation requirements that have prevented smaller farmers, who lack adequate finance to install irrigation facilities, from entering production.

Table 4.17. Comparative Advantage Indicators for Irrigated Coffee

	Export Parity (US$/mt)	DRC	Net Profit (US$/ha)	Variable Costs (US$/ha)	GM/VC Ratio	Days Worked	Labor as % of Variable Costs	Change in Yield to Gross Margin=0
Mazabuka								
1995 Price	3,703	0.08	7,189	1,358	5.72	250	22%	-85%
10yr. Avg. Price	2,035	0.16	3,080	1,358	2.69	250	22%	-70%
5yr. Avg. Price	1,572	0.23	1,830	1,358	1.77	250	22%	-64%

Table 4.18. Comparative Advantage Indicators for Irrigated Roses							
	DRC	Net Profit (US$/ha)	Variable Costs (US$/ha)	GM/VC Ratio	Days Worked	Labor as % of Variable Costs	Change in Yield to Gross Margin=0
Lusaka Average	0.13	88,045	49,864	2.13	7,200	17%	-68%

Note: *DRC calculation based on Dutch auction price (average US$0.33/stem for 1995).*

Three PAMs have been estimated for the analysis of coffee produced by commercial farmers near Mazabuka where many growers are concentrated. Since coffee is produced to very consistent standards across Zambia, all three models are based on an average yield (2.5mt/ha). Instead, the great variations in price to which coffee is prone is a more important determinant of comparative advantage so that, in this case, each model is based on a different price scenario. Specifically, the first PAM is based on the prevailing price in 1995 that was very high due to severe frosts in Brazil. The second coffee PAM is based on a short-term, five-year average price between 1989 and 1994. This is the lowest price analyzed and does not include a time when world prices were high due to Brazilian frost. The third PAM is based on a longer-term, ten-year average price and includes both a period of frost and a time when South American producers were fully on-line. Results are summarized in Table 4.17.

Importantly, the data below show that coffee production is extremely efficient at all price scenarios analyzed where individual DRC scores range from just 0.08 to 0.23 at the lowest five-year average price. These are among the best results of all activities analyzed and show that Zambia enjoys a strong comparative advantage in coffee production even when world prices are low. Variations in world price do, however, have a very serious impact on farm profitability. For the base 1995/96 season, when international coffee prices were very high, farmers were estimated to earn some US$7,198/ha (ZK6.11 million). When the long-term, ten-year average price is used for analysis, profits drop off by some 43% and at the lowest, five-year average price, profits are only equal to about US$1,830/ha (ZK1.55 million). Still, even at this lowest level, coffee remains a very profitable activity compared with other commercial crops and it is estimated that world prices could fall by a further 65% before the farmer's gross margin would equal zero.

Notably, coffee production is a labor intensive activity with an estimated requirement of 250 days work per hectare. Most of this labor is needed during harvest and coffee is an excellent seasonal employer of casual labor.[25] The total cost of labor is estimated to equal about 23% of variable costs.

The net policy transfer away from coffee (negative L) is large at US$341.21/ha (ZK290 thousand). Partly because coffee is a very a labor intensive activity, the domestic factor transfer (K) is significantly greater than either the output transfer (I) or tradable input transfer (J). Although large price variations may deter some farmers from engaging in coffee production, this crop appears a very promising activity for commercial farmers, not least because coffee is generally easier to produce and market than many other non-traditional agricultural exports.

4.3.8.3 Roses

Rose production has been one of the most successful areas of Zambian agriculture where total output has increased significantly over the past decade. In 1996, for example, some 60 hectares were under production compared with 44 hectares in 1995 and just 15 hectares in 1994. Over this period, the value of Zambia's rose sales increased steadily from US$0.3 million in 1987 to more than US$9.1 million in 1994 and US$18.3 million in 1996.

Zambia enjoys two fundamental advantages in rose production. First is inexpensive labor which is necessary for the growing, cutting, grading and packaging of blooms. Second is the Zambian climate which is well suited to quality rose production in the summer

Table 4.19. Comparative Advantage Indicators for Irrigated Paprika							
	DRC	Net Profit (US$/ha)	Variable Costs (US$/ha)	GM/VC Ratio	Days Worked	Labor as % of Variable Costs	Change in Yield to Gross Margin=0
Lusaka Average	0.25	930.41	1,419.26	0.83	425	31%	-46%

Note: *DRC calculation based on Spanish port (Cadiz) c.i.f. equivalent.*

months which coincide with the European winter. Although it is possible to grow roses during the Zambian winter, output is low and of poor quality so that the winter market is generally limited to South Africa. Very few growers target this market, preferring to rest their plants from April to October so as to produce a strong flush of long stemmed blooms from November through to March. In consequence, almost all Zambian roses are marketed on the auction floors of Holland. Zambian production comprises less than 2% of this market and shows no signs of declining. Prospects for future growth are, therefore, good despite recent depreciation of the Dutch guilder.

Zambian roses are all produced under polythene tunnels to protect the blooms from heavy rains and harsh sunlight. This method of production is capital intensive and high output is required to justify the investment. Zambia's floricultural industry was originally restricted by the availability of air freight to reach the European market. With the demise of the parastatal airline and the restrictive policies it imposed, this constraint has been removed. The current increase in volumes should also allow better airfreight rates to be negotiated. All production occurs within a radius of about 100km of Lusaka, which is the only city from where there are direct flights to Europe.

Rose growing and other horticultural export businesses have been greatly assisted by European finance, which has allowed the construction of a cold storage depot at the Lusaka International Airport. This has been fundamental to the success of a business in which logistics is a major concern. Production has also been stimulated by low interest foreign exchange loans made available by the European Union (EU), including a special "rose line of credit," for both investment finance and working capital. World Bank funds have also been made available to assist floriculture. Quantitative results for roses based on the 1995 export season are given in Table 4.18.

Most notably, the above data show rose production to be an extremely efficient activity where the DRC is just 0.13. Green-field start-up costs, however, are very high at an estimated US$0.5 million (ZK425 million) for a four-hectare project including green house construction, cold storage facilities, irrigation equipment, plant material and electrification. Therefore, with variable costs of nearly US$50 thousand/ha (ZK42.5 million), this activity is only suited to skilled entrepreneurs with access to large amounts of operating capital and equity needed to secure bank loans.

With an estimated annual labor requirement of 7,200 days per hectare, an important advantage of roses is that this crop is an extremely labor intensive activity. On a full-time basis, this translates into roughly 20 jobs per hectare. Nevertheless, labor only accounts for about 17% of total variable costs as other inputs, such as liquid fertilizers, agricultural chemicals and greenhouse maintenance, are also big budget items.

Although start-up and operation costs are high, these investments can provide very good returns where the annual net income is estimated at roughly US$88 thousand/ha (ZK74.8 million). Since many rose farms are only four hectares large, however, this figure makes little sense until it is compared to the overall profitability of alternative enterprises. Specifically, the total net profit from a typical four hectare rose operation is about US$352 thousand per year (ZK300 million). Total annual net profit from a 40-hectare coffee operation is between US$287 thousand and US$73 thousand (ZK243 million and ZK62 million) depending on world coffee prices. Similarly, the profits from 60 hectares of Virginia tobacco at the potential level

of output is estimated to be about US$55 thousand (ZK46.7 million). While these calculations show that other activities can provide very good incomes, those for roses are clearly superior. This potential for lucrative financial rewards may be expected to attract new investors and imply good potential for a limited number of skilled entrepreneurs.

4.3.8.4 Paprika

Paprika is a rapidly expanding export crop where total Zambian production in the mid-1990s stood at only about 150 tons per annum but has since increased to more than 700 tons. An important factor behind this growth has been the development of privately managed extension and marketing services by investors seeking to trade this commodity. The varieties currently grown in Zambia have been selected for quality and it may be possible to obtain a premium price in the future if high standards can be maintained.

The crop is grown for its pigment content and, until recently, was dried, de-seeded and exported in a baled form (similar to tobacco) for processing outside the country. Early in 1997, however, processing facilities in Lusaka were installed capable of handling 3,250 metric tons per year. This should allow value to be added locally and transport costs to be significantly reduced. The company that invested in these facilities also operates in Malawi and plans to transport paprika to Zambia for processing prior to export to Europe.

Although paprika provides lower returns than other non-traditional exports, it can be grown with less capital inputs than other crops in this category and is therefore potentially well suited to cultivation by small-scale and emergent farmers. Thus far, however, most production has been by the commercial sector since high yield results require irrigation and an intensive use of crop inputs. Paprika is well suited as a rotation crop with tobacco and has a very definite role to play in the process of crop diversification and export development. One PAM for the analysis of irrigated paprika grown near Lusaka has been estimated for this study. Results are given in Table 4.19.

Clearly, the results from this analysis are very good where the DRC of 0.25 indicates that Zambia enjoys a strong comparative advantage in paprika and the net profit results show this crop can be very rewarding financially. Compared with the other non-traditional export crops analyzed here, the results for paprika are less favorable but still very good in their own right, especially when compared with other traditional commercial crops including maize, cotton, soya beans and even Virginia tobacco. Paprika is the third most labor intensive activity analyzed requiring approximately 425 days of labor per hectare which is some 70% more than is needed for coffee. Since labor accounts for roughly 31% of paprika's variable costs, wage distortions are an important source of policy transfers away from this activity. Overall, the net policy transfer (negative L) is a little more than US$510/ha (ZK434 thousand) while the EPC equals (0.09) and indicates a moderate degree of distortion. As a commercially produced irrigated crop that makes heavy use of agricultural chemicals, taxes and import duties on these inputs also undermine farm profitability.

4.3.9 Livestock

4.3.9.1 Introduction

The Zambian livestock sector consists primarily of cattle (for both beef and dairy), poultry, and pigs. Small-scale producers, especially in the Southern Province, extensively keep goats, but the market for these is entirely informal and has not been quantified. A very few commercial farmers raise sheep but numbers are so small as to have no significant impact on the overall economy.

For the main livestock activities (cattle, poultry, and pigs), there are small-scale, emergent, and commercial producers operating at entirely different levels. In general, small-scale and emergent farmers are not able to maintain effective standards of disease control and livestock frequently suffer from ticks, swine fever, foot and mouth, and other diseases. The produce of these farmers cannot command commercial market prices as most is unable to measure up to the required standards of hygiene. Nevertheless, there is a substantial local market in many villages for poultry, pork, beef, and milk produced by these farmers. These rural markets can provide good cash incomes for livestock farmers but have not been well quantified.

Table 4.20. Comparative Advantage Indicators for Beef							
	DRC	Net Profit (US$/yr)	Variable Costs (US$/yr)	GM/VC Ratio	Days Worked (per herd per year)	Labor as % of Variable Costs	Change in Yield to Gross Margin=0
Mazabuka							
Small-scale	4.19	(2,767)	3,059	(0.90)	137	3%	+933%
Emergent	0.61	360	718	0.55	301	30%	-53%
Commercial - ranch	0.74	5,837	28,533	0.49	3,176	13%	-34%
Commercial - feedlot	0.75	494,230	1,606,971	0.34	16,536	1%	-28%

Notes: *DRC calculation based on regional export parity. All figures for a 12-month period (small-scale: 20 cattle w/ 60% mortality; emergent: 70 cattle with 1 death; commercial ranch: 200 breeding cow unit; commercial feedlot: 5,000 finished animals per year). Variable costs include mortality.*

By contrast, the majority of commercial producers are attempting to meet the necessary standards of disease control but with only varying degrees of success. Thus, while there is continued disease pressure upon commercial units from smaller farmers, it is possible to produce eggs, poultry, pork, beef and dairy products of a standard sufficient to meet local commercial market requirements, and in some cases, suitable even for export. This, however, is only achieved at considerable costs, which tend to offset the innate advantages of cheap grazing and extensive pastures enjoyed by the Zambian livestock sector.

The future prospects of all livestock activities are inextricably linked with the capacity of downstream processing facilities. The profitability and performance of each activity is highly dependent upon the efficiency with which the end product is processed and marketed. In every case, processing has until recently been almost exclusively controlled by parastatal organizations and has not been effectively managed. Although this scenario is slowly changing with the advent of the privatization program, the legacy of past mismanagement is still very obvious and has restricted the development and profitability of each livestock activity. Still, some progress, especially in the beef and dairy subsectors, may already be observed including improved profitability and increased throughput as a result of privatization.

4.3.9.2 Beef

There are three fundamental categories of cattle farmers in Zambia. First are the large-scale commercial farmers who produce good quality beef from ranching and feedlotting. Second are the smaller farmers who supply a substantial portion of the domestic market but produce a poorer quality product than commercial farmers. These farmers also provide many of the weaner animals used by commercial farmers for feedlotting. Finally, the third category is the traditional farmers who keep cattle mainly as a symbol of wealth and as a buffer against economic hardship. Although some of these animals will be sold commercially, most are slaughtered for home consumption or as part of wedding and funeral ceremonies. These cultural practices predominate especially in Southern Province. Zambia's national beef herd has declined by more than 50% since the early 1990s due to successive droughts.

Zambian beef has one inherent advantage, and another balancing disadvantage, compared to other countries. On the one hand, Zambian beef can be fed relatively cheaply from grazing at low stocking densities over large areas. Conversely, production costs are increased by the need for a continual veterinary input to combat the high level of endemic diseases in the country. As a result of these balancing factors, almost all Zambian beef is sold on the domestic market. This market is limited by the purchasing power of the average consumer and has been damaged in the past by the dumping of surplus beef by the European Union. If the beef industry is to expand, it must access wider markets by exporting.

There are potential export markets for Zambian beef in Europe, the Middle East, and Southern Africa. Whether these markets can be exploited depends on the extent to which endemic diseases such as foot and mouth and corridor disease can be controlled.

Table 4.21. Comparative Advantage Indicators for Dairy							
	DRC	Net Profit (US$/cow)	Variable Costs (US$/cow)	GM/VC Ratio	Days Worked	Labor as % of Variable Costs	Change in Yield to Gross Margin=0
1995/96 SEASON — Pre-Privatization							
Mazabuka							
Average	0.27	(180.91)	1,131.62	(0.01)	192	24%	+1%
Potential	0.27	19.34	1,340.78	0.15	192	20%	-13%
1996/97 SEASON — Post-Privatization							
Mazabuka							
Average	0.27	78.30	1,131.67	0.19	192	24%	-16%
Potential	0.27	360.84	1,337.13	0.37	192	21%	-27%

Note: *DRC calculations based on Zimbabwe import parity.*

Although Botswana has managed to export beef from the region to Europe, the standards required for entry of meat into the EU are such that it is not presently cost effective for Zambia to attempt to service this market. The Middle Eastern market would be much easier to penetrate but can be served more cost effectively by European and North African beef. These factors mean that regional markets within Southern Africa offer the greatest potential export opportunities. While some very small quantities of beef have already been sold to Angola and the Democratic Republic of Congo (former Zaire), the most promising export market is South Africa, which currently imports much of its beef from as far away as Australia. Presently, disease restrictions prohibit the entry of Zambian beef into South Africa and bilateral trade negotiations aimed at establishing an export corridor of certified disease free feedlots are in progress but have been mostly unsuccessful.

Results from the analysis of small-scale, emergent and commercially produced beef are summarized above. The model for the smallholder sector is based on a very low level of management but probably reflects the practices of some 40-50% of small-scale farmers. At this level, farmers rarely dip or spray their animals against tick-borne diseases and vaccines and medicines for deworming are not used. Due to the high incidence of corridor disease, these practices result in high death rates and the model here is based on a farmer starting with 20 cattle in a herd, with 60% mortality. The emergent model, on the other hand, reflects a fairly high level of management and is definitely at the top end of traditional farmer practices. In the system costed here, the farmer follows a regular vaccination program, sprays/dips their animals regularly and uses medicines for deworming. Farmers producing at this level tend to be more commercially oriented, but still farm according to local tradition and are reluctant to sell an animal for cash. For the commercial sector, two models are presented covering the ranching and feedlotting phases of production. The commercial ranch model is based on a herd of 200 breeding cows that are grazed over 1,360ha of range. Commercial farmers in Zambia rarely develop pasture although some types of supplemental feeds are often used. These farmers observe good vaccination, deworming and dipping practices. The feedlot model is based on a operation producing 5,000 finished animals per year. All values shown in Table 4.20 are for a twelve-month period.

Except for the small-scale sector, these data show that Zambian farmers are efficient in the production of export beef and that the country enjoys a good comparative advantage in this activity. The DRC scores for beef are higher than for many annual crops, but are still well below one and are entirely acceptable. The very high score of 4.19 for small-scale beef, however, is a notable exception and indicates that traditional cultural practices are inefficient from the economic point of view. Indeed, the financial returns to small-scale beef are extremely poor at an estimated loss from a 20 cow herd of US$2,767/year (ZK2.35 million) including mortality. Still, even with such high losses, most small farmers are very reluctant to sell

even one cow in order to buy the medicine needed to save the rest of their herd, due to cultural factors.

The net profits for the emergent and commercial ranch models, on the other hand, are considerably better although many other activities are still more rewarding. Indeed, many crops provide a better return to the expenditure on variable inputs as indicated by the gross margin/variable cost ratios for beef, which are somewhat low. Still, the total operating costs for a beef enterprise are much less compared with even just 20 or 30 hectares of many field crops so that beef is still very attractive given the ongoing liquidity crisis in Zambian agriculture. The feedlot model appears very profitable on an annual basis where the estimated net profit works out at a little less than US$100/head (ZK85 thousand). EPCs and NPCs for all beef models range from (0.04) to (0.08) where the greatest element of price transfer is felt by the commercial sector due to the use of taxed inputs and hired labor. Transportation-related price distortions are also important in this case since live animals may need to be transported as much as 500km from the farm to the nearest feedlot and/or abattoir.

4.3.9.3 Dairy

The dairy industry in Zambia is dominated by fewer than 50 commercial farmers. Together, these farms produce, on average, a total of about 60,000 liters of milk per day, which is sold in the formal, commercial market. There are also a considerable number of small-scale milk producers who own less than five cows each and produce unpasteurized milk for own consumption and informal sales. Very few of these farmers produce milk of adequate quality for the formal market although a number of cooling points have recently been established by Bonita, which bought the former parastatal Dairy Produce Board (DPB) to work in this direction.

Unlike other sectors of agriculture, dairy is especially dependent upon training and regulation to maintain standards of hygiene. While these facilities are provided by government-financed programs in many countries, this has not been the case in Zambia since the early 1970s. As a result, the infrastructure required for a stable dairy industry has deteriorated and there are none of the training facilities needed to facilitate formal small-scale and emergent farmer dairy production. Training and extension services are needed before the dairy sector can achieve its full potential and it remains to be seen whether Bonita can fill this gap.

Almost all milk produced in Zambia is sold on the domestic market. Although there are good regional export opportunities to the Democratic Republic of Congo, Malawi, and Zimbabwe, the former DPB lacked the capacity to transport milk to these outlets so that this potential has not been exploited. Demand in Zimbabwe is particularly strong, but exports have been effectively prohibited by the non-tariff barriers Zimbabwe uses to protect its own dairy industry. In contrast, Zimbabwe manages to export long-life milk to Zambia without restriction. Although Zambia lacks the technology to produce this particular long-life product, imported milk has damaged local sales considerably. Quantitative results from the analysis of commercial dairy are summarized in Table 4.21 on a per cow basis for a typical herd of 125 milk-producing cows.

Since the returns to dairy have changed significantly since privatization, data for both 1995/96 (before privatization) and 1996/97 (after privatization) are included. Further improvements in profitability may be expected and it is likely that current data for 1997/98 may be even more favorable.

On the whole, these data show that commercial farmers enjoy a very strong comparative advantage in dairy production where the DRC for all scenarios and time periods is just 0.27 and indicates a high level of social efficiency. The results are the same for both seasons since the border equivalent price for imported milk remained unchanged over the two years. Importantly, however, from the financial perspective, the results are much less encouraging where diary returned a large financial loss equivalent to US$22.614/year (ZK19.2 million) per 125 cow herd at the average level in 1995/96. At this level, the gross margin/variable cost ratio was also negative-indicating that diary did not even generate enough income to cover the annual depreciation costs of essential equipment including milking machines and cooling tanks. By 1996/97, however, the annual net profits from dairy had improved significantly to a potential income estimated at US$45,105/herd (ZK56.4 million).[26] Over this time, the real producer price for raw milk

Table 4.22. Comparative Advantage Indicators for Poultry (broiler chickens)							
	DRC	Net Profit (US$/ batch)	Variable Costs (US$/ batch)	GM/VC Ratio	Days Worked (per batch)	Labor as % of Variable Costs	Change in Yield to Gross Margin=0
Lusaka							
Emergent (500/batch)	0.43	512.22	969.23	0.58	17	1%	-37%
Commercial (5,000/batch)	0.43	4,359.34	9,390.91	0.54	49	1%	-35%

Note: *DRC calculations based on regional import parity.*

increased from US$0.205 to US$0.245 per liter due, in part, to the improved liquidity of Bonita compared with the old DPB.

Over both periods, dairy was subject to very considerable net policy transfers (negative L) equivalent to roughly US$157/cow (ZK133 thousand) in 1995/96 at the average level and US$163/cow (ZK204 thousand) in 1996/97. Since dairy is a capital intensive activity, many of these transfers are caused by taxes and import duties on tractors, milking machines, building materials and other necessary equipment. At 20-24% of variable costs, dairy is a very labor intensive activity and the commercial minimum wage is another important cause of price distortions. The figure of 192 days per cow includes labor for silage production.

4.3.9.4 Poultry

The poultry industry in Zambia has been constrained by the high cost of stock feeds and the poor quality of locally produced chicks. Currently all poultry produce is marketed domestically. There has been no development of an export market.

The domestic market is protected from international competition from both Zimbabwe and South Africa where the occurrence of Newcastle disease has resulted in a ban on imports. Should the Zambian poultry industry be exposed to international competition, there would be an almost certain and substantial decline in local production. This is because both Zimbabwe and South Africa enjoy considerable advantages over Zambia in terms of cheaper availability of stock feeds, lower interest rates, more developed infrastructure, and less expensive and more widely available veterinary services. Producers of broiler chickens in the Copperbelt anticipate that they might be able to compete with imports due to the higher costs of transportation from both Zimbabwe and South Africa to that area. Competition would not be possible in Lusaka and egg producers all across the country would almost certainly be forced out of business.[27]

One of the main reasons for these weaknesses is that the Zambian poultry industry has developed with few regulations and controls. Rather, before liberalization, parastatal hatcheries exerted a negative influence on the quality of the produce while the lack of any real regulations further allowed poor quality standards to become acceptable. This is true with regard to both day old chicks and point-of-lay birds. A viable industry could only be developed if proper hygiene regulations are enforced and significant investments are made in improved production technologies.

Despite these weaknesses, the domestic poultry industry has developed considerably since the introduction of economic reforms. This is especially true with respect to the “emergent sector” where many peri-urban middle class residents now supplement their regular income by raising chickens, albeit to various standards of quality. Marketing is a major problem for these producers, however, since the birds must be slaughtered after about seven weeks due to the high cost of feed. Therefore, unless these farmers have a ready and guaranteed market outlet for the birds, deep freezers are required so that a considerable amount of start-up capital is needed for this activity. For producers who fail to solve the marketing problem, and lack storage capacity, poultry may quickly become a loss-making activity. Results from the analysis of both emergent (500-bird batch) and commercial (5,000-bird batch) farmers are given above based on an assumption of 5% mortality.

Overall, these results are very favorable where the DRC for both sectors is good at 0.43 and the estimated net profits from poultry are also attractive (see

Table 4.22). Given that broiler chickens are raised in six to seven week batches, the total annual income will be about eight times as much as the per batch figures shown above assuming a regular market outlet. For emergent farmers, this brings the total annual income to an estimated US$4,098 (ZK3.48 million) while, for the commercial sector, the total income will be US$43,875 (ZK37.3 million). For producers raising more than one batch at a time, the income from poultry will be even greater. Importantly, however, only a 35% to 37% loss of yield is possible before the enterprise returns a gross margin equal to zero. For commercial farmers, where good disease control practices are observed, this should not be a major problem. For emergent farmers, on the other hand, the risk of disease is a serious threat since the hatcheries sometimes still fail to vaccinate chicks properly so that a batch may easily be wiped out after a considerable expenditure on feed. Both the emergent and commercial poultry models are subject to very small policy transfers where the EPC for both systems equals just (0.01), mainly because stock feeds are sold tax-free.

5. Sensitivity Analysis

5.1 INTRODUCTION

This chapter presents the results of three types of sensitivity tests conducted to illustrate how new economic parameters might affect Zambia's agricultural comparative advantage. By varying the assumptions used in Chapter Four, it is possible to simulate some of the effects of new policies and to indicate how robust the original conclusions actually are. To achieve these aims, the first test measures the impact of individual price distortions to determine which policy reforms could be of most benefit to farm profitability. The second test models alternative road freight costs and shows how social efficiency and farm profitability could improve as a result of investments in rural infrastructure. Finally, the third set of tests updates the analysis of the 1995/96 season using prices for 1996/97.[28]

As noted in the chapter on methodology, the input-output physical budget used for PAM estimation is itself the product of past adjustments to actual market prices. At new national opportunity costs, the use of inputs and outputs would be further adjusted and more comprehensive economic modeling is needed to determine the full impact of any new parameters including the effects on other sectors of the economy. The types of results that follow do, however, provide a better understanding of individual policies and point to some useful strategies for agricultural development.

5.2 ELIMINATION OF POLICY TRANSFERS

As noted throughout the discussion in Chapter Four, there are a number of policy distortions in the Zambian economy that undermine farm profitability. Although the economic liberalization program instituted from early 1992 has eliminated the most onerous of these distortions (including pan-territorial maize prices and fertilizer subsidies), the introduction of import duties and some very heavy taxes on a number of farm inputs continue to exert a negative influence on agricultural development. Capital and labor market distortions also detract from farm profitability. In many circumstances, these transfers mean that crops which could be produced with a high degree of socially efficiency are unattractive and risky from the farmer's point of view. Although all farm subsectors are affected by these distortions, commercial farmers feel the greatest impact since these make the most intensive use of taxable inputs, borrowed capital, and hired labor.

To illustrate how farm profitability could be improved through the elimination of policy transfers, this first set of sensitivity tests measures the impact of individual price distortions. This is done for commercial farmers producing maize and irrigated soya at the normal levels of output in Central Province. Both of these activities return a DRC score less than one, and are therefore socially efficient; but at the same time, also provide farmers a negative net return in the current policy environment. Accordingly, price reforms that make these and other such activities more profitable for farmers would have the benefit of helping Zambia produce according to its comparative advantage.

The results of these tests are presented in Tables 5.1 and 5.2 which show the per-hectare cost of each price distortion for the two activities analyzed. The percentages are the amount by which farm net profit would improve in the absence of each transfer. Policy reforms that eliminate any combination of distortions where the percentages add to 100 would mean that the activity ceases to lose money assuming input use, yield and all other farmgate prices remain unchanged.

In interpreting these results, it is important to keep in mind that policy transfers are instituted because decision makers are willing to accept some inefficiencies, and thus lower total income, in order to further non-efficiency objectives. Clearly, the elimination of

Table 5.1. Cost Of Policy Transfers (US$/ha): Commercial Maize, Average Yield, Central Province		
Policy Transfer	**Amount of Transfer**	**% of Original Net Profit**
Fuel/Transportation (30% duty + 20% VAT)	50	58%
Interest Rate Distortions	40	47%
Farm Machinery (15% duty + 20% VAT)	31	36%
Grain Bags (30% duty + 20% VAT)	17	20%
Casual Minimum Wage	11	13%
Vehicles (20% duty + 20% VAT)	11	12%
Ag. Chemicals (15% duty)	8	9%
Total Transfer & Original Net Profit	**168**	**(72,538)**

any particular input tax would mean a corresponding reduction of total government revenue, and as such, may not be in the best national interest since this money could have been invested elsewhere. By showing the effects individual policies have on farm profitability, the type of data presented above can, however, help focus attention on the costs of each transfer and point to policy reforms that could be of most benefit to agriculture.

With this in mind, a number of useful conclusions may be drawn from these tables. First, it is immediately apparent that the elimination of any single policy distortion is not sufficient to restore the profitability of either commercial maize or irrigated soya in Central Province. The largest single transfer (for fuel and transportation) accounts for only 58% of original the net loss for commercial maize and 27% of the loss for irrigated soya. In both cases, the smallest transfer is for agricultural chemicals and elimination of this tax alone would be of nominal benefit to farm profitability.

Secondly, fewer individual distortions need to be eliminated for maize to become profitable than for soya. For example, if the taxes and import duties on fuel and transportation, farm machinery, and agricultural chemicals were eliminated, this would be sufficient to restore the profitability of maize. For soya, these transfers only account for a little more than half of the original net loss and policy reforms in other areas are needed for this activity to be profitable. This is despite the fact that the total transfer away from maize is nearly US$12.94 (ZK11 thousand/ha) more than for soya.

Finally, it is worth noting that transfers related to transportation have more of an impact on farm profitability than any other set of distorting policies. Taxes and import duties on petrol, diesel fuel and mechanical spare parts are not normally thought of as major components of agricultural policy per se. Still, for every hectare cultivated, these transfers cost maize and soya bean farmers more than US$49.41/ha and US$37.65 /ha, respectively (ZK42 thousand and ZK32 thousand). Although commercial systems demand more fuel and mechanical spare parts than smaller scale operations, all subsectors make use of transportation services and are affected by these policies. While the analysis here does not show the impact on government revenue and other economic sectors, it does appear that the elimination or a reduction in taxes related to transportation could be of major benefit to agriculture.

To determine with confidence which price reforms would most benefit Zambian agriculture, much broader analysis including other farm activities is needed. Once the basic spreadsheet files for each activity have been prepared, this is relatively easy to do. An important benefit of this approach is that it can help agricultural administrators present a very persuasive case for the policy reforms they might propose.

Table 5.2. Cost of Policy Transfers (US$/ha): Commercial Soya, Irrigated, Average Yield, Central Province

Policy Transfer	Amount of Transfer	% of Original Net Profit
Fuel/Transportation (30 % duty + 20%VAT)	38	27%
Farm Machinery (15% duty + 20 % VAT)	31	22%
Irrigation Equipment (15% duty + 20% VAT)	27	19%
Interest Rate Distortions	26	18%
Vehicles (20% duty + 20% VAT)	9	7%
Grain Bags (30% duty + 20% VAT)	8	5%
Electricity (20% VAT + 3% rural electricification surcharge)	6	4%
Casual Minimum Wage	5	4%
Ag. Chemical (15% duty)	4	2%
Total Transfer & Original Net Profits	**154**	**(121,958)**

5.3 ALTERNATIVE TRANSPORTATION COSTS

This second set of sensitivity test simulates alternative transportation costs and attempts to provide an indication of the benefits that might be expected from improved rural infrastructure for farms located a variety of distances from town. Because Zambia is a large land-locked country, freight costs are a major component of import and export parity prices and an important factor underlying the nature of its comparative advantage. Likewise, transportation costs affect both farmgate input and output prices and have a corresponding impact on the overall net profitability of different agricultural activities. Within Zambia, most goods are shipped by road and a common perception is that the poor quality of much of this infrastructure has been detrimental to both the efficiency and profitability of agriculture. Map 5.1 shows the degree of accessibility of Zambia's agricultural land.

Although comprehensive economic modeling of the benefits from improved rural roads is well beyond the scope of this study, it is possible to make a number of simplifying assumptions and use the PAM to provide some rough impressions of the efficiency and net income effects for agriculture. These assumptions are explained below and applied to the analysis of small-scale farms in Eastern Province (Chipata) and Northern Province (Kasama) producing at the normal levels of output. Although both locations may be considered remote, Kasama is served by the Tanzania-Zambia Railway (TAZARA) and is less dependent on road freight. As such, only one crop, maize, is analyzed for Northern Province while both maize and soya are analyzed for Eastern Province.

For indicative purposes, the first assumption used for this analysis is that all farmers have equal access to transportation services, and that the investment program being modeled results in a simple 10% reduction in the costs of road freight. This means that the basic rate used in the original calculations improves from US$0.141 per ton per kilometer to US$0.127 (ZK120 and ZK108/mt/km). Very few Zambian transporters actually vary their charges according to the quality of roads that must be traveled and instead base their fees on the depreciation of their trucks. Although there would be less wear and tear from travelling over improved roads, fuel costs and driver salaries would not change substantially so that any large reduction in road costs seems unlikely. The second simplifying assumption is that this 10% reduction in freight costs affects domestic road rates only. All other prices are held constant including the costs of international road freight even though some of the distances traveled will be over the supposedly improved Zambian roads.

Because transportation costs are of different importance to remote and not-so-remote farmers, this sensitivity test provides data for a variety of delivery distances. The original small-scale results presented

Map 5.1
Accessiblity of Agricultural Land in Zambia

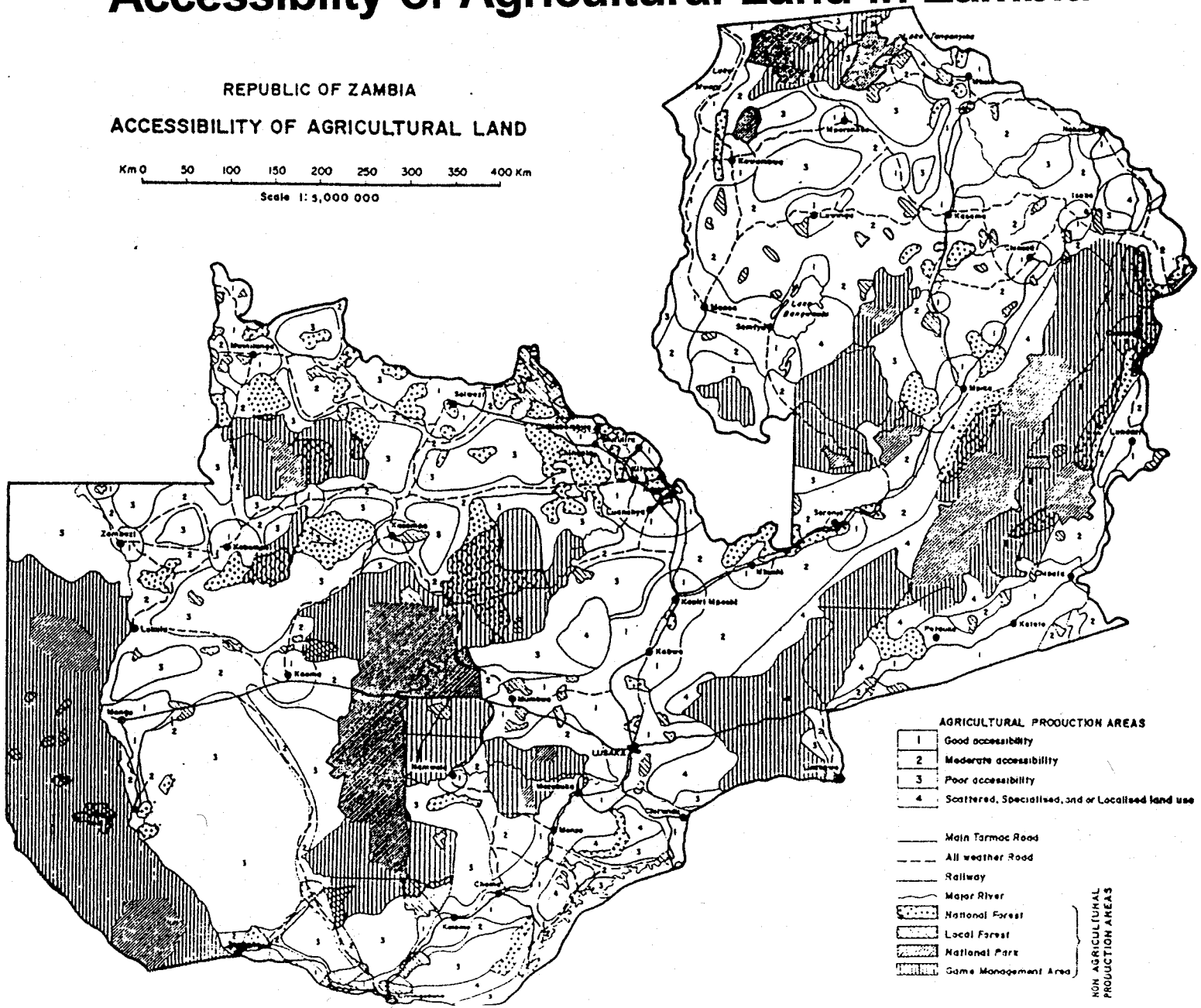


Table 5.3. Sensitivity to Alternative Transportation: Selected Small-Scale Activities, Average Yield.						
Km to Town (Farmgate Market)	Standard Rates (ZK120/mt/km)		10% Improvement (ZK108/mt/km)		Impact	
	DRC	Net Profit	DRC	Net Profit	DRC	Net Profit
NP Maize						
0	0.39	82,353	0.39	82,353	0.000	-
40	0.42	70,398	0.42	71,593	0.004	1,195
80	0.46	58,443	0.45	60,834	-0.018	2,391
120	0.50	46,488	0.49	50,074	-0.013	3,586
EP Maize						
0	0.51	117,207	0.47	117,207	-0.042	-
40	0.55	104,264	0.51	105,558	-0.046	1,294
80	0.60	91,322	0.55	93,910	-0.051	2,588
120	0.65	78,380	0.60	82,262	-0.056	3,882
EP Soya						
0	0.71	9,504	0.69	9,504	-0.016	-
40	0.72	6,214	0.71	6,543	-0.018	329
80	0.74	2,923	0.72	3,581	-0.020	658
120	0.75	(367)	0.73	620	-0.021	987

Note: *Numbers may not add because of rounding. NP = Northern Province EP = Eastern Province*

earlier were based on a delivery distance of 40km from farm to town. To show how these results would have been different at alternative distances, and to show how various farmers would benefit from improved roads, additional calculations are made for farms located 0km, 80km and 120km from Kasama and Chipata. The results of this analysis are summarized in Table 5.3.

From this very quick analysis, some useful impressions of the benefits that might result from lower road costs may be drawn. Importantly, because this analysis was only performed for three activities, much more comprehensive analysis is needed before these results should be extrapolated for other crops and locations. More detailed information is also needed on the financial and economic costs of transportation over roads of varying qualities. Further analysis could simulate a 30% and a 50% reduction in road costs which would be of greater benefit to efficiency and profitability.

Regarding efficiency, the data from Table 5.3 indicate that only nominal benefits result from the improvement of rural roads. This is especially true for Northern Province production systems since maize grown in this area is assumed to be transported by rail to the Copperbelt where the domestic product competes with imports. Therefore, the only direct road transportation costs built into these DRC calculations are for the movement of maize from the farmer's field to Kasama where the grain is sold into the next level of the maize chain. For Eastern Province systems, lower road costs are of greater overall benefit to efficiency since transportation in this area is exclusively by road. Because farmers are assumed to use more fertilizer and other heavy inputs for maize than for soya, maize efficiency scores are more sensitive to alternative road freight costs. In all cases, farms further from town become proportionally more efficient as a result of lower transportation costs than do those nearer to town.

For farm profitability, this analysis likewise suggests that improved rural roads are unlikely to have a major impact. In the case of Northern Province maize, for example, net profits improve by less than 2% for farms 40km from Kasama, by 4% for farms 80km away and by 7% for very remote farms 120km from Kasama. Put another way, the improvement of US$1.40 (ZK1,191) for farms 40km from town is equal to only about 11% of the value of just one bag of maize. In the scenarios tested above, the greatest

proportional benefits from improved infrastructure appear to be realized by Eastern Province soya farmers. Although the actual increases are all less than US$1.18/ha (ZK1,000), the improvements represent about 5% of net profits for farms 40km from Chipata and 22% of profits for farms 80km from town. For the very removed farms 120km from Chipata, lower road rates mean that soya ceases to be an unprofitable activity and that the crop is able to provide a very small positive net return.

Surprisingly, all these findings appear to suggest that there is little reason to suppose the improvement of rural roads would have a dramatic impact on either the efficiency or profitability of Zambian agriculture. Compared to the analysis of price distortions in the section above, it seems that, where the roads program only results in a 10% improvement in transportation costs, a much more effective initiative would be to eliminate taxes and import duties on diesel fuel and other transportation-related inputs.

An extremely important caveat to these findings is that many Zambian farmers simply do not have access to reliable transportation facilities of any sort. Even farmers that are only 40km from town may be so isolated by the lack of adequate infrastructure that there are few, if any, opportunities to sell their agricultural surplus into the formal markets. In these circumstances, the construction or improvement of roads would be infinitely more advantageous than tax reform. A very good area for future research may be to calculate a series actual, rather than indicative, DRC and net profit results for farmers with access to a variety of different transportation services.

5.4 COMPARISON OF EFFICIENCY AND CROP PROFITABILITY FOR 1995/96 AND 1996/97

Finally, the third set of sensitivity tests looks at how the social efficiency and private profitability of key agricultural enterprises have changed over time. Specifically, this analysis builds on the original data set by updating the 1995/96 production budgets with prices covering the 1996/97 farm season. With the help of modern database software, this type of analysis is not difficult to prepare and a system has been established in Zambia so that the analysis may be updated on an annual basis. This approach has the advantage of providing a better understanding of the dynamics of farm decision making by showing how the returns to different crops evolve over time as a result of policy decisions. Establishment of a similar system in other countries could therefore be an important step towards an improved understanding of regional trade patterns and development issues.

In interpreting the data that follow, it is important to be aware that the yield expectations and quantities of inputs used for each production model were held constant for the two time periods. Clearly, this is a major simplification since output and input use may vary considerably from season to season depending on weather patterns, inflation, marketing opportunities and other such factors. In the future, it will be important to take these factors into consideration by further refining the database monitoring system. Despite these weaknesses, the approach used here is important since it helps isolate the impact of relative price changes on the returns to agricultural production. Results for selected agricultural activities comparing the gross margin, variable costs and return to variable costs for 1995 and 1996 are given in Table 5.4.

What stands out most clearly from the above data is that agricultural production became significantly less profitable in 1996 compared with 1995 given the assumption of unchanged yields and input use. The main reason for this trend is that crop prices were lower in real terms in 1996 due to better growing conditions while input prices were also higher.

The comparison of crop profitability further shows that these price developments had particularly negative consequences for growers of maize, sorghum, sunflower and cotton. Only tobacco and commercially grown wheat became more profitable in 1996 as measured by gross margin to variable cost ratios. With respect to sorghum and sunflower, these results are mainly due to weak domestic demand and a consequent fall in farmgate prices. For cotton and maize, on the other hand, which make considerably more intensive use of cash inputs,

Table 5.4. Comparative Indicators of Efficiency and Profitability, 1995 – 1996								
	DRC		Gross Margin (US $/ha)		Variable Costs (US $/ha)		G. Marg/V. Costs	
Crop/Prov	1995	1996	1995	1996	1995	1996	1995	1996
Smallholders								
Maize (Cent)	0.27	0.26	123.08	75.46	158.99	173.89	0.77	0.43
Sorghum (So)	0.70	0.78	47.06	3.38	54.80	57.89	0.86	0.06
Sunflower (So)	0.32	0.33	32.25	19.36	33.64	31.84	0.96	0.61
Soybean (Cent)	0.71	0.79	17.49	(3.47)	115.71	131.34	0.15	(0.03)
Cotton (Cent)	0.24	0.26	145.28	82.42	84.51	89.98	1.72	0.92
Groundnut (Eas)	0.50	0.62	67.98	37.39	110.48	138.61	0.62	0.27
Tobacco (Eas)	0.30	0.25	564.48	790.53	529.92	553.47	1.07	1.43
Emergent								
Maize (Cent)	0.26	0.24	168.51	114.65	172.32	186.65	0.98	0.61
Sorghum (So)	0.46	0.50	154.97	48.69	99.68	104.49	1.55	0.47
Sunflower (So)	0.46	0.46	29.14	7.40	53.21	48.60	0.55	0.15
Soybean (Cent)	0.62	0.67	46.10	25.15	131.50	145.34	0.35	0.17
Cotton (Cent)	0.26	0.29	183.21	87.11	146.20	159.29	1.25	0.55
Groundnut (Eas)	0.53	0.61	75.94	50.82	147.00	169.18	0.52	0.30
Tobacco (Eas)	0.34	0.27	621.82	920.67	746.18	759.33	0.83	1.21
Commercial								
Maize (Cent)	0.52	0.48	41.33	(95.90)	665.15	720.43	0.06	(0.13)
Wheat (Lus)	0.16	0.13	664.71	947.67	641.18	628.53	1.04	1.51
Soybean (Cent)	0.55	0.59	54.97	1.60	389.03	424.64	0.14	0.00
Cotton (So)	0.24	0.28	488.65	253.75	687.82	746.25	0.71	0.34
Tobacco (So)	0.43	0.28	392.26	1,066.41	1,723.10	1,741.59	0.23	0.61
Coffee (So)	0.08	0.15	7,616.49	4,319.89	1,502.83	1,851.13	5.07	2.33
Sugar (So)	0.36	0.32	796.95	536.36	1,416.54	1,498.84	0.56	0.36
Paprika (Lus)	0.25	0.26	1,191.92	1,126.04	1,419.26	1,513.96	0.84	0.74

changes in both input and output prices explain the decline in profitability.

Efficiency scores, on the other hand, remained relatively stable and indicate that Zambia continues to be a very efficient producer of many different commodities. This is mostly because DRC scores are measured with reference to each commodity's import or export parity price and many of these have remained consistent with their long-term average over the two time periods analyzed. Tobacco, however, is an important exception to this trend where international supply and demand conditions sent prices significantly higher as indicated by the improved DRC scores.

5.5 FURTHER USES FOR SENSITIVITY ANALYSIS

As noted at the start of this discussion, the sensitivity tests presented here were mainly intended to illustrate some of the additional uses for comparative advantage analysis in helping to interpret agricultural policy and plan effective development strategies. Although these tests have provided additional insight to how some new economic parameters might affect the efficiency and profitability of agricultural production, much more comprehensive modeling, including a consideration of how new policies would affect other sectors of the economy, is needed. Once a basic set of PAM spreadsheets have been prepared, however, these and other types of sensitivity

tests can be used readily as very powerful and persuasive tools in the process of policy formulation. It is hoped that these examples of different types of sensitivity tests can help agricultural administrators and other policy makers devise further tests relevant to their particular areas of concern.

One especially important use for the PAM is to incorporate the analytical models as part of a database system for monitoring the returns and costs of agricultural production. By updating the analysis each year, it is possible to gain an impression of how economic liberalization continues to affect agricultural production and how the returns to different crop and livestock activities vary over time. Although the results presented here looked exclusively at the impact of price developments, the system could be easily modified to account for variations in yield and input use. Again, the development of similar systems in other countries could be an important step towards an improved understanding of regional trade patterns and how these effected by domestic and international price developments.

Another useful area where the PAM could help is with the preparation of cost-benefit studies related to agricultural projects. In addition to using the PAM to quantify the cost of individual taxes, the basic spreadsheet models can help estimate the effects of a wide variety of other policies. Examples of this would include analysis of the effects improved yields due to an extension program or the effects of higher prices that might result from improved marketing facilities. Although the PAM cannot be used to estimate the magnitude of change, it can easily show the impact of change once new production coefficients have been estimated. The improvement or loss of farm income could then be included as part of the cash flow stream used for cost-benefit analysis.

Again, care must be taken when using the PAM to estimate the effects of new policies since this is not a dynamic model of comparative advantage. Nevertheless, it is hoped that the results presented here, and these few examples of further ways the spreadsheet models could be used, will help policy makers devise further tests related to their particular area of work. In the absence of a well-defined methodology for assessing individual polices, sector planning can easily become an exercise in guesswork. The PAM is certainly not the right methodology for assessing all agricultural policies, but it can be a powerful tool when used correctly.

6. Concluding Overview

As we conclude this technical paper, it is worth observing the following pre-SAP conditions that prevented the sustainable development of the agricultural sector in Zambia:

- The country's macro-economic policies ultimately determined the structure of incentives for agricultural production and trade. The policy of price interventions, which was a component of the economy-wide control policy, worked against the necessary incentives to increased agricultural output and the direct and indirect benefits derived from that;
- The government policy of self-sufficiency in the country's staple food crop (maize) was achieved at a great expense to other crops that do possess a comparative advantage. National food security was also threatened by the policy-induced restraint on crop diversification; and
- Government subsidies on consumption not only inflated the huge government deficit but diverted resources away from the more productive pursuits of the government, including agricultural extension and supportive infrastructure provision.

The above distortionary policy environment and the resultant resource allocation pattern resulted in the following:

- Rising production of maize away from the major consuming areas;
- Rising subsidies;
- Decreasing exports of agricultural products; and
- Static contribution to the GDP.

Over the last six years, considerable attention has been given to the liberalization of the agricultural sector and the problems associated with agricultural production and the availability of inputs and markets. Despite the remaining institutional and infrastructure constraints, and the unstable policy decisions, there is general agreement that the environment for private sector development is reasonably conducive. In order to compete in international markets, Zambia has to focus on efficient production of agricultural products. This means that production should be at the lowest cost (low DRCs) and with the greatest net returns (profit) to producers. This occurs when the total costs of production, processing, transportation, and distribution are minimized. This study presents a preliminary assessment of the emerging effects of liberalization on the location of production.

Under a liberalized environment, location of production is determined significantly by the comparative advantage of producing in each agroecological zone. This depends on the production costs of each zone, transportation costs between locations, and the location of markets for the final product. In this regard, the analysis in this comparative advantage study has concluded as follows:[29]

- The major concern of the government and indeed the households is to ensure adequate availability of staple foods. Except for rice, all categories of farmers are efficient producers of the major food grains. This means that the two agroecological zones (II and III) should be encouraged to expand production of the major food grains in which they have comparative advantage.
- Data indicates that much of grain production is efficient but is generally less profitable than other export crops. In terms of the staple food (maize), superior comparative advantage and profit were observed among emergent farmers in Central province (Zone II) and are only marginally affected by management improvements. The fact that commercial farmers experience lower profits from maize production than small-scale farmers is a good explanation for the observed shift of resources to more profitable options and the resulting decrease in maize production among commercial farmers. Even though small-scale farmers obtain relatively higher profits from maize production, high input costs imply that

further expansion is likely to be constrained by limited purchasing power, especially with no cheap sources of credit. This is likely to reduce maize supply from domestic producers but the deficit may be offset by imports.

- Over the years, significant resources have been devoted to the promotion of rice production, mainly in Northern and Western Provinces. However, since DRCs for rice have been found to be greater than one, the production of this crop is generally inefficient. In addition, profits from rice production are also very low. Therefore, farmers should be encouraged to switch to relatively more efficient and profitable crops. This would obviously call for increased investment in extension work, as farmers in those areas may not be familiar with the alternative agricultural products. In the long run, the problems experienced by the rice industry could be resolved through research and adaptation of varieties with desirable consumer characteristics.

- Zambia has frequently experienced drought spells. Emergent and small-scale farmers efficiently produce drought resistant crops such as sorghum and millet and the profits improve with management. Even though investment in management improvement could be economical, market constraints (local and export) need to be resolved before encouraging further expansion. As in the case of maize, production should be limited to what can be consumed in the local market.

- The major oilseed crops in Zambia are soya beans, sunflower, and groundnuts. These oilseed crops could be efficiently produced. The problem is that sunflower and soya beans have relatively lower profits than other options. However, good profits are obtained from groundnut production and increases with management level.

- The efficiency of import substitutes (such as maize and soya beans) is derived from the fact that Zambia is a large country and is land-locked therefore, transport costs tend to be high. High transportation costs encourages production close to the final market because producers near the market enjoy relatively lower production and marketing costs. In terms of domestic comparisons, Zone II has the advantage of meeting the urban needs of import substitutes because of proximity to the major markets in Zambia. Therefore, it is expected that most of the maize for urban markets will come from this area.

- The relatively inferior DRCs for low value and bulky products (staple foods such as maize and sorghum), indicate that production should be limited to the volume which could be sold in the local market. This would enable farmers to shift some of the resources to alternatives with superior economic efficiency (DRCs). This supports the current GRZ thrust to diversify away from the dominant crop (maize).

- Farmers producing cash crops (cotton, tobacco, sugar cane, Irish potatoes, onion, and sugar beans) efficiently utilize resources and the profitability of these crop increases with management. However, these crops require high cash outlays. It is important to note that even though tobacco is the most profitable crop among small-scale and emergent farmers, high cash outlays and anti-smoking lobby groups are constraints to expansion of production. In the past, tobacco expansion has been closely related to the availability of specialized credit. Most of the soft credit programs have now been exhausted. Thus, production increases are likely to be adversely affected.

- Over the last few years, there has been a significant increase in the production of non-traditional crops. Commercial farmers for export produce most of these non-traditional products (coffee, roses, and paprika). Existing data indicates that commercial farmers producing these crops are extremely efficient. Efficiency of export crops is derived from the favorable value to weight ratio that offsets the high transportation costs. Production of these crops has been encouraged by the availability of specialized financing. Even though much of the production has been on commercial farms, the major husbandry practices are labor intensive and have therefore turned out to be major sources of employment for many people.

- It is clear that non-traditional export crops are the most profitable and efficient. However, these crops cannot be produced by all categories of farmers in all zones due to logistical and capital constraints. In the near future, these crops will continue to be predominantly produced by commercial farmers in zone II. However, contract farming appears to be a solution to the capital constraint faced by many small-scale and emergent farmers and is increasingly being employed to promote non-traditional exports (rain-fed paprika, castor, tobacco, and cotton), with low fixed capital commitments among small-scale farmers. Based on available technical packages, these crops are potential alternatives in zone III and other areas with limited options.
- Small-scale farmers keep most of the cattle, which is problematic because of its inefficiency. These farmers often incur losses due to failure to implement proper animal husbandry practices. However, some profits are observed among farmers with improved management. With abundant land, the focus must be on management improvement to reduce mortality rates and other production losses. In the dairy sub-sector, commercial farmers have comparative advantage and their profits have improved after privatization of processing facilities. Therefore, dairy production is expected to expand. It is clear that distant zones should focus on the production of high-value products. This would enable them to offset the high transportation costs.
- Liberalization is now encouraging specialization in products in which each zone has comparative advantage. For the distant zones, liberalization has narrowed the range of alternative products. On the other hand, it has expanded the range of products for Zone II.
- Even though Zone III has very stable rainfall, the region is not a major supplier of agricultural products. It appears that high transport costs tend to offset the advantages of stable rainfall in Zone III. Therefore, attempts to lower transport costs would stimulate trade between zones and would raise total level of production. Evidence from this study indicates that the benefits may not be as high as commonly believed. This is because transport is just one of the factors which determines efficient location of production.
- The impact of the findings of this study on the various objectives in agriculture could be summarized as follows:
  - *Food security*: All staple food crops could be efficiently produced to meet local requirements but are relatively less profitable than alternative activities.
  - *Exports*: Non-traditional exports are very promising in terms of contribution to export earnings, but the rate of expansion is likely to be affected by the limited availability of specialized financing. This calls for expansion of affordable credit facilities for these products. These facilities were established to overcome the impact of high inflation and interest rates experienced during the implementation of stabilization programs. The specialized financing facilities have now been exhausted. The problem is that local financial markets have not yet evolved into viable alternative sources of long-term capital. As a long-term solution, it is important that the government reduces its borrowing through treasury bills, so that the financial markets could provide capital to productive investment at reasonable rates.
  - *Income and Employment*: Most of the non-traditional products are labor intensive and their expansion could help to raise rural incomes and employment. Therefore, the growth being experienced in non-traditional sector is having a positive impact on employment generation.
  - *Raw materials*: Many of the manufacturing plants have now been privatized. With additional injection of capital, the capacity utilization and the demand for raw materials are expected to increase. The industries that process efficient and profitable crops will obtain their raw material needs. On the other hand, the industries which process relatively less

efficient and profitable products are likely to face decreasing supply of raw materials as farmers switch to more profitable alternatives.

- *Environment*: The dominance of maize production is often blamed for raising the acidity of soils in major maize producing areas. The switch to more efficient and profitable alternatives is likely to reduce fertilizer consumption and could help to lower soil acidity. In addition, most of the efficient and profitable export crops are land intensive. A switch to these products could help to reduce the cultivated area. This could help to reduce the deforestation associated with extensive land clearing and could also help to reduce soil erosion.

Notwithstanding the significance of the above conclusions from this study's agricultural comparative advantage analysis, it is equally noteworthy that agriculture, like all other sectors, is affected by earlier presented and analyzed developments in the broader economy (see Chapter One). Governments usually intervene in the economy in pursuit of such social goals as equity and food security. Indeed, particularly in restructuring economies, economic efficiency objectives often conflict with the cause for social justice and other non-economic considerations. It is therefore not uncommon that such policies distort the structure of economic incentives, a phenomenon that works against economic efficiency and optimal allocation of resources.

Low inflation, the availability of credit at manageable interest rates, and equitable tax policies are all factors that contribute to agricultural growth. The examination of the extent to which these conditions were in place in Zambia during the 1995/96 agricultural season could help in the understanding of the performance of the agricultural sector in the country. A look at the effect of inflation, interest rates, and tax policy on the agricultural production in the past two years could illustrate the real and potential threats to a sustainable agricultural production even under conditions of relative comparative advantage.

To start with the issue of inflation, one observes that although there was lower inflation in 1996 compared with 1995, existing data do not support the general assertion that farmers have benefited from this. In fact, the figure for 12-month inflation to September was higher in 1996 at 45.6% than in 1995 when the 12-month rate stood at 34.2%. On a year-to-date basis, accumulated monthly inflation was almost exactly the same in 1996 as it was in 1995. With respect to agriculture, such high inflation rates encouraged investors to seek quick returns. Thus, unless inflation can be brought under control, other forms of investments appear more attractive than traditional farm enterprises. Besides, high inflation erodes profits and makes planning difficult. This is one reason why non-traditional, dollar-based activities such as the production of export crops (roses, coffee, and tobacco) have appeared so attractive among commercial farmers in recent years.

It is important to note that, due to the good rains and abundant harvest, the 1995 crop prices for many commodities were lower in real terms (as measured by their US$ values) than they were the previous year. The problem is that input prices for fertilizer in 1996 were generally higher than those for 1995 such that farmers were being squeezed at both ends.

With respect to the question of interest rates, one can further observe that inflation developments also have a bearing on the interest rates that banks charge farmers for agricultural loans. Given the high inflation rates described earlier, interest charges have also remained high (65%). Even in real terms, once the effects of inflation are taken into account, the interest charged to farmers remains high at around 19%. Clearly, such high charges make it difficult for farmers to operate, especially since many of them are still to pay off debts incurred over previous seasons. A significant reduction in interest charges could, therefore, help towards solving the liquidity crisis now facing the Zambian agricultural sector. This would also help improve the much sought out investor confidence.

The ill-sequenced policy implementation that liberalized interest rates in 1992 was effected before the battle against inflation was won. Interest rates shot up and the

sector that had all along over-exposed itself to credit because of negative real interest rates due to controls found itself under a severe debt burden. Most farmers were driven to near bankruptcy. This state of affairs limited farmers' access to credit, particularly given that the government decided to phase out its support to agricultural lending institutions. The recovery rates of these institutions have been low for a long time but liberalization and reduced farm profitability made recovery rates nose-dive even further.

With respect to the government's tax policy, one observes that a number of tax incentives in the form of tariff reductions and zero VAT for many agricultural inputs were introduced in the most recent government budget announcements. Inputs affected by this move include agricultural chemicals, farm machinery, spare parts, and irrigation equipment. The problem is that the new tax policies tend to benefit mainly commercial farmers since the traditional sector makes much less use of the affected inputs. They also lack accountancy skills to take advantage of VAT refunds. Furthermore, with respect to the commercial sector, the impact of the reduced tariffs structure has not been great since, under the old tax regime, exemptions were only available through investment licenses.

Against the above background, the Zambian case has shown that such government interventions as the interest rate regime, the tax policy, the value added tax administration, and the subsidy on agricultural inputs to support smallholder farmers could adversely affect the principal of comparative economic advantage (CEA) in its ability to guide resources to their economically most efficient users.

Lastly, let us now try to draw a few broad conclusions based on some of the more recently introduced policy initiatives. While the government could be commended for its broad support of the reform process, areas in which it has not adhered to the new agenda are significant. Firstly and most notably, although the government's adherence to the reform process has been strong with respect to the liberalization of output marketing arrangements, it is equally true that its support for the reform of input supply and credit markets has remained quite weak. Secondly, one of the most fundamental ingredients to growth in a liberalized economy is that the rules of the game should remain stable and transparent. Despite this, the government has interfered with agricultural markets on several occasions during the 1995/96 agricultural season, thus undermining plans put in place by private traders and other investors. The most notable of these interventions included (a) the introduction of an export ban on maize; (b) the announcement of a poorly conceived and managed debt relief package for drought-affected farmers; and (c) the sale of emergency grain stocks.

Against the above background, one notes that even though Zambia's agroecological attributes provide the potential to achieve higher growth rates in certain crop and animal production activities as revealed in this study, non-agronomic factors have continued to limit the achievement of this potential. Bold initiatives are thus required to remove these constraints. The Zambian government is currently seeking to remove these problems by improving agricultural service delivery systems through its externally supported Agricultural Sector Investment Program (ASIP). So far, the impact of ASIP is yet to be felt by the Zambian farming community.

Notes

1 Ministry of Finance, Economic Analysis and Reports Unit, *Macroeconomic Indicators* (June, 1995).

2 UNDP (1992), *Development Co-operation Zambia 1991*, Lusaka, UNDP p.8.

3 World Bank (1993), *Zambia: Prospects for Sustainable and Equitable Growth*, Washington, D.C., World Bank, p. 64.

4 See Jansen, D. (1988), *Trade, Exchange Rate and Agricultural Pricing Policies in Zambia*, World Bank Comparative Studies, World Bank, Washington, D.C.

5 See Jansen, D. (1988), *Trade, Exchange Rate and Agricultural Pricing Policies in Zambia*, World Bank Comparative Studies, World Bank, Washington, D.C.

6 See Kate, A. (1994), *Effective Protection and Domestic Resource Costs in Zambia*, Lusaka, UNCTAD Consultancy Report, Ministry of Commerce, Trade & Industry, July; and Anderson, P (1994), "Capital Flows and Real Economy Development in Zambia," mimeo., Gothenburg University, December.

7 Mwanawina, I. & White, H. (1995), *Swedish Balance of Payments Support to Zambia*, draft report, Lusaka, February.

8 Agroecological zones have been determined based on such characteristics as length of growing period; occurrence of drought; minimum, night-time, and maximum temperatures during December to February; occurrence of frost in the dry season; and amount of sunshine in the rainy season.

9 For a list of Zambia's main soil types in the three agroecological zones and their limitations to crop production, please refer to Table 2.2.

10 These definitions are consistent with the methodological approach adopted for quantitative analysis. Precise definitions are given in Chapter 3.

11 Farm labor in the smallholder sub-sector is not included in official employment statistics. Thus, agriculture's contribution to formal sector employment hovers around only 14%.

12 However, the contribution to the economy beyond agricultural production itself, i.e., in terms of its backward and forward linkages, may be larger than this. Thus, the *World Bank's Prospects for Sustainable Growth* (IBRD, 1995b) estimates that Zambia's agriculture and food system encompasses at least 50% of the economy. This includes farm input supply, agricultural processing, and food wholesaling and retailing, as well as farming itself. Agricultural processing accounts for about half of the country's manufacturing sector, which accounts for about 35% of the economy.

13 See J. Keyser, G. Gray & G. Scott (1996), *Zambia's Agricultural Comparative Advantage: An Operational Framework for the Multiple Objective Analysis of Agricultural Policy and Indicative Results*, World Bank, Washington, D.C.

14 Some farmers, no doubt, are already producing at and beyond this level of management.

15 This methodology is based on the approach described by Monke and Pearson (1989) in *The Policy Analysis Matrix for Agricultural Development*, Cornell University Press, Ithaca, NY.

16 For more information on methods of farm-level analysis, see Barnard & Nix (1981), *Farm Planning and Control*, Cambridge University Press, Cambridge.

17 For example, if an input were subject to an import duty of 20%, its conversion factor would be 0.8333.

18 Specifically, this is given by the formula $A = Z\,[(1 + i)\,n\,i\,/\,(1 + i)\,n - 1]$ where A is the annual payment that will repay the cost of the fixed input; Z is the input's replacement cost; i is the real interest rate on savings; and n is the number of useful years in the input's life. For more information on working with this methodology see Monke and Pearson (1989).

19 Many of these loss-making commercial activities actually return a positive gross margin, but the farmer's net profit becomes negative once the annual depreciation costs of fixed implements are taken into account.

20 The results for Chipata in Eastern Province are an exception to this point where the export parity DRCs are much better than those based on regional import parity. This is due to differences in transportation costs where it is assumed that export maize is sold to Lilongwe (only about 145km from Chipata) and import substitute maize is sold to Lusaka (600km from Chipata).

21 A very useful study would be to calculate marginal rates of return to fertilizer since this is the primary input used to achieve the potential yield results. Specifically, because output maximization per hectare is not the most important farm objective in a land-surplus country like Zambia, lighter applications of fertilizer over a larger area may make better financial and economic sense than current recommendations.

22 Eylands (1987), *Baseline Survey on Crop and Livestock Production for the Strategic Extension Programme in Southern Province*, MAFF, Lusaka.

23 Landell Mills (1994), *Commodity Studies Report*, London.

[24] *Times of Zambia* (August 9, 1995).

[25] Most Zambian coffee is hand harvested by women who, in 1995, were typically paid ZK20 for each kilo of cherries picked. An average worker can easily harvest about 65 kilos of cherries per day which gives a daily wage rate of ZK1,300 and is substantially higher than the then minimum wage of ZK800 per day.

[26] 1995/96 US$1 = ZK850; 1996/97 US$1 = ZK1,250.

[27] Very similar circumstances apply to the Zambian pork industry, which enjoys few competitive advantages over other countries.

[28] These sensitivity tests were mostly conducted very quickly and are mainly intended to serve as examples of the useful role the PAM can play in helping to develop effective strategies for agricultural development.

[29] It is worth noting that this study did not set out to determine the optimal farm plans for each region and farmer category. Therefore, no attempt was made to quantify the resources and constraints at the disposal of the various farm categories. The study only suggests the farm enterprises and farmer categories that make the best use of resources in Zambia. As with all static analysis, the findings are likely to change if one or more assumptions are varied. However, the limited sensitivity analysis that was conducted did not lead to major contradictions in our findings.

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Appendix 1:
Yield and Transport Cost Assumptions

Yield Assumptions

	Smallholder		Emergent		Commercial	
	Average	Potential	Average	Potential	Average	Potential
Beef (mt live/year)						
Mazabuka (ranch)	0.65	1.95			57.48	
Chisamba (feedlot)					2,000.00	
Coffee (mt green bean/ha)						
Mazabuka					2.50	
Cotton (mt seed cotton/ha)						
Mazabuka					2.50	3.50
Mumbwa	0.50	1.20	0.70	1.50		
Dairy (liters per cow/day)					15.00	20.50
Finger Millet (mt/ha)						
Kasama	0.63	1.50	0.75	2.00		
Groundnuts (mt shelled/ha)						
Chipata	0.32	1.00	0.40	1.20		
Irish Potato (mt/ha)						
Mazabuka	5.00		6.00		18.00	
Mkushi	5.00		6.00		18.00	
Maize (mt/ha)						
Chipata	2.16	3.15	2.61	3.60		
Kasama	1.98	3.15	2.43	3.60		
Mazabuka	1.80	3.15	2.25	3.60	4.50	8.11
Mkushi	2.16	3.15	2.61	3.60	5.41	8.11
Onion (mt/ha)						
Mazabuka	6.50		8.00			
Lusaka	6.50	8.00				
Paprika (mt/ha)						
Lusaka					1.5	
Poultry (birds per 7wk batch)						
Lusaka			50		5,000	
Roses (million stems/ha)						
Lusaka					1.20	
Rice (mt/ha)						
Kasama	8.00	1.50	1.00	2.00		
Mongu	8.00	1.50	1.00	2.00		
Sorghum - white (mt/ha)						
Choma	0.60	2.00	1.50	3.50		
Sorghum - red (mt/ha)						
Mazabuka					4.50	
Soybeans (mt/ha)						
Chipata	0.60	1.00	0.80	1.20		
Mazabuka	0.50	1.00	0.75	1.20	1.75	2.50
Mkushi	0.60	1.00	0.80	1.20	2.00	2.50
Soybeans - irrigated (mt/ha)						
Mazabuka					2.40	3.00
Mkushi					2.40	3.00

Yield Assumptions, continued

	Smallholder		Emergent		Commercial	
	Average	**Potential**	**Average**	**Potential**	**Average**	**Potential**
Sugar Cane (mt/ha)						
Mazabuka					106.00	130.00
Sunflower (mt/ha)						
Choma	0.40	1.00	0.50	1.20		
Katete	0.40	1.00	0.50	1.20		
Tobacco - burley (mt/ha)						
Chipata	0.80	1.20	1.00	1.50		
Tobacco - Virginia (mt/ha)						
Choma					1.30	1.80
Wheat - irrigated (mt/ha)						
Lusaka					5.00	7.00

1995/96: Transportation Cost Assumptions

Domestic Rates (road)

Heavy grains or supplies less than 50 km	120 ZK/mt/km
Heavy grains or supplies more than 50 km	100 ZK/mt/km
Cotton or other light/bulky any distance	145ZK/mt/km
Beef (MT live), farmgate to town	363ZK/mt/km
Beef (MT live), Mazabuka to Lusaka	39.22US$ fixed price

Forex % and Conversion Factors (road)

Foreign exchange percentage	75% imported fuel & spares
Conversion factor	0.64 inclusive 30% duty on fuel & 20% VAT on fare
Conversion factor, VAT exempt crops	0.77 VAT only is reclaimed for coffee

Calculation of Fixed Price Between Select Towns (road). US$1 = 850ZK

	Type of good	Km	ZK/mt	US$/mt
Lusaka - Chipata	Heavy	600	60,000	70.59
Choma - Mazabuka	Heavy	161	16,100	18.94
Lusaka - Choma	Heavy	285	28,500	33.53
Lusaka - Kasama	Heavy	850	85,000	100.00
Lusaka - Katete	Heavy	500	50,000	58.82
Lusaka - Mazabuka	Heavy	125	12,500	14.71
Lusaka - Mazabuka	Cotton	125	18,125	21.32
Lusaka - Mkushi	Heavy	300	30,000	35.29
Lusaka - Mongu	Heavy	610	61,000	71.76
Lusaka - Mumbwa	Heavy	150	15,000	17.65
Lusaka - Mumbwa	Cotton	150	21,750	25.59
Lusaka - Ndola	Heavy	325	32,500	38.24
Lusaka - Ndola	Cotton	325	47,125	55.44
Mkushi - Ndola	Heavy	209	20,900	24.59
Kapiri Mposhi - Lusaka	Heavy	206	20,600	24.24
Solwezi - Ndola	Heavy	284	28,400	33.41

INTERNATIONAL ROUTES
Forex % and Conversion Factors (road, to and from Zambia)

Foreign exchange percentage	75%	
Conversion factor	0.75	Includes levy to enter Zambia and duty/tax on domestic fuel

1995/96: Transportation Cost Assumptions, continued

Road (fixed prices)	US$/MT	Ocean (fixed prices)	US$/MT
Chipata - Lilongwe	**10.00**	**Argentina - South Africa**	**6.00**
Dar es Salaam - Lusaka (cotton)	**145.00**	**Argentina - Tanzania**	**38.00**
Dar es Salaam - Ndola (cotton)	**133.00**	**Gulf Port - South Africa**	**30.00**
Durban - Johannesburg	**21.00**	**Gulf Port - Tanzania**	**N/A**
Jo'burg to Lusaka or Mazabuka	**90.00**	**North Europe - South Africa**	**31.00**
Lusaka or Mazabuka - Francistown	**50.00**	**North Europe - Tanzania**	**33.00**
Lusaka or Mazabuka - Harare	**36.00**	**North Europe - Tanzania (cotton)**	**119.00**
Lusaka or Mazabuka to Jo'burg	**60.00**	**South Europe - Tanzania**	**30.00**
Ndola - Harare	**56.00**	**PORT FEES - Dar es Salaam**	**14.00**
Ndola - Lubumbashi	**25.00**	**PORT FEES - all other ports**	**11.00**
Jo'burg to Lusaka (beef carcass)	**180.00**		

NOTE: Forex % and Conv. Factors for foreign routs will always equal 100% and 1 respectively.
Foreign routes are indicated with **BOLD LETTERING**

1996/97: Transportation Cost Assumptions

Domestic Rates (road)

Heavy grains or supplies less than 50 km	135	ZK/mt/km
Heavy grains or supplies more than 50 km	115	ZK/mt/km
Cotton or other light/bulky any distance	160	ZK/mt/km
Beef (MT live), farmgate to town	**385**	ZK/mt/km
Beef (MT live), Mazabuka to Lusaka	**39.22**	US$ fixed price

Forex % and Conversion Factors (road)

Foreign exchange percentage	**75%**	imported fuel & spares
Conversion factor	**0.67**	inclusive 25% duty on fuel & 20% VAT on fare
Conversion factor, VAT exempt crops	**0.80**	VAT only is reclaimed for coffee

Calculation of Fixed Price Between Select Towns (road)

US$1 = ZK1,250

	Type of good	Km	ZK/mt	US$/mt
Lusaka - Chipata	Heavy	600	**69,000**	**55.20**
Choma - Mazabuka	Heavy	161	**8,515**	**14.81**
Lusaka - Choma	Heavy	285	**32,775**	**26.22**
Lusaka - Kasama	Heavy	850	**97,750**	**78.20**
Lusaka - Katete	Heavy	500	**57,500**	**46.00**
Lusaka - Mazabuka	Heavy	125	**14,375**	**11.50**
Lusaka - Mazabuka	Cotton	125	**20,000**	**16.00**
Lusaka - Mkushi	Heavy	300	**34,500**	**27.60**
Lusaka - Mongu	Heavy	610	**70,150**	**56.12**
Lusaka - Mumbwa	Heavy	150	**17,250**	**13.80**
Lusaka - Mumbwa	Cotton	150	**24,000**	**19.20**
Lusaka - Ndola	Heavy	325	**37,375**	**29.90**
Lusaka - Ndola	Cotton	325	**52,000**	**41.60**
Mkushi - Ndola	Heavy	209	**24,035**	**19.23**
Kapiri Mposhi - Lusaka	Heavy	206	**23,690**	**18.95**

INTERNATIONAL ROUTES:
Forex % and Conversion Factors (road, to and from Zambia)

Foreign exchange percentage	**75%**	
Conversion factor	**0.80**	Includes levy to enter Zambia and duty/tax on domestic fuel

NOTE: Forex % and conv. factors for foreign routes will always equal 100% and 1 respectively.
Foreign routes are indicated with **BOLD LETTERING**.

1996/97: Transportation Cost Assumptions, continued

Road (fixed prices)	US$/MT	Ocean (fixed prices)	US$/MT
Chipata - Lilongwe	**10.00**	**Argentina - South Africa**	**36.00**
Dar es Salaam - Lusaka (cotton)	**176.00**	**Argentina - Tanzania**	**38.00**
Dar es Salaam - Ndola (cotton)	**150.00**	**Gulf Port - South Africa**	**30.00**
Durban - Johannesburg	**22.00**	**Gulf Port - Tanzania**	**N/A**
Jo'burg to Lusaka or Mazabuka	**100.00**	**North Europe - South Africa**	**31.00**
Lusaka or Mazabuka - Francistown	**50.00**	**North Europe - Tanzania**	**33.00**
Lusaka or Mazabuka - Harare	**35.00**	**North Europe - Tanzania (cotton)**	**119.00**
Lusaka or Mazabuka to Jo'burg	**55.00**	**South Europe - Tanzania**	**30.00**
Ndola - Harare	**53.00**	**PORT FEES - Dar es Salaam**	**14.00**
Ndola - Lubumbashi	**25.00**	**PORT FEES - all other ports**	**11.00**
Jo'burg to Lusaka (beef carcass)	180.00		

Appendix 2: Data Tables

In the data that follow, there are separate tables for each farm sector and production level covering the 1995/96 and 1996/97 farming seasons. Importantly, yield expectations and quantities of inputs used for each production model were held constant for two time periods so that the updated results only indicate the impact of relative price changes on the returns to agricultural production.

For each sector, production level and time period, there are separate tables where the activities are ranked by the following indicators: (i) DRC; (ii) net profits; (iii) variable costs; and (iv) gross margin/variable cost ratio.

1995 / 96

1995/96: Small Scale Activities (Average Management), Sorted by DRC (all indicators).

Activity	Location	Parity Basis	Farmgate Parity (US$/MT)	DRC	Net Profit (US$/ha)	Gross Margin (US$/ha)	G. Marg Var Cost	Variable Costs (US$/ha)	Labor Days (ha)	Labor-% Var Costs	Output Trans (I)	Trad. Input Trans (J)	Dom. Factor Trans (K)	Net Policy Trans (L)	NPC	EPC	Pct. Change in Yield to G. Margin = 0	Pct. Change in Yield to DRC = 1
Average Management																		
Maize	Mkushi	Import Argentina	262.41	0.06	123	123	0.77	159	65	19%	17	8	5	4	0.03	0.02	-46%	-75%
Maize	Mazabuka	Import Argentina	278.00	0.10	113	113	0.78	145	65	21%	30	7	(1)	24	0.07	0.06	-46%	-73%
Maize	Kasama	Import Argentina	242.00	0.10	82	82	0.50	163	65	14%	18	8	5	5	0.04	0.03	-35%	-69%
Maize	Chipata	Import Argentina	207.4	0.14	123	123	0.77	159	65	14%	(5)	8	12	(26)	(0.01)	(0.04)	-46%	-71%
Cotton	Mumbwa	Import UK	800.10	0.17	145	151	1.78	85	125	70%	(6)	4	3	(13)	(0.01)	(0.03)	-64%	-79%
Sugar Beans	Solwezi	Import Zimbabwe	892.59	0.17	388	388	2.00	194	100	18%	1	4	11	(13)	0.00	(0.00)	-67%	-78%
Onion	Lusaka	Import Zimbabwe	400.00	0.18	579	579	0.80	721	225	15%	-	60	54	(114)	-	(0.02)	-46%	-77%
Finger Millet	Kasama	Kasama price	280.00	0.18	118	118	3.10	38	60	55%	-	2	2	(4)	-	(0.01)	-78%	-81%
Onion	Mazabuka	Import Zimbabwe	385.29	0.19	464	464	0.64	721	225	15%	(26)	60	63	(148)	(0.01)	(0.04)	-41%	-77%
Sugar Beans	Chipata	Import Zimbabwe	835.41	0.19	441	441	2.27	194	100	18%	(11)	4	15	(30)	(0.01)	(0.02)	-70%	-77%
Cotton	Mumbwa	Export UK	619.34	0.24	145	151	1.78	85	125	70%	(13)	4	5	(22)	(0.04)	(0.05)	-65%	-75%
Maize	Mkushi	Import Zimbabwe	141.41	0.27	123	123	0.77	159	65	19%	8	8	8	(8)	0.03	(0.00)	-46%	-54%
Tobacco (burley)	Chipata	Export Malawi	1,425.00	0.30	559	564	1.07	530	550	37%	(22)	16	26	(64)	(0.02)	(0.04)	-55%	-60%
Sunflower	Katete	Import Zimbabwe	177.18	0.30	37	37	1.28	29	40	49%	(4)	2	3	(9)	(0.05)	(0.08)	-58%	-68%
Maize	Mkushi	Export Zaire	140.41	0.31	123	123	0.77	159	65	19%	(24)	8	19	(52)	(0.07)	(0.12)	-46%	-60%
Maize	Mazabuka	Import Zimbabwe	146.00	0.32	113	113	0.78	145	65	21%	12	7	5	(0)	0.05	0.03	-46%	-49%
Sunflower	Choma	Import Zimbabwe	202.47	0.32	32	32	0.96	34	40	56%	(1)	2	2	(5)	(0.01)	(0.04)	-51%	-65%
Maize	Chipata	Export Malawi	120.00	0.35	123	123	0.77	159	65	14%	(4)	8	12	(25)	(0.02)	(0.06)	-46%	-49%
Maize	Kasama	Import Zimbabwe	121.00	0.42	82	82	0.50	163	65	14%	19	8	8	3	0.08	0.07	-35%	-38%
Maize	Mazabuka	Export Botwana	110.00	0.48	113	113	0.78	145	65	21%	(17)	7	15	(39)	(0.07)	(0.14)	-46%	-43%
Groundnuts	Chipata	Export South Africa	609.41	0.50	68	68	0.62	110	100	32%	(6)	1	7	(14)	(0.03)	(0.04)	-39%	-49%
Maize	Kasama	Export Tanzania	100.00	0.55	82	82	0.50	163	65	14%	(18)	8	17	(42)	(0.07)	(0.15)	-35%	-36%
Maize	Chipata	Import Zimbabwe	75.41	0.56	123	123	0.77	159	65	14%	(27)	8	20	(55)	(0.13)	(0.27)	-46%	-31%
White Sorghum	Choma	Eport Botswana	111.06	0.70	47	47	0.86	55	88	68%	(3)	2	3	(8)	(0.04)	(0.08)	-48%	-29%
Soyabeans	Mkushi	Export South Africa	234.71	0.71	17	17	0.15	116	80	33%	(6)	2	7	(15)	(0.04)	(0.06)	-14%	-28%

1995/96: Small Scale Activities (Average Management), Sorted by DRC (all indicators), continued

Activity	Location	Parity Basis	Farmgate Parity (US$/MT)	DRC	Net Profit (US$/ha)	Gross Margin (US$/ha)	G. Marg Var Cost	Variable Costs (US$/ha)	Labor Days (ha)	Labor-% Var Costs	Output Trans (I)	Trad. Input Trans (J)	Dom. Factor Trans (K)	Net Policy Trans (L)	NPC	EPC	Pct. Change in Yield to G. Margin = 0	Pct. Change in Yield to DRC = 1
Average Management																		
Soyabeans	Chipata	Export South Africa	199.41	0.72	7	7	0.07	106	80	27%	(11)	2	9	(23)	(0.08)	(0.10)	-7%	-27%
Irish Potato	Mkushi	Import Zimbabwe	515.41	0.76	(18)	(18)	(0.01)	2,253	264	6%	(33)	45	156	(234)	(0.01)	(0.03)	1%	-21%
Soyabeans	Mazabuka	Export South Africa	270.00	0.78	0	0	-	114	80	33%	-	2	5	(7)	-	(0.02)	0%	-21%
White Sorghum	Solwezi	Export Botswana	58.35	0.83	41	41	0.89	46	88	61%	(12)	2	6	(20)	(0.20)	(0.27)	-49%	-19%
Irish Potato	Mazabuka	Import Zimbabwe	461.29	0.87	(102)	(102)	(0.05)	2,249	264	6%	(20)	45	151	(216)	(0.01)	(0.03)	5%	-12%
Rice	Kasama	Import price, (landed Ndola)	108.32	1.12	5	5	0.05	118	130	39%	(11)	3	9	(23)	(0.10)	(0.20)	-5%	9%
Rice	Mongu	Import price, (landed Lusaka)	94.13	1.13	26	26	0.23	115	130	40%	(16)	3	11	(30)	(0.15)	(0.28)	-19%	10%
Beef	Mazabuka	Regional Export	673.63	4.19	(2,767)	293	(0.90)	3,059	137	3%	(30)	-	52	(82)	(0.04)	(0.04)	933%	489%

1995/96: Small Scale Activities (Potential Management), Sorted by DRC (all indicators).

Activity	Location	Parity Basis	Farmgate Parity (US$/MT)	DRC	Net Profit (US$/ha)	Gross Margin (US$/ha)	G. Marg Var Cost	Variable Costs (US$/ha)	Labor Days (ha)	Labor-% Var Costs	Output Trans (I)	Trad. Input Trans (J)	Dom. Factor Trans (K)	Net Policy Trans (L)	NPC	EPC	Pct. Change in Yield to G. Margin = 0	Pct. Change in Yield to DRC = 1
Potential Management																		
Maize	Mazabuka	Import Argentina	278.00	0.06	217	217	0.92	235	75	15%	53	13	(2)	42	0.07	0.06	-50%	-76%
Maize	Mkushi	Import Argentina	262.41	0.07	144	144	0.54	267	75	13%	25	13	10	3	0.03	0.02	-37%	-71%
Cotton	Mumbwa	Import UK	800.10	0.09	442	447	3.80	118	150	60%	(14)	6	6	(26)	(0.01)	(0.02)	-79%	-88%
Maize	Kasama	Import Argentina	242.00	0.13	88	88	0.29	303	75	9%	28	13	12	4	0.04	0.03	-24%	-64%
Cotton	Mumbwa	Export UK	619.34	0.14	442	447	3.80	118	150	60%	(30)	6	12	(48)	(0.04)	(0.05)	-80%	-86%
Maize	Chipata	Import Argentina	207.41	0.14	153	153	0.59	259	75	10%	(7)	13	20	(40)	(0.01)	(0.04)	-39%	-67%
Finger Millet	Kasama	Kasama price	280.00	0.14	270	270	2.22	122	75	22%	-	5	7	(13)	-	(0.01)	-71%	-75%
Sugar Beans	Solwezi	Import Zimbabwe	892.59	0.16	455	455	1.86	244	120	17%	2	5	13	(17)	0.00	(0.00)	-66%	-77%
Sugar Beans	Chipata	Import Zimbabwe	835.41	0.18	518	518	2.12	244	120	17%	(13)	5	18	(37)	(0.01)	(0.02)	-69%	-76%
Maize	Mazabuka	Import Zimbabwe	146.00	0.23	217	217	0.92	235	75	15%	21	13	9	(0)	0.05	0.03	-50%	-54%
Tobacco (burley)	Chipata	Export Malawi	1,425.00	0.24	935	941	1.34	701	600	30%	(32)	23	38	(93)	(0.02)	(0.04)	-61%	-65%
Sunflower	Choma	Import Zimbabwe	202.47	0.29	80	80	0.95	85	45	25%	4	6	15	(17)	0.02	(0.01)	-51%	-65%
Maize	Mkushi	Import Zimbabwe	141.41	0.30	144	144	0.54	267	75	13%	12	13	14	(15)	0.03	(0.00)	-37%	-46%
Maize	Mkushi	Export Zaire	140.41	0.34	144	144	0.54	267	75	13%	(36)	13	30	(79)	(0.07)	(0.13)	-37%	-53%
White Sorghum	Choma	Export Bostwana	111.06	0.35	220	220	1.84	120	103	37%	(10)	8	10	(28)	(0.04)	(0.09)	-67%	-57%
Sunflower	Katete	Import Zimbabwe	177.18	0.37	82	82	1.00	82	45	19%	1	6	25	(29)	0.01	(0.02)	-52%	-62%
Maize	Chipata	Export Malawi	120.00	0.37	153	153	0.59	259	75	10%	(6)	13	20	(38)	(0.02)	(0.07)	-39%	-42%
Groundnuts	Chipata	Export South Africa	609.41	0.38	272	272	0.95	286	140	17%	(19)	4	22	(46)	(0.03)	(0.04)	-49%	-58%
Maize	Mazabuka	Export Botswana	110.00	0.40	217	217	0.92	235	75	15%	(30)	13	26	(68)	(0.07)	(0.14)	-50%	-48%
Soyabeans	Mazabuka	Export South Africa	270.00	0.49	65	65	0.39	164	95	27%	-	4	9	(12)	-	(0.02)	-29%	-45%
Maize	Kasama	Import Zimbabwe	121.00	0.55	88	88	0.29	303	75	9%	15	13	16	(14)	0.04	0.01	-24%	-26%
Soyabeans	Mkushi	Export South Africa	234.71	0.57	54	54	0.32	168	95	27%	(10)	4	12	(25)	(0.04)	(0.06)	-25%	-38%
Soyabeans	Chipata	Export South Africa	199.41	0.60	29	29	0.18	161	95	21%	(19)	4	15	(38)	(0.08)	(0.12)	-16%	-35%
Maize	Chipata	Import Zimbabwe	75.41	0.62	153	153	0.59	259	75	10%	(39)	13	31	(82)	(0.13)	(0.32)	-39%	-22%
Maize	Kasama	Export Tanzania	100.00	0.66	88	88	0.29	303	75	9%	(28)	13	30	(71)	(0.07)	(0.17)	-24%	-25%
Rice	Mongu	Import price, landed Lusaka	94.13	0.94	73	73	0.38	192	150	28%	(31)	7	21	(58)	(0.15)	(0.32)	-29%	-4%
Rice	Kasama	Import price,	108.32	0.95	32	32	0.16	200	150	26%	(20)	7	18	(44)	(0.10)	(0.23)	-14%	-3%

1995/96: Emergent Activities (Average Management), Sorted by DRC (all indicators)

Activity	Location	Parity Basis	Farmgate Parity (US$/MT)	DRC	Net Profit (US$/ha)	Gross Margin (US$/ha)	G. Marg Var Cost	Variable Costs (US$/ha)	Labor Days (ha)	Labor-% Var Costs	Output Trans (I)	Trad. Input Trans (J)	Dom. Factor Trans (K)	Net Policy Trans (L)	NPC	EPC	Pct. Change in Yield to G. Margin = 0	Pct. Change in Yield to DRC = 1
Average Management																		
Maize	Mkushi	Import Argentina	262.41	0.06	165	169	0.98	172	65	18%	21	9	4	9	0.03	0.02	-51%	-77%
Maize	Mazabuka	Import Argentina	278.00	0.10	160	163	1.02	160	65	19%	38	7	(3)	33	0.07	0.06	-52%	-75%
Maize	Kasama	Import Argentina	242.00	0.10	121	124	0.70	177	65	13%	22	8	4	9	0.04	0.03	-42%	-72%
Maize	Chipata	Import Argentina	207.41	0.14	164	168	0.97	173	65	13%	(6)	9	13	(27)	(0.01)	(0.03)	-51%	-72%
Onion	Lusaka	Import Zimbabwe	400.00	0.16	753	757	0.90	843	250	14%	-	68	64	(132)	-	(0.02)	-48%	-78%
Onion	Mazabuka	Import Zimbabwe	385.29	0.17	612	616	0.73	843	250	14%	(32)	68	74	(174)	(0.01)	(0.03)	-43%	-78%
Cotton	Mumbwa	Import UK	800.10	0.18	174	183	1.25	146	125	40%	(8)	5	4	(17)	(0.01)	(0.02)	-56%	-74%
Sugar Beans	Chipata	Import Zimbabwe	835.41	0.20	481	485	2.19	221	100	16%	(12)	5	18	(35)	(0.01)	(0.02)	-69%	-76%
Finger Millet	Kasama	Kasama price	280.00	0.23	137	141	2.58	55	60	39%	-	3	3	(5)	-	(0.01)	-73%	-75%
Cotton	Mumbwa	Export UK	619.34	0.26	174	183	1.25	146	125	40%	(18)	5	8	(30)	(0.04)	(0.05)	-56%	-68%
Maize	Mkushi	Import Zimbabwe	141.41	0.26	165	169	0.98	172	65	18%	10	9	7	(6)	0.03	0.01	-51%	-57%
Maize	Mazabuka	Import Zimbabwe	146.00	0.30	160	163	1.02	160	65	19%	15	7	5	3	0.05	0.03	-52%	-53%
Maize	Mkushi	Export Zaire	140.41	0.30	165	169	0.98	172	65	18%	(30)	9	21	(59)	(0.07)	(0.11)	-51%	-62%
Tobacco (burley)	Chipata	Export Malawi	1,425.00	0.34	613	622	0.83	746	600	28%	(27)	20	37	(85)	(0.02)	(0.04)	-48%	-54%
Maize	Chipata	Export Malawi	120.00	0.34	164	168	0.97	173	65	13%	(5)	9	13	(26)	(0.02)	(0.05)	-51%	-52%
Maize	Kasama	Import Zimbabwe	121.00	0.40	121	124	0.70	177	65	13%	12	8	8	(4)	0.04	0.02	-42%	-43%
Poultry (broilers)	Lusaka	Import parity	4.14	0.43	512.22	559.71	0.58	969.23	17	1%	-	17.89	18.05	(35.94)	-	(0.01)	-37%	-50%
Maize	Mazabuka	Export Botswana	110.00	0.45	160	163	1.02	160	65	19%	(21)	7	17	(45)	(0.07)	(0.12)	-52%	-48%
White Sorghum	Choma	Export Botswana	111.06	0.46	151	155	1.55	100	88	37%	(8)	6	8	(21)	(0.04)	(0.09)	-62%	-49%
Sunflower	Choma	Import Zimbabwe	202.47	0.46	25	29	0.55	53	40	35%	(1)	3	3	(7)	(0.01)	(0.04)	-36%	-50%
Sunflower	Katete	Import Zimbabwe	177.18	0.46	30	34	0.70	49	40	29%	(5)	3	4	(12)	(0.05)	(0.08)	-42%	-51%
Maize	Kasama	Export Tanzania	100.00	0.51	121	124	0.70	177	65	13%	(22)	8	19	(48)	(0.07)	(0.13)	-42%	-41%
Maize	Chipata	Import Zimbabwe	75.41	0.52	164	168	0.97	173	65	13%	(32)	9	22	(63)	(0.13)	(0.23)	-51%	-35%
Groundnuts	Chipata	Export South Africa	609.41	0.53	72	76	0.52	147	120	29%	(8)	3	10	(21)	(0.03)	(0.04)	-34%	-45%
Soyabeans	Mazabuka	Export South Africa	270.00	0.60	36	40	0.31	131	80	29%	-	3	6	(9)	-	(0.02)	-24%	-38%
Beef	Mazabuka	Regional Export	673.63	0.61	360	393	0.55	718	301	30%	(90)	5	173	(269)	(0.04)	(0.04)	-35%	-53%
Soyabeans	Mkushi	Export South Africa	234.71	0.62	42	46	0.35	131	80	29%	(8)	3	9	(19)	(0.04)	(0.06)	-26%	-37%

1995/96: Emergent Activities (Average Management), Sorted by DRC (all indicators), continued

Activity	Location	Parity Basis	Farmgate Parity (US$/MT)	DRC	Net Profit (US$/ha)	Gross Margin (US$/ha)	G. Marg Var Cost	Variable Costs (US$/ha)	Labor Days (ha)	Labor-% Var Costs	Output Trans (I)	Trad. Input Trans (J)	Dom. Factor Trans (K)	Net Policy Trans (L)	NPC	EPC	Pct. Change in Yield to G. Margin = 0	Pct. Change in Yield to DRC = 1
Average Management																		
Soyabeans	Chipata	Export South Africa	199.41	0.65	24	27	0.22	124	80	23%	(15)	3	12	(31)	(0.08)	(0.10)	-18%	-35%
Irish Potato	Mkushi	Import Zimbabwe	515.41	0.69	199	202	0.08	2,480	240	5%	(40)	52	175	(267)	(0.01)	(0.03)	-8%	-28%
White Sorghum	Solwezi	Export Botswana	58.35	0.73	110	114	1.12	102	88	37%	(29)	6	15	(50)	(0.20)	(0.30)	-54%	-26%
Irish Potato	Mazabuka	Import Zimbabwe	461.29	0.78	103	106	0.04	2,470	240	5%	(24)	52	169	(245)	(0.01)	(0.03)	-4%	-19%
Rice	Kasama	Import price, landed Ndola	108.32	1.01	17	21	0.15	134	130	34%	(13)	4	11	(28)	(0.10)	(0.18)	-14%	1%
Rice	Mongu	Import price, landed Lusaka	94.13	1.03	42	46	0.35	131	130	35%	(20)	4	13	(37)	(0.15)	(0.25)	-26%	2%

1995/96: Emergent Activities (Potential Management), Sorted by DRC (all indicators).

Activity	Location	Parity Basis	Farmgate Parity (US$/MT)	DRC	Net Profit (US$/ha)	Gross Margin (US$/ha)	G. Marg Var Cost	Variable Costs (US$/ha)	Labor Days (ha)	Labor-% Var Costs	Output Trans (I)	Trad. Input Trans (J)	Dom. Factor Trans (K)	Net Policy Trans (L)	NPC	EPC	Pct. Change in Yield to G. Margin = 0	Pct. Change in Yield to DRC = 1
Potential Management																		
Maize	Mazabuka	Import Argentina	278.00	0.06	269	273	1.11	245	75	14%	61	12	(4)	53	0.07	0.07	-54%	-77%
Maize	Mkushi	Import Argentina	262.41	0.07	190	194	0.70	276	75	13%	29	12	8	9	0.03	0.02	-42%	-73%
Cotton	Mumbwa	Import UK	800.10	0.10	503	512	2.65	193	150	36%	(17)	6	8	(31)	(0.01)	(0.02)	-73%	-84%
Maize	Kasama	Import Argentina	242.00	0.12	131	135	0.43	312	75	8%	32	12	10	10	0.04	0.03	-31%	-66%
Maize	Chipata	Import Argentina	207.41	0.14	198	202	0.75	268	75	10%	(8)	12	21	(40)	(0.01)	(0.03)	-44%	-69%
Finger Millet	Kasama	Kasama Price	280.00	0.14	378	382	2.71	141	75	19%	-	7	9	(15)	-	(0.01)	-74%	-78%
Cotton	Mumbwa	Export UK	619.34	0.15	503	512	2.65	193	150	36%	(38)	6	15	(59)	(0.04)	(0.05)	-73%	-80%
Sugar Beans	Chipata	Import Zimbabwe	835.41	0.19	553	557	2.07	269	120	16%	(14)	5	21	(41)	(0.01)	(0.02)	-68%	-75%
Maize	Mazabuka	Import Zimbabwe	146.00	0.23	269	273	1.11	245	75	14%	24	12	8	5	0.05	0.04	-54%	-56%
Tobacco (burley)	Chipata	Export Malawi	1,425.00	0.23	1,200	1,209	1.43	843	650	27%	(41)	28	45	(113)	(0.02)	(0.04)	-62%	-67%
White Sorghum	Choma	Expot Botswana	111.06	0.25	444	448	3.07	146	103	30%	(18)	11	15	(44)	(0.04)	(0.08)	-77%	-70%
Sunflower	Choma	Import Zimbabwe	202.47	0.26	91	95	0.92	103	45	21%	(3)	6	7	(16)	(0.01)	(0.04)	-48%	-62%
Maize	Mkushi	Import Zimbabwe	141.41	0.28	190	194	0.70	276	75	13%	14	12	13	(11)	0.03	0.01	-42%	-50%
Sunflower	Katete	Import Zimbabwe	177.18	0.29	93	97	0.96	101	45	16%	(11)	6	10	(27)	(0.05)	(0.09)	-49%	-60%
Maize	Mkushi	Export Zaire	140.41	0.33	190	194	0.70	276	75	13%	(41)	12	31	(84)	(0.07)	(0.11)	-42%	-56%
Maize	Chipata	Export Malawi	120.00	0.35	198	202	0.75	268	75	10%	(7)	12	20	(39)	(0.02)	(0.06)	-44%	-46%
Groundnuts	Chipata	Export South Africa	609.41	0.36	344	348	1.08	321	160	18%	(23)	6	26	(55)	(0.03)	(0.04)	-52%	-61%
Maize	Mazabuka	Export Botswana	110.00	0.38	269	273	1.11	245	75	14%	(34)	12	27	(73)	(0.07)	(0.13)	-54%	-51%
Soyabeans	Mazabuka	Export South Africa	270.00	0.46	92	95	0.53	179	95	25%	-	4	9	(14)	-	(0.02)	-35%	-48%
Maize	Kasama	Import Zimbabwe	121.00	0.49	131	135	0.43	312	75	8%	17	12	15	(10)	0.04	0.02	-31%	-32%
Soyabeans	Mkushi	Export South Africa	234.71	0.53	80	83	0.46	183	95	24%	(11)	4	13	(29)	(0.04)	(0.06)	-32%	-42%
Soyabeans	Chipata	Export South Africa	199.41	0.56	48	51	0.29	176	95	19%	(23)	4	17	(45)	(0.08)	(0.11)	-23%	-39%
Maize	Chipata	Import Zimbabwe	75.41	0.57	198	202	0.75	268	75	10%	(44)	12	33	(89)	(0.13)	(0.27)	-44%	-27%
Maize	Kasama	Export Tanzania	100.00	0.60	131	135	0.43	312	75	8%	(32)	12	31	(75)	(0.07)	(0.15)	-31%	-30%
Rice	Kasama	Import price, landed Ndola	108.32	0.83	64	68	0.28	241	160	23%	(26)	7	22	(56)	(0.10)	(0.20)	-22%	-11%
Rice	Mongu	Import price,	94.13	0.83	118	122	0.53	231	160	24%	(41)	7	26	(74)	(0.15)	(0.29)	-35%	-12%

1995/96: Commercial Activities (Average Management), Sorted by DRC (all indicators).

Activity	Location	Parity Basis	Farmgate Parity (US$/MT)	DRC	Net Profit (US$/ha)	Gross Margin (US$/ha)	G. Marg Var Cost	Variable Costs (US$/ha)	Labor Days (ha)	Labor-% Var Costs	Output Trans (I)	Trad. Input Trans (J)	Dom. Factor Trans (K)	Net Policy Trans (L)	NPC	EPC	Pct. Change in Yield to G. Margin = 0	Pct. Change in Yield to DRC = 1
Average Management																		
Coffee	Mazabuka	Export Europe-current	3,703.28	0.08	7,189	7,761	5.72	1,358	250	22%	(42)	83	216	(341)	(0.00)	(0.02)	-85%	-82%
Maize	Mkushi	Import Argentina	262.41	0.13	(107)	41	0.06	665	95	19%	81	87	118	(124)	0.07	(0.01)	-6%	-57%
Roses	Lusaka	VBA Auction, Holland	0.13	0.14	88,045	106,136	2.13	49,864	7,200	17%	-	484	5,387	(5,872)	-	(0.00)	-68%	-60%
Maize	Mazabuka	Import Argentina	278.00	0.16	(121)	27	0.04	619	95	20%	76	83	116	(123)	0.07	(0.01)	-4%	-54%
Coffee	Mazabuka	Export Europe-Long-term	2,035.00	0.16	3,080	3,653	2.69	1,358	250	22%	(42)	83	216	(341)	(0.01)	(0.03)	-70%	-68%
Cotton (irr)	Mazabuka	Import	803.39	0.16	237	489	0.71	688	212	34%	(27)	122	178	(326)	(0.01)	(0.09)	-42%	-69%
Wheat (irr)	Lusaka	Import USA	302.00	0.17	395	647	0.98	659	95	19%	84	111	129	(155)	0.06	(0.03)	-51%	-55%
Coffee	Mazabuka	Export Europe - Short-term	1,527.00	0.23	1,830	2,402	1.77	1,358	250	22%	(42)	83	216	(341)	(0.01)	(0.04)	-64%	-58%
Cotton (irrigated)	Mazabuka	Export	622.62	0.24	237	489	0.71	688	212	34%	(61)	122	189	(372)	(0.04)	(0.14)	-42%	-61%
Paprika	Lusaka	Export Spain	1,681.76	0.25	930	1,182	0.83	1,419	425	31%	(29)	137	344	(510)	(0.01)	(0.09)	-46%	-56%
Sugar cane	Mazabuka	Export to region	30.53	0.32	478	789	0.36	2,204	171	13%	(358)	215	610	(1,183)	(0.06)	(0.11)	-26%	-64%
Irish Potato	Mkushi	Import Zimbabwe	515.41	0.40	2,614	2,866	0.55	5,181	205	5%	(119)	326	577	(1,023)	(0.01)	(0.06)	-36%	-52%
Tobacco (virginia)	Choma	Export Zimbabwe	1,698.53	0.43	160	392	0.23	1,723	775	44%	12	122	550	(660)	0.01	(0.07)	-19%	-43%
Poultry (broilers)	Lusaka	Import parity	4.14	0.43	4,359	5,094	0.54	9,390.91	49	1%	-	215.6	206.38	(422)	-	(0.01)	-35%	-48%
Irish Potato	Mazabuka	Import Zimbabwe	461.29	0.45	2,335	2,586	0.50	5,143	205	5%	(71)	326	558	(956)	(0.01)	(0.06)	-34%	-46%
Maize	Mkushi	Export Zaire	140.41	0.49	(107)	41	0.06	665	95	19%	(61)	87	165	(313)	(0.07)	(0.29)	-6%	-32%
Soyabeans (irr.)	Mazabuka	Export South Africa	270.00	0.50	(124)	128	0.30	421	85	27%	-	92	127	(219)	-	(0.24)	-24%	-30%
Maize	Mkushi	Import Zimbabwe	141.41	0.52	(107)	41	0.06	665	95	19%	21	87	138	(204)	0.03	(0.21)	-6%	-22%
Red Sorghum	Mazabuka	Export Botswana	125.00	0.55	55	204	0.41	502	155	36%	-	72	143	(215)	-	(0.25)	-30%	-23%
Soyabeans	Mkushi	Export South Africa	234.71	0.55	(94)	55	0.14	389	85	30%	(19)	66	123	(209)	(0.04)	(0.27)	-13%	-29%
Soyabeans	Mazabuka	Export South Africa	270.00	0.57	(131)	18	0.05	382	85	30%	-	66	116	(182)	-	(0.23)	-5%	-27%
Soyabeans (irr.)	Mkushi	Export South Africa	234.71	0.61	(143)	108	0.25	425	85	27%	(23)	92	135	(249)	(0.04)	(0.33)	-21%	-23%
Maize	Mazabuka	Import Zimbabwe	146.00	0.68	(121)	27	0.04	619	95	20%	30	83	131	(184)	0.05	(0.23)	-4%	-12%
Dairy	Mazabuka	Import parity	0.27	0.70	(181)	(6)	(0.01)	1,131.62	192	24%	53.46	25.39	184.73	(156.7)	0.04	0.03	1%	-23%
Beef (range)	Mazabuka	Regional Export	673.63	0.74	5,837	14,041	0.49	28,533	3,176	13%	(2,652)	2,058	8,886	(13,596)	(0.04)	(0.08)	-33%	-34%
Beef (feedlot)	Mazabuka	Regional Export	673.63	0.75	494,230	541,178	0.34	1,606,97	116,536	1%	(64,896)	5,360	203,771	(274,072)	(0.03)	(0.03)	-25%	-28%
Maize	Mazabuka	Export Botswana	110.00	0.97	(121)	27	0.04	619	95	20%	(42)	83	155	(281)	(0.07)	(0.53)	-4%	-1%

1995/96: Commercial Activities (Potential Management), Sorted by DRC (all indicators).

Activity	Location	Parity Basis	Farmgate Parity (US$/MT)	DRC	Net Profit (US$/ha)	Gross Margin (US$/ha)	G. Marg Var Cost	Variable Costs (US$/ha)	Labor Days (ha)	Labor-% Var Costs	Output Trans (I)	Trad. Input Trans (J)	Dom. Factor Trans (K)	Net Policy Trans (L)	NPC	EPC	Pct. Change in Yield to G. Margin = 0	Pct. Change in Yield to DRC = 1
Potential Management																		
Maize	Mkushi	Import Argentina	262.41	0.05	142	291	0.38	768	105	17%	65	96	137	(168)	0.03	(0.02)	-29%	-69%
Maize	Mazabuka	Import Argentina	278.00	0.05	286	435	0.60	730	105	18%	137	96	111	(70)	0.07	0.03	-39%	-71%
Wheat (irrigated)	Lusaka	Import USA	302.00	0.10	835	1,086	1.46	742	105	18%	118	119	130	(131)	0.06	(0.00)	-61%	-65%
Cotton (irrigated)	Mazabuka	Import	803.39	0.13	623	875	1.13	772	240	34%	(38)	125	195	(358)	(0.01)	(0.07)	-54%	-75%
Cotton (irrigated)	Mazabuka	Export	622.62	0.19	623	875	1.13	772	240	34%	(86)	125	211	(422)	(0.04)	(0.11)	-58%	-71%
Maize	Mazabuka	Import Zimbabwe	146.00	0.25	286	435	0.60	730	105	18%	55	96	138	(180)	0.05	(0.06)	-39%	-45%
Maize	Mkushi	Import Zimbabwe	141.41	0.28	142	291	0.38	768	105	17%	31	96	148	(213)	0.03	(0.11)	-29%	-41%
Tobacco (virginia)	Choma	Export Zimbabwe	1,698.53	0.29	914	1,147	0.64	1,782	800	43%	16	131	555	(669)	0.01	(0.05)	-41%	-58%
Sugar cane	Mazabuka	Export to region	30.53	0.30	652	963	0.36	2,708	193	12%	(439)	271	727	(1,437)	(0.06)	(0.12)	-26%	-65%
Maize	Mkushi	Export Zaire	140.41	0.33	142	291	0.38	768	105	17%	(92)	96	189	(377)	(0.07)	(0.21)	-29%	-49%
Soyabeans	Mazabuka	Export South Africa	270.00	0.36	8	157	0.38	414	90	29%	-	69	121	(190)	-	(0.15)	-28%	-45%
Soyabeans (irr.)	Mazabuka	Export South Africa	270.00	0.39	(34)	218	0.47	468	90	26%	-	94	133	(227)	-	(0.18)	-33%	-40%
Maize	Mazabuka	Export Botswana	110.00	0.44	286	435	0.60	730	105	18%	(76)	96	182	(354)	(0.07)	(0.26)	-39%	-38%
Soyabeans (irr)	Mkushi	Export South Africa	234.71	0.48	(61)	190	0.40	476	90	25%	(29)	94	143	(266)	(0.04)	(0.26)	-29%	-33%
Dairy	Mazabuka	Import parity	0.27	0.59	19	195	0.15	1,341	192	20%	72.90	28.67	180.98	(136.75)	0.04	0.03	-13%	-33%

1996/97

1996/97: Small Scale Activities (Average Management), Sorted by DRC (all indicators).

Activity	Location	Parity Basis	Farmgate Parity (US$/MT)	DRC	Net Profit (US$/ha)	Gross Margin (US$/ha)	G. Marg Var Cost	Variable Costs (US$/ha)	Labor Days (ha)	Labor-% Var Costs	Output Trans (I)	Trad. Input Trans (J)	Dom. Factor Trans (K)	Net Policy Trans (L)	NPC	EPC	Pct. Change in Yield to G. Margin = 0	Pct. Change in Yield to DRC = 1
Average Management																		
Maize	Mkushi	Import Argentina	267.77	0.07	75.46	75.46	0.43	173.89	65	18%	21.39	6.33	2.73	12.33	0.04	0.04	-32%	-72%
Maize	Mazabuka	Import Argentina	289.00	0.10	(18.81)	(18.81)	(0.12)	162.66	65	19%	27.00	5.31	(0.06)	21.75	0.06	0.06	14%	-70%
Maize	Chipata	Import Argentina	233.80	0.11	16.90	16.90	0.10	174.91	65	15%	6.74	6.33	7.97	(7.56)	0.01	0.00	-9%	-70%
Maize	Kasama	Import Argentina	242.00	0.13	42.18	42.18	0.24	177.60	65	15%	17.67	5.82	4.33	7.52	0.04	0.04	-20%	-65%
Sugar Beans	Solwezi	Import Zimbabwe	923.00	0.17	247.42	247.42	1.22	202.58	100	20%	7.16	2.87	7.63	(3.35)	0.01	0.01	-56%	-77%
Onion	Lusaka	Import Zimbabwe	400.00	0.18	587.63	587.63	0.82	712.37	225	15%	-	48.07	47.11	(95.18)	-	(0.02)	-46%	-77%
Cotton	Mumbwa	Import UK	792.91	0.18	82.42	86.02	0.96	89.98	125	67%	(4.61)	4.05	2.63	(11.28)	(0.01)	(0.02)	-49%	-78%
Onion	Mazabuka	Import Zimbabwe	388.50	0.18	483.63	483.63	0.68	712.37	225	15%	(18.50)	48.07	53.28	(119.85)	(0.01)	(0.03)	-42%	-76%
Sugar Beans	Chipata	Import Zimbabwe	849.80	0.19	283.42	283.42	1.40	202.58	100	20%	(7.57)	2.87	12.54	(22.98)	(0.01)	(0.01)	-59%	-76%
Finger Millet	Kasama	Kasama price	236.00	0.23	93.52	93.52	2.36	39.68	60	60%	-	1.75	1.38	(3.13)	-	(0.01)	-72%	-75%
Tobacco (burley)	Chipata	Export Malawi	1,805.00	0.25	786.93	790.53	1.43	553.47	550	40%	(25.08)	9.72	21.88	(56.68)	(0.02)	(0.03)	-61%	-66%
Maize	Mkushi	Import Zimbabwe	155.77	0.26	75.46	75.46	0.43	173.89	65	18%	6.89	6.33	7.56	(7.00)	0.02	0.00	-32%	-53%
Cotton	Mumbwa	Export UK	589.26	0.26	82.42	86.02	0.96	89.98	125	67%	(11.75)	4.05	5.01	(20.81)	(0.04)	(0.05)	-50%	-72%
Maize	Mkushi	Export Zaire	175.77	0.27	75.46	75.46	0.43	173.89	65	18%	(18.38)	6.33	15.99	(40.70)	(0.04)	(0.07)	-32%	-62%
Sunflower	Katete	Import Zimbabwe	169.00	0.32	16.16	16.16	0.56	28.64	40	56%	(2.45)	1.70	1.99	(6.14)	(0.03)	(0.06)	-38%	-65%
Maize	Mazabuka	Import Zimbabwe	157.00	0.33	(18.81)	(18.81)	(0.12)	162.66	65	19%	9.45	5.31	5.79	(1.65)	0.04	0.02	14%	-46%
Sunflower	Choma	Import Zimbabwe	188.78	0.33	19.36	19.36	0.61	31.84	40	60%	(0.50)	1.70	1.34	(3.53)	(0.01)	(0.03)	-39%	-63%
Maize	Chipata	Export Malawi	120.00	0.42	16.90	16.90	0.10	174.91	65	15%	(3.24)	6.33	11.29	(20.86)	(0.01)	(0.05)	-9%	-41%
Maize	Kasama	Import Zimbabwe	130.00	0.43	42.18	42.18	0.24	177.60	65	15%	(31.78)	5.82	8.76	(46.36)	(0.13)	(0.23)	-20%	-37%
Maize	Chipata	Import Zimbabwe	101.80	0.43	16.90	16.90	0.10	174.91	65	15%	(14.32)	6.33	14.99	(35.64)	(0.06)	(0.12)	-9%	-39%
Maize	Mazabuka	Export Botwana	110.00	0.57	(18.81)	(18.81)	(0.12)	162.66	65	19%	(13.50)	5.31	13.44	(32.25)	(0.06)	(0.12)	14%	-32%
Groundnuts	Chipata	Export South Africa	624.80	0.63	37.39	37.39	0.27	138.61	100	29%	(4.37)	0.98	7.31	(12.65)	(0.02)	(0.03)	-21%	-36%
White Sorghum	Solwezi	Export Botswana	95.10	0.76	7.04	7.04	0.14	51.57	88	61%	(4.44)	1.75	3.10	(9.29)	(0.07)	(0.10)	-13%	-24%
White Sorghum	Choma	Eport Botswana	110.19	0.78	3.38	3.38	0.06	57.89	88	66%	(2.20)	1.75	2.35	(6.31)	(0.03)	(0.06)	-6%	-22%
Soyabeans	Mkushi	Export South Africa	247.40	0.79	(3.47)	(3.47)	(0.03)	131.34	80	29%	(4.10)	1.75	7.11	(12.96)	(0.03)	(0.04)	3%	-20%
Irish Potato	Mkushi	Import Zimbabwe	500.77	0.80	(414.66)	(414.66)	(0.18)	2,254.66	264	6%	(23.79)	36.16	137.96	(197.91)	(0.01)	(0.03)	23%	-18%
Soyabeans	Chipata	Export South Africa	219.80	0.81	(7.73)	(7.73)	(0.06)	124.94	80	26%	(8.20)	1.75	8.48	(18.43)	(0.06)	(0.07)	7%	-18%
Soyabeans	Mazabuka	Export South Africa	275.00	0.88	(14.60)	(14.60)	(0.11)	130.04	80	30%	-	1.49	5.60	(7.08)	-	(0.01)	13%	-11%

1996/97: Small Scale Activities (Average Management), Sorted by DRC (all indicators), continued

Activity	Location	Parity Basis	Farmgate Parity (US$/MT)	DRC	Net Profit (US$/ha)	Gross Margin (US$/ha)	G. Marg Var Cost	Variable Costs (US$/ha)	Labor Days (ha)	Labor-% Var Costs	Output Trans (I)	Trad. Input Trans (J)	Dom. Factor Trans (K)	Net Policy Trans (L)	NPC	EPC	Pct. Change in Yield to G. Margin = 0	Pct. Change in Yield to DRC = 1
Average Management																		
Irish Potato	Mkushi	Import Zimbabwe	444.50	0.92	(491.54)	(491.54)	(0.22)	2,251.54	264	6%	(14.23)	36.16	134.59	(184.99)	(0.01)	(0.03)	28%	-7%
Maize	Kasama	Export Tanzania	70.00	0.99	42.18	42.18	0.24	177.60	65	15%	(17.67)	5.82	16.11	(39.60)	(0.09)	(0.23)	-20%	0%
Rice	Mongu	Import price, landed Lusaka	97.12	1.32	19.50	19.5	0.16	124.50	130	42%	(13.97)	2.55	9.47	(26.00)	(0.13)	(0.26)	-14%	22%
Rice	Kasama	Import price, landed Ndola	103.02	1.37	1.01	1.01	0.01	126.99	130	41%	(10.52)	2.55	8.46	(21.53)	(0.10)	(0.21)	-1%	25%
Beef	Mazabuka	Regional Export	673.63	4.19	(2,767)	293	(0.90)	3,059	137	3%	(30)	-	52	(82)	(0.04)	(0.04)	933%	489%

1996/97: Small Scale Activities (Average Management), Sorted by DRC (all indicators).

Activity	Location	Parity Basis	Farmgate Parity (US$/MT)	DRC	Net Profit (US$/ha)	Gross Margin (US$/ha)	G. Marg Var Cost	Variable Costs (US$/ha)	Labor Days (ha)	Labor-% Var Costs	Output Trans (I)	Trad. Input Trans (J)	Dom. Factor Trans (K)	Net Policy Trans (L)	NPC	EPC	Pct. Change in Yield to G. Margin = 0	Pct. Change in Yield to DRC = 1
Average Management																		
Maize	Mkushi	Import Argentina	267.77	0.07	75.46	75.46	0.43	173.89	65	18%	21.39	6.33	2.73	12.33	0.04	0.04	-32%	-72%
Maize	Mazabuka	Import Argentina	289.00	0.10	(18.81)	(18.81)	(0.12)	162.66	65	19%	27.00	5.31	(0.06)	21.75	0.06	0.06	14%	-70%
Maize	Chipata	Import Argentina	233.80	0.11	16.90	16.90	0.10	174.91	65	15%	6.74	6.33	7.97	(7.56)	0.01	0.00	-9%	-70%
Maize	Kasama	Import Argentina	242.00	0.13	42.18	42.18	0.24	177.60	65	15%	17.67	5.82	4.33	7.52	0.04	0.04	-20%	-65%
Sugar Beans	Solwezi	Import Zimbabwe	923.00	0.17	247.42	247.42	1.22	202.58	100	20%	7.16	2.87	7.63	(3.35)	0.01	0.01	-56%	-77%
Onion	Lusaka	Import Zimbabwe	400.00	0.18	587.63	587.63	0.82	712.37	225	15%	-	48.07	47.11	(95.18)	-	(0.02)	-46%	-77%
Cotton	Mumbwa	Import UK	792.91	0.18	82.42	86.02	0.96	89.98	125	67%	(4.61)	4.05	2.63	(11.28)	(0.01)	(0.02)	-49%	-78%
Onion	Mazabuka	Import Zimbabwe	388.50	0.18	483.63	483.63	0.68	712.37	225	15%	(18.50)	48.07	53.28	(119.85)	(0.01)	(0.03)	-42%	-76%
Sugar Beans	Chipata	Import Zimbabwe	849.80	0.19	283.42	283.42	1.40	202.58	100	20%	(7.57)	2.87	12.54	(22.98)	(0.01)	(0.01)	-59%	-76%
Finger Millet	Kasama	Kasama price	236.00	0.23	93.52	93.52	2.36	39.68	60	60%	-	1.75	1.38	(3.13)	-	(0.01)	-72%	-75%
Tobacco (burley)	Chipata	Export Malawi	1,805.00	0.25	786.93	790.53	1.43	553.47	550	40%	(25.08)	9.72	21.88	(56.68)	(0.02)	(0.03)	-61%	-66%
Maize	Mkushi	Import Zimbabwe	155.77	0.26	75.46	75.46	0.43	173.89	65	18%	6.89	6.33	7.56	(7.00)	0.02	0.00	-32%	-53%
Cotton	Mumbwa	Export UK	589.26	0.26	82.42	86.02	0.96	89.98	125	67%	(11.75)	4.05	5.01	(20.81)	(0.04)	(0.05)	-50%	-72%
Maize	Mkushi	Export Zaire	175.77	0.27	75.46	75.46	0.43	173.89	65	18%	(18.38)	6.33	15.99	(40.70)	(0.04)	(0.07)	-32%	-62%
Sunflower	Katete	Import Zimbabwe	169.00	0.32	16.16	16.16	0.56	28.64	40	56%	(2.45)	1.70	1.99	(6.14)	(0.03)	(0.06)	-38%	-65%
Maize	Mazabuka	Import Zimbabwe	157.00	0.33	(18.81)	(18.81)	(0.12)	162.66	65	19%	9.45	5.31	5.79	(1.65)	0.04	0.02	14%	-46%
Sunflower	Choma	Import Zimbabwe	188.78	0.33	19.36	19.36	0.61	31.84	40	60%	(0.50)	1.70	1.34	(3.53)	(0.01)	(0.03)	-39%	-63%
Maize	Chipata	Export Malawi	120.00	0.42	16.90	16.90	0.10	174.91	65	15%	(3.24)	6.33	11.29	(20.86)	(0.01)	(0.05)	-9%	-41%
Maize	Kasama	Import Zimbabwe	130.00	0.4	42.18	42.18	0.24	177.60	65	15%	(31.78)	5.82	8.76	(46.36)	(0.13)	(0.23)	-20%	-37%
Maize	Chipata	Import Zimbabwe	101.80	0.43	16.90	16.90	0.10	174.91	65	15%	(14.32)	6.33	14.99	(35.64)	(0.06)	(0.12)	-9%	-39%
Maize	Mazabuka	Export Botwana	110.00	0.57	(18.81	(18.81)	(0.12)	162.66	65	19%	(13.50)	5.31	13.44	(32.25)	(0.06)	(0.12)	14%	-32%
Groundnuts	Chipata	Export South Africa	624.80	0.63	37.39	37.39	0.27	138.61	100	29%	(4.37)	0.98	7.31	(12.65)	(0.02)	(0.03)	-21%	-36%
White Sorghum	Solwezi	Export Botswana	95.10	0.76	7.04	7.04	0.14	51.57	88	61%	(4.44)	1.75	3.10	(9.29)	(0.07)	(0.10)	-13%	-24%
White Sorghum	Choma	Eport Botswana	110.19	0.78	3.38	3.38	0.06	57.89	88	66%	(2.20)	1.75	2.35	(6.31)	(0.03)	(0.06)	-6%	-22%
Soyabeans	Mkushi	Export South Africa	247.40	0.79	(3.47)	(3.47)	(0.03)	131.34	80	29%	(4.10)	1.75	7.11	(12.96)	(0.03)	(0.04)	3%	-20%
Irish Potato	Mkushi	Import Zimbabwe	500.77	0.80	(414.66)	(414.66)	(0.18)	2,254.66	264	6%	(23.79)	36.16	137.96	(197.91)	(0.01)	(0.03)	23%	-18%

1996/97: Small Scale Activities (Average Management), Sorted by DRC (all indicators), continued

Activity	Location	Parity Basis	Farmgate Parity (US$/MT)	DRC	Net Profit (US$/ha)	Gross Margin (US$/ha)	G. Marg Var Cost	Variable Costs (US$/ha)	Labor Days (ha)	Labor-% Var Costs	Output Trans (I)	Trad. Input Trans (J)	Dom. Factor Trans (K)	Net Policy Trans (L)	NPC	EPC	Pct. Change in Yield to G. Margin = 0	Pct. Change in Yield to DRC = 1
Average Management																		
Soyabeans	Chipata	Export South Africa	219.80	0.81	(7.73)	(7.73)	(0.06)	124.94	80	26%	(8.20)	1.75	8.48	(18.43)	(0.06)	(0.07)	7%	-18%
Soyabeans	Mazabuka	Export South Africa	275.00	0.88	(14.60)	(14.60)	(0.11)	130.04	80	30%	-	1.49	5.60	(7.08)	-	(0.01)	13%	-11%
Irish Potato	Mkushi	Import Zimbabwe	444.50	0.92	(491.54)	(491.54)	(0.22)	2,251.54	264	6%	(14.23)	36.16	134.59	(184.99)	(0.01)	(0.03)	28%	-7%
Maize	Kasama	Export Tanzania	70.00	0.99	42.18	42.18	0.24	177.60	65	15%	(17.67)	5.82	16.11	(39.60)	(0.09)	(0.23)	-20%	0%
Rice	Mongu	Import price, landed Lusaka	97.12	1.32	19.50	19.50	0.16	124.50	130	42%	(13.97)	2.55	9.47	(26.00)	(0.13)	(0.26)	-14%	22%
Rice	Kasama	Import price, landed Ndola	103.02	1.37	1.01	1.01	0.01	126.99	130	41%	(10.52)	2.55	8.46	(21.53)	(0.10)	(0.21)	-1%	25%
Beef	Mazabuka	Regional Export	673.63	4.19	(2,767)	293	(0.90)	3,059	137	3%	(30)	-	52	(82)	(0.04)	(0.04)	933%	489%

1996/97: Small Scale Activities (Potential Management), Sorted by DRC (all indicators).

Activity	Location	Parity Basis	Farmgate Parity (US$/MT)	DRC	Net Profit (US$/ha)	Gross Margin (US$/ha)	G. Marg Var Cost	Variable Costs (US$/ha)	Labor Days (ha)	Labor-% Var Costs	Output Trans (I)	Trad. Input Trans (J)	Dom. Factor Trans (K)	Net Policy Trans (L)	NPC	EPC	Pct. Change in Yield to G. Margin = 0	Pct. Change in Yield to DRC = 1
Potential Management																		
Maize	Mazabuka	Import Argentina	289.00	0.05	(16.40)	(16.40)	(0.06)	268.14	75	13%	47.25	9.35	0.03	37.87	0.06	0.06	7%	-72%
Maize	Mkushi	Import Argentina	267.77	0.09	64.12	64.12	0.21	299.52	75	12%	31.20	9.56	7.23	14.41	0.04	0.04	-18%	-67%
Cotton	Mumbwa	Import UK	792.91	0.09	294.19	297.79	2.39	124.61	150	58%	(11.06)	5.22	5.15	(21.43)	(0.01)	(0.02)	-71%	-87%
Maize	Chipata	Import Argentina	233.80	0.11	(7.32)	(7.32)	(0.03)	287.04	75	10%	9.83	9.35	13.91	(13.43)	0.01	0.00	3%	-66%
Cotton	Mumbwa	Export UK	589.26	0.15	294.19	297.79	2.39	124.61	150	58%	(28.20)	5.22	10.87	(44.29)	(0.04)	(0.05)	-72%	-84%
Maize	Kasama	Import Argentina	242.00	0.15	21.90	21.90	0.07	327.75	75	9%	28.11	9.56	10.19	8.36	0.04	0.04	-7%	-60%
Sugar Beans	Solwezi	Import Zimbabwe	923.00	0.16	280.37	280.37	1.08	259.63	120	18%	8.59	3.59	10.14	(5.15)	0.01	0.01	-52%	-76%
Sugar Beans	Solwezi	Import Zimbabwe	849.80	0.19	323.57	323.57	1.25	259.63	120	18%	(9.08)	3.59	16.03	(28.71)	(0.01)	(0.01)	-56%	-74%
Finger Millet	Kasama	Kasama price	236.00	0.19	201.38	201.38	1.53	131.62	75	23%	-	3.98	6.89	(10.87)	-	(0.01)	-62%	-67%
Tobacco (burley)	Chipata	Export Malawi	1,805.00	0.20	1,292.07	1,295.68	1.80	720.32	600	33%	(37.62)	13.30	31.38	(82.30)	(0.02)	(0.03)	-67%	-71%
Maize	Mazabuka	Import Zimbabwe	157.00	0.24	(16.40)	(16.40)	(0.06)	268.14	75	13%	16.54	9.35	10.27	(3.08)	0.04	0.02	7%	-50%
Maize	Mkushi	Export Zaire	175.77	0.31	64.12	64.12	0.21	299.52	75	12%	(26.80)	9.56	26.56	(62.92)	(0.04)	(0.08)	-18%	-55%
Maize	Mkushi	Import Zimbabwe	155.77	0.31	64.12	64.12	0.21	299.52	75	12%	10.05	9.56	14.27	(13.78)	0.02	0.00	-18%	-44%
Sunflower	Choma	Import Zimbabwe	188.78	0.31	22.31	22.31	0.25	89.69	45	24%	3.09	4.35	11.94	(13.20)	0.02	(0.01)	-21%	-58%
Groundnuts	Chipata	Export South Africa	624.80	0.36	270.99	270.99	0.97	279.01	140	20%	(13.66)	3.24	18.07	(34.97)	(0.02)	(0.03)	-50%	-60%
Sunflower	Katete	Import Zimbabwe	169.00	0.39	23.68	23.68	0.27	88.32	45	20%	1.46	4.35	18.59	(21.48)	0.01	(0.02)	-22%	-55%
White Sorghum	Choma	Export Bostwana	110.19	0.39	75.42	75.42	0.59	128.82	103	35%	(7.33)	5.89	8.84	(22.06)	(0.03)	(0.07)	-39%	-51%
Maize	Chipata	Export Malawi	120.00	0.45	(7.32)	(7.32)	(0.03)	287.04	75	10%	(4.73)	9.35	18.76	(32.83)	(0.01)	(0.06)	3%	-33%
Maize	Chipata	Import Zimbabwe	101.80	0.47	(7.32)	(7.32)	(0.03)	287.04	75	10%	(20.89)	9.35	24.15	(54.38)	(0.06)	(0.14)	3%	-31%
Maize	Mazabuka	Export Botswana	110.00	0.49	(16.40)	(16.40)	(0.06)	268.14	75	13%	(23.63)	9.35	23.65	(56.63)	(0.06)	(0.13)	7%	-37%
Maize	Kasama	Import Zimbabwe	130.00	0.54	21.90	21.90	0.07	327.75	75	9%	6.97	9.56	17.24	(19.83)	0.02	(0.01)	-7%	-26%
Soyabeans	Mazabuka	Export South Africa	275.00	0.57	42.35	42.35	0.22	188.53	95	24%	-	2.92	8.91	(11.83)	-	(0.01)	-19%	-36%
Soyabeans	Mkushi	Export South Africa	247.40	0.64	21.47	21.47	0.11	191.65	95	24%	(6.83)	2.92	11.36	(21.11)	(0.03)	(0.05)	-10%	-30%
Soyabeans	Chipata	Export South Africa	219.80	0.68	8.20	8.20	0.04	187.16	95	20%	(13.66)	2.92	13.82	(30.40)	(0.06)	(0.08)	-4%	-27%
Rice	Mongu	Import price, landed Lusaka	97.12	1.15	59.46	59.46	0.28	210.54	150	28%	(26.20)	4.88	18.62	(49.71)	(0.13)	(0.31)	-23%	9%
Rice	Kasama	Import price, landed Ndola	103.02	1.22	23.23	23.23	0.11	216.77	150	28%	(19.72)	4.88	16.81	(41.42)	(0.10)	(0.26)	-10%	12%
Maize	Kasama	Export Tanzania	70.00	1.32	21.90	21.90	0.07	327.75	75	9%	(28.11)	9.56	28.93	(66.61)	(0.09)	(0.30)	-7%	16%

1996/97: Emergent Activities (Average Management), Sorted by DRC (all indicators).

Activity	Location	Parity Basis	Farmgate Parity (US$/MT)	DRC	Net Profit (US$/ha)	Gross Margin (US$/ha)	G. Marg Var Cost	Variable Costs (US$/ha)	Labor Days (ha)	Labor-% Var Costs	Output Trans (I)	Trad. Input Trans (J)	Dom. Factor Trans (K)	Net Policy Trans (L)	NPC	EPC	Pct. Change in Yield to G. Margin = 0	Pct. Change in Yield to DRC = 1
Average Management																		
Maize	Mkushi	Import Argentina	267.77	0.07	110.97	114.65	0.61	186.65	65	17%	25.85	6.44	1.58	17.83	0.04	0.04	-39%	-74%
Maize	Mazabuka	Import Argentina	289.00	0.09	(0.16)	3.52	0.02	176.30	65	18%	33.75	5.61	(1.87)	30.00	0.06	0.06	-2%	-73%
Maize	Chipata	Import Argentina	233.80	0.11	40.41	44.09	0.23	187.67	65	14%	8.14	6.44	7.83	(6.13)	0.01	0.00	-20%	-72%
Maize	Kasama	Import Argentina	242.00	0.12	75.25	78.93	0.41	190.80	65	14%	21.69	6.03	3.38	12.28	0.04	0.04	-30%	-69%
Onion	Lusaka	Import Zimbabwe	400.00	0.16	749.33	753.01	0.89	846.99	250	14%	-	55.87	56.22	(112.08	-	(0.02)	-48%	-77%
Onion	Mazabuka	Import Zimbabwe	388.50	0.17	621.33	625.01	0.74	846.99	250	14%	(22.77)	55.87	63.81	(142.44)	(0.01)	(0.03)	-43%	-77%
Cotton	Mumbwa	Import UK	792.91	0.19	79.83	87.11	0.55	159.29	125	38%	(6.45)	4.33	3.65	(14.43)	(0.01)	(0.02)	-36%	-72%
Sugar Beans	Chipata	Import Zimbabwe	849.80	0.20	311.56	315.24	1.40	224.76	100	18%	(8.41)	3.90	14.69	(27.01)	(0.01)	(0.02)	-59%	-75%
Maize	Mkushi	Import Zimbabwe	155.77	0.24	110.97	114.65	0.61	186.65	65	17%	8.33	6.44	7.42	(5.53)	0.02	0.01	-39%	-57%
Maize	Mkushi	Export Zaire	175.77	0.26	110.97	114.65	0.61	186.65	65	17%	(22.21)	6.44	17.59	(46.24)	(0.04)	(0.07)	-39%	-65%
Tobacco (burley)	Chipata	Export Malawi	1,805.00	0.27	913.38	920.67	1.21	759.33	600	32%	(31.35)	12.70	31.38	(75.42)	(0.02)	(0.03)	-57%	-62%
Finger Millet	Kasama	Kasama price	236.00	0.28	108.38	112.06	2.06	54.44	60	44%	-	2.17	1.96	(4.13)	-	(0.01)	-68%	-70%
Cotton	Mumbwa	Export UK	589.26	0.29	79.83	87.11	0.55	159.29	125	38%	(16.45)	4.33	6.99	(27.76)	(0.04)	(0.05)	-36%	-63%
Maize	Mazabuka	Import Zimbabwe	157.00	0.29	(0.16)	3.52	0.02	176.30	65	18%	11.81	5.61	5.45	0.75	0.04	0.03	-2%	-52%
Maize	Chipata	Export Malawi	120.00	0.38	40.41	44.09	0.23	187.67	65	14%	(3.92)	6.44	11.85	(22.21)	(0.01)	(0.04)	-20%	-46%
Maize	Kasama	Import Zimbabwe	130.00	0.39	75.25	78.93	0.41	190.80	65	14%	5.38	6.03	8.82	(9.47)	0.02	(0.00)	-30%	-43%
Maize	Chipata	Import Zimbabwe	101.80	0.40	40.41	44.09	0.23	187.67	65	14%	(17.31)	6.44	16.31	(40.06)	(0.06)	(0.11)	-20%	-44%
Sunflower	Choma	Import Zimbabwe	188.78	0.46	3.72	7.40	0.15	48.60	40	40%	(0.62)	2.19	2.11	(4.92)	(0.01)	(0.03)	-14%	-50%
Sunflower	Katete	Import Zimbabwe	169.00	0.47	6.92	10.60	0.23	45.40	40	35%	(3.07)	2.19	2.92	(8.18)	(0.03)	(0.06)	-19%	-50%
Poultry (broilers)	Lusaka	Import parity	4.14	0.47	943.29	975.77	0.91	1,076.23	17	1%	-	14.94	17.69	(32.63)	-	(0.01)	-48%	-45%
White Sorghum	Choma	Export Botswana	110.19	0.50	45.01	48.69	0.47	104.49	88	36%	(5.50)	4.37	6.43	(16.29)	(0.03)	(0.07)	-33%	-43%
Maize	Mazabuka	Export Botswana	110.00	0.51	(0.16)	3.52	0.02	176.30	65	18%	(16.88)	5.61	15.01	(37.50)	(0.06)	(0.10)	-2%	-39%
White Sorghum	Solwezi	Export Botswana	95.10	0.58	-	40.40	0.38	106.12	88	36%	(11.10)	4.37	8.39	(23.85)	(0.07)	(0.12)	-28%	-37%
Beef	Mazabuka	Regional Export	673.63	0.61	360	393	0.55	718	301	30%	(90)	5	173	(269)	(0.04)	(0.04)	-35%	-53%
Groundnuts	Chipata	Export South Africa	624.80	0.61	47.14	50.82	0.30	169.18	120	28%	(5.46)	2.22	9.64	(17.32)	(0.02)	(0.03)	-23%	-37%
Soyabeans	Mazabuka	Export South Africa	275.00	0.66	24.26	27.94	0.19	145.22	80	26%	-	2.17	6.28	(8.45)	-	(0.01)	-16%	-32%
Soyabeans	Mkushi	Export South Africa	247.40	0.67	21.47	25.15	0.17	145.34	80	26%	(5.46)	2.19	8.12	(15.78)	(0.03)	(0.04)	-15%	-32%
Soyabeans	Chipata	Export South Africa	219.80	0.70	12.13	15.81	0.11	140.47	80	23%	(10.93)	2.19	10.71	(23.83)	(0.06)	(0.07)	-10%	-29%

1996/97: Emergent Activities (Average Management), Sorted by DRC (all indicators), continued

Activity	Location	Parity Basis	Farmgate Parity (US$/MT)	DRC	Net Profit (US$/ha)	Gross Margin (US$/ha)	G. Marg Var Cost	Variable Costs (US$/ha)	Labor Days (ha)	Labor-% Var Costs	Output Trans (I)	Trad. Input Trans (J)	Dom. Factor Trans (K)	Net Policy Trans (L)	NPC	EPC	Pct. Change in Yield to G. Margin = 0	Pct. Change in Yield to DRC = 1
Average Management																		
Irish Potato	Mkushi	Import Zimbabwe	500.77	0.72	(285.67)	(281.99)	(0.11)	2,489.99	240	5%	(28.55)	43.27	155.62	(227.44)	(0.01)	(0.03)	13%	-24%
Irish Potato	Mazabuka	Import Zimbabwe	444.50	0.83	(373.89)	(370.21)	(0.15)	2,482.21	240	5%	(17.08)	43.27	151.35	(211.70)	(0.01)	(0.03)	18%	-15%
Maize	Kasama	Export Tanzania	70.00	0.85	75.25	78.93	0.41	190.80	65	14%	(21.69)	6.03	17.84	(45.55)	(0.09)	(0.20)	-30%	-11%
Rice	Mongu	Import price, landed Lusaka	97.12	1.15	37.74	41.42	0.30	138.58	130	38%	(17.47)	2.99	11.18	(31.64)	(0.13)	(0.23)	-23%	11%
Rice	Kasama	Import price, landed Ndola	103.02	1.18	15.25	18.93	0.13	141.07	130	37%	(13.15)	2.99	9.88	(26.02)	(0.10)	(0.19)	-12%	13%

1996/97: Emergent Activities (Potential Management), Sorted by DRC (all indicators).

Activity	Location	Parity Basis	Farmgate Parity (US$/MT)	DRC	Net Profit (US$/ha)	Gross Margin (US$/ha)	G. Marg Var Cost	Variable Costs (US$/ha)	Labor Days (ha)	Labor-% Var Costs	Output Trans (I)	Trad. Input Trans (J)	Dom. Factor Trans (K)	Net Policy Trans (L)	NPC	EPC	Pct. Change in Yield to G. Margin = 0	Pct. Change in Yield to DRC = 1
Potential Management																		
Maize	Mazabuka	Import Argentina	289.00	0.05	6.03	9.71	0.03	278.01	75	13%	54.00	8.82	(2.27)	47.44	0.06	0.06	-3%	-74%
Maize	Mkushi	Import Argentina	267.77	0.08	103.01	106.69	0.35	308.89	75	12%	35.65	8.93	5.63	21.09	0.04	0.04	-26%	-69%
Maize	Chipata	Import Argentina	233.80	0.10	19.10	22.78	0.08	296.90	75	10%	11.23	8.82	13.40	(10.99)	0.01	0.00	-7%	-68%
Cotton	Mumbwa	Import UK	792.91	0.10	307.62	314.90	1.48	213.10	150	34%	(13.82)	5.18	6.37	(25.37)	(0.01)	(0.02)	-60%	-83%
Maize	Kasama	Import Argentina	242.00	0.14	58.80	62.48	0.19	337.12	75	9%	32.13	8.93	8.74	14.46	0.04	0.04	-16%	-63%
Cotton	Mumbwa	Export UK	589.26	0.17	307.62	314.90	1.48	213.10	150	34%	(35.25)	5.18	13.51	(53.94)	(0.04)	(0.05)	-60%	-77%
Finger Millet	Kasama	Kasama Price	236.00	0.17	290.84	294.52	1.97	149.48	75	20%	-	5.14	7.80	(12.94)	-	(0.01)	-67%	-71%
Tobacco (burley)	Chipata	Export Malawi	1,805.00	0.19	1,664.55	1,671.83	1.97	848.17	650	31%	(47.03)	16.56	36.56	(100.14)	(0.02)	(0.03)	-69%	-73%
Sugar Beans	Chipata	Import Zimbabwe	849.80	0.19	347.75	351.42	1.25	280.38	120	17%	(9.84)	4.31	17.97	(32.12)	(0.01)	(0.02)	-56%	-74%
Maize	Mazabuka	Import Zimbabwe	157.00	0.23	6.03	9.71	0.03	278.01	75	13%	18.90	8.82	9.43	0.64	0.04	0.03	-3%	-53%
White Sorghum	Choma	Expot Botswana	110.19	0.26	200.04	203.72	1.33	153.70	103	29%	(12.83)	8.45	12.36	(33.64)	(0.03)	(0.06)	-58%	-66%
Maize	Mkushi	Import Zimbabwe	155.77	0.28	103.01	106.69	0.35	308.89	75	12%	11.49	8.93	13.69	(11.13)	0.02	0.01	-26%	-48%
Sunflower	Choma	Iport Zimbabwe	188.78	0.28	24.71	28.39	0.27	106.01	45	20%	(1.49)	4.71	6.16	(12.35)	(0.01)	(0.03)	-21%	-57%
Maize	Mkushi	Export Zaire	175.77	0.29	103.01	106.69	0.35	308.89	75	12%	(30.63)	8.93	27.73	(67.29)	(0.04)	(0.07)	-26%	-58%
Sunflower	Katete	Import Zimbabwe	169.00	0.31	26.08	29.76	0.28	104.64	45	17%	(7.36)	4.71	8.24	(20.31)	(0.03)	(0.07)	-22%	-54%
Groundnuts	Chipata	Export South Africa	624.80	0.34	347.54	351.22	1.14	308.78	160	21%	(16.39)	4.29	20.82	(41.51)	(0.02)	(0.03)	-53%	-62%
Maize	Chipata	Export Malawi	120.00	0.41	19.10	22.78	0.08	296.90	75	10%	(5.40)	8.82	18.94	(33.16)	(0.01)	(0.05)	-7%	-38%
Maize	Chipata	Import Zimbabwe	101.80	0.43	19.10	22.78	0.08	296.90	75	10%	(23.87)	8.82	25.10	(57.79)	(0.06)	(0.12)	-7%	-36%
Maize	Mazabuka	Export Botwana	110.00	0.46	6.03	9.71	0.03	278.01	75	13%	(27.00)	8.82	24.73	(60.56)	(0.06)	(0.11)	-3%	-41%
Maize	Kasama	Import Zimbabwe	130.00	0.48	58.80	62.48	0.19	337.12	75	9%	7.97	8.93	16.80	(17.76)	0.02	(0.00)	-16%	-32%
Soyabeans	Mazabuka	Export South Africa	275.00	0.52	71.25	74.92	0.37	202.13	95	23%	-	3.25	9.39	(12.64)	-	(0.01)	-27%	-42%
Soyabeans	Mkushi	Export South Africa	247.40	0.58	46.82	50.50	0.25	205.24	95	22%	(8.20)	3.25	12.30	(23.75)	(0.03)	(0.04)	-20%	-36%
Soyabeans	Chipata	Export South Africa	219.80	0.62	30.00	33.68	0.17	200.75	95	19%	(16.39)	3.25	15.21	(34.86)	(0.06)	(0.08)	-15%	-33%
Rice	Mongu	Import price, landed Lusaka	97.12	0.99	103.64	107.32	0.42	252.68	160	25%	(34.94)	5.53	23.47	(63.94)	(0.13)	(0.28)	-30%	-1%
Rice	Kasama	Import price, landed Ndola	103.02	1.04	56.17	59.85	0.23	260.15	160	25%	(26.30)	5.53	21.01	(52.84)	(0.10)	(0.23)	-19%	2%
Maize	Kasama	Export Tanzania	70.00	1.10	58.80	62.48	0.19	337.12	75	9%	(32.13)	8.93	30.16	(71.22)	(0.09)	(0.24)	-16%	6%

1996/97: Commercial Activities (Average Management), Sorted by DRC (all indicators).

Activity	Location	Parity Basis	Farmgate Parity (US$/MT)	DRC	Net Profit (US$/ha)	Gross Margin (US$/ha)	G. Marg Var Cost	Variable Costs (US$/ha)	Labor Days (ha)	Labor-% Var Costs	Output Trans (I)	Trad. Input Trans (J)	Dom. Factor Trans (K)	Net Policy Trans (L)	NPC	EPC	Pct. Change in Yield to G. Margin = 0	Pct. Change in Yield to DRC = 1
Average Management																		
Maize	Mkushi	Import Argentina	267.77	0.13	(223)	(96)	(0.13)	720	95	18%	67.58	71.82	120.51	(124.75)	0.05	(0.01)	16%	-54%
Wheat (irrigated)	Lusaka	Import USA	317.00	0.13	737	948	1.51	629	95	20%	75.00	95.89	130.71	(151.60)	0.05	(0.02)	-61%	-61%
Coffee	Mazabuka	Export Europe	2,506.00	0.15	3,753	4,320	2.33	1,851	350	22%	(37.50)	169.04	319.06	(525.60)	(0.01)	(0.04)	-70%	-69%
Maize	Mazabuka	Import Argentina	289.00	0.16	(450)	(323)	(0.47)	683	95	19%	67.50	69.26	117.69	(119.46)	0.06	(0.00)	96%	-51%
Cotton (irrigated)	Mazabuka	Import Holland	795.43	0.18	43	254	0.34	746	212	32%	(21.48)	108.52	179.41	(309.41)	(0.01)	(0.08)	-26%	-67%
Roses	Lusaka	VBA Auction,	0.11	0.24	54,425	70,829	1.25	56,851	7,200	15%	-	512.48	5,606.55	######	-	(0.01)	-55%	-47%
Paprika	Lusaka	Export Spain	1,687.05	0.26	915	1,126	0.74	1,514	425	29%	(26.16	133.47	350.76	(510.39)	(0.01)	(0.08)	-43%	-54%
Cotton (irrigated)	Mazabuka	Export	591.78	0.28	43	254	0.34	746	212	32%	(57.19)	108.52	191.32	(357.02)	(0.04)	(0.14)	-26%	-57%
Tobacco (virginia)	Choma	Export Zimbabwe	2,366.22	0.28	877	1,066	0.61	1,742	775	45%	8.44	107.45	544.29	(643.31)	0.00	(0.04)	-39%	-59%
Sugar cane	Mazabuka	Export to region	30.53	0.32	325	536	0.36	1,499	171	13%	(243.56)	146.01	415.14	(804.71)	(0.06)	(0.11)	-26%	-64%
Maize	Mkushi	Export Zaire	175.77	0.41	(223)	(96)	(0.13)	720	95	18%	(46.03)	71.82	158.38	(276.23)	(0.04)	(0.18)	16%	-38%
Irish Potato	Mkushi	Import Zimbabwe	500.77	0.41	1,183	1,394	0.27	5,230	205	5%	(85.66)	299.85	539.99	(925.50)	(0.01)	(0.05)	-21%	-50%
Irish Potato	Mkushi	Import Zimbabwe	444.50	0.48	925	1,136	0.22	5,200	205	5%	(51.23)	299.85	526.85	(877.93)	(0.01)	(0.05)	-18%	-43%
Poultry (broilers)	Lusaka	Import parity	4.14	0.48	8,329	8,971	0.86	10,469	49	1%	-	171.42	202.98	(374.41)	-	(0.01)	-46%	-42%
Maize	Mkushi	Import Zimbabwe	155.77	0.48	(223)	(96)	(0.13)	720	95	18%	17.26	71.82	137.28	(191.83)	0.02	(0.15)	16%	-23%
Soyabeans (irr.)	Mazabuka	Export South Africa	275.00	0.53	(64)	147	0.31	471	85	25%	-	79.82	128.23	(208.04)	-	(0.20)	-24%	-29%
Soyabeans	Mkushi	Export South Africa	247.40	0.59	(125)	2	0.00	425	85	28%	(13.66)	53.83	120.77	(188.27)	(0.03)	(0.21)	0%	-26%
Soyabeans (irr.)	Mkushi	Export South Africa	247.40	0.62	(46)	166	0.35	474	85	25%	(16.39)	79.82	133.87	(230.08)	(0.03)	(0.26)	-26%	-23%
Soyabeans	Mazabuka	Export South Africa	275.00	0.63	(142)	(15)	(0.03)	419	85	28%	-	53.24	115.72	(168.96)	-	(0.19)	4%	-22%
Dairy	Mazabuka	Import parity	0.27	0.67	78	210	0.19	1,132	192	24%	47.64	20.86	190.16	(163.37)	0.03	0.02	-16%	-26%
Maize	Mazabuka	Import Zimbabwe	157.00	0.70	(450)	(323)	(0.47)	683	95	19%	23.63	69.26	132.32	(177.96)	0.04	(0.18)	96%	-11%
Red Sorghum	Mazabuka	Export Botswana	120.00	0.72	(181)	(54)	(0.10)	553	155	33%	-	60.63	144.93	(205.56)	-	(0.26)	11%	-12%
Beef (range)	Mazabuka	Regional Export	673.63	0.74	5,837	14,041	0.49	28,533	3,176	13%	(2,652)	2,058	8,886	(13,596)	(0.04)	(0.08)	-33%	-34%
Beef (feedlot)	Mazabuka	Regional Export	673.63	0.75	494,230	541,178	0.34	1,606,971	16,536	1%	(64,896)	5,360	203,771	(274,072)	(0.03)	(0.03)	-25%	-28%
Maize	Mazabuka	Export Botwana	110.00	1.32	(450)	(323)	(0.47)	683	95	19%	(33.75)	69.26	151.44	(254.46)	(0.06)	(0.55)	96%	11%

1996/97: Commercial Activities (Potential Management), Sorted by DRC (all indicators).

Activity	Location	Parity Basis	Farmgate Parity (US$/MT)	DRC	Net Profit (US$/ha)	Gross Margin (US$/ha)	G. Marg Var Cost	Variable Costs (US$/ha)	Labor Days (ha)	Labor-% Var Costs	Output Trans (I)	Trad. Input Trans (J)	Dom. Factor Trans (K)	Net Policy Trans (L)	NPC	EPC	Pct. Change in Yield to G. Margin = 0	Pct. Change in Yield to DRC = 1
Potential Management																		
Maize	Mazabuka	Import Argentina	289.00	0.04	(260.03)	(133.14)	(0.17)	781.29	105	18%	121.65	76.02	111.85	(66.22)	0.06	0.03	22%	-70%
Maize	Mkushi	Import Argentina	267.77	0.05	(1.53)	125.36	0.15	810.86	105	17%	80.32	76.02	127.30	(123.00)	0.04	0.00	-14%	-67%
Wheat (irrigated)	Lusaka	Import USA	317.00	0.09	1,168.23	1,379.35	1.67	827.33	105	17%	105.00	103.76	139.01	(137.77)	0.05	0.00	-63%	-64%
Cotton (irrigated)	Mazabuka	Import	795.43	0.14	342.53	553.65	0.65	846.35	240	31%	(30.07)	110.77	196.44	(337.28)	(0.01)	(0.06)	-40%	-73%
Tobacco (virginia)	Choma	Export Zimbabwe	2,366.22	0.20	1,909.19	2,099.10	1.17	1,788.90	775	44%	11.68	113.46	547.81	(649.59)	0.00	(0.03)	-55%	-70%
Cotton (irrigated)	Mazabuka	Export	591.78	0.23	342.53	553.65	0.65	846.35	240	31%	(80.06)	110.77	213.10	(403.93)	(0.04)	(0.10)	-43%	-67%
Maize	Mazabuka	Import Zimbabwe	157.00	0.24	(260.03)	(133.14)	(0.17)	781.29	105	18%	42.58	76.02	138.21	(171.65)	0.04	(0.05)	22%	-45%
Maize	Mkushi	Import Zimbabwe	155.77	0.26	(1.53)	125.36	0.15	810.86	105	17%	25.88	76.02	145.45	(195.59)	0.02	(0.07)	-14%	-43%
Maize	Mkushi	Export Zaire	175.77	0.27	(1.53)	125.36	0.15	810.86	105	17%	(69.01)	76.02	177.08	(322.10)	(0.04)	(0.13)	-14%	-54%
Sugar cane	Mazabuka	Export to region	30.53	0.30	443.70	654.82	0.36	1,841.18	193	12%	(298.70)	184.03	494.25	(976.98)	(0.06)	(0.12)	-26%	-65%
Soyabeans	Mazabuka	Export South Africa	275.00	0.40	(4.10)	122.79	0.27	454.41	90	27%	-	55.42	120.76	(176.18)	-	(0.12)	-22%	-42%
Soyabeans (irr.)	Mazabuka	Export South Afric	275.00	0.43	35.49	246.61	0.47	525.95	90	23%	-	81.52	134.24	(215.76)	-	(0.15)	-33%	-37%
Soyabeans (irr.)	Mkushi	Export South Africa	247.40	0.50	55.91	267.03	0.50	532.17	90	23%	(20.49)	81.52	141.43	(243.43)	(0.03)	(0.21)	-34%	-32%
Maize	Mazabuka	Export Botwana	110.00	0.51	(260.03)	(133.14)	(0.17)	781.29	105	18%	(60.83)	76.02	172.68	(309.52)	(0.06)	(0.23)	22%	-31%
Dairy	Mazabuka	Import parity	0.27	0.57	360.84	492.87	0.37	1,337.13	192	21%	64.97	23.27	186.63	(144.93)	0.03	0.03	-27%	-35%