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Analysis of Comparative Advantage and Agricultural Trade in Mozambique

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Foreword

The analysis of agricultural comparative advantage within the agroecological zones of Mozambique started in 1995. It was implemented through a Cooperative Agreement between REDSO/ESA and the University of Swaziland. Under this agreement, the Faculty of Agronomy and Forestry Engineering at the Eduardo Mondlane University in Maputo entered into a sub-agreement with the Center for Agricultural Research and Policy Analysis (CARPA) of the University of Swaziland.

The research project was aimed at conducting a comprehensive analysis of the comparative economic advantage of alternative productive uses of agricultural resources in southern Africa. Also, the project evaluated potential changes in production and trade patterns in response to changes in the economic policy environment of the region.

The research was carried out by a team lead by Prof. Firmino G. Mucavele and including Prof. Gilead I. Mlay and Ms. Farizana Omar. Many technicians were involved during the research and helped collect data. Among the people involved, it would be important to mention the collaboration of the Mr. José Pacheco, Vice-Ministry of Agriculture and Fisheries, Mr. Sérgio Yé, agronomist and director of agriculture in Tete Province, Mr. Cossa, agricultural extensionist in Gaza Province, Hanifa Ismael, agronomist, Mr. João Joaquim, extensionist in Inhambane province, Mr. Manuel Zacarias, agricultural technician in Cabo Delgado province , Ms. Joana Cambera in Nampula province, and officials of the National Agricultural Research Institute (INIA). Five field supervisors and 20 enumerators helped collect primary data on budgets, production coefficients, prices and agricultural technologies. Ms. Hanifa Panachande, my secretary, helped enter data and to type parts of the text. Ms. Graça, my driver, was always ready to drive members of the team during the field work stage. For all these people who participated in this research, their effort is much appreciated.

Dennis Weller, Chief
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Executive Summary

The analysis of comparative advantage and agricultural trade in Mozambique is a part of the Regional Trade and Changing Comparative Advantage Analysis in Eastern and Southern Africa. This study is a broad-based research activity aimed at analyzing the changing agricultural comparative advantage and its implications for the enhancement of trade and food security in Mozambique.

The specific objectives of the study are to:

1. Reveal and analyze the changing agricultural comparative advantage in Mozambique and to assess its implications for enhanced trade and food security;
2. Analyze the potential of investing in technological, institutional, and infrastructure development and human resources to increase competitiveness;
3. Determine the extent of agricultural protection and policy distortions in Mozambique and evaluate the potential for trade between Mozambique and Southern Africa Development Community (SADC) countries;
4. Provide relevant information to researchers and policymakers for a better formulation of food, agriculture and trade policies;
5. Generate data and useful information for a regional analysis of trade and food security.

It is expected that the results from the study will be useful in evaluating the extent and importance of cross-border trade in eastern and southern Africa. Through dissemination of data and information among researchers and policymakers in the region, better food, agriculture and trade policies can be formulated for efficient and effective regional integration.

The farming systems in Mozambique are favorable for growing a diverse set of crops throughout the year. Bio-diversity is very high and there is a high potential for agricultural production. Presently, agriculture is the major economic sector in the country, contributing to 45 percent of the GDP and employing about 80 percent of the labor force.

Among other SADC countries, Mozambique is unique in the sense that it has extensive borders with South Africa, Swaziland, Zimbabwe, Zambia, Malawi and Tanzania. This geography could potentially foster development of agricultural trade with SADC countries.

The country is undergoing a structural adjustment program. Some lessons from structural adjustment programs in agriculture and trade in Mozambique can be summarized as follows:

1. Price adjustments are not sufficient to achieve a sustained agricultural supply response from a large and growing number of poor household farmers. For instance, increases in maize prices did not achieve a significant supply response from household farmers in Manica and Sofala provinces;
2. Price shifts in agricultural commodities result in a change of crop composition rather than an overall increase in output;
3. Increases in the input prices decrease demand growth, especially in the absence of seasonal credit. This tends to diminish poor farmers' access to inputs and new technologies. Also, farmers then tend to increase the area dedicated to subsistence crops;
4. Increasing market prices of food crops combined with uncertainty in the supply of food in the market can increase the risk averseness of farmers at the margin of subsistence and reinforce their emphasis on subsistence production given the high and growing market dependence.

The research was carried out in the 10 regions according to the classification defined by the National Agricultural Research Institute (INIA). The

agroecological division framework includes three macro-agroecological zones: northern, central, and southern. These macro-agroecological zones were based on the type of climate, vegetation, altitude, soils and farming systems.

The northern macro-agroecological zone lies between Zambezi and Rovuma Rivers and is represented by Lichinga meteorological station. This agroecological zone has the following characteristics:

- rainfall between September and May varies from 1,500 to 2,200 mm with an average of 1,750 mm;
- low (less than 20 percent) to moderate (21 to 30 percent) risk of drought for rainfed agriculture;
- the preferred and cultivated crops are mainly maize, cotton, coconuts, cashew nuts, cassava, sorghum, millet and groundnut (peanuts);

The central macro-agroecological zone is located between Save and Zambezi Rivers and is represented by the Beira meteorological station. The major characteristics of this macro-agroecological zone are:

- good rainfall between September and May, with levels varying from 2,100 to 2,900 mm, with an average of 2,500 mm;
- moderate (31 to 45 percent) risk of drought for rainfed agriculture;
- major cultivated crops are maize, cotton, cassava, bananas, citrus, sugarcane, vegetables, sorghum, cashew nuts and rice.

The southern macro-agroecological zone is located south of the Save River and is represented by the Chokwé meteorological station where the basic characteristics are:

- low rainfall between September and May, with levels varying from 350 mm to 1,700 mm, with an average rainfall of 900 mm;
- high (61 to 75 percent) to very high (more than 75 percent) risk of drought for rainfed agriculture;
- the preferred and cultivated crops are maize, rice, groundnut, cowpea, cassava, citrus, sugar cane, vegetables and cashew nuts.

According to the INIA classification, the 10 agroecological regions are defined as follows:

Region 1 (R1) is located in the southern macro-agroecological zone. It is dry and arid, with low rainfall levels and high humidity. It covers the interior of the Maputo Province and the southern part of the Gaza Province;

Region 2 (R2) is situated in the southern macro-agroecological zone. It lies along the coastal zone of the Save river;

Region 3 (R3) covers central and northern Gaza Province and the interior of Inhambane Province;

Region 4 (R4) is located in the central part of the country and is characterized by medium altitude;

Region 5 (R5) is located in the low altitudes of Sofala and Zambézia provinces;

Region 6 (R6) is a semi-arid zone, which includes the Zambeze valley and the southern region of Tete Province;

Region 7 (R7) is a region of medium altitudes, covering the provinces of Zambézia, Nampula, Tete, Niassa, and Cabo Delgado;

Region 8 (R8) is the coastal area of Zambézia, Nampula and Cabo Delgado provinces;

Region 9 (R9) covers the interior areas of the northern region of Cabo Delgado Province;

Region 10 (R10) is a region of high altitude located in the provinces of Zambézia, Niassa, Marávia-Angónia and Manica.

Twenty-one representative smallholder farms were involved in determining input use and the opportunity cost of land, labor, and water. Six of the farms are located in the north, in Cabo Delgado and Nampula provinces. In the center, another six of the farms are located in Tete and Manica provinces. The remaining nine farms are in the south, in Inhambane, Gaza and Maputo provinces. These farms were analyzed to determine the coefficients of input use and to determine the crop budgets for production of maize, sorghum, sunflower, beans, cowpea, potatoes, onions, cotton and cassava.

Net social profits (NSPs), domestic resource ratio costs (DRCs) and social cost benefits (SCBs) are determined as measures of comparative advantage. Nominal protection coefficients (NPC), effective policy coefficients (EPC), producer subsidy equivalent (PSE), and subsidy raito to producers (SRP) were calculated and are used here to estimate agricultural protection and policy distortions indicators for each region and each of the three technologies.

The analyses of the 10 regions were done using maps and spatial plotting of the DRCs and EPCs. The assessment of comparative advantage was done by comparing current levels of domestic opportunity costs, relative to market prices.

The results of the study reveals that the northern macro-agroecological zone has a comparative advantage in producing all the crops considered in this study. The northern macro-agroecological zone includes regions R7, R10, R8 and R9, where the average rainfall is above 2,000 mm per year and the risk of drought is below 20 percent.

The production of maize is particularly advantageous in the region R7. In the Cabo Delagado Province potential technology has a strong DRC (0.465) with the highest NSP of 2,440,052.00 Meticais. The strongest SCB ratio (0.531) of producing maize is obtained in Cabo Delgado using otential technology. This was expected since Cabo Delgado has good soil for agriculture, good rainfall pattern and the maize varieties used by the smallholder farmers are better suited to the environment. Extension services are better organized to provide assistance to the farmers of Metuge, Cabo Delgado. In the province of Nampula, the DRC values show that the province has a comparative advantage for all technologies.

The dilemma of maize production in Mozambique is that there is greater consumption in the south but, as stated above, the comparative advantage to produce maize is in the north, in the provinces of Cabo Delgado, Niassa and Nampula, region R7. The distance between Cabo Delgado and Maputo provinces is about 2,300 km; This aspect calls for an evaluation of possible alternatives for resource allocation for maize production, infrastructure policies and food security policies and strategies to cope with the dilemma. Agricultural policies need to be evaluated in order to identify possible instrument policies that may introduce inefficiencies into the production and trade of trade. Protection policies aimed at providing poor consumers in large urban areas, such as Maputo city, access to maize may exist. Most often these protection measures are introduced with the intent to achieve food security; however, this security is not achieved.

Ideally, one could recommend to transport maize from the northern part of Mozambique to the south, but the roads are poorly maintained and the transportation cost is too high. Rural markets are nonexistent and the railways from the interior of the country to the sea do not operate regularly. The maritime transport system needs to be improved to allow for the movement of produce from the north to the center and the south and to move industrial goods from the southern to the northern part of the country.

It was concluded that institutional arrangements such as legal systems, weights, grades, measures, and enforceable contracts should be established to improve agricultural marketing. In addition, liberalized markets require institutional arrangements to provide incentives for producers.

Infrastructure such as roads, telecommunications, warehouses, vehicles and agro-processing plants must be improved through public financing; the government should be the leading agent in these improvements. Organizations such as municipal councils, cooperatives, private firms and individuals should be involved in this effort.

Glossary of Acronyms and Abbreviations

DRC	Domestic Resource Cost
EPC	Effective Policy Coefficient
GDP	Gross Domestic Product
GIS	Geographical Information System
GOM	Government of Mozambique
GPS	Global Position System
INIA	National Agricultural Institute
IRT	Improved Recommended Technologies
LCP	Local Current Practices
NPC	Nominal Protection Coefficients
NRP	Nominal Rate of Protection
NSP	Net Social Profit
PAM	Policy Analysis Matrix
POT	Potential Technologies
PSE	Producer's Subsidy Equivalent
SADC	Southern Africa Development Community
SCB	Social Cost Benefits
SRP	Subsidy Ratio to Producers

1. Introduction

1.1 BACKGROUND AND MOTIVATION OF THE STUDY

The economic environment in southern Africa is characterized by a rapid liberalization of markets, the increase of cross-border trade, and the elimination of trade barriers such as tariffs and quotas. The introduction of trade liberalization policies in southern Africa assumes that countries have some comparative advantage in the production of agricultural products and, through trade, countries in the region would improve food security. However, the parameters of competitiveness are unknown. The pattern of price changes resulting from structural adjustment programs is highly complex and the extent of its impact is not fully understood.

The changing economic environment in southern Africa and the need for economic integration and collaboration requires a continuous assessment of agricultural production and productivity if trade is to be enhanced. Trade among the Southern African Development Community (SADC) countries is still highly regulated and there is no free movement of agricultural products. The adoption of free trade requires a removal of distortions in agricultural markets and efficient agricultural production.

Along with the changing economic environment in Southern Africa, several questions are raised relative to the performance of the agricultural sector in Mozambique and the possibilities for establishing effective and efficient trade within the region. Some of these questions include the following:

1. Is there any comparative advantage for agricultural production in Mozambique? Do the agroecological zones have comparative advantage for agricultural production and trade?
2. What are the implications of the changing economic environment in southern Africa with respect to agricultural trade and food security in Mozambique?
3. What should the priorities for the allocation of resources among the agroecological zones be?
4. Which sectors of the economy and/or infrastructure should be invested in to enhance agricultural comparative advantage and food security in Mozambique?

Given the existence of excellent sea ports, the country is ready for international trade. There is a belief that Mozambique has a comparative economic advantage in agricultural production but to date no clear evidence has been presented to illustrate which crops or agricultural products have a comparative advantage in Mozambique. Moreover, Mozambique is unique within the SADC region in the sense that it has extensive borders with South Africa, Swaziland, Zimbabwe, Zambia, Malawi and Tanzania. There are potential conditions to develop agricultural trade with SADC countries.

Mozambique is a large country with a land area of 799,380 square kilometers. The 1997 census indicates that Mozambique has a population of approximately 15 million (Instituto Nacional de Estatistica, 1997), and the population is growing at an average annual rate of 2.7 percent. The per capita gross domestic product (GDP) is US $100 (Banco de Moçambique, 1997).

The climate and ecology of the country are very diverse. The farming systems are favorable for growing a diverse set of crops throughout the year. Biodiversity is very high and there is a high potential for agricultural production. Presently, agriculture is the major economic sector in the country, contributing to 45 percent of the GDP and employing about 80 percent of the labor force (Government of Mozambique, 1996). Approximately 50,000 square kilometers of the land area is cultivated, while grazing land is about

448,450 square kilometers, forest and woodland is estimated to be 147,880 square kilometers (Government of Mozambique, 1996).

Given the territorial extension of the country and the high bio-diversity, the approach used in this study was to divide the country into macro-agroecological zones according to the climate, temperature and rainfall, ecology, altitude, soils and farming systems in the country. Under the macro-agroecological zones, 10 regions were defined according to the farming systems, soil types and rainfall. Then, the measures of agricultural comparative advantage and protection were determined and evaluated.

1.2 RESEARCH OBJECTIVES

This study is a broad-based research activity aimed at analyzing the changing agricultural comparative advantage and its implications for the enhancement of trade and food security in Mozambique. The specific objectives of the study are to:

1. Reveal and analyze the changing agricultural comparative advantage in Mozambique and assess its implications for enhanced trade and food security;
2. Analyze the potential of investing in technological, institutional, human resources and infrastructure development to increase competitiveness;
3. Determine the extent of agricultural protection and policy distortions in Mozambique and evaluate the potential for trade between Mozambique and SADC countries;
4. Provide relevant information to researchers and policymakers for a better formulation of food, agriculture and trade policies;
5. Generate data and useful information for a regional analysis of trade and food security.

This study is a part of the Regional Trade and Changing Comparative Advantage Analysis in Eastern and Southern Africa. The results from the study will be useful in determining the extent and importance of cross-border trade in eastern and southern Africa. Through dissemination of data and information among researchers and policymakers in the region, better food, agriculture, and trade policies can be formulated for efficient and effective regional integration.

Comparative advantage evaluates the economic efficiency of alternative productive uses of scarce resources such as land, labor, capital and water resources. Therefore, this study is also intended to provide first hand information about the uses of primary factors of production, the biophysical conditions of the country, the level of technology and production systems.

2. Agricultural Production and Trade

2.1 TRENDS OF AGRICULTURAL PRODUCTION

In the last two decades, agricultural production in Mozambique was drastically affected by war, drought and incidences of plagues and diseases. In the last five years, however, agricultural production has been improving. The major factors contributing to the improvement of agricultural production are:

1. Peace agreement ending the civil war in October 1992;
2. Favorable rainfall levels in the last four years;
3. Changing economic environment and improvement of agricultural markets; and
4. Improvement of some rural infrastructure.

The production of maize, cassava, peanuts, beans and cotton was relatively high between 1995 and 1997, especially in Cabo Delgado, Nampula, Niassa and Zambézia provinces. In the 1995/96 agricultural season, production was exceptionally good. In Manica, the yields of maize increased up to 2,600 kgs per hectare, in Zambézia some farmers reached 3,000 kgs per hectare. (GOM, 1996) The yields of maize in Manica province in 1996/97 varied from 500 to 1,540 kgs per hectare, while in the provinces of Nampula and Zambézia the yields varied from 800 to 2,000 kgs per hectare. These yields are an improvement compared to the 300 kg per hectare in the southern part of Mozambique and a little more than 500 kgs per hectare in the northern part of Mozambique. (Mucavele, 1996)

The number of household farms increased during the period from 1994 to 1997 due to returnees from the neighboring countries as well as the resettlement of

Table 2.1: Total Production of Major Crops from 1980 to 1995 (metric tons)

Year	Maize	Rice	Sorghum	Cassava	Peanuts	Beans	Cotton
1980	65,400	49,879	611	8,800	6,272	9,596	64,872
1981	83,807	35,148	1,008	10,755	4,998	15,284	73,688
1982	101,905	42,847	1,874	8,991	1,673	7,882	60,742
1983	66,708	23,759	1,481	9,261	671	4,357	24,732
1984	92,148	26,140	2,731	7,295	2,085	3,816	19,722
1985	68,912	33,436	2,113	12,495	2,313	4,585	6,024
1986	33,631	43,519	829	10,024	1,231	3,966	10,762
1987	43,119	43,470	586	9,858	2,087	9,734	28,248
1988	60,504	40,837	1,876	28,743	2,796	7,815	19,171
1989	93,844	29,002	2,950	22,775	2,117	15,335	28,014
1990	96,680	25,472	1,360	28,875	5,057	16,573	29,708
1991	89,790	41,815	2,990	22,103	6,877	15,209	39,984
1992	75,082	16,571	1,419	20,743	8,695	12,956	44,638
1993	142,683	17,785	2,370	31,575	14,892	23,271	47,002
1994	146,020	29,000	2,044	30,195	8,976	15,967	49,457
1995	168,619	13,567	1,677	36,150	18,156	30,429	50,968

Source: Direcção National de Planificação, Ministry of Plan and Finance, 1997

displaced people in the rural areas. Table 2.1 presents the total production of major crops from 1980 to 1995.

Livestock production in Mozambique can be divided into two periods. The first period was from 1980 to 1986, and the second period was from 1987 to 1995. The first period was characterized by a sharp decline of livestock production and a displacement of large quantities of animals due to the war and lack of veterinary assistance in the rural areas. In the second period, the decline of production stopped and the levels of production were stabilized at a low level, approximately 2,000 tons. Figure 2.1 presents livestock production from 1980 to 1995.

Beef production decreased from 8,343 tons in 1980 to 845 tons in 1995. The highest level of pork production was reached in 1981 with a total production of 3,907 tons. Pork production in 1997 was about 500 tons.

One of the policy goals of the Government of Mozambique is to reduce malnutrition by about 50 percent by the year 2015 (UNDP, 1996). To achieve this goal, agricultural production and productivity should increase. Labor and land are available, but capital investment is lacking (Government of Mozambique, 1996).

2.2 AGRICULTURE AND TRADE POLICIES

Effective and efficient agricultural production requires land, labor and capital. Mozambique has large extensions of land and a favorable climate for agricultural production. According to the Mozambican law, the land belongs to the state. However, communal property of land is recognized and private ownership of land is allowed. Farmers, corporations and international joint ventures that want to engage in commercial agriculture in Mozambique are granted a maximum concessionaire of land ownership for 50 years, which can be renewed.

Farmer limitations and the perceptions about agricultural work hamper the advantages of agricultural production. Due to the fact that 73 percent of agricultural laborers are illiterate, training is lacking. The majority do not have access to credit and investment (Banco de Moçambique, 1996). Technological "know-how" is very limited and no supplements are used for improving the productivity of land. It is estimated that 80 percent of the agricultural production is carried out by women (Mucavele, 1994). Men seek work outside rural areas and most of them perceive agriculture as a low level economic activity.

Agriculture is associated with high degree of uncertainty and risk due to natural disasters and human calamities such as floods, droughts and wars. Infrastructure in the countryside is underdeveloped; it is characterized by poor roads, lack of storage facilities and markets. Given these limitations, banking institutions are not financing agricultural enterprises (Banco de Moçambique, 1995).

Agriculture and trade policies in Mozambique have gone through a number of changes since independence in 1975. Immediately after independence, socialist policies were introduced in the country. Those policies favored state enterprises, characterized by heavy investment in state farms and the overall economy was centrally controlled. Between 1975 and 1977, trade was characterized by free movement of goods and services and lower tariffs. Between 1978 and 1983, due to fiscal imbalance and problems of balance of payments, the economy adopted protectionist measures through rationing of foreign exchange and higher tariffs. Since 1987, the country has been implementing trade liberalization measures to restore the open economy environment (Banco de Moçambique, 1994).

The major structural adjustment policies involving market, trade liberalization and institutional policy reforms are the:

- adjustment of the exchange rate, mainly through devaluation;
- improvement of interest rate policy aimed to promote domestic savings and create conditions for efficient allocation of resources;
- introduction of effective mechanisms to control money supply and credit;

- improvement of fiscal policy directed at reducing government expenditure and deficit financing;
- deregulation of prices of goods, services, and factor inputs; and
- reduction of the public sector and improvement of the management of the public sector.

Some lessons from structural adjustment programs in agriculture and trade in Mozambique can be summarized as follows:

1. Price adjustments are not sufficient to achieve a sustained agricultural supply response from a large and growing number of poor household farmers. For instance, increases in prices of maize did not achieve a significant supply response from household farmers in Manica and Sofala provinces.
2. Price shifts in agricultural commodities result in change of crop composition rather than an overall increase in output.
3. Increases in the input prices decrease demand growth, especially in the absence of seasonal credit, and tend to result in poor household farmers having limited access to inputs and new technologies. Also, an increase in input prices tends to increase the area for subsistence crops.
4. Increasing market prices of food crops combined with uncertainty in the supply of food in the market can increase the risk averseness of farmers at the margin of subsistence and reinforce their emphasis on subsistence production given the high and growing market dependence.

The Ministry of Agriculture and Fisheries has just finished preparing a medium/long-term program called PROAGRI (the National Program for Agricultural Development). This program follows the Agriculture Policy approved in 1995 (Government of Mozambique, 1995). The objectives of this program are to:

1. achieve food security through a diversification of agricultural production and by increasing production and productivity;
2. improve farmers' agro-industry;
3. increase the production of agricultural products for export, using domestic resources on a sustainable basis and without neglecting the welfare of rural households.

A close analysis of the PROAGRI shows that the program is too vast and highly diversified. It might be important to remember that experiences in African countries reveal that countries which relied upon their comparative advantage in agriculture performed better both in agricultural and overall growth. These countries also diversified their economies more rapidly than those which pursued strategies of diversification, both in the agricultural sector and in other sectors, at the cost of their traditional agriculture.

3. Analytical Framework

3.1 MEASURES OF COMPARATIVE ADVANTAGE

The measurement of comparative advantage in agriculture has been developed following different approaches. Many researchers have attempted to measure comparative advantage in agricultural production directly, using economic models to capture the interaction of national resources, production technology, product demand, and government interventions. Some of the models were built to answer specific questions of agricultural production. Those models required a large investment in data collection and analysis. As a result, those models were appropriate primarily for academic research or high-stakes investment decisions and policy choices. (Masters, 1995)

The policy analysis matrix (PAM) developed by Monke and Pearson (1989) is one of the approaches developed in a systematic way. It includes all data needed to calculate the producer's subsidy equivalent (PSE), net social profits (NSP), domestic resource costs (DRC), and the social cost benefits (SCB).

3.1.1 The Policy Analysis Matrix (PAM)

The PAM approach is based on estimation of budgets using market prices and social opportunity costs. Benefits, costs and profits are determined in a systematic way: first, using budgets derived through market prices, and second, using social opportunity costs. Inputs are sub-divided into tradable and domestic. Table 3.1 presents the PAM approach.

Matrix entries A, B, and C are the sum of products of market prices (P) and quantities (Q) representing all of a production activity's outputs (with subscript x), tradable inputs (with subscript i) and non-tradable domestic factor inputs (with subscript j). Entries E, F, and G use the same quantities but are valued at social opportunity costs or shadow prices (P^*). The bottom row is the difference between the other two rows. The last column is benefits minus costs. Thus, the PAM is a double-entry accounting system of identities, with no behavioral equations. The behavioral content of the PAM is embodied in the shadow prices used and in the interpretation of the matrix.

The common indicators of comparative advantage and the indicators of protection and policy distortions are presented in Table 3.2.

Table 3.1: Policy Analysis Matrix (PAM)

	BENEFITS	COST		
	Gross Revenue	Tradable Inputs	Domestic Factors	Net Profit
Budget at Market Prices	$A = Ó_x P_x Q_x$	$B = Ó_i P_i Q_i$	$C = Ó_j P_j Q_j$	D
Budget at Social Opportunity Costs	$E = Ó_x P^*_x Q_x$	$F = Ó_i P^*_i Q_i$	$G = Ó_j P^*_j Q_j$	H
Divergences	I	J	K	L

Table 3.2: Common Indicators of Comparative Advantage, Agricultural Protection and Policy Distortion	
Indicators of Comparative Advantage	**Indicators of Agricultural Protection and Policy Distortion**
NSP = E-F-G	NPC = A/E
DRC = G/(E-F)	EPC = (A-B)/(E-F)
SCB = (F+G)/E	PSE = L/A
	SRP = L/E

This approach allows the determinants of comparative advantage to be explicitly traced to specific elements of the PAM. The presentation of data and results using PAM allows a better comparison among different indicators.

3.1.2 Indicators of Comparative Advantage

Indicators of comparative advantage include the net social profits (NSP), domestic resource cost (DRC) and social cost-benefit (SCB) ratios. The NSP is one of the fundamental measures of profitability. It is defined as:

$$\mathbf{NSP = Q_x P^*_x - Ó_i Q_i P^*_i - Ó_j Q_j P^*_j}$$

NSP is expressed in local currency and it is an accurate indicator of comparative advantage. This measure can only be used to compare similar types of activities, such as alternative agricultural product projects competing for a given fixed resource. For agricultural production, resources are typically fixed only in the aggregate.

The DRC is the major indicator of comparative advantage. It is commonly used as a measure of comparison across the countries. The DRC is defined as:

$$\mathbf{DRC = Ó_j Q_j P^*_j / (Q_x P^*_x - Ó_i Q_i P^*_i)}$$

This measure of comparative advantage ensures that the cut-off between efficient and inefficient activities always equals one. The DRCs can not only be used to compare across countries but also across activities within a country. Given that domestic factor costs are placed in the numerator and tradable factors are placed in the denominator, the DRC formula makes it possible for an activity to appear more efficient by replacing some non-tradable factors with an equivalent value of tradable inputs. This substitution might be thought desirable by analysts who favor high-input activities, but it might also be thought undesirable by those who favor increased demand for local land and labor.

The SCB uses the same data as the DRC, within a slightly different formula:

$$\mathbf{SCB = (Ó_j Q_j P^*_j + Ó_i Q_i P^*_i) / Q_x P^*_x}$$

The SCB ratio is the only ratio which accurately replicates farming activities.

3.1.3 Indicators of Protection and Policy Distortions

Four indicators can be used for the measurement of protection and policy distortions, namely NPC, EPC, PSE and SRE. The NPC is the ratio between the observed market price (P) paid to producers of a given product and the good's underlying social opportunity cost (P^*):

$$\mathbf{NPC = P/P^*}$$

If NPC is less than one, there is a government restriction, the product is more heavily taxed than others. There can exist a market failure such as in the case where the product generates positive externalities. If NPC exceeds one, there is a subsidy associated with production of the commodity.

A general variant of the NPC is the nominal rate of protection (NRP), which is the NPC minus one. This would be positive for "protected" production activities. Since market failures and opportunity costs for non-tradable goods are hard to measure, the NPC is used primarily with tradable goods, for which

opportunity costs are generally the good's value in trade, measured as its "border price" or "trade parity."

The P^* can be estimated by finding a relevant foreign price (P^f), multiplied by the exchange rate (e), plus or minus whatever marketing costs (m) are needed to make the foreign good equivalent to the domestic good. Where marketing costs are expressed in proportional terms. Therefore, P^* will be:

$$\mathbf{P^* = eP_f(1 + m)}$$

However, because of trade restrictions, producers receive this opportunity cost plus a tariff, or a "rent" to owners of scarce import quotas and licenses. Where these costs are proportional to price (ad-valorem), it can be estimated by including the tariff:

$$\mathbf{P = (1 + t)P^*}$$

Thus, the NPC simply measures the level of ad-valorem tariff which would be equivalent to whatever combination of trade restrictions may be in place:

$$\mathbf{NPC = P/P^* = (1+t)P^*/P^* = (1 + t)}$$

The advantage of NPCs is that they can be measured at any point along the marketing chain and are not affected by this as long as all marketing costs and policy effects are strictly proportional to price. NPCs are useful for taking account of market and policy failures in product markets, but they do not take account of divergences in input markets.

The EPC takes account of multiple distortions such as interaction among different tariffs in determining the incidence of protection. The EPC is an extension of the NPC concept to include restrictions on trade in inputs such as the tariff-equivalent incidence of policy on value added (v), defined as revenue (P_xQ_x) minus the sum of all input costs ($Ó_iP_iQ_i$).

$$\mathbf{EPC = v/v^* = (P_xQ_x - Ó_ip_iq_i)/(P^*_xQ^*_x - Ó_iP_i^*Q^*_i)}$$

The EPC is clearly analogous to the NPC, except that value added determines returns to fixed factors (labor, capital, land), whereas price determines only gross revenue, for instance returns to fixed factors plus cost of variable inputs. EPC is useful to compare products with very different levels of input use. By using EPC instead of NPC for ranking the results of comparative advantage analyses, measures are likely to differ if the degree of protection imposed on their inputs is very different. In either case, the EPC will be a more accurate indicator of protection, in the sense that it provides a more accurate ranking of quality and welfare changes induced by distortions. This improved measurement is achieved primarily by collecting a larger number of opportunity costs (P^* and P_{i*},s), each of which is measured much as it is for the NPC.

The PSE is the level of producer subsidy that would be necessary to replace the array of actual farm policies employed in the country in order to leave farm income unchanged. It can be thought of as the "cash" value of policy transfers occasioned by price and nonprice policies. The PSE includes policy effects on all inputs (P_i) and factors (P_j). One type of PSE is the "total" PSE defined as:

$$\mathbf{Total\ PSE = Q_x(P_x-P_x^*) - Ó_iQ_i(P_i-P_i^*) - Ó_jQ_j(P_j-P_j^*)}$$

This measure is expressed in national currency and it cannot be used to compare across different activities or countries. For this reason, as an alternative, a "percentage" PSE is used as a proportion of market revenue:

$$\mathbf{Percentage\ PSE = Total\ PSE/P_xQ_x}$$

The percentage PSE is expressed as a proportion of actual farm revenue instead of the economic opportunity cost. Percentage PSEs are attractive measures, but the use of market prices in the denominator makes the results sensitive to the "mix" of policies between product-and input-market interventions. To solve this problem, the denominator should use opportunity costs (P_{x*}). This will provide rankings that correspond more closely with the changes in quantities produced.

Another tariff-equivalent measure analogous to the PSE is the subsidy ratio to producers (SRP). This is defined as:

$$\mathbf{SRP = Total\ PSE/P^*_xQ^x}$$

3.2 GEOGRAPHICAL INFORMATION SYSTEMS (GIS) APPROACH

Geographical information system (GIS) approach provides a powerful tool for integrating data on aggregate economic manner as well as the micro-economic information from field surveys. Biophysical conditions are very important to determine the agricultural comparative advantage, together with resource endowments, markets and infrastructure. The use of GIS and spatial analysis provides a framework important to interface agricultural parameters with biophysical attributes. It helps to evaluate agricultural production, its potential and the relations of the farming systems with altitude and climate. Spatial analysis illuminates the points where data should be collected for the determination of agricultural comparative advantage. Moreover, using the global positioning system (GPS) makes it possible to locate major roads, markets, population distribution, transport infrastructure, land marks, socio-economic infrastructure and farming systems.

The interface of results helps to draw conclusions from the study and it facilitates in the search for potential solutions to problems under study as well as the formulation of new policies and strategies for agriculture and trade development.

Methodologically, the definition of agroecological zones is important for determinating the comparative advantage and analyzing agricultural protection and policy distortions. It allows comparative analysis among agroecological zones with similar characteristics.

4. Empirical Framework and Data Analysis

4.1 RESEARCH DOMAIN AND TECHNOLOGIES

The research was carried out in the 10 regions according to the classification defined by the National Agricultural Research Institute (INIA). Agricultural production in Mozambique is dominated by smallholder farmers, who provide about 75 percent of national production. For a better determination of agricultural comparative advantage indicators, 24 farming points were selected in a stratified way. Three large farms were observed and secondary data were collected on production, input use, prices, processing and marketing.

Twenty-one representative smallholder farms were involved into the determination of input use, opportunity cost of land, labor, and water. Six smallholder farms are located in the north, in the provinces of Cabo Delgado and Nampula. Six farms are located in the center of the country in the provinces of Tete and Manica. Nine farms were selected in the south, provinces of Inhambane, Gaza and Maputo. These farms were analyzed to determine the coefficients of input use to determine the crop budgets for production of maize, sorghum, sunflower, beans, cowpea, potatoes, onions, cotton and cassava.

Three types of technologies are analyzed: traditional or local current practices (LCP), improved recommended technologies (IRT) and potential technologies (POT). LCP vary from north to south. In the northern part of the country, slash-and-burn techniques are still the major practices, land for agricultural production is largely available and climate conditions are favorable. In the center and south, land is becoming a scarce resource and farming tends to be sedentary.

4.2 AGROECOLOGICAL ZONES

Given the high biophysical diversity of Mozambique, the analytical framework includes the definition macro-agroecological and agroecological zones. Measures of comparative advantage and indicators of protection and policy distortions are determined by agroecological zones. Data on climate, soils, altitude, farming systems, infra-structure such as roads, railways, ports, rural marketing centers and trade locations are spatially analyzed. ARCVIEW GIS software was used to organize and present the data on agroecological zones, and the results of research are spatially presented.

The definition of agroecological zones in Mozambique is a complex task. For the purpose of this study, the classification developed by INIA was used. The agroecological division framework includes three macro-agroecological zones: north, center, and south, as shown in map 4.1. These macro-agroecological zones are based on the type of climate, vegetation, altitude, soils and farming systems.

The northern macro-agroecological zone lies between Zambezi and Rovuma Rivers and is represented by Lichinga meteorological station. This agroecological zone has the following characteristics:

- rainfall from September to May varies from 1,500 to 2,200 mm, with an average rainfall of 1,750 mm;
- it is an agroecological zone with low (less than 20 percent) to moderate risk (21 to 30 percent) of drought for rainfed agriculture;
- the preferred and cultivated crops are mainly maize, cotton, coconuts, cashew nuts, cassava, sorghum, millet and groundnut (peanuts);

The central macro-agroecological zone is located between Save and Zambezi Rivers and is represented by the Beira meteorological station. The major characteristics of this macro-agroecological zone are:

- good rainfall levels from September to May, varying from 2,100 to 2,900 mm, with average of 2,500 mm;
- moderate risk (31 to 45 percent) of drought for rainfed agriculture;
- major cultivated crops are maize, cotton, cassava, bananas, citrus, sugarcane, vegetables, sorghum, cashew nuts and rice.

The southern macro-agroecological zone is located south of the Save River and is represented by the Chokwé meteorological station where the basic characteristics are:

- low rainfall levels from September to May, varying from 350 mm to 1,700 mm, with an average rainfall of 900 mm;
- high (61 to 75 percent) to very high risk (less than 75 percent) of drought for rainfed agriculture;
- the preferred and cultivated crops are maize, rice, groundnut, cowpea, cassava, citrus, sugar cane, vegetables and cashew nuts.

The macro-agroecological zones are important to set up the research domains under which agroecological regions are defined. According to the INIA classification, 10 agroecological regions are defined and presented in map 4.2.

Region 1 (R1) is located in the southern macro-agroecological zone. It is dry, arid, with low rainfall levels and high humidity. It covers the interior of the Maputo Province and the southern part of the Gaza Province.

Region 2 (R2) is situated in the southern macro-agroecological zone. It lies in the coastal zone of the Save river.

Region 3 (R3) covers the center and north of the Gaza Province and the interior of the Inhambane Province.

Region 4 (R4) is located in the central part of the country and is characterized by medium altitude.

Region 5 (R5) is located in the low altitudes of the provinces of Sofala and Zambézia.

Region 6 (R6) is a semi-arid zone, which includes the Zambeze valley and the south region of Tete Province.

Region 7 (R7) is a region of medium altitudes, covering Zambézia, Nampula, Tete, Niassa, and Cabo Delgado provinces.

Region 8 (R8) is the coastal area of Zambézia, Nampula and Cabo Delgado provinces.

Region 9 (R9) covers the interior zones in the northern region of Cabo Delgado Province.

Region 10 (R10) is a region of high altitude located in Zambézia, Niassa, Marávia-Angónia and Manica provinces.

4.3 DATA COLLECTION

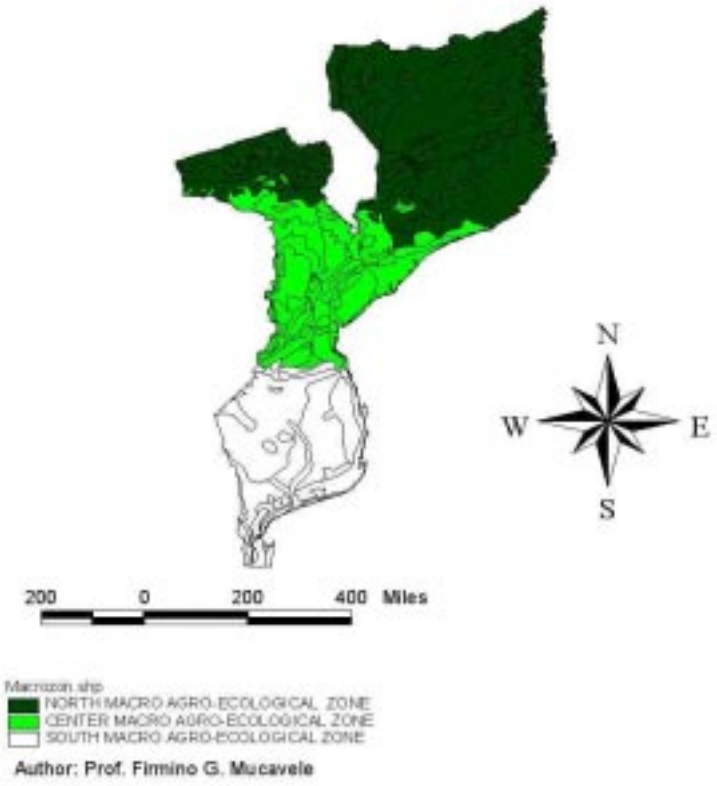
4.3.1 General Approach

Two types of data were collected: primary and secondary data. Primary data was collected with respect to crop budgets, input use, yields and opportunity cost of non-tradable inputs. Where secondary data was available, primary data was collected for validation, verification and enhancement of the available information. For a better presentation and analysis of data, all information was spatially organized according to the agroecological regions.

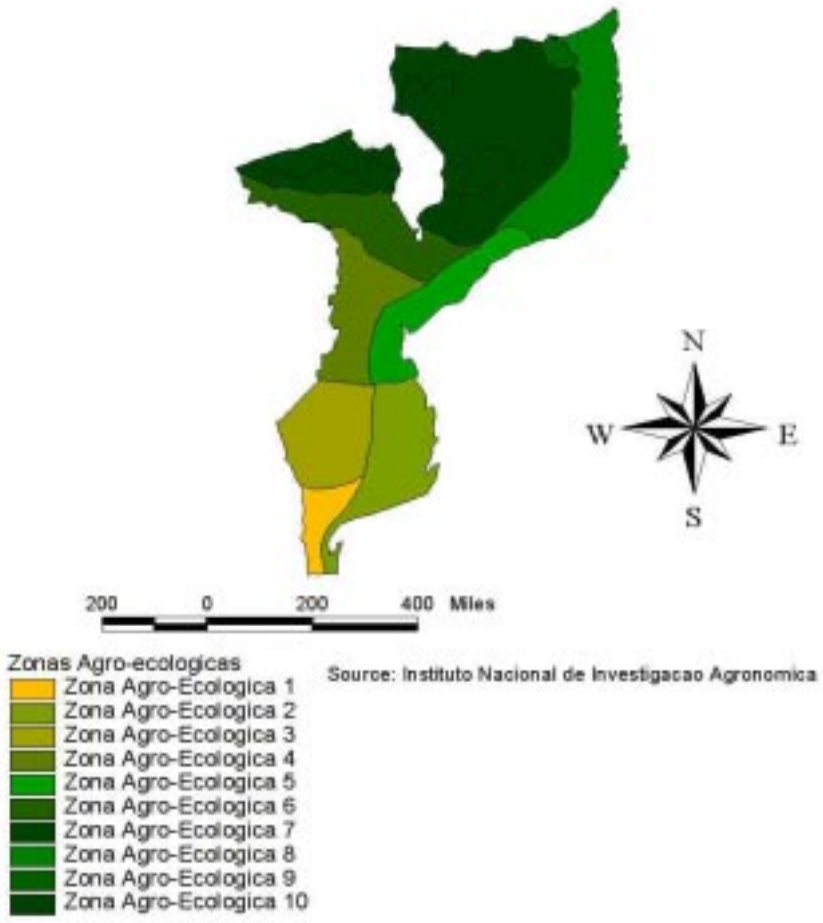
4.3.2 Crops

Nine crops were included in the study, namely maize, cotton, potato, sorghum, sunflower, onions, cassava, beans and cowpeas. The study concentrated on obtaining reliable estimates of how much seed, fertilizer, manure, irrigation water, animal and mechanical traction, family and hired labor and other farm-level inputs are used in the local current technologies. For the potential technologies, the amounts of input recommended by the representative research stations were

Map 4.1: Macro Agroecological Zones



Map 4.2: Agroecological Regions



used. Since the opportunity costs of tradable goods are defined by trade opportunities, it was necessary to include all of the transport, processing and marketing inputs needed to reach foreign markets.

The intermediate inputs were also categorized into tradable and non-tradable components to capture the incidence of trade policy on the cost of the input. In summary, the complete decomposition involved input-output coefficient determination for all traded inputs into the non-traded service, plus market prices and opportunity costs for the indirect inputs. Monke and Pearson (1989) suggest that a useful rule of thumb is to avoid decomposition of anything that accounts for less than five percent of production costs. If no other information is available, it is generally better to guess at the decomposition than not to decompose. A good starting point for many services would be that half of costs are tradable and the other half are non-tradable capital and labor.

4.3.3 Prices

Two sets of values were compiled for each budget item: market prices and opportunity costs. Since prices varied across transactions, averaging was done where the coefficient of variation was less than 30 percent, thereby smoothing out random fluctuations. Relevant prices were carefully selected for the reference year, 1995. The problems encountered were related to the product quality, packaging and volume, as well as the season and location in which sales or purchases occur. To minimize differences in measurements, all data were collected with reference to the same agricultural season. The production and consumption locations were carefully analyzed and parity prices were estimated. For maize, the import parity price that was quoted in the southern agroecological zone, where maize is net imported, was used. For the export price, the price quoted in the central and northern zones were used since the regions are net exporters of maize.

One critical question related to market prices was whether crops were being purchased or sold by farmers. Farmers are often net buyers of food crops, so that their farm production decisions are made with reference to farmgate purchase prices. These farmgate prices are often far higher than sales prices. In the cases where the crop was grown for subsistence, an import parity price was used if the region was a net importer. However, for farmers growing crops for export, such as cotton, export parity price was used.

For the opportunity costs of traded crops and inputs a key choice is between using foreign price observations – suitably corrected for international marketing costs – and using local observations of import or export prices. When trade does not actually occur, it is obviously necessary to find foreign-market prices. For standard-grade commodities, such as sunflower, prices used were those published in the FAO's "Monthly Bulletin of Statistics" and those published by the Ministry of Industry, Commerce and Tourism. For local grade systems, adjustments were made for transport and marketing costs. Existing data on prices were analyzed and specific price quotations were obtained from government sources, the central bank, and non-government organizations (NGOs).

The opportunity costs of non-tradable goods and services were the most difficult prices to estimate. Land values were estimated as opportunity cost of land. Capital costs are often highly distorted by inflation and other factors, and these costs must be estimated from urban borrowing rates, plus transaction costs and loss factors associated with on-lending to farmers. Values for farm labor were estimated using the opportunity cost where the crop is produced, keeping in mind the differences in skills, motivation and season.

4.4 DATA ANALYSIS

NSPs, DRCs and SCBs are determined as measures of comparative advantage. NPC, EPC, PSE, and SRP are estimated as indicators of agricultural protection and policy distortions. For each agroecological region, measures of comparative advantage and policy intervention are estimated considering the three technologies.

The analyses of the 10 regions was done using maps and spatial plotting of the DRCs and EPC. The assessment of comparative advantage is done by comparing current levels of domestic opportunity costs, relative to market prices in trade.

5. Results of Research and Analysis of Comparative Advantage and Agricultural Trade

5.1 MEASURES OF AGRICULTURAL COMPETITIVENESS AND POLICY INTERVENTION

The northern macro-agroecological zone has a comparative advantage in producing all the crops considered in this study. This zone includes regions R7, R10, R8 and R9. All technologies reveal a comparative advantage in the north macro-agroecological zone.

Maize

The production of maize is particularly advantageous in region R7. The potential technology has a strong DRC (0.465) in the Cabo Delgado Province with the highest net social profit of 2,440,052.00 Meticais. The strongest SCB ratio (0.531) of producing maize is also obtained in Cabo Delgado using potential technology. This was expected since Cabo Delgado has good soils for agriculture, good rainfall pattern and the maize varieties used by the smallholder farmers are better suited for the environment. Extension services are better organized to provide assistance to the farmers of Metuge, Cabo Delgado. In the Nampula Province, DRC values show that the province has a comparative advantage for all technologies.

In the Nampula province it is necessary to note that the DRCs for local technologies are stronger than the DRCs of the improved and potential technologies. This may be related to the fact that most of the inputs used in the local technologies are non-tradable and their opportunity costs are low, relative to the improved technologies which require more tradable inputs such as fertilizers, pesticides and hybrid varieties. Moreover, this fact can be associated to the transaction costs due to bad roads, lack of input markets and technological know-how.

In the central agroecological zone, maize production in Manica Province, region R4, has a comparative advantage in all technologies and the strongest DRC is 0.471, using improved technology. In the Tete Province, region R6, local technologies are the only ones with comparative advantage, having a DRC equal to 0.649. The maize enterprises using improved and potential technologies in Tete Province do not have comparative advantage, and they present negative NSP and the SCBs are above one. This result was not expected. It seems that hybrid maize seed used in the improved and potential technologies do not yield as well in the field as they did in the research stations. Observations during the studies revealed that when hybrid seed is not properly supplied with fertilized and little water was available for irrigation, as was the case in Tete, the resulting crops have weak DRCs and negative NSPs. This can be one of the reasons explaining the weak DRCs and negative NSPs. Table 5.1 presents the measures of comparative advantage for maize enterprises using three technologies in each of the three macro- agroecological zones of the country.

The southern agroecological zone, regions R1, R2 and R3 generally do not have comparative advantage for maize enterprises. Inhambane Province has a comparative advantage in producing maize with any level of technologies while the Gaza Province has a comparative advantage in producing maize only under local technology. Again, improved and potential technologies do not have comparative advantage and the NSPs of maize enterprises are negative for those technologies.

Amazingly, in Inhambane, region R2, where the rainfall is about 900 mm with high risk of low rainfall (61 to 75 percent) and very high risk of drought for rainfed agriculture, the local technology has one of the best DRCs of about 0.483. This is close to the strongest DRC which was verified in Cabo Delgado Province

Table 5.1: Measures of Comparative Advantage for Maize Enterprises

Agro-ecological Zone	Province	Technology	NSP (Meticais)	DRC	SCB
NORTH	Cabo Delgado	Local	598,130.0	0.556	0.581
	Cabo Delgado	Improved	540,250.0	0.684	0.723
	Cabo Delgado	Potential	2,440,052.0	0.465	0.531
	Nampula	Local	570,550.0	0.495	0.542
	Nampula	Improved	244,900.0	0.826	0.854
	Nampula	Potential	770,957.5	0.678	0.725
CENTER	Manica	Local	291,100.0	0.745	0.764
	Manica	Improved	2,124,600.0	0.471	0.533
	Manica	Potential	2,021,910.0	0.572	0.621
	Tete	Local	367,570.0	0.649	0.672
	Tete	Improved	-190,725.0	1.123	1.105
	Tete	Potential	-630,325.0	1.261	1.225
SOUTH	Inhambane	Local	641,250.0	0.483	0.549
	Inhambane	Improved	550,250.0	0.661	0.732
	Inhambane	Potential	766,650.0	0.754	0.798
	Gaza	Local	39,600.0	0.965	0.968
	Gaza	Improved	-877,700.0	1.606	1.475
	Gaza	Potential	-780,365.0	1.380	1.302
	Maputo	Local	-449,000.0	1.592	1.540
	Maputo	Improved	-1,134,825.0	1.708	1.569
	Maputo	Potential	-1,649,345.0	1.901	1.725

under potential technologies with good rainfall and the smallest risk of drought, the lowest degree of disease infestation and the lowest degree of plague attack. The maize varieties used in Inhambane are open polinated, short cycle, use few chemicals, are resistant to drought and tolerant to diseases. These agronomic aspects may explain the strong DRCs. However, in depth analysis still needs to be done with local agronomists and farmers.

The NPCs calculated from the maize enterprises indicate that the northern and central agroecological zones are slightly taxed relative to the southern agroecological zone, given the pan-territorial price system that is still prevailing. In the southern agroecological zone, the maize policy may have introduced some distortions which are subsidizing its production; the NPC shows a policy subsidy of about 20 to 21 percent. It seems, however, that the effective subsidy varies between 12 to 43 percent. It would be better to contract production in the other agroecological zones so that other activities can expand. Table 5.2 presents the policy analysis measures for maize enterprises in Mozambique.

All the indicators presented in Table 5.2 show that the current agricultural and trade policies in Mozambique might effectively protect production in the south or north, and central agroecological zones might subsidize the south about 8 to 10 percent given the pan-territorial price system. The Cabo Delgado Province presents the lowest EPC while Maputo Province has the highest EPC.

Table 5.2: Policy Analysis Measures for Maize Enterprises						
Agro-ecological Zone	Province	Technology	NPC	EPC	PSE	SRP
NORTH	Cabo Delgado	Local	0.885	0.926	-0.078	-0.069
	Cabo Delgado	Improved	0.885	0.968	-0.032	-0.028
	Cabo Delgado	Potential	0.885	0.954	-0.045	-0.040
	Nampula	Local	0.868	0.941	-0.062	-0.054
	Nampula	Improved	0.868	0.981	-0.018	-0.016
	Nampula	Potential	0.868	0.964	-0.036	-0.031
CENTER	Manica	Local	0.904	0.958	-0.043	-0.038
	Manica	Improved	0.904	0.994	-0.006	-0.006
	Manica	Potential	0.904	0.988	-0.012	-0.011
	Tete	Local	0.857	0.903	-0.106	-0.091
	Tete	Improved	0.857	0.935	-0.065	-0.056
	Tete	Potential	0.857	0.937	-0.063	-0.054
SOUTH	Inhambane	Local	0.987	1.121	0.107	0.105
	Inhambane	Improved	0.987	1.193	0.154	0.152
	Inhambane	Potential	0.987	1.169	0.140	0.139
	Gaza	Local	1.201	1.316	0.238	0.286
	Gaza	Improved	1.201	1.451	0.294	0.353
	Gaza	Potential	1.201	1.432	0.286	0.343
	Maputo	Local	1.210	1.308	0.232	0.280
	Maputo	Improved	1.210	1.434	0.288	0.349
	Maputo	Potential	1.210	1.423	0.281	0.340

The dilemma of maize production in Mozambique is that the consumption center is in the south, but the comparative advantage to produce maize is the north, in Cabo Delgado, Niassa and Nampula provinces, region R7. The distance between Cabo Delgado and Maputo provinces is about 2,300 km; this aspect calls for an evaluation of possible alternatives for resource allocation for maize production, infrastructure policies, and food security policies and strategies to cope with the dilemma. There is a need to evaluate agricultural policies in order to identify possible instrument policies which may introduce inefficiencies into the production and trade. Also, protection policies aimed at providing poor consumers in large urban areas, such as Maputo, access to maize may exist. Most often these protection measures were introduced with the intent to attain food security which ultimately was not achieved. A careful analysis of the price system needs to be undertaken to develop a better understanding of the protection indicators.

Cotton

Cotton production in Mozambique has a comparative advantage in all agroecological zones which is illustrated by the DRC values. Table 5.3 presents the measures of comparative advantage for cotton production in Mozambique. However, adopting improved and potential technologies in Gaza Province is not economically viable, the DRC is weak (1.306 and 1.450, respectively).

In Maputo Province, local technology has a weak DRC (1.592). The best agroecological zone for cotton enterprises is in the north, regions R7, R8, R9 and R10, where the strongest DRC is 0.42 in the Nampula

Table 5.3: Measures of Comparative Advantage for Cotton Enterprises					
Agro-ecological Zone	Province	Technology	NSP (Meticais)	DRC	SCB
NORTH	Cabo Delgado	Local	3,598,000.0	0.456	0.441
	Cabo Delgado	Improved	4,540,850.0	0.484	0.503
	Cabo Delgado	Potential	6,440,052.0	0.465	0.480
	Nampula	Local	2,570,550.0	0.420	0.240
	Nampula	Improved	3,244,900.0	0.528	0.552
	Nampula	Potential	4,770,960.0	0.678	0.685
CENTER	Manica	Local	2,291,100.0	0.740	0.768
	Manica	Improved	2,824,800.0	0.771	0.793
	Manica	Potential	3,821,960.0	0.872	0.880
	Tete	Local	667,550.0	0.949	0.970
	Tete	Improved	790,790.0	0.963	0.995
	Tete	Potential	835,326.0	0.973	0.986
SOUTH	Inhambane	Local	941,250.0	0.687	0.699
	Inhambane	Improved	1,850,250.0	0.691	0.708
	Inhambane	Potential	2,896,650.0	0.730	0.798
	Gaza	Local	69,600.0	0.980	0.960
	Gaza	Improved	-77,700.0	1.306	1.170
	Gaza	Potential	-180365.0	1.450	1.344
	Maputo	Local	-449,000.0	1.592	1.540
	Maputo	Improved	134,825.0	0.998	0.954
	Maputo	Potential	249,345.0	0.998	0.960

Province. Table 5.4 presents policy analysis measures for cotton enterprises in Mozambique.

Tete, Inhambane, Gaza and Maputo provinces effectively subsidize cotton enterprises with subsidies ranging from 12 to 69 percent. The major subsidy is in Gaza Province, while the major taxation is in Nampula Province, with about 27.7 percent, given the pan-territorial price system used in the country. The potential technology yields are heavily taxed in the northern agroecological zones, while production in the southern agroecological zone is heavily subsidized.

Potato

Potato production in Mozambique has a comparative advantage in all macro-agroecological zones for the three technologies considered. Table 5.5 presents the measures of comparative advantage for potato production in Mozambique.The DRCs vary from 0.413 in Cabo Delgado, in the northern agroecological zone, to 0.991 in Inhambane, in the southern agroecological zone. However, Gaza and Maputo provinces are slightly subsidized as shown by the NPCs and EPCs in Table 5.6.

Sorghum

For sorghum production, the country has a comparative advantage in all the three macro-agroecological zones. If they are adopted, the three technologies – local, improved and potential – would result in positive NSPs. In this study, the DRC ranges from 0.365 to 0.861, and the EPC varies from 0.916 to 1.094, illustrating that there is almost no subsidy or taxation for sorghum production.

Table 5.4: Policy Analysis Measures for Cotton Enterprises						
Agro-ecological Zone	Province	Technology	NPC	EPC	PSE	SRP
NORTH	Cabo Delgado	Local	0.709	0.899	-0.108	-0.115
	Cabo Delgado	Improved	0.709	0.905	-0.112	-0.128
	Cabo Delgado	Potential	0.709	0.914	-0.155	-0.140
	Nampula	Local	0.645	0.791	-0.092	-0.094
	Nampula	Improved	0.645	0.785	-0.099	-0.096
	Nampula	Potential	0.645	0.723	-0.136	-0.112
CENTER	Manica	Local	0.936	0.988	-0.083	-0.088
	Manica	Improved	0.936	0.999	-0.096	-0.026
	Manica	Potential	0.936	0.985	-0.092	-0.071
	Tete	Local	1.157	1.321	0.256	0.221
	Tete	Improved	1.157	1.488	0.215	0.190
	Tete	Potential	1.157	1.339	0.318	0.298
SOUTH	Inhambane	Local	0.987	1.121	0.107	0.105
	Inhambane	Improved	0.987	1.193	0.154	0.152
	Inhambane	Potential	0.987	1.169	0.140	0.139
	Gaza	Local	1.180	1.388	0.349	0.387
	Gaza	Improved	1.180	1.556	0.488	0.497
	Gaza	Potential	1.180	1.690	0.558	0.560
	Maputo	Local	1.315	1.396	0.332	0.350
	Maputo	Improved	1.315	1.405	0.401	0.416
	Maputo	Potential	1.315	1.422	0.390	0.398

Sunflower

Sunflower production has a comparative advantage mainly in the northern and central agroecological zones. In Inhambane Province, in the south, potential technology has a DRC of 0.797. In Gaza and Maputo provinces, the DRC values are weak, ranging from 0.998 to 1.193. The EPC varies from 0.822 to 1.291. The provinces located in the northern agroecological zone tend to be taxed, while the provinces located in the central and southern agroecological zones tend to be subsidized.

Beans

Bean production has a comparative advantage in all agroecological zones for the three technologies considered in this study. The DRC ranges from 0.547 in the Manica province, to 0.871 in the Tete Province, both provinces are located in the central agroecological zone. The lowest EPC is 0.749, observed in the Manica Province, located in the central agroecological zone; the highest EPC is 1.093, observed in Maputo Province, located in the southern agroecological zone. Cowpeas, like sunflower, have a production comparative advantage throughout the country. The strongest DRC (0.453) was found in Inhambane Province located in the southern agroecological zone. The DRC ranges from 0.453 to 0.866. The EPC varies from 0.858, observed in the Manica Province, located in the central agroecological zone, to 1.114, observed in the Maputo Province, located in the southern agroecological zone.

Table 5.5: Measures of Comparative Advantage for Potato Enterprises					
Agro-ecological Zone	Province	Technology	NSP (Metcais)	DRC	SCB
NORTH	Cabo Delgado	Local	6,599,000.0	0.413	0.391
	Cabo Delgado	Improved	8,540,850.0	0.497	0.483
	Cabo Delgado	Potential	9,440,052.0	0.498	0.470
	Nampula	Local	5,570,990.0	0.480	0.540
	Nampula	Improved	6,255,980.0	0.494	0.550
	Nampula	Potential	7,880,980.0	0.522	0.684
CENTER	Manica	Local	6,295,500.0	0.640	0.746
	Manica	Improved	6,824,920.0	0.621	0.733
	Manica	Potential	7,821,960.0	0.272	0.854
	Tete	Local	5,667,550.0	0.840	0.970
	Tete	Improved	6,790,744.0	0.869	0.995
	Tete	Potential	7,835,355.0	0.872	0.986
SOUTH	Inhambane	Local	941,250.0	0.987	0.898
	Inhambane	Improved	1,050,288.0	0.991	0.891
	Inhambane	Potential	1,896,654.0	0.930	0.894
	Gaza	Local	99,660.0	0.989	0.955
	Gaza	Improved	117,700.0	0.956	0.934
	Gaza	Potential	180,365.0	0.945	0.921
	Maputo	Local	649,000.0	0.898	0.901
	Maputo	Improved	734,880.0	0.854	0.914
	Maputo	Potential	949,500.0	0.988	0.978

Onions

The production of onions is also viable. In this study, the DRC varies from 0.456, using potential technology, in Cabo Delgado Province, in the northern agroecological zone, to 0.892, using local technology, observed in Maputo Province. The EPC varies from 0.819 in Cabo Delgado Province, in the northern agroecological zone, to 1.190, observed in the Gaza Province, in the southern agroecological zone.

Cassava

Cassava production is viable in all agroecological zones. In this study, the DRC varies from 0.415 in Cabo Delgado, in the northern agroecological zone, to 0.672 in Tete, located in the central agroecological zone. The EPC ranges from 0.922 to 1.099.

5.2 SUMMARY OF MAJOR RESULTS

Overall, the country shows a comparative advantage in producing most of the agricultural products considered in this study. More specifically, Cabo Delgado, Nampula, Niassa and Zambézia provinces, in regions R7, R8, R9 and R10, where the average rainfall is above 2,000 mm per year and the risk of drought is below 20 percent, have the greatest comparative advantage. Improved and potential technologies in the northern and central macro-agroecological zones raise strong DRCs. Potential technologies in most crops in Gaza and Maputo provinces do not have comparative advantage, having weak DRCs. In the southern agroecological zone, most of the adopted local technologies are already showing strong DRCs compared

Table 5.6: Policy Analysis Measures for Potato Enterprises						
Agro-ecological Zone	**Province**	**Technology**	**NPC**	**EPC**	**PSE**	**SRP**
NORTH	Cabo Delgado	Local	0.600	0.701	-0.098	-0.100
	Cabo Delgado	Improved	0.600	0.686	-0.078	-0.098
	Cabo Delgado	Potential	0.600	0.654	-0.098	-0.093
	Nampula	Local	0.615	0.654	-0.080	-0.074
	Nampula	Improved	0.615	0.632	-0.071	-0.086
	Nampula	Potential	0.615	0.624	-0.056	-0.072
CENTER	Manica	Local	0.722	0.798	-0.089	-0.097
	Manica	Improved	0.722	0.752	-0.089	-0.095
	Manica	Potential	0.722	0.741	-0.091	-0.080
	Tete	Local	0.843	0.861	-0.096	-0.023
	Tete	Improved	0.843	0.888	-0.099	-0.090
	Tete	Potential	0.843	0.831	-0.095	-0.093
SOUTH	Inhambane	Local	0.886	0.893	-0.067	-0.095
	Inhambane	Improved	0.886	0.899	-0.054	-0.059
	Inhambane	Potential	0.886	0.891	-0.044	-0.058
	Gaza	Local	0.994	1.000	0.149	0.182
	Gaza	Improved	0.994	1.052	0.128	0.144
	Gaza	Potential	0.994	1.020	0.108	0.100
	Maputo	Local	0.925	1.093	0.432	0.350
	Maputo	Improved	0.925	0.985	-0.201	-0.116
	Maputo	Potential	0.925	0.982	-0.190	-0.098

to improved and potential technologies. Given the pan-territorial price system, the EPCs obtained in this study show that agricultural products in the northern zone are taxed. In the southern and central agroecological zones, some agricultural products are subsidized.

In the case of maize production, it was verified that the south does not have an economic advantage. However, the major centers of maize consumption are in the south, while the production centers are in the central and northern part of the country. Ideally, one could recommend that maize be exported from the north of Mozambique to the south. However, the secondary and tertiary roads were destroyed during the war and the cost of transport is very high. Rural markets are nonexistent and railways from the interior of the country to the sea do not operate regularly. The maritime transport system needs to be improved to allow the movement of produce from the north to the center and south, and to move industrial goods from the southern to the northern part of the country. Tables 5.7A, 5.7B and 5.7C present summaries of the results.

Table 5.7A: Summary of Measures of Competitiveness and Policy Interventions				
Crop	**Agroecol. Zone**	**Province**	**DRC**	**EPC**
Maize	North	Cabo Delgado	0.465 - 0.684	0.926 - 0.968
Maize	North	Nampula	0.495 - 0.826	0.941 - 0.981
Maize	Center	Manica	0.471 - 0.745	0.958 - 0.994
Maize	Center	Tete	0.649 - 1.261	0.903 - 0.937
Maize	South	Inhambane	0.483 - 0.754	1.121 - 1.193
Maize	South	Gaza	0.965 - 1.606	1.316 - 1.451
Maize	South	Maputo	1.592 - 1.901	1.308 - 1.434
Cotton	North	Cabo Delgado	0.456 - 0.484	0.899 - 0.919
Cotton	North	Nampula	0.420 - 0.678	0.723 - 0.791
Cotton	Center	Manica	0.740 - 0.872	0.985 - 0.999
Cotton	Center	Tete	0.945 - 0.973	1.321 - 1.488
Cotton	South	Inhambane	0.687 - 0.730	1.121 - 1.193
Cotton	South	Gaza	0.980 - 1.450	1.388 - 1.690
Cotton	South	Maputo	0.988 - 1.592	1.396 - 1.422
Potato	North	Cabo Delgado	0.413 - 0.498	0.654 - 0.701
Potato	North	Nampula	0.480 - 0.522	0.624 - 0.654
Potato	Center	Manica	0.640 - 0.672	0.741 - 0.798
Potato	Center	Tete	0.840 - 0.872	0.831 - 0.861
Potato	South	Inhambane	0.930 - 0.991	0.891 - 0.899
Potato	South	Gaza	0.945 - 0.989	1.000 - 1.052
Potato	South	Maputo	0.854 - 0.898	0.982 - 1.093

Table 5.7B Summary of Measures of Competitiveness and Policy Interventions				
Crop	**Agro-ecological Zone**	**Province**	**DRC**	**EPC**
Sorghum	North	Cabo Delgado	0.365 - 0.587	0.996-1.008
Sorghum	North	Nampula	0.494 - 0.826	0.933-0.991
Sorghum	Center	Manica	0.576 - 0.844	0.958-1.094
Sorghum	Center	Tete	0.655 - 0.861	1.003-1.007
Sorghum	South	Inhambane	0.481 - 0.653	1.000-1.013
Sorghum	South	Gaza	0.465 - 0.606	0.916-0.951
Sorghum	South	Maputo	0.592 - 0.802	1.008-1.011
Sunflower	North	Cabo Delgado	0.556 - 0.644	0.822-0.988
Sunflower	North	Nampula	0.620 - 0.678	0.925-0.991
Sunflower	Center	Manica	0.646 - 0.885	0.985-1.000
Sunflower	Center	Tete	0.733 - 0.887	1.001-1.018
Sunflower	South	Inhambane	0.797 - 0.833	0.924-1.003
Sunflower	South	Gaza	0.982 - 1.250	1.182-1.291
Sunflower	South	Maputo	0.998 - 1.193	1.092-1.028
Beans	North	Cabo Delgado	0.615 - 0.668	0.852-0.981
Beans	North	Nampula	0.686 - 0.721	0.884-0.898
Beans	Center	Manica	0.547 - 0.672	0.749-0.799
Beans	Center	Tete	0.649 - 0.871	0.834-0.869
Beans	South	Inhambane	0.630 - 0.696	0.891-0.899
Beans	South	Gaza	0.645 - 0.799	0.906-1.053
Beans	South	Maputo	0.651 - 0.793	0.969-1.093
Cowpeas	North	Cabo Delgado	0.461 - 0.681	0.929-0.998
Cowpeas	North	Nampula	0.490 - 0.866	0.988-0.999
Cowpeas	Center	Manica	0.471 - 0.545	0.858-0.992
Cowpeas	Center	Tete	0.449 - 0.661	0.993-0.932
Cowpeas	South	Inhambane	0.453 - 0.854	0.991-1.093
Cowpeas	South	Gaza	0.565 - 0.606	1.006-1.111
Cowpeas	South	Maputo	0.592 - 0.670	1.101-1.114

Table 5.7C Summary of Measures of Competitiveness and Policy Interventions				
Crop	**Agro-ecological Zone**	**Province**	**DRC**	**EPC**
Onions	North	Cabo Delgado	0.456 - 0.686	0.819-0.929
Onions	North	Nampula	0.520 - 0.698	0.823-0.891
Onions	Center	Manica	0.640 - 0.871	0.915-0.999
Onions	Center	Tete	0.645 - 0.773	0.821-0.988
Onions	South	Inhambane	0.688 - 0.790	1.001-1.103
Onions	South	Gaza	0.780 - 0.850	0.998-1.190
Onions	South	Maputo	0.788 - 0.892	0.996-1.022
Cassava	North	Cabo Delgado	0.415 - 0.458	0.989-1.001
Cassava	North	Nampula	0.482 - 0.522	1.000-1.002
Cassava	Center	Manica	0.620 - 0.671	0.991-0.998
Cassava	Center	Tete	0.640 - 0.672	0.831-0.991
Cassava	South	Inhambane	0.430 - 0.591	0.991-1.099
Cassava	South	Gaza	0.445 - 0.489	1.000-1.054
Cassava	South	Maputo	0.455 - 0.592	0.922-0.993

6. Implications of the Results for Agricultural Policies and Trade

6.1 POLICY FORMULATION AND INTERVENTIONS IN AGRICULTURAL TRADE

Overall, the agricultural comparative advantage is in the northern agroecological zone represented by the Cabo Delgado, Nampula, Zambézia and Niassa provinces. The study shows that maize production in Cabo Delgado and Nampula provinces, located in the northern agroecological zone, are particularly economically advantageous. Major consumption centers are located in the Maputo, Gaza and Inhambane provinces in the southern agroecological zone. The distance between Cabo Delgado and Maputo is about 2,300 km. Therefore, this implies that policies and strategies should be designed to allow trade between northern and southern Mozambique. Presently, the roads and railways are poorly maintained and the infrastructure in the country is underdeveloped or nonexistent. The first implication of this study is that infrastructure in rural areas needs to be improved if the productive comparative advantage is to be explored. A transport network policy should be formulated and developed in order to link production regions with consumption centers, and there should be a coordinated system of maritime transport with railways and storage facilities.

Some of the macro policies in Mozambique are aimed at reducing poverty, establishing required conditions for food security, increasing production and productivity, and improving agricultural markets. To achieve these objectives, there is a need to take advantage of highly productive zones and introduce potential technologies for efficient allocation and use of scarce resources.

The economy has undergone a transformation from a controlled economy to a much more liberal economy implemented through the removal of import restrictions, liberalized foreign exchange allocations, removal of price controls and tax rationalization. The environment is becoming favorable to promote trade within the country and with neighboring countries.

The agricultural sector in Mozambique is characterized by a large number of small subsistence farmers who hardly enter agricultural markets. In many areas of Mozambique, the bulk of agricultural output comes from a large number of small farms, each operating independently. To organize an efficient assembly, processing and distribution is too complicated. To supply inputs for production such as improved seeds, fertilizers and pesticides is difficult. This study shows that there is a comparative advantage in agricultural production which implies that the large number of small farmers will have to enter the market and a system of production, processing, storage and distribution has to be developed, especially in the remote underdeveloped rural areas.

The climate is favorable for production. That can be illustrated by high yields achieved in maize production in 1996 with low input use.

Potential technologies can increase land productivity and overall production if inputs, including improved seed, fertilizer and pesticides, are supplied on time. Water is a major constraint in the Tete, Gaza and Inhambane provinces, regions R6, R2 and R3. Some improved technologies show weak DRC compared to the local current technologies. This fact can be associated to the lack of fertilizer and irrigation. The lack of rural credit associated with low productivity technologies results in weak DRCs. On the other hand, due to the transaction costs associated to fertilizer, the cost of production is not efficient. Agricultural extension policies should be reviewed in order to establish a system of services which can help farmers to acquire inputs and minimize risk and uncertainty.

6.2 OPTIONS FOR AGRICULTURAL TRADE

The results of this study imply that allocation of scarce resources has to be improved through the redirection of resources to competitive activities. It can be concluded that the promotion of agricultural production in the northern part of the country should be encouraged given the favorable agro-ecological conditions. One option is to devise mechanisms that the private sector could invest in those potential zones such as Cabo Delgado, Niassa, Nampula and Zambézia. The problem is that infrastructure is nonexistent or poorly developed in those areas.

To bring more options for trade within Mozambique and within the region, it is important to recall that agricultural marketing system involves the development of:

1. information flows, such as present and prospective supplies, stocks, prices, costs and marketing margins;
2. institutional arrangements, including legal systems, weights, grades, measures and enforceable contracts;
3. infrastructure, such as roads, telecommunications, warehouses, vehicles and agro-processing plants;
4. organizations, such as government, municipal councils, cooperative, private firms and individuals;
5. entrepreneurial activities which can be evaluated through stockholding and risk bearing capacity, financial resources, personal contacts and personal reputation of the farmers involved in the market.

Information flows in Mozambique are inefficient. Timely, accurate information about present and prospective supplies of agricultural products, the existence of stocks of agricultural products and future needs of agricultural products is lacking or completely absent. Information on prices of agricultural products are not disseminated to producers, costs of transport are uncertain, and agricultural marketing margins do not reflect commodity scarcities.

Institutional arrangements, including legal systems, weights, and grades, are not actualized. The contract systems used in agriculture such as concessionaire systems are not feasible for development of agricultural marketing.

The infrastructure network in rural areas is very poor or does not exist. Roads were destroyed during the wwar and some were never repaired, telecommunications do not operate efficiently, and rural warehouses for storage of agriculture produce do not exist. Agro-processing plants are obsolete and some of them use highly inefficient technologies.

Non-government organizations are not coordinated, and the government is closing most of the marketing parastatals. Municipal councils are new institutions. They do not operate, but they may be part of the solution to improve agricultural marketing in the rural areas. Cooperatives in the past were not well promoted. Given the existing conditions in Mozambique, however, cooperatives could be very important in promoting agricultural marketing and to compete with private agricultural marketing firms and individuals.

Entrepreneurial skills are lacking for most of the smallholder farmers in the country. Most of the smallholder farmers as well as the small traders do not use stockholding and risk bearing processes of agricultural marketing to improve their profitability. They do not have financial resources, personal contacts or/ and personal reputation to survive in competitive agricultural markets.

7. Conclusions and Recommendations

7.1 CONCLUSIONS

Agricultural production in Mozambique has a comparative advantage in the northern agroecological zone, mainly in the Cabo Delgado, Nampula, Niassa and Zambézia provinces where strong DRCs were verified. The use of potential technologies improve the comparative advantage of the provinces located in the northern and central agroecological zones. In the southern agroecological zones, introduction of improved and potential technologies almost do not improve the DRCs. The existing local technologies in the Gaza and Inhambane provinces have strong DRCs.

The production of maize has a comparative advantage in the northern agroecological zone using local, improved and potential technologies. Crops like cotton and sunflower have a comparative advantage in the northern and central agroecological zones. The production of potatoes, sorghum, beans, cowpeas, onions and cassava has a comparative advantage for the three technologies considered in the three agroecological zones.

The potential centers for the production of the major crops such as maize, sorghum, beans and cassava are located in the northern part of the country but the centers of consumption are in the south. There is strong evidence that trade within the country is a possibility. However, because of the high cost of transport, storage and processing, it may be very costly to attempt to transport agricultural produce from Cabo Delgado to Maputo. Policies should be developed to improve infrastructure to allow for the flow of agricultural products from the north to the south. It is important to ensure that increased production can be collected and sold in a timely fashion, so the producer has an incentive to produce and meet the needs of consumers.

7.2 RECOMMENDATIONS

The results show that agricultural production in Mozambique has comparative advantage mainly for the crops considered in this study. Therefore, it would be wise to recommend the expansion of agricultural extension services to improve agricultural technologies with priority given to smallholder farmers.

Institutional arrangements including legal systems, weights, grades, measures, and enforceable contracts should be established to improve agricultural marketing. Liberalized markets require institutional arrangements to provide incentives for producers.

Infrastructures such as roads, telecommunications, warehouses, vehicles and agro-processing plants must be improved through public financing; the government should be the leading agent. Organizations such as municipal councils, cooperatives, private firms and individuals should be involved in this effort.

References

Banco de Moçambique, *Relatório do Banco de Moçambique.* (Maputo, Mozambique: Banco de Moçambique, 1997.)

Banco de Moçambique, *Relatório do Banco de Moçambique. (*Maputo, Mozambique: Banco de Moçambique, 1995.)

Banco de Moçambique, *Relatório do Banco de Moçambique*. (Maputo, Mozambique: Banco de Moçambique, 1994.)

The Economist Intelligence Unit, "Country Report: Mozambique and Malawi," United Kingdom, third quarter 1996.

Government of Mozambique. "Produção Empresarial mais a Comercialização do Sector Familiar", Direcção National de Planificação, Ministério do Plano e Finanças, Maputo, Mozambique, 1997.

Government of Mozambique, *Steps Towards Economic and Social Development*. (Paris, France: Government of Mozambique Consultative Group Meeting, April 16-17, 1995.)

Government of Mozambique, *Plano Económico e Social 1995*. (Maputo, Mozambique: Direcção National de Estatística, Comissão National do Plano, 1995.)

Government of Mozambique, *Política Agrária e Estratégias de Implementação*. (Maputo, Mozambique: Ministry of Agriculture and Fisheries, 1995.)

Government of Mozambique, *Informação Estatística 1995*. (Maputo, Mozambique: Comissão National do Plano, 1995.)

Government of Mozambique and World Bank, *Revisão das Despesas Públicas do Sector Social*, Draft Report. (Maputo, Mozambique: Government of Mozambique and the World Bank, 1994)

Government of Mozambique, *Plano Económico e Social 1994*. (Maputo, Mozambique: Comissão National do Plano, 1994.)

Government of Mozambique, *Anuário Estatístico de 1993*. (Maputo, Mozambique: Direcção National de Estatística, Comissão National do Plano, 1994.)

Government of Mozambique, *Plano Económico e Social 1991*. (Maputo, Mozambique: Comissão National do Plano, 1991.)

Government of Mozambique, *Informação Estatística 1989*. (Maputo, Mozambique: Comissão National do Plano, 1989.)

Instituto Nacional de Estatística, *Censo Populacional de 1997*. (Maputo, Mozambique: Instituto Nacional de Estatística, 1997.)

Instituto Nacional de Investigação Agronómica, *Zonagem agro-ecológica*. (Maputo, Mozambique: Instituto Nacional de Investigacao, 1994.)

International Monetary Fund, *International Financial Statistics*. (Washington, D.C.: IMF, p. 368-369, 1993.)

Masters, W.A, *Guidelines on National Comparative Advantage and Agricultural Trade*. (Washington, D.C.: USAID, APAP III, Methods and Guidelines, number 4001, 1995.)

Monke, E.A., and S.R. Pearson, *The Policy Analysis Matrix for Agricultural Development*. (Ithaca, N.Y.: Cornell University Press, 1989.)

Mucavele, F.G., *Base de Dados de Pesquisa 1994-1997*. (Maputo, Mozambique: Faculdade de Agronomia e Engenharia Florestal, Universidade Eduardo Mondlane, 1997.)

Mucavele, F.G. *Estratégias para Acelerar o Crescimento Econmico em Moçambique: Dinamização da Economia Rural com Enfase na Comercialização*. (Paper presented to the Round Table Meeting, March 6, 1996, Ministry of Plan and Finance, Maputo, Mozambique, 1996.)

Mucavele, Firmino G. *Indicadores de Economia National Moçambicana e a Economia da Agricultura Familiar em Moçambique*. (Maputo, Mozambique: Faculdade de Agronomia, Eduardo Mondlane University, 1994.)

Mucavele, Firmino G. *A Mathematical Programming Model for Farm Household Evaluation: Economic Efficiency Analysis of Farms Under Risk and Uncertainty in Mozambique*. (Gainesville, Florida: University of Florida, 1994.)

Rwelamira, J.K. and T.E. Kleynhans, *SADC Agricultural Potential Assessment: Country Profiles*. (South Africa: Development Bank of South Africa, 1996.)

UNDP, *Human Development Report*. (New York, N.Y.: Oxford University Press, 1996.)

World Bank, *African Development Indicators*. (Washington, D.C.: World Bank, 1996.)

USAID, *Country Program Strategic Plan FY 1990-1992: Mozambique*. (Maputo, Mozambique: USAID, 1990.)