# THE COMPARATIVE ADVANTAGE OF LONG-TERM CROPS IN LESOTHO

**by**

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Malefu L Makosholo
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## ABSTRACT

This study is one of several investigations undertaken over the years to determine the Comparative Economic Advantage of agricultural production in selected Southern African countries. The specific purpose of the Lesotho study was to generate information required to guide decision-makers in agriculture towards productive allocation of resources and identify feasible infrastructure investment options to take advantage of available trade opportunities within and beyond the region. It was also required to analyse the factors involved in the structure and development of inter- and intra-industrial trade (Gini and IIT) for the SACU region of which Lesotho is a part. The inter-industry analysis shows that there is concentration in the market of apples, asparagus, cherries and peaches. On the other hand, the intra-industry analysis with respect to apples, asparagus, cherries and peaches suggests that the SACU countries exported more than they imported during the period 1994-1998.

The study also evaluated the comparative economic advantage of irrigated long-term crops in the four agro-ecological zones of Lesotho based on analyses of profitability coefficients and domestic resource costs. For these, the analysis was

carried out using the net present value (NPV) approach. Further, economic efficiency and policy distortions were examined by the use of such a measure as the nominal protection ratio (NPR), effective policy ratio (EPR), and net policy effect (NPE).

The CEA analysis based on the NPV approach yielded higher private returns relative to economic returns for the measures of economic efficiency and policy distortions in the Lowlands, Foothills, the Senqu River Valley and the Mountains of Lesotho for all the crops examined. It was revealed that apples were dominant and were more profitable in all zones. These results suggest that in the presence of government intervention, Lesotho could exploit comparative advantage in contracting production of apples and peaches in the Lowlands and Foothills so that other activities can expand. In the Mountains, the protection policies have raised the price of apples by 61 per cent above the social price for importing the commodity, i.e. Mountain farmers received 61 per cent more than the export parity prices. In the Senqu River Valley and Mountains, only apples could be contracted. Thus, should economic values of inputs prevail; farmers would receive lower returns, meaning that they may not compete effectively in the world market.

The results of DRC based on the returns to land when NPV was employed, indicate that apples, asparagus, cherries and peaches for the Lowlands have comparative economic advantage, with asparagus production being the highest followed by peaches. However, in the Foothills apples are more efficient than peaches although the dominance is weak. However as the majority of farmers lack easy access to land in Lesotho, it is doubtful if results based on the prevailing land prices can have much predictive value. The absence of a clear policy and law enforcement also leads to lack of land price market, which in turn affects the impact of capital gains and losses. In this case, it may be necessary to conduct detailed studies to determine the economic prices of land in Lesotho on the basis of which reliable CEA analysis can be conducted.

The study concludes that in the short-term, the commodities examined could contribute to the attainment of food security in Lesotho. For the future, Lesotho producers would benefit to a greater extent from expanding production for the international markets. It must be noted however that the coefficients of the CEA analyses do not provide sufficient information to guide future decisions for investment. For more long-term investment decisions, it is recommended that detailed cost-benefit analyses be carried out for each agro-ecological zone and location identified for any future project aimed at expanding the production of long-term crops in Lesotho.

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| | |
|---|---|
| ACP | African, Caribbean and Pacific countries |
| AEZ | Agro-Ecological zones |
| ANR | Annual Net Returns |
| AGOA | African Growth and Opportunity Act |
| ASAP | Agricultural Sector Adjustment Program |
| BLNS | Botswana, Lesotho, Namibia and Swaziland |
| CEA | Comparative Economic Advantage |
| CET | Common External Tariff |
| CIF | Cost Insurance Freight |
| CUTT | Customs Union Task Team |
| DCF | Discounted Cash Flow |
| DRC | Domestic Resource Cost |
| EPC | Effective Protection Coefficient |
| EPR | Effective Protection Ratio |
| EU | European Union |
| FAO | Food and Agricultural Organization |
| FDI | Foreign Direct Investment |
| FOB | Free on Board |
| FSSP | Food self sufficiency policy |
| FTA | Free Trade Area |
| GATT | General Agreement on Tariffs and Trade |
| GDP | Gross Domestic Product |
| GIS | Geographic Information Technology |

| | |
|---|---|
| GPA | Government Procurement Agreement |
| GSP | Generalized System of Preferences |
| ITA | Information Technology Agreement |
| IIT | Intra-Industrial Trade |
| KOL | Kingdom of Lesotho |
| LDC | Least Developed Country |
| MFN | Most Favored Nation |
| NPE | Net Policy Effect |
| NPR | Nominal Protection Ratio |
| NPV | Net Present Value |
| PAM | Policy Analysis Matrix |
| SAA | South African Agricultural Areas |
| SACU | South African Customs Union |
| SADC | South African Development Community |
| TDCA | Trade Development and Cooperation Agreement |
| UK | United Kingdom |
| US | United States |
| WTO | World Trade Organization |

# CHAPTER 1

## INTRODUCTION

*"The day will come when nations will be judged not by military or economic strength, nor by the splendour of their capital cities and public buildings, but by the well-being of their people: by, among other things, their opportunities to earn a fair reward for their labour, their ability to participate in the decisions that affect their lives; by the respect that is shown for their civil and political liberties; by the provision that is made for those who are vulnerable and disadvantaged" . . -UNICEF (1998)*

## 1.1 Introduction

Like many of the poorer rural areas of Southern Africa, Lesotho is faced with increasing poverty and unemployment. Agriculture, which offers the most direct route to improving livelihoods in the short term (Kingdom of Lesotho, 2002) continues to decline and policies recommended by several studies are never adopted, and levels of HIV/Aids incidence are increasing, although no study has been conducted to determine its impact on agriculture. Despite its poor performance and its inability to become an engine of transformation, Lesotho's agricultural sector needs significant support to remain a primary source of income and food security for the rural poor. This also poses a challenge to respond and react to the food crisis that Lesotho has faced in recent years. Lesotho's agriculture needs a sustainable rehabilitation program that means increased productivity and output over the longer term, so that the Basotho can benefit from multilateral approaches to trade. Production should be appropriate for local resources so that it can compete at a commercial level, and high value commodities should be produced instead of unprofitable traditional products.

## 1.2 Background

Regionalism and multilateral approaches to trade, embodied in the principles of the World Trade Organisation (WTO), have been the subject and the vehicle driving economic integration and market liberalisation since the early 1990s (Department of Agriculture, 1994; Blumberg and Wentzel, 1994). Before 1995

agriculture was exempted from some General Agreement on Tariffs and Trade (GATT)[1] rules (Salvatore, 1998). Quantitative import restrictions were allowed, provided that domestic production of the commodity in question was also subject to certain restrictions, or to domestic price stabilisation or price support policies (Blondin, 1983; Michie and Smith, 1999).

The rationale for this support and protection was to ensure food security for developing countries; to support small-scale farming to make up for a lack of capital, or to prevent the rural poor from migrating into already congested cities. Other mechanisms for protecting agriculture which were not covered by GATT were variable import levies and domestic subsidies, which provided additional loopholes for agricultural policy makers, especially in the European Union (EU) and the United States (US), whose interest was to protect their own agricultural sector.

It was only during the Uruguay Round, according to Sodersten and Reed (1994), that agriculture was taken seriously, due to issues related to comparative advantage (which necessitates competition without supportive measures to producers). World market instabilities and the effects of protectionism, which resulted in inefficient self-sufficiency policies, were other related issues (Michie and Smith, 1999). The negotiating objectives included, among others, the improvement of market access through the reduction of import barriers, increased discipline regarding the use of subsidies and other measures affecting trade on agricultural products (FAO, 1996). In other words, the ideal situation, it was believed, be for countries to enlarge their markets by exploiting the comparative advantages of their products and to compete internationally without supportive measures.

[1] WTO followed on GATT after the Uruguay Round of trade negotiations

A distinguishing characteristic of this globalisation process, however, is that it was accompanied by a knowledge-based economy, that is, Internet-driven technological processes, which reduced costs and made relevant information more readily available. This enabled improvement of productivity, competitiveness and information management, which is essential for success (Porter, 1998). Key economic resources such as capital, labour, raw materials, technology, markets, etc. are increasingly organised on a global scale, either directly or through networking relations. Whereas investment followed trade in the formerly protected world economy, in the global economy trade follows investment, while investment follows productivity growth and sustainable competitiveness (Spies, 1999). Therefore the difference between competitive advantage and comparative advantage cannot be ignored, while it should also be noted that the focus of this study is on comparative advantage. Competitiveness is a response to trade relations. It complements the replacement of exchange of goods and services under the comparative advantage trade regime, with an adverse exchange, under a competitive advantage trade regime when markets are free (Spies, 1999; Ortmann, 2000). As a result nations could come together to form trading blocs in a region to explore opportunities available for potential markets in other countries.

The implicit logic of bloc formation involves creating free and fair market conditions in international trade and relates to the economic concept of comparative advantage and national competitiveness (Linnemann, Bos and De Wolff, 1973). While competitive advantage predicts that trade flows occur as a result of relative cost differentials (even when there are distorting measures) between countries or regions, comparative advantage predicts increased competitiveness through continuous technological innovation without supportive measures (Grossmann and Maggi, 2000). Regional trade blocs are therefore important facets of a design for international competitiveness, which are closely related to the comparative advantage through liberalisation of foreign markets (Ortmann, 2000).

Accompanying the market liberalisation and integration that has taken place among Southern African countries, especially among the least developed nations, including Lesotho, is increasing pressure for agricultural producers and agribusiness to improve product and service quality. In addition, animal welfare and food safety must be considered while protectionism in disguise must be avoided by applying sanitary and phyto-sanitary measures. According to Porter (1998), therefore productivity must be enhanced and production and transaction costs reduced.

Changes in the region, including the liberalization of South African market with the rest of the world and, in particular, the EU-SA Trade, Development and Coordination Agreement (TDCA), have presented opportunities to which agriculture has to adapt (KOL and United Nations Development Program, 2002). Lesotho's proximity to South Africa means that benefits accruing from trade agreements and any regional arrangements could be tapped. Until now Lesotho has not participated sufficiently in the development and implementation of economic regional policies to realise the benefits. Moreover, from late 1970 until 1995, agricultural policies, and in particular import and price policies applicable to the staple grain sector increased food insecurity for most households in Lesotho (Department of Economics and Marketing, 1996).

More specifically, until 1995, the agricultural policy framework was characterised by extensive state intervention in the production, marketing, processing and pricing of agricultural products. Market signals were thereby distorted and the result was an inefficient allocation of resources, and the ability of the private sector to partake in the market on a competitive basis was severely weakened (Ministry of Agriculture and Land Reclamation, 1997). Furthermore, the intervention by government in the marketing of agricultural products and other inherent factors played a major role in the decreased productivity and therefore

almost uncontrolled poverty of Lesotho farmers (African Development Fund, 1998).

Land tenure is another factor contributing to the poor performance of agriculture in Lesotho, although the Government of Lesotho has made efforts to enhance citizens' access to land, and provide security of tenure by instituting the 1979 Land Act and the 1980 Land Regulations. Traditionally all land and associated rights are conferred on different grades of chiefs who have power to allocate land both in urban and rural areas including prime agricultural land, without consultation with government authorities, thereby restricting free access to land by potential investors. Neither the 1979 Land Act nor the 1980 Land Regulations, both of which currently govern the administration of land in the country, is clearly understood by most people. Although it provided some opportunities for securing titles, it was not effective in rural areas, where the basic situation remained traditional. The Act prevents non-citizens from holding land. The implementation of environmental standards for land use is very difficult and has resulted in, for example, rangeland being stocked beyond its carrying capacity (Department of Livestock, 1996). Soil erosion and the formation of gullies have depleted and contributed to the declining qualities of arable land, from 13 per cent in 1960 to 9 per cent in 2001 ((Ministry of Environment, 1998). Overall, the system of land tenure and customary practices has diminished incentives to maintain the natural resource base, or to invest in land improvement and productivity-enhancing technologies.

In 1996 the Lesotho Government instituted major reforms. The process led to the current policy reforms relating to poverty alleviation, household food security and employment creation. The overriding strategy for achieving the above policy goals involves commercialisation of agriculture into an efficient and competitive sector, responsive to market signals (both domestic and international), and utilising resources in an efficient and sustainable manner (African Development Fund, 1997). The agricultural sector growth strategy explains government's

intention of pursuing a policy of sectoral development based on Comparative Economic Advantage (CEA) in a competitive, outward- looking framework (African Development Fund, 1998).

Through the Agricultural Sector Adjustment Program (ASAP), the Government of Lesotho seeks to broaden the productive base of the rural economy by intensification of competitive crops and livestock products and diversification into higher-value commodities (African Development Bank, 1998). Of particular importance regarding the ASAP is the further development and expansion of high-value crops, such as vegetables and fruits, for increased exports. It is within the framework mentioned above, that this study will investigate the CEA of long-term crops in Lesotho. Due to limited land resources in Lesotho and liberated agricultural markets in South Africa, Lesotho needs an analytical tool that will enable predictions about the future of food security, production and consumption, and therefore the kinds of investment in farming and agribusiness infrastructure, which will be necessary.

The studies that have investigated comparative advantages in the Southern African region include a study conducted in Malawi on agricultural production which employed the policy analysis matrix (PAM) to determine the production efficiency of short-term field crops (wheat, maize and cotton). Net private and social profits were compared, and sources of disparity between the two were traced. The study revealed that output transfers have a major influence on the net policy effect in the agricultural sector.

Another study conducted by Jooste and Van Zyl (1999) used the domestic resource cost (DRC) methodology to determine the comparative advantage of short-term crops and livestock products for different technologies and agro-ecological zones, based on returns to land and water. The study found that water cost will influence the comparative advantage of dry land production in relation to irrigation production and that the amount of water used will influence the

comparative advantage of production in future. The results also show that dry land production practices may, in some instances, be more advantageous than irrigation production practices, and that the intensity of water use may cause one crop to lose its comparative advantage to another crop.

Other studies include that conducted by the Department of Agricultural Economics and Agribusiness Sokoine University (1999) in Tanzania, which was also on short-term crops. The study researched Tanzania's CEA for producing cotton, rice and coffee in their respective growing areas. The findings pointed to the need for revised policies relating to the agriculture sector. As Southern African countries move towards freer trade and deeper integration, comparative advantage studies form a framework through which these countries could exploit comparative advantages that may exist within a region. The Government of Lesotho also realises that, and in order to effect growth in agriculture, there is a need to broaden the productive base of the rural economy by intensifying competitive high-value crops, such as fruits and vegetables, that could be exported. Most of the policy reforms are outlined in the Agricultural Sector Adjustment Program for Lesotho Agriculture (KOL, 1998) that emphasises the need for Lesotho to pursue a policy of sectoral development based on comparative advantage.

## 1.3 Problem Statement

The completion of policy reforms pertaining to the deregulation of the grain market in 1996 (which currently leads agriculture into commercialisation and crop diversification), and continued negotiations for integration with neighboring countries, means that crop farming in Lesotho could improve significantly compared to the past (ADF, 1998). Investigation into the production of high-value crops, such as asparagus, apples, cherries, peaches and other crops that can be grown in Lesotho, should be encouraged (ADF, 1997), and international markets found to exploit advantages presented by expanding export markets to the

developed countries. This is especially important when considering that the demand for a wider variety of fruits and vegetables is expected to grow in developed countries as their consumers are becoming more sophisticated (Johnson, 1998).

A study by Rural Industries Research and Development (1999) found that many developing countries are turning to exporting horticultural products, i.e. fruits and vegetables, in an effort to diversify their agricultural exports. However, little research has been done on production, marketing, and exporting these crops. In order to guide reforms therefore, especially regarding what to produce when traditional agriculture has failed, an investigation into commodities that are suitable for the limited available arable land should be carried out (Minot and Goletti, 1998). Given acute resource constraints, Lesotho should pursue its objective of household food security through diversifying household income. Resources could be shifted to the production of high-value crops, both for domestic consumption and for export (KOL, 1996), thereby facilitating a significant expansion of exportable commodities (both “raw” and processed). This is in line with the Lesotho Department of Marketing’s mission statement of facilitating local producers’ access to internal and external markets (Ministry of Trade and Industry, 1996). By investigating commodities that could have comparative economic advantages, other development challenges could be dealt with.

Due to the binding land constraint, it is apparent that Lesotho should seriously explore production strategies that will increase returns from land. An investigation in the CEA of agricultural production of high value crops will inform the process of an efficient allocation and utilisation of scarce resources including land, and provide guidance to viable approaches to address the issue of food security in Lesotho. A regional approach to the issue of food security entails that countries concentrate on production of commodities in which they have a comparative advantage, and import commodities for which they do not have a

comparative advantage. Moreover, an in depth investigation into the comparative economic advantages of high-value crops will contribute significantly to the decision-making process by producers and policymakers regarding what to produce and designing policies to foster such developments in order to achieve goals for agricultural transformation.

## 1.4 Research Objectives

The primary objective of this study is to analyse the CEA of selected high value crops in Lesotho. CEA is the first step for generating information and guiding agriculture towards the productive allocation of resources and therefore identifying the kinds of investment and infrastructure, which will be required. In order to achieve the primary objective the following secondary objectives will be addressed:

- Trade opportunities will be evaluated by analysing the structure and development of inter and intra industrial trade by investigating the extent to which exports and imports are regionally concentrated or diversified and by explaining trade patterns.

- Crop budgets will be compiled for selected high-value crops in order to provide data for Lesotho, which is essential for conducting a CEA analysis for the country.

- The CEA of selected crops will be evaluated for various agro-ecological zones and different technological levels in Lesotho; and

Areas of policy, technology and institutional intervention will be identified in order to enhance economic efficiency and direct agricultural resources to their most productive uses.

## 1.5 Methodology

The theory of comparative advantage was initiated by extending the optimisation principle, which defines efficient choice of output by producers into the arena of international trade (Grubel, 1977; Salvatore 1998). Thus, a country could benefit from trading with other countries, if it concentrates its productive capacity on goods and services that it produces relatively efficiently (Dasgupta, 1972; Hassan and D'Silva, 1994). Therefore, existing or new agricultural activities of highest economic efficiency should be identified, along with the extent to which exports and imports will be regionally concentrated or diversified. By doing so national incomes can be increased (Shujie, 1997) if farmers are encouraged to produce those commodities, which exploit existing or new patterns of comparative advantage.

### *1.5.1 Domestic Resource Cost (DRC) methodology*

In order to meet the objectives of this study the CEA will be investigated using the Domestic Resource Cost (DRC) methodology. According to Hassan and Faki (1993), the DRC methodology generates quantitative indicators of the efficiency of using domestic resources to produce a given commodity. These quantitative indicators are an analytical tool for an empirical evaluation of economic efficiency among alternative enterprises. The level of efficiency with which resources are used for the identified crops will therefore be determined.

In order to capture and analyse the impact and effect of the quantitative indicators of CEA analysis, commodities considered for this study will be grouped in areas that are relatively homogeneous with respect to the biophysical conditions needed for agricultural production. For the grouping of commodities the adoption, based on Masters (1995), will be as follows:

- The agro-ecological zoning will be a framework for classifying production environments according to biophysical conditions. A geographic information system (GIS) will be used to generate agro-ecological zones by overlaying a climatic map with a generalised soil map (Berding, 1985). Several factors will be taken into account, namely altitude, climate, soils, rainfall and economic aspects of regions. The GIS will then be used to capture a crop's biophysical requirements with corresponding areas on the agro-ecological zone map. Then DRC measures will be calculated for different crops considered for different zones in this study.
- Due to variation in production approaches and differing availability of arable land, variations within agro–ecological zones will be defined according to distinct activities.
- In order to capture variations in markets and factors pertaining to infrastructure, prices of inputs and outputs, and transportation costs for the production of various crops in the study will be taken in each agro-ecological zone. These prices and costs will reflect the opportunity cost of either producing a commodity locally or importing either from another zone or from outside the country.
- Variations in resource endowments will be reflected by the relative rental values of those resources in the different market centres.

As the commodities being dealt with by this study are mainly long-term crops, variations in production over the crop cycle (a 20- year rotation is adopted) must be valued before DRC is analysed. In this regard a similar approach is used than that used by Hassan and Olbrich, (1999), to do a comparative analysis of the economic efficiency of water use by plantation forestry and irrigation agriculture in the Crocodile River catchment area in South Africa.

### 1.5.2 Inter-industrial trade methodology

Inter-industrial trade refers to the natural comparative advantage of a country in certain commodities, which is determined by measuring the concentration of exports and imports. The degree of concentration can vary from no concentration (total diversification) to total concentration. The extent to which concentration varies is determined by various factors, such as (Jooste, 1996):

- Different preferences of consumers, which result in different trade streams;
- Trade barriers which prohibit or restrict trade between different regions;
- Trade barriers which prohibit or restrict trade in certain products or product types;
- Production capacity and climatic factors;
- Trade agreements and trade incentives;
- Infrastructure (if existing infrastructure cannot facilitate the processing of primary goods to final products, these primary goods will be exported to a region or country where the necessary processing can be done. Hence, this market will be targeted by processors of the final product);
- The political stability or instability of a region/country; and
- The ability to pay, which is a function of the level of income.

For the purpose of this study, the level of concentration is important, as it will show where imports and exports of analysed products are concentrated or diversified. Inter-Industrial Trade will be investigated with the help of the Gini-Hirschmann coefficient. For example, if Lesotho cherries are only exported to one country, the Gini-Hirschmann coefficient will be 100. Correspondingly, a low coefficient indicates a high diversification of the exporting country and by the same token the Gini-Hirschmann coefficient could also show equally distributed destinations (Grubel and Lloyd, 1975). This methodology is similar to that used by Grote and Sartorius Von Bach (1994) and Jooste (1996) who respectively investigated avocado and meat trade.

### *1.5.3 Intra-industrial trade*

The measure of intra-industrial trade is defined as the value of exports of an industry that is exactly matched by a corresponding value of imports, or vice versa, induced as a result of growing product differentiation (Grubel and Lloyd, 1975). In this study the intra-industrial trade coefficient (IIT) will be calculated to identify the main trends in intra-industrial trade between countries who trade in apples, asparagus, cherries and peaches.

## 1.6 Delimitation of the study

In order to ensure that the study is manageable, the analysis will cover only some of the long-term and medium-term horticultural crops grown in Lesotho. These are cherries, apples, peaches and asparagus. Farming practices will be limited to irrigation, with the exception of asparagus farming. Due to a paucity in data the 1998/99-production season will be used for all budgets and the subsequent analysis.

## 1.7 Data sources

Data compiled by District Marketing Officers forms the basis of the CEA analysis. Secondary data on the production of different commodities was gathered from the Lesotho Bureau of Statistics. Supporting data was gathered from producers and co-operatives, other role-players and publications including:

- Leribe cherry producers;
- The Eastern Free State Fruit Producers' Co-operative in Bethlehem;
- The Agricultural Research Station in Ficksburg;
- Harmonia asparagus farm; and
- The Agricultural Marketing Bulletins.

To verify and ensure realism of the different budgets, the following procedures were executed:

- Data relating to the enterprise budgets was compared with information collected from farmers in the Eastern Free State and Lesotho who are producers of products included in the study.
- Different budgets for a specific enterprise within a particular zone were compared.
- Discussions were conducted with the extension, crop and horticultural officers regarding the accuracy of different budgets in each particular zone.
- Meetings with groups of farmers and horticulturists were held in each zone and in the Eastern Free State to verify the budgets.

With regard to macro-economic data, such as foreign exchange rates, producer price indices, international prices and transport costs, the Reserve Bank, the commercial banks and Spoornet was consulted. Various international publications and the Internet were also used to obtain information related to international trade in products included in this study.

## 1.8 Outline of the study

Chapter 2 is a literature review. The first section discusses economic evolution and performance of Lesotho. The second section provides an overview of Lesotho agriculture with parts discussing its salient features, structure and its contribution to Lesotho's economy. Fruit production, on which the main analysis of this study is based, is also discussed. Concentration of trade in the SACU and intra-industry trade will be presented in Chapter 3. Chapter 4 provides details of private and social prices. Chapter 5 will outline regional delineation by zones. In Chapter 6, CEA results will be presented along with the sensitivity analysis. Chapter 7 will include conclusion and recommendations.

# CHAPTER 2

## LITERATURE REVIEW

## 2.1 Introduction

Lesotho has committed itself to deregulating and liberalising its agricultural sector. This has taken place within the context of a worldwide trend towards increased liberalisation of agriculture. Consequently Lesotho, like other countries, must compete internationally in an open agricultural market. The first step to becoming competitive internationally is to use scarce resources efficiently, and by exploiting any comparative economic advantages that may exist. Secondly, the external policy of a country like Lesotho, with a weak economy, in an effort to improve its competitiveness, has to be directed towards greater integration with other countries. Shepherd (1993) states that the only way that small and weak countries can compete in a world market, increasingly comprising powerful economic blocs, such as those in Europe and the Pacific Rim, is by economic integration.

This chapter is designed to give an overview of the Lesotho agricultural economy and the policies that are directly related to the performance of agriculture. But first the economic evolution and performance, which will show the conditions and environment in which agriculture operates under, will be discussed. The subsection that follows reviews agriculture's contribution to the economy. The third part of this chapter discusses the external environment within which Lesotho operates. It will concentrate on a review of customs unions, in particular the SACU, of which a summary of its contents will be given to show its working and implications for Lesotho. The last part will review theories of comparative economic advantage.

## 2.2 General characteristics

As a result of altitude and latitude, Lesotho has a temperate climate and well-marked seasons (Ministry of Natural Resources, 2000). These are spring (August to October), summer (November to January), autumn (February to April) and winter (May to July). The variance in temperature is wide, ranging from a maximum of 32 degrees centigrade (in summer) to as low as 6 degrees centigrade (in winter).

About 80 to 85 per cent of the annual rainfall, averaging 700 mm, falls in the seven months from October to April, with the highest rainfall averaging 1200 mm (Ministry of Natural Resources, 2000). The volume, timeliness and distribution of rain in Lesotho are subject to extremely wide variance that causes significant variation in the level and composition of agricultural output. Furthermore, when it rains, it falls in heavy downpours, causing surface run-offs that worsen the country's soil erosion problem. Hail and frost occur during April to September, causing great damage to crops, fruits and vegetable gardens. In winter, the cold winds and snow flurries as well as snowstorms in the mountains, often render large areas inaccessible for extended periods of time.

Lesotho is landlocked and depends almost entirely on road and air transport for internal and external movements of agricultural goods and services. There are no navigable waters or railways except a short 2 km rail spur connecting Maseru (the capital city) to the South African rail system. For all these modes of transportation, Lesotho depends heavily on effective co-operation with its more industrialised neighbour, South Africa. The high cost of road construction as a result of the mountainous nature of the land constitutes another obstacle to the expansion of the internal road network. The nature of the transportation system constrains the timely haulage of agricultural inputs to farms and output from the farm gate to market centres.

Lesotho's population increased from an estimated 1.6 million in 1988 to 2.0 million in 1996 (Bureau of Statistics, 1999) and this exerts pressure on agriculture, which is practised on only 9 per cent of arable land. According to BOS (2000), approximately 40 per cent of the population do not own land. The population is growing at a rate of 2.6 per cent per annum and carries a density of 68 per $km^2$ compared to 24 $km^2$ for Africa (BOS, 2000). It is estimated that population density per $km^2$ of arable land has increased from 442 in 1976 to 740 in 1994 (Ministry of Planning and Manpower Development, 2000). As a result of the high population density and mainly the mountainous country, only 9 per cent of the land is arable and land holdings are typically small. Of the total population, 81.1 per cent live in the rural areas, while 18.9 per cent of the population resides in urban areas.

The overall socio-economic picture of Lesotho is not impressive. First poverty remains pervasive throughout the country. Unemployment continues to be high at almost 30 per cent (Ministry of Planning and Manpower Development, 2000); about half of the population is considered poor; and income inequality is among the highest in the world (World Bank, 2001). Poverty is concentrated mainly in rural areas. It also appears that the increase in domestic employment has not fully compensated for the losses in employment due to the decline of government production and reduced opportunities for Basotho workers in South African mines (World Bank, 2001).

Secondly the HIV/AIDS pandemic has emerged as a major health concern with potentially devastating consequences for Lesotho's economy. Already life expectancy has declined from 53 years in 1989 to 45 years in 1999 (World Bank, 2001). The level of population growth is expected to be 20 percent lower by 2015 than in a no-HIV baseline, and life expectancy is expected to be 31 years (World Bank, 2001). Since HIV/AIDS affects the economically active, mainly urban population disproportionately, it affects the country's educated population most, thus reducing the pool of skilled human capital (World Bank, 2001).

## 2.3 Lesotho's economic evolution and performance

Lesotho has experienced a relatively liberal foreign trade regime through its membership of the SACU. Lesotho has been evolving towards the rule of law and democracy as demonstrated by the 2002 elections. The process of consolidating democratic institutions augurs well for political stability and the quality of economic policies. Lesotho's open economy, as measured by foreign trade, is ranked third highest among African countries with similar developmental characteristics (Ministry of Planning, 2000) and this open economy has given Lesotho a direct involvement in foreign trade.

According to the Ministry of Planning and Manpower Development (2000), Lesotho's foreign trade and investment performance stands out when compared with countries that have similar developmental characteristics. The openness of Lesotho's economy, as measured by foreign trade as a percentage of Gross Domestic Product (GDP), was 198 per cent in 1999, the third highest among African countries. Only SACU partners Botswana (200 per cent) and Namibia (208 per cent) were more open. Lesotho also compares favourably to a group of countries that are similar in terms of resource endowments, their landlocked status, and level of economic development. A second measure is exports per capita (Central Bank of Lesotho, 1998), which amounted to US$81 in 1999, putting it first among similarly endowed countries. Thirdly, the country's share of exports in GDP (18 per cent) was significantly above average. Over 1989-1999, the growth in real trade was higher than the growth in real GDP. Export growth has driven Lesotho's economy, with an average annual growth rate of export volume at 11 per cent from 1990-98. Imports grew by 1.4 per cent over the same period.

Lesotho's real GDP growth rate was 12.9 per cent in 1994, 8.9 per cent in 1995 and 12.3 per cent in 1996 (CBL, 2000). In the 5-year period from 1992 to 1996,

an average growth rate of 8.4 per cent was recorded (CBL, 2000). Due to good rains, agriculture was one of the driving forces behind this growth. But despite the relatively impressive GDP growth, it has not resulted in significant poverty reduction. Poverty is worst in the rural areas where the profitability of farming is low and dependence on migrant Basotho miners' remittances is high. In this regard it is important to note the worsening outlook for Basotho miners working in South Africa due to a volatile world market for gold. Lesotho continues to face many structural challenges and a failure to remedy them could affect future growth and poverty reduction efforts. These challenges include structural reforms relating to issues such as the civil service, privatisation and private sector development, and decentralisation of government services.

## 2.4 The agricultural sector

### *2.4.1 Salient features*

The macroeconomic importance of Lesotho's agricultural sector is evidenced by the fact that 81.1 per cent of the population reside in rural areas (Bureau of Statistics, 2000) where most agricultural production activities take place. More than 50 per cent of the population derive their livelihood from crop and livestock production, while about 60 per cent of the labour force is employed in this sector (Ministry of Planning, 2000). Although agriculture accounts for 16 per cent of exports and 75 per cent of the country's basic food needs, only 25 per cent of the agricultural population produce enough on their land to meet their own food requirements (Ministry of Trade and Industry, 1999).

The outlook for agriculture is not positive. The area harvested has been decreasing, and due to declining soil productivity, total factor productivity has been declining at the rate of 1.2 to 1.5 per cent annually (Department of Crops, 1999) whilst agricultural yields have been declining at a rate of 1 per cent annually since 1966 (Kingdom of Lesotho, 1999).

Soil erosion and the formation of gullies have claimed over 80 per cent of the country's arable land area (Ministry of Agriculture and Land Reclamation, 1997). Arable land in Lesotho constitutes only about 9 per cent of the land area, down from 13 per cent in the mid-1960s (Ministry of Agriculture and Land Reclamation, 1997). Increased herd sizes combined with a rigid land tenure system, among other factors, entailing excessive communal grazing, have resulted in a serious loss of soil fertility. These factors together with inappropriate technology and institutional arrangements have resulted in declining productivity.

### *2.4.2 Contribution of agriculture to the Lesotho economy*

Although agriculture's importance as a source of household income has diminished considerably over the years, from a GDP of 50 per cent in 1966 to 17 per cent in 2000 (BOS, 2000), the sector remains the largest single source of livelihoods. About 23 per cent of rural households depend on agriculture as their primary source of income and food security and another 32 per cent as their secondary source (Kingdom of Lesotho, 2002).

Population growth which is estimated at 2.6 per cent per year (Bureau of Statistics, 2001) has a considerable effect on the performance of the economy. Growing uncertainty about the future of the migrant labour market in the RSA and the limited scale of Lesotho's industrial and commercial base, imply that agriculture will have to absorb many of the 18 000 to 22 000 workers that are added annually to the labour force (United Nations Development Program, 2002). The adoption and implementation of policy reform, aimed at improving the agricultural sector's efficiency and competitiveness would considerably strengthen opportunities for agriculture to absorb these people. Furthermore, agriculture has strong linkages with other sectors of the economy, and agricultural growth could have a positive, stimulating effect on the economy as a whole (KOL, 1996).

The recent adoption of environmental protection policies and plans, as well as the massive harnessing of Lesotho's water resources, are likely to have a positive impact on the performance of the agricultural sector (FAO, 2002). Several agricultural projects have been initiated in the mountains, which are benefiting from the water and environment policies. However, water resource use under the Lesotho Highlands Water Project will need further renegotiations if irrigation water is to be supplied by this project on the Lesotho side (TAMS, 1999).

### *2.4.3 Agricultural structure*

Agriculture in Lesotho is predominantly smallholder-based. There are two distinct cropping seasons, namely spring and summer. The summer season is the principal one, during which about 75 per cent of the cropping area, equivalent to about 300 000 ha, is cropped, with the rest left fallow (Department of Crops, 1996). Only about 10 000 to 20 000 ha are cropped during winter (Department of Crops, 1996). The farming system involves strong interaction between crops, livestock and off-farm activities. The main source of cash and dynamism is off-farm employment (CBL, 1999).

Maize and sorghum are the principal crops grown primarily for household food security and account for about 80 per cent of the cropped area annually (BOS, 2000). Pulses and a variety of vegetables account for the remaining hectares. On-farm consumption and informal local sales account for over 95 per cent of the grain produced in the country annually (BOS, 2000). During the period 1977 to 1994, aggregate crop production was characterised by wide and significant annual variations. Maize production showed a rising trend (from around 72 000 to 120 000 tons per year), while sorghum production was generally stagnant (at around 40 000 tons) and wheat production was falling (from around 28 000 to 18 000 tons).

In spite of Government efforts to increase productivity, declining yield trends were evident for all the five main crops. Maize and sorghum showed a decline from around 1 000 kg to less than 600 kg per hectare, and wheat from 1 000 kg to less than 400 kg per hectare. Beans declined from around 500 kg to 400 kg per hectare and peas from 800 kg to 170 kg per hectare. From 1968 to 1993, self-sufficiency in major staples (maize and wheat) fluctuated between 40 to 50 per cent for maize and 15 to 50 per cent for wheat. The balance of the population's nutritional requirements has been supplied by imports, mostly from South Africa.

Between 1984 and 1994, the national sheep herd numbered 1.4 million. There were 0.9 million goats and 0.58 million cattle. Since 1991, there was a slight increase in the number of cattle and a slight decrease in sheep and goats. Total livestock units had increased by less than 0.2 per cent per year. Cattle accounted for only 20 per cent of total number of livestock (BOS, 2000). Cattle are kept mainly for ploughing, followed by home consumption of milk, breeding for replacement of oxen and cows, savings and emergency sales. Sheep and goats are kept for wool and mohair, own slaughter and cash sales.

### *2.4.4 Fruit production*

Fruit production in Lesotho is largely a function of the climatic conditions, and for this reason it is largely confined to the Lowlands, Foothills and sheltered valleys in the mountains. Lesotho has cold winters with occasional late frost in spring that affects fruit production (Westwood, 1993). As a result, tropical and subtropical fruits do not thrive in the climate of Lesotho. Therefore, production is largely confined to deciduous fruits namely (KOL, 1984):

- Pome fruit – apples, pears and quinces
- Stone fruit: peaches, plums, apricots, nectarines, and cherries.
- Nut fruit trees: almonds.

Currently Government's strategy for Mountain Agriculture, a mountain-based project within the Lesotho Highlands Water Development Authority, emphasises commercialisation, diversification, efficient resource use, and the comparative advantage of mountain areas for production of temperate fruit and vegetables which can only be efficiently produced on a commercial scale by means of irrigation (KOL, 2002).

As mentioned most fruit production activities are concentrated in the Lowlands and Foothills with cherry production in the northern Lowland of Lesotho. Producers of fruit (peaches, apples and especially cherries) belong mainly to the Hololo River Irrigation Scheme in the northern Lowlands (Botha-Bothe District). Since 1975, the scheme has demonstrated the feasibility of fruit production (Cunningham, 1996). Marketing of crops however remains problematic. The factors responsible for marketing problems are: (i) low quantities of fruit that is available which only justifies transport to urban market centres in the peak period; and (ii) the low level of business and marketing skills of farmers (Ministry of Agriculture and Land Reclamation, 1997). As a whole, fruit production in these irrigation schemes proved to be more successful than vegetable production (Ministry of Agriculture and Land Reclamation, 1997). However experience shows that commercial success requires selection of well adapted cultivars that give high and consistent yields every year. Apples are produced in all agro-economical zones of Lesotho, while peaches grow well in the Lowlands, the Foothills and in the Senqu River Valley, but peaches are not suited for the mountain areas.

There is no organised marketing system for the fresh produce sub-sector (vegetable and fruits). Horticultural production is traditionally centred on subsistence activities. Farmers produce mainly for their household needs while only small quantities are marketed, primarily at the village level (Ministry of Agriculture and Land Reclamation, 1997). Fresh produce consumed in urban centres are mostly imported from RSA. It is estimated that Lesotho imports

some 60 to 70 per cent of its total consumption of fruits and vegetables from South Africa (BOS, 1996). Current government policy aims at reducing the reliance on imports through increased domestic production (KOL, 1997).

The structure of the marketing system reflects the importance of imports and the fact that the majority of farmers in most rural areas produce principally for their own use. Consequently, disposal of farm surpluses mainly takes the form of an informal system of rural assembly with no traditional markets or market days in the rural areas. When there are surpluses greater than what can be disposed of in the immediate neighbourhood, farmers must either rely on buyers moving into the farms from the towns or farmers must transport their produce to a suitable town-based buyer.

Past attempts to develop a domestic vegetable marketing system failed because it was based on over-ambitious projections of increases in domestic production (KOL, 1996). These projections have led government planners, supported by donors, to design a marketing system that operates separately from, and replace existing systems, principally serving imports (Savage, Kraidy and Mannion, 1985).

### *2.4.5 Lesotho imports*

Lesotho is able to meet only about half its food needs from domestic production (KOL, 1997). It imports maize, fruits, vegetables, meat and dairy products from South Africa, and wheat from other international markets. Most of Lesotho's staple crops are consumed on-farm or traded informally (Ministry of Agriculture, 1996). For maize and wheat, domestic deficits are compensated for principally by the import of whole grain by large–scale millers who depend mainly on imported raw materials. Traders and small-scale roller millers also import whole grain in comparatively small amounts. In fact, the substantial import volumes of grains are visible at established large-scale agricultural processing activities

located close to the border with South Africa. Fruits and vegetables are imported from South Africa (see Table 2.1) principally by large wholesalers based in the main Lowlands border towns.

**Tabel 2.1: Fruit and vegetable imports (metric tons)**

| Crop | 1995 | 1996 | 1997 | 1998 | 1999 | 2000 |
|---|---|---|---|---|---|---|
| Apples | 282.67 | Na | 517.34 | 132.26 | 304.44 | 84.66 |
| Oranges | 234.39 | Na | 278.31 | 82.91 | 269.37 | 118.38 |
| Bananas | 172.27 | Na | 343.84 | 119.35 | 144.4 | 75.21 |
| Grapes | 57.53 | Na | 93.45 | 26.84 | 55.42 | 2.99 |
| Peaches | 66.91 | Na | 108.14 | 32.93 | 112.34 | 5.45 |
| Pineapples | 15.01 | Na | 24.15 | 6.49 | 28.63 | 4.54 |
| Avocados | 4.96 | Na | 12.77 | 2.06 | 12.91 | 4.49 |
| Watermelons | 15.95 | Na | 18.25 | 9.64 | 34.83 | 7.94 |
| Lemons | 5.65 | Na | 4.11 | 0.22 | 6.53 | 1.45 |
| Paw Paws | 8.14 | Na | 5.46 | 0.18 | 14.04 | 21.35 |
| Mangos | 14.49 | Na | 9.43 | 1.50 | 17.36 | 3.24 |
| Pears | 30.98 | Na | 301.38 | 108.56 | 107.5 | 26.04 |
| Guavas | 4.51 | Na | - | - | 27.05 | 1.21 |
| Naartjies | 2.55 | Na | 21.21 | 1.44 | 24.33 | 0.61 |
| Nectarines | 0.05 | Na | 2.32 | 0.13 | 7.67 | - |
| Other | 2.06 | Na | - | - | - | 0.12 |
| Plums | - | Na | 10.61 | 0.19 | - | - |
| Kiwi fruit | - | Na | 0.22 | - | - | - |

*Source: BOS (2000)*

### *2.4.6 Lesotho exports*

Lesotho's main export commodities are wool and mohair (see Table 2.2) that is sold to the EU through South African brokers based at seaports. Lesotho's imports and exports of cattle are more or less balanced. Asparagus and paprika are produced mainly for the export market (Ministry of Agriculture, 2002).

**Table 2.2: Most important agricultural exports**

| Year | Mohair Export (Ton) | Wool Export (Ton) | Paprika Export (Ton) | Asparagus Export (Ton) |
|---|---|---|---|---|
| **1995** | 545.47 | 1 955.17 | - | 392 |
| **1996** | 373.73 | 2 082.53 | **-** | 306 |
| **1997** | 121.25 | 1 801.62 | **-** | 208.64 |
| **1998** | 3 191.98 | 1 462.28 | **-** | 92.32 |
| **1999** | 2 584.42 | 2 091.36 | 1.911 | 40.11 |
| **2000** | 224.51 | 1 447.29 | 2.1 | 36.51 |
| **2001** | Na | Na- | 6.512 | Na |

*Source: BOS (2002)*

### 2.4.7 Lesotho past and current agricultural marketing policy

A year after Lesotho gained independence, the Agricultural Marketing Act (1967) was passed (Kingdom of Lesotho, 1997). This Act has remained in place for almost 30 years, and still provides the framework within which Government regulates agricultural marketing. As evidenced by the grain sector, the Act enables the Minister of Agriculture to make regulations that restrict the channels through which agricultural commodities are traded, allowing the Government to enforce the prices at which trade takes place.

Until the early 1980's, Government organisations were the sole channels for maize deliveries to the mills. Of these organisations, Co-op Lesotho Limited, created in 1980, had an effective monopoly of seasonal input supply. During this period, however, restrictions on domestic trade in grain and inputs were progressively eased to allow the participation of private traders, even though Co-op Lesotho continued to trade in both grains and agricultural inputs until 1993.

For a period of almost 15 years, the prices of maize and wheat were controlled throughout the marketing chain from the point of purchase from farmers to the point of retail sale of meal and flour (Ministry of Agriculture, 1996). The gazetting of maximum wholesale and retail prices ended with the liberalisation of maize and wheat, which was effected in 1996.

In recent years, the Government, with strong donor support, has radically altered its strategy towards the development of agricultural marketing and processing (FAO and KOL, 1997). This stems from recognition that:

- The food self sufficiency policy (FSSP) led to high prices for basic foodstuffs;
- Continuation of FSSP type policies will not lead to food self sufficiency, nor will it lead to an efficient allocation of resources in the agricultural sector;

- The construction and operation of state owned processing facilities is not a viable or efficient means of providing markets for domestically produced crops and livestock products; and
- It will become progressively more difficult to enforce administered prices and border control as agricultural markets in South Africa are liberalised.

Recognising the inefficient and ineffectual nature of past interventionist policies for agriculture, the Government has radically altered its strategy for accelerating agricultural development (KOL, 1997). The current Government strategy for the agricultural sector is spelled out in the Ministry of Agriculture's Agricultural Sector Adjustment Program (ASAP). The major components of this strategy are commercialisation, privatisation and market liberalisation.

Liberalisation of agricultural market involves that market forces are the sole determinant of prices. It was realised that enforcing administered prices and border control will not lead to food self sufficiency and the efficient allocation of resources in the agricultural sector of Lesotho. The effort to change the policy is supported by Van Schalkwyk, Van Zyl, Botha and Baley, (1997) who state that the policy strategy had to be altered by deregulating prices and removing quantitative restrictions on imports.

The FAO and KOL (1999) also encouraged the Lesotho Government to engage in strategies that will lead to further liberalisation of the pricing and marketing arrangements, as well as the diversification of production towards non-traditional export crops, such as asparagus, fruits and flowers. It is believed that the resulting price structure will lead to a more efficient allocation of resources to diversification of agricultural production and to an increase in the real incomes of both producers and households (FAO, 1999).

The Privatisation Unit in the Ministry of Finance was establishment to identify a number of state-owned processing facilities for privatisation (Ministry of

Agriculture, 1997). Examples include a vegetable cannery and freezing-plant, which are still to be sold to private firms, while the state-owned milling complex has been sold, with Basotho among the shareholders. The management and ownership of the National Abattoir have been restructured as part of the present technical assistance project.

### *2.4.8 Land tenure policy development*

Census statistics indicate that in 1976 arable land was estimated at 13 per cent of Lesotho's total land area, but by 1996 this had shrunk to an estimated 9 per cent (Ministry of Agriculture and Land Reclamation, 1997). The situation today, taking into account uncontrolled peri-urban sprawl, continued soil erosion, and other forms of land degradation, is almost certainly worse. At the time of the Land Policy Review Commission in 1987 (Ministry of Agriculture, 1996), it was established that the bottom (poorest) 20 per cent of the population had land-use rights to only 5.3 per cent of the land whilst the top (richest) 20 per cent had access to 37.5 per cent of the land. In addition, it was estimated that some 25.4 percent of the rural population are land-less – a figure that is ever rising (Bureau of Statistics, 1997). This questions the validity of the assumption of equity attached to traditional land tenure policy.

According to the land Act (1979) all land in urban areas are owned by household title (UNDP, 1993). However, land in rural areas, with the exception of residential and commercial land, remained under allocation to different purposes, although provision was made for voluntary conversion into agricultural leases (Ministry of Agriculture, 1984). In addition inheritance rules for arable land were modified. The family was given the responsibility of deciding how land passes from generation to generation. The Act also introduced the concept of Selected Agricultural Areas (SAA), primarily to facilitate re-arrangement of land holdings (Mosase, 1984), for the development of agriculture by modern farming techniques.

Provision was made for distribution of land according to family needs, although it is still under inspection procedures. This involved the equity measure, not provided for under the Land Act (1979) of transferring a piece of land from one family to another (Kishindo, 1992). The SAA facility provides for re-arrangement of land parcels for purposes of enhancing productivity only. With land holdings limited to a maximum of 20 ha, except with the Minister's exemption, the potential of the SAA facility to enhance agriculture profoundly is limited. This restriction also places Lesotho in a less competitive position in the sub-region, considering that commercial farmers in South Africa are investing in countries such as Mozambique, Zambia, Zaire and others, where they have access to vast areas of land.

Where the Act touched on agricultural land, it concentrated on arable land and did not cover commercial grazing practices on non-arable land, a major area of concern regarding soil erosion and other bad land-use practices (UNDP, 1993). Neither did the Act address questions of economy of scale or optimal agricultural land holdings or guarantees and deficiencies highlighted by the Land Policy Review Commission in 1987.

In the light of continuing difficulties with agricultural production, it was decided that legislation be revisited (KOL, 1997). This investigation is at present being administered by the Ministries of Local Government, Agriculture, Trade and Industry, Natural Resources, Works, Law and Constitutional Affairs, Justice, Tourism, the Office of the Prime Minister and Non-Governmental Organisations.

In 1999 the Government of Lesotho, with assistance from the World Bank, engaged in an elaborate and complex exercise aimed at defining an overall development plan for the agricultural sector (KOL, 1999) within the policy framework of food security, poverty alleviation and employment creation. Having identified that land tenure is a major constraint to agricultural development and

productivity in Lesotho, it became evident that the country desperately needs a land policy and a land management framework that can address the situation. Both strategies combined will guide the Government and the non-governmental institutions on proper land allocation.

Agrarian reform and administration offers specific opportunities, which include implementation of the Land Regulation (1992) for the issue of agricultural leases (KOL, 1997). It emphasises the 5-year period of grace for payment of land rent. Selected agricultural areas will be used to re-organise land holdings that will show signals of existing land market in Lesotho. As produce markets are deregulated, share cropping and sub-leasing will be included. The intended benefits include improved land management, arresting land degradation and soil erosion, and promotion of the commercialisation of agriculture by facilitating investments in land improvements and intensive production.

According to the KOL (1997), an improved land tenure system will enhance the security of land tenure, the facilitation of private investment in productivity-enhancing techniques and structures, and allow agricultural diversification involving high-value crops or intensive livestock production. This will also encourage the adoption of conservation measures and land-use plans that will address the economic utilisation of scarce land resources.

### *2.4.9 Irrigation policy*

In the first two decades after independence the promotion of irrigation concentrated on the establishment of large-scale communally operated farms, the largest being 11 donor-funded irrigation projects covering 2 500 hectares. All these schemes encountered problems with social and scheme organisation, due to lack of consultation with farmers, enforced membership of schemes, and co-operative working methods that discouraged individual incentive (Ministry of Agriculture, 1996). These schemes showed that when farmers are in control of

their own land, yields and performance are far better. It also demonstrated that high employment and income possibilities are achieved by means of irrigation. Irrigation is the main strategy by which the Government can realise its objective of promoting the commercialisation of agriculture. Crop diversification can also be easily realised, as most of the high-value crops are hampered by periodic droughts.

It is estimated that some 17 000 hectares of area cultivated in Lesotho is irrigable (FAO, 1989) and could support irrigated crop production (Department of Crops, 2001). It is estimated that from the 17 000 hectares of visible irrigable land, 70 000 tons of vegetables and 25 000 tons of fruit could be produced. According to the Department of Crops (2001), this is enough to feed the entire population and leave a surplus for export.

Although the Government does not have a formal policy on irrigation, communal farming is no longer considered to be the appropriate option for irrigation schemes; the focus is on individually based irrigation, both on schemes and on single plots of land.

The nature of the country's topography limits the potential for irrigation from transfer schemes, as most of the arable land that would otherwise be irrigable is situated too far from a water source, or at too high an elevation in relation to the water source. Fruit and vegetables are recommended as the prime crops for irrigation as they do not only generate higher returns, but also have lower water requirements per hectare, which vary less during the growing cycle.

## 2.5 External trading environment

As already mentioned in chapter 1, the other economies of the Southern African region are significantly poorer than that of the RSA. Compared to cross-country norms, these countries are much more agriculturally oriented and characterised

by large productivity differences between the agricultural and non-agricultural sectors (Van Rooyen, 1994). Any successful development strategy for these countries must be aimed at increasing agricultural productivity. Countries such as Lesotho, Namibia and Swaziland have weak economies and may not be able to successfully penetrate international markets unless they are part of an economic bloc, in this case including South Africa through the SACU agreement.

Lesotho's economic wellbeing is dependent on foreign trade and its welfare is intimately linked to that of South Africa as Lesotho attempts to take advantage of opportunities offered by global markets. To tap these benefits, Lesotho must actively pursue measures that would realise gains from both participation in regional arrangements and the World Trade Organisation (WTO). In the next section, regional, bilateral or unilateral liberalisation and integration strategies that Lesotho can take advantage of as it becomes part of the world economy, will be discussed. The WTO will be discussed first, as it forms the basis on which trade amongst countries is based. Secondly, the trading blocs and agreements will be discussed.

### *2.5.1 WTO*

Lesotho's Charter Membership of the World Trade Organisation provides the possibility of greater integration into the world economy. Like all WTO members Lesotho benefits from better access to other WTO members and from the minimisation of protectionist policies. Lesotho receives better than Most Favoured Nation (MFN) treatment from its principal trade partners by virtue of either regional agreements or special preferences offered by developed countries.

With its least developed country (LDC) status, Lesotho is entitled to certain benefits not available to either developed countries or economies in transition such as South Africa. This status provides longer transition periods for

implementing WTO mandated reforms of domestic regulations affecting international trade. These include, inter alia, laws governing intellectual property rights protection, food and plant sanitation, import licenses, and industrial product standards, often referred to as behind-the-border policies in the trade policy literature.

### *2.5.2 African Growth and Opportunity Act (AGOA)*

The Africa Growth Opportunities Act (AGOA) and Investment Act (2000) have enhanced the generalised system of preferences (GSP) that provides highly concessionaire access to Lesotho's exports. AGOA is a temporary policy with a special preference offered by the United States (US). Under AGOA exporters from the least developed countries of Sub-Saharan Africa have duty and quota free access to the US market for textiles and clothing for articles assembled in qualifying LDCs. Lesotho belongs to the group of 16 lesser-developed beneficiary countries benefiting from special provisions for textiles and apparel. These countries must however implement a visa system for the articles to prevent fraud.

In 2002 Lesotho emerged as a major exporter of apparel to the US, the largest market for apparel in the world, and the largest supplier from Sub-Saharan Africa with exports of US$260 million from April 2001 to April 2002 (KOL, 2002). It accounted for 25 percent of total apparel exports to the US originating in Sub-Saharan Africa over 2001-2002. It currently accounts for 0.5 percent of US imports of apparel and is ranked the third supplier in terms of value of exports (KOL, 2002).

### *2.5.3 Southern African Development Community (SADC)*

SADC countries pursue macroeconomic and trade policies that are gradually opening up the regional market to international competition. Probably the most

important component of the SADC agreement relates to member countries reducing the tariff on traded products, eliminating non-tariff barriers and other issues that would determine the implementation of the Trade Protocol.

Implementation of the SADC Protocol is expected to benefit Lesotho in that its access to regional markets will be improved, as the removal of tariffs implies that the country's products will be in a position to compete within the SADC region. It is anticipated that this will boost the country's exports, thereby improving the balance of payments as well as employment prospects (Central Bank of Lesotho, 1999).

The Protocol would also allow for the opening of the SACU market to other non-SACU, SADC member states. This may mean that improved access to cheaper inputs from the regional non-SACU market (especially South Africa) would be faced with increased competition from member countries. Thus, it is important that Lesotho's products are able to face this new competition as the inability to do so may have adverse effects on the country's economy.

### *2.5.4 SACU*

#### 2.5.4.1 Concepts and effects on trade of customs unions

One of the major aspects of international trading relations after World War II, was the development of regional trade groupings, primarily in the form of customs unions (Sodersten and Reed, 1994). The formation of a customs union such as the Southern African Customs Union, of which Lesotho is a member, involves changing tariff regimes between the countries forming the union as well as between the union members and the outside world.

The effects of forming a customs union can be measured in terms of trade creation and trade diversion (Salvatore, 1998). Trade creation occurs when some

domestic production of a nation that is a member of the customs union is replaced by lower-cost imports from another member nation. Assuming that all economic resources are fully employed before and after formation of the customs union, the union increases the welfare of member nations because it leads to greater specialisation in production based on comparative advantage (Salvatore, 1998; Australian Bureau of Agricultural and Resource Economics, 1999). A trade-creating customs union also increases the welfare of non-members because some of the increases in its real income (due to its greater specialisation in production) spill over into increased imports from the rest of the world.

According to Heller's model (1973), trade-diverting customs union results in both trade creation and trade diversion, and therefore it can increase or reduce the welfare of union members, depending on the relative strength of these two opposing forces. The welfare of non-members can be expected to decline because their economic resources can only be utilised less efficiently than before trade was diverted away from them. In other words, lower-cost imports from outside the customs union are replaced by higher-cost imports from a union member, as a result of the preferential trade treatment given to member nations. Trade diversion therefore shifts production from more efficient producers outside the customs union to less efficient producers inside the union.

#### 2.5.4.2 Factors promoting trade creation in a customs union

The first group of factors is concerned with the degree of overlap between bundles of goods, which the member countries produced before joining the union. According to Sodersten and Reed (1994), if there is no overlap between these bundles (as might be the case if an agricultural country joined a manufacturing country), then there is no scope for trade creation. But a considerable overlap then means there is scope for both inter-industry and intra-industry trade creation. Conversely, the less the overlap between the union

members and the rest of the world, the lower will be the scope for trade diversion.

The second group concerns differences in production costs between countries regarding industries, which they have in common (Heller, 1973). The greater the difference in costs between member countries, the greater will be the gains, which can be made from trade creation. On the other hand, the smaller the difference in costs between the lowest-cost union producer and the lowest-cost non-union producer, the lower will be the losses from trade diversion (Sodersten and Reed, 1994).

The third group is the tariff factors. The higher the tariffs charged before the union on goods for which there will be trade creation, the higher will be the gains (Houck, 1992). The lower the pre-union tariffs on goods for which there will be trade diversion, and the lower the common external tariff on those goods after union, the lower will be the losses from trade diversion (Salvatore, 1998).

The fourth factor is the size of the customs union. The more countries there are within the customs union, the more likely it is to increase welfare (Salvatore, 1998). The reason is that the more countries there are within the union, the more likely the union is to include the lowest-cost producers of each good, and so the less likely trade diversion will be.

#### 2.5.4.3 Welfare effects and benefits from customs unions

The formation of a customs union leads to the realisation of administration savings, due to the elimination of the need for customs officers, border patrols and so on for trade among member nations. Secondly, by acting as a single unit in international trade negotiations, any customs union is likely to have more bargaining power than any of its members separately (Du Plessis, 1987).

The greatest benefit that is likely to result from the formation of a customs union is increased competition (Heller, 1973). When trade barriers among member nations are eliminated, producers in each nation must become more efficient to meet competition by other producers within the union. The increased level of competition is also likely to stimulate the development and utilisation of new technology. These efforts will cut costs of production to the benefit of consumers.

Another possible benefit is a stimulus to invest, to take advantage of the enlarged market and to meet the increased competition. However joining a customs union is the second-best option. The best policy would be for a nation to unilaterally eliminate all trade barriers (Houck, 1986), which is neither possible, (Schiller, 1998) nor likely, as countries are inclined to protect their infant industries (Sodersten and Reed, 1994).

#### 2.5.4.4 Background to the formation of SACU

SACU is seen by most Southern African countries as the most coherent and advanced of the integration efforts in the region (Calland and Weld, 1994). It is a free trade area with a common outside border, while each state's sovereignty is recognised. Formed in 1910 between South Africa, Lesotho and Swaziland, SACU is the oldest agreement and technically the most advanced of the regional groupings in the Southern and East African Region. The SACU agreement was renegotiated in 1969 with the independence of the three smaller countries-Botswana, Lesotho and Swaziland and again in 1990 when Namibia achieved its independence from South Africa. The present Southern African Customs Union is between South Africa and the smaller four countries known as the BNLS.

According to Shepherd and McCarthy (1993), the union is a strong and highly integrated core for a much looser, function-based co-operation. It is seen by most Southern African countries as the most coherent and advanced of the integration efforts in the region (Calland and Weld, 1994).

The prospects of the SACU are observed in the context of the changes in the larger global environment. Therefore when products especially agricultural products, are traded internationally, it is important that the idea of marketing is directed to a few prospects that the region has. According to Van Rooyen (1994), there are several rules that have been looked into and considered when SACU was formed some of which follow below.

1. The proximity rule explains that ideally economic co-operation or trading starts and includes neighbouring countries. The principle is based on low transport and communication costs that would be incurred;
2. Policy compatibility rule resulting from a compatible economic and political agendas and policies stating that there must be co-operation. This provides a basis for sustainable gains to a region as regional and global forces are allowed to play a positive influence.
3. The compensation rule states that innovative compensation measures among member countries are required, to develop future comparative advantage positions in the region through development investment programs. This ideally means that gains from regional co-operation should not only benefit the region as a whole but also individual members, although there could be a possibility of individual members becoming worse off than before integration (Maasdorp, 1999). However winner countries should be in a position to compensate looser countries.

SACU aims at maintaining the free interchange of goods between member countries. It meets annually to discuss matters that are related to the Agreement. There are technical liaison committees that help in the running of SACU. These are Customs Technical Liaison Committee, the Trade and Industry Liaison committee and the Ad hoc Sub-Committee on Agriculture, which meet three times a year to discuss the Agreement on agricultural issues.

After the formation of the Government of National Unity in South Africa, SACU was renegotiated to address needs of members more effectively. A new agreement was reached in 2002. The main provisions retained from the 1969 agreement are the following:

(a) free trade in locally produced goods;
(b) free movement of goods once cleared through customs;
(c) common external tariffs;
(d) common excise tariffs;
(e) infant industry protection for BLNS;
(f) no intra-SACU restrictions allowed;
(g) similar customs and excise legislation;
(h) import control where each member state has its own regulations; and
(i) freedom of transit and non-discrimination on transit duties.

There was also agreement on various new provisions that include the following:

(a) SACU will be an international juristic person;
(b) six new institutions are to be formed, namely, a Council of Ministers, Customs Union Commission, Secretariat, Tariff Board, Technical Liaison Committees (i.e., Agriculture, Customs technical, Trade and Industry and Transport), and a Tribunal;
(c) efficient co-operation on customs issues, industrial development, competition issues, agriculture, unfair trade practices and dispute settlement; and
(d) a new revenue-sharing arrangement.

Issues that created problems under the 1969 agreement were thus largely addressed. The accepted provisions provide a proper framework for economic integration and not merely co-operation. The new institutional framework also provides a basis for greater autonomy in respect of economic development and other SACU countries can play a vital role in ensuring that South Africa's political

and economic supremacy in the region is used positively to implement mutually beneficial policies. The new Tariff Board effectively removes South Africa's control over tariff-setting for SACU as a whole, with the consequence that tariffs intended to protect South African manufacturers and primary producers that hold only marginal benefits for partner countries through the tariff revenue sharing formula will now not distort the benefits provided. Greater integration should also entail increased investment in sectors that hold a comparative advantage in BLNS countries.

Members of the SACU remain contracting parties to the WTO in their own right and benefits from the WTO special and differential treatment afforded developing and LDCs in the form of exemptions or delayed implementation of certain provisions and technical assistance from international organisations.

## 2.6 Conclusion

From this chapter's discussion, it is evident that the majority of Lesotho's' population live in rural areas where agricultural production is mostly practised. The question of sustaining agriculture is therefore central to the policies and strategies that have a direct impact on agriculture. Hence agriculture is expected to continue to play a major role in meeting the country's core objectives of reducing poverty, improving household food security and generating employment in an economically diversified and ecologically sustainable way. To achieve this, policies such as land tenure review and irrigation are seen as a way that agricultural productivity and incomes could be increased.

Lesotho should maximise gains from participation in regional arrangements through its status as an LDC, by conferring trade treatment and access to foreign assistance. Its proximity to South Africa and membership to the SADC and the South African Customs Union, are its greatest advantages. Lesotho could use regional integration and most importantly, integrate with South Africa as a more

developed country. This, according to World Bank (2002a), would be a stepping stone to greater integration into the world economy. It could offer opportunity to realise economies of scale in policy implementation and to reduce the cost of policies related to international trade.

# CHAPTER 3

## PREFERENCES IN APPLE, ASPARAGUS CHERRY AND PEACH TRADE: A SACU PERSPECTIVE

## 3.1 Introduction

Increasing trade, and in particular exports, have become an issue of national importance for Southern African countries. As a result, the long-neglected field of export development and promotion is gradually gaining status in policy circles (Digges, Gordon and Marter, 1997). In this regard, Mukherjee and Robinson (1996) indicate that the Southern African region is not performing as poorly as commonly perceived. They state that intra-regional trade seems somewhat above what was expected based on the experience of other countries, but also acknowledge that intra-regional trade has not increased much from historically low levels and institutional change has been impeded on for a variety of reasons.

This chapter focus on trade patterns applicable to apple, asparagus, cherry and peach trade. It highlights major trading partners and provides details on export growth. In addition, intra and inter-industrial trade coefficients are calculated for SACU.

## 3.2 Exports and imports of apples, asparagus, cherries and peaches by SACU

The data used in this section was taken from Comtrade statistics published in 2000.

### *3.2.1 Apple Trade*

#### 3.2.1.1 Exports

Table 3.1 shows the major destinations of apples from SACU between 1994 and 1998. Note should be taken that only those countries that imported more than 1 million tons of apples each are reported.

In 1994 the United Kingdom (UK) was the biggest importer of apples from the SACU area, importing over 100 million tons of apples. Belgium, the US and Germany imported between 19 million and 46 million tons each, while the rest of the countries listed imported between one million and 9 million tons of apples each. In total 53 countries imported apples from SACU. In 1995 fifty countries imported fresh apples from SACU. Once again the UK imported most apples from SACU, being supplied with over 79 million tons of apples. Belgium, the US, Germany and Saudi Arabia were the next biggest importers of apples. In 1996, the UK, Belgium, Germany and the US imported more than 100 million tons of apples from SACU. The 1997 and 1998 the bulk of SACU's fresh apples were exported to the UK and Belgium, the US, Germany, Zimbabwe, Mauritius, Angola, Russian Federation, Saudi Arabia and Canada.

**Table 3.1: SACU apple exports (1994 - 1998) (in descending order; ≥ 100 million tons)**

| 1994 | 1995 | 1996 | 1997 | 1998 |
|---|---|---|---|---|
| United Kingdom | United Kingdom | United Kingdom | United Kingdom | United Kingdom |
| Belgium | Belgium | Belgium | Belgium | Belgium |
| United States | United States | Germany | United States | Netherlands |
| Germany | Germany | United States | Germany | Germany |
| Saudi Arabia | Saudi Arabia | Russian Federation | Zimbabwe | United States |
| Zimbabwe | Italy | Zimbabwe | Mauritius | Zimbabwe |
| Hong Kong | Hong Kong | Saudi Arabia | Angola | Russian Federation |
| Zambia | Zimbabwe | Canada | Russian Federation | Saudi Arabia |
| Mauritius | Mauritius | Mauritius | Saudi Arabia | Mauritius |
| Reunion | France | Reunion | Canada | Hong Kong |
| France | Canada | United Arab Emirates | Reunion | Malaysia |
| Australia | Portugal | France | Cyprus | Kenya |
| Greece | Greece | Angola | Mozambique | Canada |
| Spain | Angola | Kenya | Kenya | Zambia |

| 1994 | 1995 | 1996 | 1997 | 1998 |
|---|---|---|---|---|
| Portugal | Zambia | Italy | Italy | Angola |
| Angola | Kenya | Mozambique | Malta | Singapore |
| Mozambique | Singapore | Zambia | Zambia | Reunion |
| Kenya | Mozambique | Hong Kong | France | Mozambique |
| Singapore | Spain | Cote D`Ivoire | Hong Kong | Italy |
| Canada | Zaire | Portugal | Malaysia | France |
| United Arab Emirates | Seychelles | Singapore | Thailand | Cote D`Ivoire |
| Taiwan, Province of China | Gabon | Greece | Singapore | Taiwan, Province of China |
| Maldives | Maldives | Spain | Benin | Congo, Democratic Republic of |
| Zaire | Ghana | Zaire | Ghana | United Arab Emirates |
| Gabon | Croatia | Malaysia | Congo, Democratic Republic of | Gabon |
| Seychelles | Malawi | Seychelles | Greece | Greece |
| San Marino | Cote D`Ivoire | Gabon | Poland | Spain |
| Malaysia | Comoros | Benin | Gabon | Austria |
| Comoros | Sri Lanka | Ghana | United Arab Emirates | Yugoslavia |
| Sri Lanka | Congo | Maldives | Cote D`Ivoire | Ghana |
| Cote D`Ivoire | Saint Helena | Sri Lanka | Indonesia | Seychelles |
| Malawi | Vietnam | Comoros | Netherlands | Portugal |
| Somalia | Cameroon | Croatia | Seychelles | Bangladesh |
| Congo | Netherlands | Malawi | Yugoslavia | Thailand |
| Uganda | Malaysia | Indonesia | Malawi | Kuwait |
| Peru | Sierra Leone | Thailand | Sri Lanka | Senegal |
| Cameroon | Central African Republic | Brunei Darussalam | Kuwait | Maldives |
| Sao Tome & Principe | Ethiopia | Vietnam | Maldives | Malawi |
| Saint Helena | Swaziland | Congo | Portugal | Sri Lanka |
| Moldova, Republic of | Chad | Senegal | Congo | Comoros |
| Ghana | Sweden | Bangladesh | Bangladesh | Cameroon |
| Nigeria | Benin | Cameroon | Comoros | Cambodia (Kampuchea) |
| Montserrat | Mali | Switzerland | Cameroon | Sweden |
| Malta | Australia | Saint Helena | Senegal | Congo |
| Ethiopia | Tanzania | Tanzania | Vietnam | Peru |
| Switzerland | Nigeria | Netherlands | Taiwan, Province of China | Philippines |
| Mauritania | Uganda | Ethiopia | Cambodia (Kampuchea) | Vietnam |
| Central African Republic | Madagascar | Central African Republic | Tanzania | Saint Helena |
| Cape Verde | | Colombia | Australia | Egypt |
| Mali | | Australia | Egypt | Gambia |
| Sweden | | Sierra Leone | Zaire | Ethiopia |
| Swaziland | | Sweden | Qatar | Togo |
| | | Chad | Togo | Japan |
| | | Uganda | Saint Helena | Tanzania |
| | | Burundi | Ethiopia | Cape Verde |
| | | Japan | Central African Republic | Chad |
| | | Qatar | Lebanon | Mali |
| | | | Uganda | Uganda |
| | | | Madagascar | Central African Republic |

*Source: SARS (2000)*

#### 3.2.1.2 Imports

SACU is a net exporter of apples, but do occasionally import apples. In 1994 SACU imported 11 014 tons of apples. In 1995 imported apples to SACU originated mainly from SADC, and in particular Zimbabwe. In 1996 only Zimbabwe and France supplied SACU with fresh apples, the total amount being 1 220 tons. In 1997, apples were imported only from Zimbabwe (20 tons). In 1998 no imports of fresh apples were recorded.

#### 3.2.1.3 Growth in imports of apples originating from SACU – 1996 to 2000

Table 3.2 shows the annual growth in value and quantity of apple imports originating from SACU for selected countries for the period 1996 – 2000. The largest growth in terms of value and quantity was recorded for the Syrian Arab Republic (179% and 269% respectively). In this period, Brazil increased its imports by 101 per cent. In general, more increases than decreases were observed amongst the ten biggest importers of SACU apples in the period 1996 to 2000. Growth was also recorded for, amongst others, the US, Italy, New Zealand, Chile, Belgium, The Netherlands and China. France, Argentina and Canada's growth decreased by 1 per cent, 17 per cent and 13 per cent respectively for the period under discussion.

**Table 3.2: Growth in apple imports originating from SACU (1996 to 2000)**

| Exporters | Annual growth in value | Annual growth in quantity (%) |
|---|---|---|
| France | -9 | -1 |
| US | -2 | 1 |
| Italy | -5 | 6 |
| New Zealand | -4 | 4 |
| Chile | -2 | 0 |
| Belgium | 5 | 18 |
| Netherlands | -12 | 0 |
| China | 7 | 14 |
| Argentina | -18 | -17 |
| Canada | -8 | -13 |
| Poland | 2 | 14 |
| Brazil | 95 | 101 |
| Germany | -4 | 8 |
| Spain | -10 | -1 |
| Australia | 0 | 7 |
| Austria | -11 | -3 |
| Iran (Islamic Republic of) | 4 | 3 |
| United Kingdom | -14 | -12 |
| Czech Republic | -7 | 1 |
| Greece | -10 | 0 |
| Singapore | -26 | -12 |
| Lebanon | -3 | -4 |
| Kyrgyzstan | -26 | -11 |
| Japan | -23 | -7 |
| Turkey | -42 | -35 |
| Belarus | | |
| Slovenia | -11 | -3 |
| Uzbekistan | -20 | 4 |
| United Arab Emirates | -18 | 10 |
| Ukraine | -25 | -32 |
| Tajikistan | -15 | 15 |
| Kazakstan | | |
| Uruguay | 16 | 12 |
| Portugal | 7 | 36 |
| Syrian Arab Republic | 179 | 269 |
| Korea, Rep. of Korea | -38 | -24 |
| Moldova, Rep.of | | |
| Hungary | -43 | -41 |

*Source: ITC calculations based on Comtrade statistics (2001)*

### *3.2.2 Asparagus Trade*

#### 3.2.2.1 Exports

Table 3.3 shows the major destinations of fresh asparagus from SACU between 1994 and 1998. In total, 54 countries from different regions imported asparagus from SACU over this period. On average Germany imported the largest quantity, namely more than 700 000 tons, followed by the Netherlands with 172 852 tons. The other five biggest importers, Belgium, United Kingdom, Austria, France and Spain, imported between 16 000 and 46 000 tons, while Luxembourg, Zaire and Switzerland imported at around 1 000 tons of asparagus on average over the stated period.

**Table 3.3: SACU asparagus exports (1994 - 1998) (in descending order)**

| 1994 | 1995 | 1996 | 1997 | 1998 |
|---|---|---|---|---|
| Germany | Germany | Germany | Germany | Netherlands |
| Netherlands | Netherlands | Netherlands | Netherlands | Germany |
| Belgium | United Kingdom | United Kingdom | United Kingdom | United Kingdom |
| United Kingdom | Belgium | France | France | France |
| Austria | Austria | Austria | Luxembourg | United States |
| France | France | Belgium | Spain | Spain |
| Spain | Switzerland | Congo | Austria | Austria |
| Luxembourg | Hong Kong | Switzerland | United States | Belgium |
| Zaire | Zambia | Georgia | Singapore | Luxembourg |
| Switzerland | Seychelles | Luxembourg | Belgium | Switzerland |
| United Arab Emirates | Qatar | Hong Kong | Denmark | Denmark |
| Congo | Cote D`Ivoire | Greece | Hong Kong | Zimbabwe |
| Italy | United Arab Emirates | Mauritius | Switzerland | Angola |
| Cote D`Ivoire | Angola | Zambia | India | Italy |
| Hong Kong | Zaire | Japan | United Arab Emirates | Singapore |
| Gabon | Congo | Reunion | Italy | Mozambique |
| Japan | Comoros | Cote D`Ivoire | Greece | Kenya |
| Angola | Mozambique | Angola | Kenya | Mauritius |
| Saudi Arabia | Gabon | Seychelles | Mozambique | Tanzania |
| Singapore | Ethiopia | Mozambique | Cote D`Ivoire | Hong Kong |
| Mauritius | Cameroon | United Arab Emirates | Angola | United Arab Emirates |
| Cameroon | Singapore | Qatar | Qatar | Cote D`Ivoire |
| Ghana | Djibouti | Zimbabwe | Tanzania | Lebanon |
| Comoros | Bahrain | Australia | Zambia | Qatar |
| Zimbabwe | Malawi | Comoros | Gabon | Japan |
| | Australia | Zaire | Australia | Uganda |
| | | Saudi Arabia | Mauritius | Zambia |
| | | Ghana | Reunion | DRC |
| | | Uganda | Cameroon | Gabon |
| | | Denmark | Lebanon | Reunion |
| | | Gabon | Saudi Arabia | Seychelles |

| 1994 | 1995 | 1996 | 1997 | 1998 |
|---|---|---|---|---|
| | | Malawi | Malawi | Malawi |
| | | | Congo | Portugal |
| | | | Ghana | Malaysia |
| | | | Guinea | Congo |

*Source: SARS (2000)*

### 3.2.2.2 Imports

Table 3.4 shows imports of asparagus by SACU. From 1994 to 1998 SACU's major suppliers of fresh asparagus were Zimbabwe, the Netherlands, France, Kenya, Israel, Jordan, New Zealand, Germany and the United Kingdom. Over this period Zimbabwe exported the highest volumes to SACU. In 1994, it exported 44 808 tons of asparagus to SACU, whereas the total tonnage imported was 45 901. The supply of asparagus to SACU in 1995 was 65 489 tons, while the total tonnage imported was 68 467. From 1996 to 1998, Zimbabwe's exports into SACU were 38 879, 13 578 and 18 444 tons respectively for the three years.

**Table 3.4: Countries exporting asparagus to SACU (1994 – 1998) (in descending order)**

| 1994 | 1995 | 1996 | 1997 | 1998 |
|---|---|---|---|---|
| Zimbabwe | Zimbabwe | Zimbabwe | Zimbabwe | Zimbabwe |
| Netherlands | Kenya | Jordan | Netherlands | Jordan |
| France | Netherlands | New Zealand | Kenya | Netherlands |
| | Israel | Germany | United Kingdom | |

*Source: SARS (2000)*

### 3.2.2.3 Growth in imports of asparagus originating from SACU

Table 3.5 shows the annual growth in value and quantity of asparagus imports originating from SACU for selected countries for the period 1996 – 2000. Of the 40 countries that imported asparagus from SACU, 25 experienced positive growth. The decline in growth in the other trading countries averaged 10 per cent. Although Mexico, Peru and the US were the biggest importers, more substantial growth was realised by the Czech Republic, which increased its imports from SACU by 125 per cent, though its share in world exports is very low.

**Table 3.5: Growth in asparagus imports originating from SACU (1996 to 2000)**

| Exporters | Annual growth in value | Annual growth in quantity (%) |
|---|---|---|
| Mexico | 32 | 33 |
| Peru | 20 | 29 |
| US | 0 | 6 |
| Spain | -9 | 0 |
| Greece | -14 | -9 |
| Netherlands | -9 | -3 |
| Australia | 4 | 10 |
| France | -13 | -6 |
| Philippines | -9 | -9 |
| Thailand | 5 | 28 |
| New Zealand | 4 | 3 |
| Chile | 6 | 1 |
| Belgium | 7 | 13 |
| Italy | 6 | 19 |
| Hungary | 3 | 11 |
| Germany | 9 | 20 |
| Colombia | -8 | -4 |
| China | -22 | -11 |
| Poland | -7 | -4 |
| Argentina | -17 | -18 |
| Slovakia | -1 | na |
| Austria | 48 | 34 |
| Guatemala | -10 | -14 |
| Finland | 405 | na |
| Czech Republic | 57 | 125 |
| United Kingdom | 1 | 8 |
| Morocco | -33 | -9 |
| Ecuador | -26 | -6 |
| Zimbabwe | -33 | -22 |
| United Arab Emirates | 66 | 68 |
| Canada | 12 | -1 |
| Bulgaria | 101 | 49 |
| Singapore | -40 | -23 |
| Switzerland | 39 | 42 |
| Costa Rica | -34 | -19 |

*Source: ITC calculations based on Comtrade statistics (2000)*

### *3.2.3 Cherries*

#### 3.2.3.1 Exports

Table 3.6 shows the major export destinations of fresh cherries from SACU between 1994 and 1998. In 1994 Zimbabwe, Mauritius, Germany, the Netherlands and the United Kingdom were the biggest importers of fresh cherries from the SACU region. In 1995 the United Kingdom and Spain were the largest importers of fresh cherries from SACU in terms of quantities. In 1996 South Korea, Taiwan, Zambia, the Netherlands, Hong Kong, France, Mauritius, Germany and Mozambique were major export destinations. In 1997, when exports reached a high of 136 160 tons, the highest tonnage was exported to the United Kingdom, the Netherlands and the United Arab Emirates, with the remaining volume being exported to other countries listed. In 1998 SACU's export of fresh cherries declined to its lowest levels since 1994. The main destinations were Mozambique, China, United Arab Emirates, Zambia and Kenya.

**Table 3.6: SACU fresh cherry exports (1994 - 1998) (in descending order)**

| 1994 | 1995 | 1996 | 1997 | 1998 |
|---|---|---|---|---|
| Zimbabwe | UK | South Korea | UK | Mozambique |
| Mauritius | Spain | Taiwan | Netherlands | China |
| Germany | Turkey | Zambia | United Arab Emirates | United Arab Emirates |
| Netherlands | Brazil | Netherlands | United States | Zambia |
| UK | United Arab Emirates | Hong Kong | Canada | Kenya |
| France | Czechoslovak | France | Spain | United States |
| Bulgaria | Czech Republic | Mauritius | Germany | Canada |
| Switzerland | Greece | Germany | Hungary | Spain |
| Hungary | Netherlands | Mozambique | Switzerland | Germany |
| Germany | Zimbabwe | Spain | Bulgaria | Hungary |
| Spain | France | Canada | Greece | Switzerland |
| Canada | Bulgaria | United States | Morocco | Bulgaria |
| | Switzerland | Hungary | Italy | France |
| | Hungary | Switzerland | Suriname | UK |
| | Germany | Bulgaria | | Netherlands |
| | Canada | France | | Greece |
| | United States | Greece | | |
| | | Israel | | |

*Source: SARS (2000)*

Table 3.7 shows countries importing glazed cherries from SACU. SACU's export market for glazed cherries ranges from nine to 20 countries. In 1994 nine countries imported cherries from SACU and the highest volumes were traded with the United States, Mauritius, Zimbabwe and Seychelles. In 1995, Italy, Kenya and Zimbabwe were the biggest importers of glazed cherries from SACU. Mauritius was the highest importer in 1996, followed by Zimbabwe and Mozambique. Zimbabwe was the highest importer in 1997, followed by Kenya and Mozambique, and in 1998 Zimbabwe was the highest importer, followed by Zambia, Mozambique and Kenya.

**Table 3.7: SACU glazed cherry exports (1994 - 1998) (in descending order)**

| 1994 | 1995 | 1996 | 1997 | 1998 |
|---|---|---|---|---|
| United States | Italy | Mauritius | Zimbabwe | Zimbabwe |
| Mauritius | Kenya | Zimbabwe | Kenya | Zambia |
| Zimbabwe | Zimbabwe | Mozambique | Mozambique | Mozambique |
| Seychelles | Japan | Zambia | Malawi | Kenya |
| Zambia | Mozambique | Kenya | Spain | Seychelles |
| Maldives | Comoros | Tanzania | Zambia | Madagascar |
| Mozambique | Zambia | Seychelles | Angola | DRC |
| Saint Helena | Zaire | Zaire | Tanzania | Malawi |
| Angola | Seychelles | Angola | DRC | Tanzania |
| | Tanzania | Sao Tome | | Saint Helena |
| | Saint Helena | Saint Helena | | Australia |
| | Malawi | | | |

*Source: SARS (2000)*

### 3.2.3.2 Imports

Table 3.8 provides a breakdown of SACU's total fresh cherry imports from the world. Imports mainly originated from between nine and 21 countries. In 1994 Canada exported close to 130 000 tons of fresh cherries into SACU, Germany more than 36 000 tons, Spain more than 17 000 tons, and Switzerland more than 16 000 tons. SACU imported over 9 000 tons of fresh cherries from the United Kingdom and 4 000 tons from France. The remainder was imported from Hungary, Greece and Zimbabwe. In 1994 nine countries contributed to supplying

SACU with fresh cherries. The top four suppliers of fresh cherries to SACU in 1995 were Canada, Czech Republic, Germany and Spain.

In 1996 Canada, Germany, United States, United Arab Emirates, Spain, the United Kingdom, Bulgaria, Morocco and France dominated the SACU cherry import market. In 1997 the United States was the leading exporter to SACU, followed by Canada, Spain, the United Kingdom, Germany, Switzerland, Bulgaria, Greece and the Netherlands. In 1998 the United States maintained its leading position as an exporter to SACU, followed by Canada, Spain, Germany, Hungary, Switzerland, Bulgaria, France and the United Kingdom.

**Table 3.8: SACU imports of fresh cherries (1994 to 1998) (in descending order)**

| 1994 | 1995 | 1996 | 1997 | 1998 |
|---|---|---|---|---|
| Canada | Canada | Canada | United States | United States |
| Germany | Czech .Republic | Germany | Canada | Canada |
| Spain | Germany | United States | Spain | Spain |
| Switzerland | Spain | United Arab Emirates | United Kingdom | Germany |
| United Kingdom | Czechoslovakia | Spain | Germany | Hungary |
| France | United Arab Emirates | United Kingdom | Switzerland | Switzerland |
| Greece | United Kingdom | Bulgaria | Bulgaria | Bulgaria |
| Zimbabwe | United States | Morocco | Greece | France |
| | Brazil | France | Netherlands | United Kingdom |
| | Greece | Greece | Surinam | Netherlands |
| | Netherlands | Switzerland | Italy | Greece |
| | Bulgaria | Israel | Morocco | |
| | Turkey | Netherlands | | |
| | Zimbabwe | | | |

*Source: SARS (2000)*

Only one country, France, exported glazed cherries to SACU in 1997 and 1998. In 1996 SACU imported glazed cherries from France, the United States, Belgium and Japan. In 1995 France, Germany and Canada exported glazed cherries to SACU, while in 1994 only the United States exported glazed cherries to SACU.

### *3.2.4 Peach*

#### 3.2.4.1 Exports

The major export destinations of peaches from SACU in the period 1994 to 1998 are shown in Table 3.9. In 1994, the United Kingdom imported the highest volumes of peaches, followed by Saudi Arabia, Belgium, Mozambique, Zambia, United Arab Emirates, Mauritius, Singapore, Germany and Angola. The quantities imported were 3 352 566 tons for the United Kingdom and 460 583, 54 922, 30 162, 23 167, 22 770, 18 375, 17 462, 1 5580 and 10 905 tons respectively for the other nine countries. In 1995, once again, the United Kingdom was the largest importer of SACU peaches, increasing its volume to 7 259 875 tons. In this year, 20 countries were supplied with over 10 000 tons of peaches by SACU.

In 1996, Kuwait imported the largest quantity of peaches from SACU, namely 63 188 861 tons. The United Kingdom was the second larger importer, while the following countries followed with around 10 000 tonnage: Saudi Arabia, Mauritius, Belgium, Mozambique, Zimbabwe, Italy, Singapore, Angola, Zambia, France, Kenya, Reunion, the Netherlands, Spain, United Arab Emirates, Cote D'Ivoire and Gabon.

For the two years, 1997 and 1998, the EU was still most important destination for peaches from SACU. The export destinations in the EU include the United Kingdom, Belgium, Germany and France. Outside the EU, Saudi Arabia and United Arab Emirates were the main export destinations.

## Table 3.9: SACU exports of peaches (1994 to 1998) (in descending order)

| 1994 | 1995 | 1996 | 1997 | 1998 |
|---|---|---|---|---|
| United Kingdom | United Kingdom | Kuwait | United Kingdom | United Kingdom |
| Saudi Arabia | Saudi Arabia | United Kingdom | Saudi Arabia | Belgium |
| Belgium | Belgium | Saudi Arabia | Belgium | Netherlands |
| Mozambique | Mauritius | Mauritius | United Arab Emirates | Saudi Arabia |
| Zambia | Mozambique | Belgium | Mauritius | United Arab Emirates |
| United Arab Emirates | Zambia | Mozambique | Kuwait | Mauritius |
| Mauritius | Germany | Zimbabwe | Mozambique | Germany |
| Singapore | Unallocated | Italy | Zimbabwe | France |
| Germany | Zimbabwe | Singapore | Germany | Angola |
| Angola | Angola | Angola | Netherlands | Zimbabwe |
| France | Spain | Zambia | Angola | Mozambique |
| Zimbabwe | Reunion | France | Zambia | Spain |
| Kenya | France | Kenya | Reunion | Reunion |
| Cote D`Ivoire | Italy | Reunion | France | Zambia |
| Iceland | Netherlands | Netherlands | Cote D`Ivoire | Kuwait |
| Switzerland | Singapore | Spain | Kenya | Hong Kong |
| Saint Helena | Kenya | United Arab Emirates | Hong Kong | Qatar |
| Gabon | United Arab Emirates | Cote D'Ivoire | Italy | Kenya |
| Cameroon | United States | Gabon | Spain | Cote D`Ivoire |
| Australia | Cameroon | Austria | Gabon | Italy |
| Austria | Gabon | Switzerland | Bahrain | Bahrain |
| Zaire | Zaire | Seychelles | Senegal | Luxembourg |
| Portugal | Austria | Zaire | Singapore | Sri Lanka |
| East Timor | Seychelles | Hong Kong | Switzerland | Poland |
| Malawi | Hong Kong | Greece | DRC | Japan |
| Greece | Congo | Congo | Portugal | Malawi |
| Seychelles | Cote D`Ivoire | Saint Helena | Qatar | Singapore |
| Congo | Djibouti | Qatar | Egypt | Sweden |
| Ethiopia | Saint Helena | Bahrain | Malawi | Gabon |
| Central African Rep. | Malawi | Comoros | Seychelles | Switzerland |
| Sweden | Kuwait | Malawi | Greece | DRC |
| Comoros | Sweden | Sierra Leone | Lebanon | Ghana |
| Gambia | Switzerland | Thailand | Tanzania | Senegal |
| | Maldives | Cameroon | Thailand | Seychelles |
| | Bahrain | Ghana | Congo | Saint Helena |
| | Qatar | Central African Rep. | Austria | Cameroon |
| | Comoros | Ethiopia | Cameroon | Greece |
| | Central African Rep. | Tanzania | Ghana | Tanzania |
| | Swaziland | Australia | Zaire | Congo |
| | Guinea | Sweden | Saint Helena | Egypt |
| | Ethiopia | Malaysia | Benin | Jordan |
| | Senegal | Vietnam | Madagascar | Portugal |
| | Chad | Egypt | Comoros | Lebanon |
| | Sierra Leone | Benin | Uganda | Ethiopia |
| | Benin | Uganda | Ethiopia | Bulgaria |
| | Gambia | United States | Central African Republic | Uganda |
| | Uganda | Taiwan, Province of China | Denmark | Benin |
| | | | Australia | Austria |
| | | | Guinea | Thailand |
| | | | Maldives | Comoros |
| | | | | Canada |
| | | | | United States |
| | | | | Malaysia |

*Source: SARS (2000)*

#### 3.2.4.2 Imports

Only five countries exported peaches to SACU. In 1994 large volumes of peaches were imported from Greece, Zimbabwe and Liberia. The total tonnage of peaches imported amounted to 45 995 tons. In 1995 six countries, namely Israel, Greece, Egypt, the United Kingdom, United States and Zimbabwe supplied peaches to SACU, with the highest volumes coming from Israel and Greece. A total of 80 803 tons of peaches were imported in 1995.

In 1996 SACU imported 28 967 tons of peaches from five countries, the United States, Greece, Morocco, Zimbabwe and Israel. The 1997 2 509 tons came from three countries, Egypt, Zimbabwe and Morocco. In 1998, the 26 499 tons of peaches imported by SACU came from two countries, the United States and Bulgaria.

#### 3.2.3.3 Growth in imports of peaches originating from SACU

From 1996 to 2000, SACU experienced growth in the imports of its peaches by 24 countries. The most significant and the highest growth was realised by Taiwan, with a 221 per cent increase in annual growth of peaches imported from SACU. Jordan had a significant high of 165 per cent growth in quantity imported from SACU; United Arab Emirates increased by 88 per cent, Australia by 61 per cent while Greece had an annual growth of 50 per cent and Denmark increased growth by 44 per cent. Spain, Hungary, Iran, Yugoslavia, Singapore, Mexico also increased their imports of peaches significantly(>20 per cent). However, growth of the imports by the rest of the countries declined. The highest importer of SACU peaches, Italy, showed a decline in imports of 2 per cent annually in the period 1996 to 2000. Chile, which is one of the top five importers of SACU peaches, had a negative growth of 5 per cent.

**Table 3.10: Growth in peach imports originating from SACU (1996 to 2000)**

| Exporters | Annual growth in value (%) | Annual growth in quantity (%) |
|---|---|---|
| Italy | -9 | -1 |
| Spain | 6 | 20 |
| United States of America | 8 | 8 |
| France | -7 | 1 |
| Chile | -2 | -5 |
| Greece | 28 | 50 |
| Netherlands | -4 | -1 |
| Australia | 55 | 61 |
| Belgium | -2 | -1 |
| Germany | -12 | -3 |
| Turkey | -7 | 8 |
| Syrian Arab Republic | | |
| Morocco | 10 | 19 |
| Uzbekistan | -38 | -26 |
| Argentina | -8 | -8 |
| Jordan | 147 | 165 |
| Israel | 45 | |
| Taiwan, Province of (China) | 97 | 221 |
| Kyrgyzstan | -18 | -5 |
| United Kingdom | -19 | -21 |
| Austria | -16 | -9 |
| China | 8 | 3 |
| Canada | 15 | 9 |
| New Zealand | -29 | -23 |
| Mexico | 38 | 29 |
| United Arab Emirates | 38 | 88 |
| Venezuela | -37 | -35 |
| Iran (Islamic Republic of) | 49 | 21 |
| Portugal | -10 | 1 |
| Yugoslavia | 9 | 25 |
| Area Nes | -72 | -69 |
| Hungary | 32 | 20 |
| Zimbabwe | -9 | -8 |
| Singapore | 10 | 24 |
| Denmark | 18 | 44 |

*Source: ITC calculations based on Comtrade statistics (2000)*

## 3.3 Inter- and intra-industrial trade estimation

### *3.3.1 Inter-industrial trade*

Inter-industrial trade refers to the natural comparative advantage of a country in certain commodities, which is determined by measuring the concentration of exports and imports. The degree of concentration can vary from a situation with no concentration (total diversification) to a situation of total concentration. The extent to which concentration varies is determined by amongst others, different preferences of consumers and trade policies, which result in different trade streams. Trade barriers set by policy makers will prohibit or restrict trade between different regions. If there are trade barriers, which prohibit or restrict trade in certain products or product types, then trade will be towards countries that do not have such measures. Production capacity and climatic factors, trade agreements and trade incentives are other determinants of the concentration in product markets.

In this study, based on the objectives, the methodology that is adopted to investigate concentration of trade for the products investigated in the previous section is the Gini-Hirschmann coefficient. The Gini-Hirschmann coefficient will indicate a high level of concentration if a country has concentrated the largest part of its exports to or imports from a few regions. For example, if cherries are only exported to one country, the Gini-Hirschmann coefficient will reach 1. Correspondingly, a coefficient approaching zero, indicates high diversification of the exporting country and by the same token, the Gini coefficient could also show equally distributed destinations (Grubel and Lloyd, 1975).

Data relating to imports and exports of apples, asparagus, cherries and peaches traded by SACU are used. The data used was captured from SARS time series information as well as the International Trade Centre database.

The Gini-Hirschmann coefficient is defined as follows (Grote and Sartorius Von Bach, 1994):

$$G_i = \left[ \sum_{i=1}^{n} \left[ \frac{X_{ij}}{X_i} \right]^2 \right]^{½} \times 100$$

with: $X_{ij}$ = Exports (imports) from country i to j

$X_i$ = Total export (import) volume of country i

i = 1…n

The above equation is used to analyse both exports and imports of products relating to SACU, in order to determine the extent to which exports and imports are regionally concentrated or diversified, and to explain trade patterns.

### *3.3.2 Estimating intra-industrial trade*

In this study the Intra-industrial trade coefficient (IIT) is used to explain the situation where countries simultaneously import and export essentially the same products. Intra-industrial trade arises from the diversity of preferences among consumers, possibly coupled with income differences. Similarity of tastes between trading partners may also play a major role.

Where the IIT coefficient is 0, it indicates that a country either imports or exports. A coefficient of 100 indicates that import volume equals export volume of a specific commodity, i.e. a situation where all imports are re-exported. A coefficient of 50 indicates that given an export surplus, one third of the export volume will be imported, and not 50 per cent as might be assumed.

The intra-industrial trade coefficient IIT is defined as (Grubel and Lloyd, 1975):

$$IIT = \frac{\left[(X_i + Y_i) - |X_i - Y_i|\right]}{(X_i + Y_i)} \times 100$$

with: IIT = Intra-industrial trade coefficient

$X_i$ = Export volume of product i

$Y_i$ = Import volume of product i

### *3.3.3 Results*

#### 3.3.3.1 Concentration in apple imports & exports

Table 3.11 shows the Gini coefficients for apple imports and exports. The level of concentration for apple imports was high in the period 1994 to 1998. This indicates that majority of apple imports come mainly from one or a very few countries; in this case mainly Zimbabwe. Exports of apples from SACU are highly concentrated, even though exports go to many countries. The Gini coefficient ranged between 0.85 and 0.96 from 1994 to 1998. The bulk of exports went to the EU, the US and the Middle East (see Table 3.11).

**Table 3.11: Gini coefficient for imported and exported apples**

| Year | 1994 | 1995 | 1996 | 1997 | 1998 |
|---|---|---|---|---|---|
| Imports | 1.00 | 0.35 | 0.75 | 1.00 | 1.00 |
| Exports | 0.91 | 0.89 | 0.96 | 0.85 | 0.86 |

#### 3.3.3.2 Concentration in asparagus imports and exports

Asparagus imports were highly concentrated from 1994 to 1998. The Gini coefficient reached a low of 0.81 in 1998. Ten countries, all from different regions, supplied SACU with fresh asparagus. Zimbabwe was the top SADC supplier, followed by Kenya, the Netherlands, the United Kingdom and France.

As is the case with imports, exports were also highly concentrated. From 1994 to 1998 the Gini coefficient ranged between 0.92 and 0.97, with the lowest value of 0.92 being reached in 1998. Exports are mainly concentrated to EU countries such as Italy, Austria, France, Denmark, Portugal, Luxembourg, the Netherlands and Greece.

**Table 3.12: Gini coefficient for imported and exported asparagus**

| Year | 1994 | 1995 | 1996 | 1997 | 1998 |
|---|---|---|---|---|---|
| Imports | 0.97 | 0.95 | 0.99 | 0.96 | 0.81 |
| Exports | 0.94 | 0.97 | 0.95 | 0.93 | 0.92 |

### 3.3.3.3 Concentration in cherry imports and exports

Table 3.13 shows the Gini coefficients for imported and exported fresh and glazed cherries from 1994 to 1998. As with the other products discussed, imports of cherries are also highly concentrated, especially glazed cherries. Imports of fresh cherries mainly originated from North America and the EU. A similar situation exists for glazed cherries, with the difference that the EU has become a more important source than the US since 1996.

In general the Gini coefficients calculated for exported cherries show a relatively high degree of concentration. Interesting to note, is the lower levels of concentration for glazed cherry exports from 1996; this shows that exports volumes are spread over more countries than in 1995 and 1994.

**Table 3.13: Gini coefficient for imported and exported cherries**

| Year | Differentiated product | Imports | Exports |
|---|---|---|---|
| 1994 | Fresh cherries | 0.79 | 0.89 |
| | Glazed cherries | 1.00 | 0.89 |
| 1995 | Fresh cherries | 0.79 | 0.91 |
| | Glazed cherries | 0.91 | 0.90 |
| 1996 | Fresh cherries | 0.86 | 0.78 |
| | Glazed cherries | 0.79 | 0.64 |
| 1997 | Fresh cherries | 0.78 | 0.94 |
| | Glazed cherries | 1.00 | 0.74 |
| 1998 | Fresh cherries | 0.87 | 0.72 |
| | Glazed cherries | 1.00 | 0.66 |

### 3.3.3.4 Concentration in peach imports and exports

The calculated Gini coefficients for imported peaches are shown in Table 3.14. The coefficients range between 0.75 and 0.93, indicating a high level of concentration. Greece, Israel and the US were the most important sources of imports.

The exports of peaches from SACU region is also highly concentrated. From a regional perspective, the EU, the Middle East and SADC are the most important trading partners.

**Table 3.14: Gini coefficient for imported and exported peaches**

| Year | 1994 | 1995 | 1996 | 1997 | 1998 |
|---|---|---|---|---|---|
| Imports | 0.89 | 0.93 | 0.75 | 0.95 | 0.78 |
| Exports | 0.97 | 0.967 | 0.99 | 0.92 | 0.84 |

### 3.3.3.5 Intra-industrial trade coefficients

Table 3.15 shows the IIT coefficients calculated for apples, asparagus and peaches. The calculated IIT coefficients are, as expected, very low. This is indicative that South Africa is mainly exporting the products, and also is not being used as a transit point for these products to other African countries.

**Table 3.15: IIT coefficients for apples, asparagus and peaches**

| Product | 1994 | 1995 | 1996 | 1997 | 1998 |
|---|---|---|---|---|---|
| Apples | 0.00 | 0.00 | 0.00 | 0.00 | 2.6 |
| Asparagus | 8.0 | 14.5 | 5.7 | 1.8 | 3.0 |
| Peaches | 2.2 | 1.8 | 0.1 | 0.1 | 0.7 |

### 3.3.3.6 Intra-industrial trade of SACU cherries with the rest of the world

Table 3.16 shows the IIT coefficients for fresh and glazed cherries. In 1994, the coefficient shows that glazed cherries were basically exported by SACU. This is indicated in the earlier section, which showed that only one country, the US, exported to South Africa, whereas the bulk of SACU's exports went to four countries. This is an indication therefore, that SACU only exported glazed cherries, or did not significantly import cherries.

In 1995 the IIT coefficient for fresh cherries was 49, very close to 50, meaning that given an export surplus, which was realised in that particular year, almost one third of the cherries exported was again imported.

**Table 3.16 IIT coefficients for SACU with the rest of the world**

| Year | Products | IIT coefficients |
|---|---|---|
| 1994 | Fresh cherries | 28 |
| | Glazed cherries | 0 |
| 1995 | Fresh cherries | 49 |
| | Glazed cherries | 87 |
| 1996 | Fresh cherries | 28 |
| | Glazed cherries | 30 |
| 1997 | Fresh cherries | 61 |
| | Glazed cherries | 31 |
| 1998 | Fresh cherries | 8 |
| | Glazed cherries | 37 |

## 3.4 Conclusion

SACU supplies fruit to some of the top world markets - Germany, the United Kingdom, Spain, the United States and the Netherlands (which has a key trans-shipment port for the European Union). Potential growth markets seem to exist, particularly in those countries that do not impose restricting phyto-sanitary standards. Economic growth, cultural factors and nutritional knowledge influence the consumption of fruit in the EU. Citizens of these countries have relatively high incomes, which usually leads them to exhibit an increased consciousness of heath and nutritional values associated with fruit and vegetables. Due to a wider interest in healthier eating, i.e. in fruit and vegetables, it is expected that consumption of all fresh fruit will increase in these countries.

The analysis in this section suggest that SACU exports for the products considered is highly concentrated in only a few markets, although the number of markets being exported to are significant. On the one hand this indicates that SACU is relatively competitive internationally in so far as exports of these products are concerned, but on the other hand a concern is the high volumes of product going to a select few markets. Changes in SPS and other regulations, as well as consumer preferences in these markets could result in market share that is lost with devastating consequences for the local industries.

# CHAPTER 4

## A FRAMEWORK FOR MEASURING CEA

## 4.1 Introduction

A limited supply of resources has driven nations to take advantage of proceeds that result from trade between regions, within a country, as well as between a country and the rest of the world (Porter, 1998). In essence a nation will voluntarily engage in trade because resource allocation could be efficient, and welfare gains maximised in the absence of government intervention (Sodersten and Reed, 1994). Government interference implies distortion of market prices of goods and services. The starting point is therefore the supposition that actual prices are much poorer reflectors of social benefit, particularly in developing countries (Sell, 1991). One example is that of a domestic industry which encourages the application tariffs and quotas. The domestic price of the output is retained above the import price. But the outputs of one industry are often the inputs of another. Consequently, when an industry contemplates exporting, it finds that the very system which protects it in its home market, puts it at a disadvantage in export markets.

Another reason why the relative gap between domestic and world prices is highly divergent between industries, is the extensive use of import quotas (Houck, 1992). The situation is controlled by restricting imports and, naturally, the least essential goods are most restricted. It may result in growth of domestic industry behind protective quotas, however this is not necessarily beneficial to the long-run comparative advantage of a country. If an unsuitable industry becomes established, it handicaps any other industry that uses the same inputs and outputs (Antle, Lekakis and Zaneas, 1998). For instance, a high-cost local egg producing plant will handicap egg-using industries, unless the former is subsidised so that it can supply at prices no higher than the import price.

The above emphasises that an economic analysis such as the one carried in this study, necessitates the use of prices other than market prices of goods and services. Thus economic prices of goods and services which best reflect the scarcity value must be calculated and used for analysing the comparative economic advantage of production in this study.

## 4.2 Methodologies to investigate CEA

The measure of CEA is the domestic resource cost (DRC) ratio. DRC is an analytical tool for empirical evaluation of economic efficiency among alternative enterprises, and is a commonly used criterion for measuring CEA. It generates several measures of relative economic efficiency of production alternatives, as well as determining, according to Masters and Winter (1995), the most or relatively efficient alternative production activities for a country or region, in terms of its contribution to national income.

To determine which enterprise is the most efficient, this study uses the following formula employed by Hassan and Faki (1993) to generate DRC ratios for Sudan's irrigated land resources:

$$C_i = (\Sigma_r N_r X_{ri}) / (P_i Q_i - \Sigma_j R_j Q_{ji}) \qquad \text{Equation 4.1}$$

Where:

$C_I$ measures the value of domestic resources used, in saving or generating a unit value added in activity i;

$N_r$ is the opportunity cost of a unit of non-tradable primary factor r;

$X_{ri}$ is the quantity of factor r used in activity i;

$P_i$ and $Q_j$ are the import or export parity price and quantity of tradable product i, and

$R_j$ and $Q_{ij}$ are the import or export parity price and quantity of tradable imput j used in activity i.

The denominator in equation 4.1 derives value added (VAD) in activity i, and the numerator calculates the economic value or cost of domestic resources (CDRS) used to produce Qi. When CDRS is expressed in local currency and VAD in foreign currency, $C_i$ computes the DRC ratio of activity i. Thus, the DRC analysis measures relative efficiency in terms of the cost in local currency of domestic resources required to save or generate one unit of foreign exchange. This coefficient is then compared to the effective or parallel exchange rate, entailing that if:

> $DRC_i$ < e, then the country has a comparative advantage in producing commodity i.

But if:

> $DRC_i$ > e, there is no comparative advantage. In other words, in the case of Lesotho it would cost more South African Rand (R) to produce one unit of commodity i locally than to buy the same unit abroad.

An alternative measure of economic efficiency that is easier to interpret is the resource cost ratio (RCR), which is obtained from Equation 4. When both the numerator and denominator are expressed in the same currency units, the RCR is obtained. Resource cost ratio indicates the efficiency of each production alternative in using domestic resources to earn or save one unit of foreign exchange.

The RCR value is then interpreted as follows:

$0 < RCR < 1$ implies that value added per unit of product i is larger than the value of domestic resource used to produce this unit; thus i has comparative advantage.

$RCR_i > 1$ implies that the value of domestic resources used to generate one unit of i is greater than the value added per unit of i, thus there is no comparative advantage.

$RCR_i < 0$ implies that the value of the tradable inputs used to generate one unit of i is larger than the unit price of i (negative value added); hence there is net loss of foreign exchange and no comparative advantage.

However, the major difficulty of using DRC and RCR methods, according to Hassan and Faki (1993), arises from valuing inputs and outputs, particularly when choosing the appropriate opportunity cost of a non-trade primary factor such as land, labour, capital and water, when no market for the factor exists.

In the investigation conducted by Hassan and DiSilva (1994), they concluded that it is important to conduct CEA analysis within an agro-ecological framework since agricultural production is primarily a biological process that is highly dependent on the prevailing biophysical conditions. Jooste and Van Zyl (1999) iterated that agricultural suitability reveals the similarity in natural resource endowments and production potential, and hence complementarity on competitiveness in trade, between countries.

In this study, RCR measures of CEA will be calculated for different fruit enterprises. The agro-ecological zoning will be adapted as the framework for classifying production environments according to biophysical conditions.

## 4.3 Measures of efficiency and effects of policy

The analysis of profitability and computation of RCRs begins by determining social prices of inputs and outputs and constructing enterprise budgets. Thereafter, several measures of the relative economic efficiency of production alternative are generated. The most important measures are shown and defined in Table 4.1. They are nominal protection ratio (NPR), effective policy ratio (EPR), and net policy effect (NPE) and are defined according to Monke and Pearson (1989).

**Table 4.1: Measures of economic efficiency and policy distortions**

| | Tradable | | | Non-tradable domestic resources |
|---|---|---|---|---|
| | Products | | Inputs | |
| Value at market prices | MP | | MR | Y |
| Value at social prices | P | | R | N |
| Policy effect (tax/subsidy) | MP-P | | MR – R | Y – N |
| Private profitability | PP | = | MP – MR – Y | |
| Social profitability | SP | = | P – R – Y | |
| Nominal protection ratio | NPR | = | MP/P | |
| Effective protection ratio | EPR | = | (MP – MR)/(P – R) | |
| Total net policy effect | NPE | = | PP – SP | |
| Value added | VAD | = | P – R | |

*Adapted from: Monke and Pearson (1989)*

### 4.3.1 Market and economic profitability

Actual prices at which farmers buy inputs and sell outputs are used to compute market profitability. In other words, the criterion used by farmers to assess and compare alternative plans open to them regarding the exploitation of resources at their disposal is private profitability. These prices originate from the enterprise budgets collected from different zones in Lesotho. The market price of an item is normally the best estimate of its marginal value product and of its opportunity cost, but where distortions are known to exist it may be necessary to recalculate "actual" market prices or the shadow price.

In other words, a shadow price may be a better indicator of the value of a good or service (Ward and Deren, 1991), i.e a shadow price is a better estimate of a product's true opportunity cost to the economy, since prices paid and received by farmers often do not reflect the true economic cost of resources used and products generated. This is due to various market distortions such as taxes, subsidies and other restrictions on prices. This is evident from the well-known works of Little and Maurice (1976), who state that when the market price of any good or service is changed to make it more closely representative of the opportunity cost (the value of a good or service in its next best alternative use) to the society, the new value assigned becomes the "shadow price". Sometimes, according to Tsakok (1990), it is referred to as an accounting price that serves as an estimate of the economic value of the good or service in question. Similarly, according to Hassan and Faki (1993), because markets are imperfect, prices of tradables often do not correspond to their true economic value.

### 4.3.2 Shadow (economic) prices

Shadow prices are defined as the increase in welfare resulting from any marginal change in the availability of commodities or factors of production (Dixit and Nicholas, 1974). Most literature on shadow prices derives shadow pricing rules from the first order conditions of the optimisation model resulting in rules that link production to international trade (Little and Mirrlees, 1974). Economic values differ from market values because of market failure, which is the failure to attain the conditions of perfect competition such that some form of societal intervention is required to ensure that social welfare is maximised (Sodersten and Reed, 1994). As already mentioned, one of the major distortions is government failure, namely interventions that are designed to correct for market failure, but that are either inappropriate, insufficient, or excessive, or interventions that disrupt an

otherwise efficiently functioning market. Hence economic prices must be calculated.

## 4.4 Methodology used to calculate shadow prices in Lesotho

Because price distortion exists, some form of shadow pricing is required for planning and appraising investments. The first step in conducting economic analysis therefore is to remove the taxes from the values, since taxes do not represent real resource flows. Export subsidies, similarly, do not represent real resource flows; therefore subsidies should also be ignored. Taxes and subsidies constitute transfer payments, not real flows of resources.

Among the different theoretical methodologies examined by Bradfield (1993, quoted in Jooste, 1999), the world price approach, which is the most practical for the calculation of shadow prices, will be used together with the opportunity cost approach. This section discusses methods and the approach used for calculating shadow prices for different variables.

### 4.4.1 Tradable and non-tradable goods and services

Two components are involved in calculating shadow prices, namely tradable and non-tradable goods and services (Ward and Deren, 1991), and different criteria are used to calculate these two components. Hence, proper definitions are required.

According to Gittenger (1982) tradable goods and services are those traded items for which if they are exports, f. o. b. price > domestic cost of production, or the items may be exported through government intervention using export subsidies. If the traded items are imports, domestic cost of production > cif price.

Non-tradable goods and services are those for which cif price > domestic cost of production > FOB price. These goods and services may be items that are non-traded because of government intervention, e.g. import bans, quotas, tariffs and the like (Gittenger, 1982). This also means that the import price of products or services is greater than the cost of domestic production, but the cost of domestic production is greater than the price of that product or service on the world market (Sell, 1991). Tsakok (1990) defines non-tradable goods and services as those, which do not have foreign or border prices. In essence, these definitions are similar and were considered for the purpose of this study.

### 4.4.2 Shadow pricing of tradable goods and services

Social prices for traded goods and services are based on import/export parity prices converted at the equilibrium exchange rate, with part handling and transport costs to the target market added or subtracted (Sell, 1991). This clearly indicates that economic prices for traded goods and services are established on the basis of the world price approach, because the price of a commodity that is significant in international trade or that is freely traded, is based on projections of prices at some distant foreign point. It is therefore necessary when calculating the economic values for the tradable goods and services that involve deriving a shadow price, to take into account parity prices based on international prices. When a commodity is exported because it has a comparative advantage, the export parity price is used. But if a crop serves as a substitution for imports overseas, the import parity price is used. Lesotho's fruit production is mainly for the export market. On the other hand, fruits such as peaches are consumed mainly by the domestic market (Ministry of Agriculture and Land Reclamation, 1996), and the surplus goes into the export market, as well as substituting for imported peaches.

To determine the social or economic prices of tradables, the conversion method is employed. First, the world prices of goods and services are determined and

adjusted according to the cost-insurance-and-freight components of imported goods and services (Ward and Deren, 1991). The tariff protection method, which indicates a percentage deviation of the domestic price from the international price, could also be used. The appropriate adjustment is therefore made to derive the economic price. In order to calculate the economic value of the Lesotho currency (Maloti), the buying power parity approach is used (Yao, 1997). Economic price of fuel was also calculated using the conversion method, whilst the economic price of electricity is adapted from other studies (TAMS, 1999).

#### 4.4.2.1 Conversion method

When information regarding transport cost and insurance is available, shadow prices of the traded goods and services can be determined as follows:

$$CIFW_{ij} = (IntP_{ij} + TransC_{ij} + Ins_{ij}) \times ExhR_{ij} \qquad \text{Equation 4.2}$$

Where:

$CIFW_{ij}$ = Cost – Insurance – freight – value of imports in domestic prices;
$IntP_{ij}$ = International market price in US and;
$TransC_{ij}$ = Transport cost;
$Ins_{ij}$ = Insurance;
$ExhR_{ij}$ = Exchange rate in Rand/US$;
i = Product identification;
j = year.

The following approach is used when information regarding transport cost and insurance is not available. In order to reflect domestic prices of goods and services a factor is used to adjust the world prices. The approach is denoted by the following equation.

$$CIFW = (IntP_{ij} \times (I + TransF_{ij})) \times ExhR_{ij} \qquad \text{Equation 4.3}$$

Where:

$CIFW_{ij}$ = Cost-Insurance – freight-value of imports in domestic prices j;

$IntP_{ij}$ = International Market price in US$;

$TransF_{ij}$ = Transport-and-Insurance Cost factor as percentage of cost j;

$ExhR_{ij}$ =Exchange rate in Rand/US$;

i = Product identification;

j = year.

#### 4.4.2.2 Tariff protection method

Sell (1991) and Bradfield (1987, in Jooste, 1999) state that, since tariff protection rates are an indication of the percentage deviation of domestic prices from international prices, shadow price calculation can be conducted using the tariff protection method.

$$W_p = D_p/(I + T_{pr}) \qquad \text{Equation 4.4}$$

Where:

$W_p$ = World price;

$D_p$ = Domestic price;

$T_{pr}$ = Tariff protection rate expressed as a percentage.

The assumption is that the ad valorem duty represents the deviation between the domestic price and the world price.

#### 4.4.2.3 Capital

In this study the scarcity value of capital is represented by the prime lending rate of the Central Bank of Lesotho in Lesotho.

#### 4.4.2.4 Shadow pricing of fuel

Factor adjustment regarding the shadow prices of fuel, is calculated by first, calculating the average price of diesel as landed cost (Table 4.2 for 1999). The average pump cost is also calculated. The conversion factor is the ratio of shadow price to the pump price. For the purpose of this study the calculated factor will serve both the petrol and diesel adjustment from current market prices to shadow prices.

**Table 4.2: Calculation of the factor adjustment regarding the shadow price of fuel**

| | |
|---|---|
| US cents/gallon | 49.34 |
| Gallon/ liter conversion | 3.80 |
| US cents/liter | 12.99 |
| Exchange rate | 5.14 |
| SA FOB | 66.79 |
| Freight | 5.86 |
| Insurance | 0.07 |
| CIF | 72.72 |
| Ocean leakage | 0.22 |
| Landing and wharfage | 1.19 |
| Railage | 11.49 |
| Landed price | 85.62 |
| | |
| Dealers' margin | 16.00 |
| Storage and handling | 2.07 |
| Delivery | 4.43 |
| Road maintenance levy | 20.00 |
| MVA | 6.67 |
| Industry margin | 15.50 |
| Shadow price | 150.29 |
| Pump price | 207.42 |
| Conversion factor | 0.72 |

#### 4.4.2.5 The shadow exchange rate

The shadow exchange rate is a summary indicator of the trade-related distortions and it is used to adjust for distortions in the official rate (Liebenberg et al., 1991). The Lesotho economy is closely tied to that of the RSA and both countries are members of the Common Monetary Area. Hence, the Lesotho currency, the

Maloti, is equivalent to the South African Rand, and for the purpose of this study the shadow exchange rate of the Rand will be calculated to represent the shadow value of the Maloti.

In accordance with Tower and Pursell (1986), the shadow exchange rate will be used in this study to value goods and services of tradable inputs and outputs. The shadow exchange rate is used to convert domestic values into world market prices or vice versa.

According to Tsakok, (1990), both the standard conversion factor (SCF), and the shadow exchange rate are useful tools for adjusting distortions in the market. The SCF is the ratio of the official exchange rate to the shadow exchange rate (Sell, 1991). It is used to adjust distortions introduced by trade regimes between the border prices of traded goods and domestic shadow price of non-traded goods (Gittinger, 1982). According to Liebenberg et al. (1991), the adjustment is necessary because an overvalued official exchange rate understates the border prices of traded goods and services in local currency, and conversely, an undervalued official rate overstates them (Poonyth and van Zyl, 2000). Because the increases or decreases in production in South Africa affect Lesotho, as most imports come from South Africa (and that the producer price index for Lesotho is normally not computed), the shadow exchange rate of the South African Rand will be calculated using the producer price index for South Africa and the United States of America. This is because the South African Rand is commonly valued against the US Dollar. According to Bradfield (1993 in Jooste and Van Zyl, 1999), the year that conforms to the requirements listed below is 1975, which was used as a base year for calculating the economic value of the South African exchange rate. The shadow exchange rate indicates the opportunity cost of a unit of foreign exchange in the limited sense that it shows what the actual cost or benefit is in terms of domestic currency (given current distortions).

Bradfield (1993, in Jooste, 1999), suggests the following practical requirement to be considered when selecting the base year:

- the economic growth rate must be stable or near to the long term growth rate of the economy;
- the balance of payments must be near equilibrium;
- there should not have been any major economic or political crisis in the world;
- there must be domestic political stability;
- international economies must be relatively stable;
- the rate of unemployment must not be excessively high; and
- The rate of inflation must not deviate too much from the long-term trend in inflation.

In this study the shadow exchange rate will be calculated using the buying power parity (BPP) approach, which is also used by the Industrial Development Corporation of South Africa (IDC) as indicated by Jooste (1999). This method uses the producer price index of the United States since the South African Rand is compared to the US Dollar. According to the equation below, that employed BPP, the calculated shadow exchange rate in 1999 is R 5.14.

$$SE = (PI_{SA}/PI_{FC})/ E_{bj} \qquad \text{Equation 4.5}$$

Where:

SE = Shadow exchange rate;

$PI_{SA}$ = Producer price index for South Africa;

$PI_{FC}$ = Producer price index for the USA;

$E_{bj}$ = Base year exchange rate.

#### 4.4.2.6 Shadow interest rate

The shadow interest rate may be useful for evaluating the interest rate prevailing in domestic markets as a consequence of government fiscal and monetary policy (Ricketts and Rawlins, 2001). Secondly, according to Mayashekho (1980), a Government may use a shadow interest rate to judge the optimality of foreign and domestic borrowing. Thirdly, the shadow interest rate may be used to evaluate the productivity of the investment undertaken (Sell, 1995). In this study the shadow interest rate for deposits was taken to be 10.89 per cent, which is the interest free of taxes that the Central Bank of Lesotho is lending to the commercial banks.

### 4.4.3 The tradable/non-tradable composition of the value of inputs and outputs

The cost of production is separated into tradable and non-tradable components (Ward and Deren, 1991). Some items have a greater proportion of tradable elements than others do, as shown by Table 4.3, which indicates the tradable/non-tradable composition of the value of inputs and products. Bradfield (1993) in Jooste (1999) studied the input-output table of South Africa. In his examination he acknowledges that most inputs used in the South African economy are made up of tradable and non-tradable components. This means that for the production of tradable goods and services, non-tradable inputs are required; for the production of non-tradable goods and services tradable inputs are required, and non-tradable goods and services require tradable inputs, and non-tradable goods and services require non-tradable inputs. As most or all tradable inputs in Lesotho are imported from South Africa, the 1993 input–output table for South Africa was used to estimate the tradable/non-tradable composition of the value of inputs and products. That is, the tradable and non-tradable components for each of the items appearing in the table were

subsequently used in the enterprise budgets to calculate the domestic resource cost, for different products in each zone.

**Table 4.3: The tradable/non-tradable composition of the value of inputs and outputs**

| Item | Percent Traded | Percent Non-traded |
|---|---|---|
| Fertiliser and pesticides | 98 | 2 |
| Other purchased inputs | 95 | 5 |
| Fixed cost | 95 | 5 |
| Variable costs | 50 | 50 |
| Electricity | 85 | 15 |
| Contract services | 95 | 5 |
| Transport | 60 | 40 |

## 4.5 Shadow prices of non-tradables

The shadow cost of non-tradable goods and services (e.g. labour, land, and water) are among the most difficult to estimate. Labour, for example, differs in many respects from other production factors (Reynolds, 1965). In Lesotho, like in many developing countries, wage rates for labour may not accurately reflect its opportunity cost. Land is one of the examples of non-tradable goods which, when competitive leasing and hiring of land is observed, land rents are used, as agricultural land markets are missing or imperfect in many places.

### 4.5.1 Labour

A generally acknowledged rule of economic development, irrespective of the socio-economic system, is that the national objective should be to derive maximum economic welfare from the disposition of the scarce resources available. Unskilled agricultural labour is an abundant resource in developing countries, and most development projects draw upon this resource for both construction and operational purposes (McDiarmid, 1977). Usually, however, the investment designer has considerable leeway regarding the proportions of labour, land and capital to be used, and there is of course a wide range of

choices among different investments serving the same economic objectives. In the presence of such choices, it follows that the impact on the cost of using any production factor can be measured either in straightforward financial terms by the prevailing wage or by the effect of such use on the economy as a whole.

The economic price of a particular worker is the total measurable impact on the economy of which the worker is a part by his employment in a particular occupation (Reynolds, 1965). In its broadest sense the economic cost of a unit of labour used for a specific purpose may be divided into an immediate cost. This is the production that would have occurred if the unit of labour had been used in the optimal available alternative employment, and the additional consumption (in lieu of saving) that may result from the employment of labour for the purpose contemplated. McDiarmid (1977) states that economic wages might show greater stability than market wages over time. Therefore the use of the economic prices of labour should improve the design of the economic analysis. The design should reflect the combination of factors having the lowest economic cost when flexibility in the combination of such factors is technically feasible.

#### 4.5.1.1 Arguments against economic pricing of labour

There are arguments against the economic pricing of labour, particularly the economic pricing of common labour. The argument is that the estimation of the ratio of economic price to market price is clearly not relevant to day-to-day decisions on private (or, for the most part, public) financial operations. The ordinary person concerned with his/her own affairs may go through life quite well without any knowledge of his/her true economic value to society. Similarly, the private entrepreneur need not look beyond income and such flow statements.

McDiarmid (1977) places serious critics of economic pricing into three overlapping categories. The first group holds that the concept for economic price, particularly because of the time dimension required, is too abstract and

"shadowy" a concept to occupy serious economists. The second group would argue that if government wishes to enforce a minimum wage measure or to subsidise an interest rate, its judgement should be respected and the price of labour or capital that it establishes should be used in economic project analysis. The third group of critics feels that if a factor of production is given a valuation differing from that determined by market forces, there may be a requirement for extensive monetary subsidies. This is because the market wage, not the economic wage, would be paid in the actual production process. This is certainly correct because economic pricing does not change unit labour costs normally incurred. But it is a known fact that in the economic analysis, the objective is to minimise social, not monetary, cost. Hence we continue to estimate economically, goods and services involved in the study, including labour.

#### 4.5.1.2 Economic pricing of labour

A question when determining economic wage rates, however, is how to evaluate arbitrary non-market forces, e.g. the impact of labour unions and minimum wage levels. The existence of such arbitrary factors may mean that labour cannot be engaged in alternative occupations at a wage lower than the minimum market wage, which is also taken as a minimum economic wage, since employers will not hire additional workers if their marginal productivity is lower than the wages that the employers are legally required to pay. This reasoning, however, does not take account of the border socio-economic factors that enter into the computation of a real economic wage.

For the general allocation of resources, the economic pricing of labour is desirable, because of imperfections in both the capital market and the labour market. The removal of these imperfections might cause such serious hardship for the disadvantaged that the action would be entirely unacceptable on social or political grounds (Schmid, 1989). The examples of such unacceptable actions would be the repeal of minimum wage laws, the suppression of collective

bargaining, and the elimination of unemployment insurance that enables people to keep their labour off the market if the remuneration offered falls below a certain minimum.

The reason for seeking the economic price rather than accepting the prices determined by market forces is that doubt exits about the latter performing the allocation function of a proper pricing mechanism. That is, market prices do not assure that labour, as one of the factors of production, is employed at its maximum, with reasonably uniform marginal productivity among its alternative uses (Gittinger, 1982).

In valuing labour for economic analysis, it is recommended that unskilled labour be distinguished from skilled labour because the difference between the economic and market price of labour tends to vary inversely with the degree of skill, the gap being wider for unskilled agricultural labour (Harberger, 1971). When labour is hired, its price or the actual wage rate is the private price (Little and Mirrlees, 1974). But if it is family labour, the private price is the opportunity cost of family labour, which is equal to the wage rate of the best alternative employment opportunity apart from farming (Gittinger, 1982).

#### 4.5.1.3 Skilled labour

Skilled labour in developing countries is considered to be in short supply, and skilled people would most likely be fully employed (Ward and Deren, 1991). This is the reason why wages paid to these workers are, in general, assumed to represent their true marginal value product, and are entered at their market values in the economic accounts (Sell, 1995). The social price of skilled labour is therefore taken to be the actual wage rate. It is acknowledged that the market wage rate for skilled labour is generally a good reflection of its true opportunity cost. McDiarmid (1977) also states that, in developing countries, skilled labour is likely to be priced at or below its economic value. Therefore, for the purpose of

this study, the shadow wage adjustment factor for skilled labour is taken to be one.

#### 4.5.1.4 Unskilled labour

In agriculture, unskilled labourers are workers who cannot operate any agricultural machinery or drive a tractor (Little and Mirlees, 1974). The various categories of unskilled labour deserve special attention. The fact is that workers consume commodities which they have themselves produced partly or entirely by labour, which ought to be valued at a shadow wage substantially below the market wage. Nelson et al. (1974) call this the multiplier effect of employment, because the extra employment generated indirectly is valuable in itself, and therefore makes the shadow wage rate less than it would otherwise have been. In order to account for this, the shadow price of unskilled labour should be used instead.

According to Gittinger (1982) employment of unskilled labour entails no opportunity costs. To calculate the shadow price, the cost of the commitment and the value of the consumption committed through employment, are added to calculate the shadow price adjustment factor for unskilled labour. This factor is applied to all wage rates of unskilled labour in order to convert it to shadow wages.

According to Conningarth Consultants (1995) the adjustment factor is calculated as follows:

3 kg mealie meal @ R1/kg = R3/day = R21/week Equation 4.6

Market price:
Unskilled labourers: R34.50/week

Shadow price adjustment factor = 21/34.50 = 0.609 Equation 4.7

Conningarth Consultants (1995) calculated the shadow price adjustment factor for unskilled labour during the slack seasons as 0.609. In this study the shadow adjustment factor of 0.609 will be used for unskilled labour.

### *4.5.2 Shadow price of water*

While Lesotho could be regarded as having an abundant supply of water, from an irrigation point of view, it is not always available in sufficient quantities at the right place or the right time. Its shadow price is the forgone output from not using it for the next best alternative use.

There are several ways of valuing irrigation water economically. A more appropriate measure of the economic value of water would be an estimate of the marginal value product of irrigation (Tsakok, 1990). But measuring marginal productivity of irrigation water would require the measurement of many complex biophysical processes influencing the utilisation of, and response to, irrigation water (Mullins, 1992). Such data are usually generated from controlled irrigation experiments, which are not available for this investigation.

Secondly, if availability is not a constraint, water's shadow price is equal to the cost of operating and maintaining the delivery system. In this case information of a detailed cost-benefit appraisal of the investment in the irrigation system, which is beyond the scope of this study, would be needed.

#### 4.5.2.1 The case of irrigation water in Lesotho

Even though the government of Lesotho ensures an adequate supply of adequate water even in times of drought, a policy document did not exist before 1999. Even the policy document that was approved in 1999 (TAMS, 1999) does

not refer to water for agricultural production. For the purposes of irrigation, farmers only have to apply for licenses to irrigate their fields, without actually paying for irrigation water (TAMS, 1999). The analysis of water resources of Lesotho by TAMS (1999) shows that water is available in sufficient quantities in all parts of the country, but recurring shortages can have a severe impact if imposed on an already strained demand and supply situation. The country has also been periodically subjected to what is generally recognised as hydrological/meteorological drought events, as are all Southern African countries, to the extent of water being rationed for areas like the city of Maseru (Ministry of Natural Resources, 2000). The above statement implies that in the whole of Southern African region competition for water is becoming tougher. Therefore, all economic analyses should attach a value to irrigation water, which will affect the comparative advantage of commodities produced in Lesotho.

Because of the complexities involved to determine the shadow pricing of water, a simpler approach is used in this study, i.e. to employ the level of water charges as an indication of the economic benefit of irrigation water (Tsakok, 1990). The amount of irrigation water that each enterprise uses under proper management is taken to reflect the true quantity of water used by a particular crop. The minimum charge for domestic fresh water, which is not taxed, will be applied on this quantity to provide a cost. The scarcity value of R0.50 is calculated by adding to the calculated economic value of water, as suggested by Hassan and Van der Merwe (1997), to reflect the opportunity cost of water.

### *4.5.3 Land*

There are several factors other than its productivity that affect land values. Amongst the many factors, only two that are related to policy will be mentioned. Firstly, it is acknowledged that agricultural land has value because investors expect that land will yield profits in future years (Hattingh and Herzberg, 1980). But the price of land is affected by inflationary expectations and expectations of

mortgage rates (US Department of Agriculture, 1987). For instance, if inflation is brought under control during a particular period while interest rates are still high, the consequence will be that farm values will decline significantly (Oster et al., 1984).

Secondly, political factors and possible further deregulation may affect land prices. If the government is sympathetic to consumers by attempting to keep prices of commodities low, then land prices will be affected.

#### 4.5.3.1 Valuing agricultural land

There are several ways by which land could be valued. In a perfectly competitive market, the opportunity cost of land would be its price, and this price would be equal to its marginal value product (the extra revenue from increasing the quantity of the input used, all other quantities remaining constant). However, the most common case in agriculture would be one in which land changes use but not management control (Gittinger, 1982). The incremental net benefit, that is the incremental cash flow of the enterprise when market prices have been converted to economic values, will include an allowance for the net value of production forgone by changing the land use (Oster et al, 1984).

In other instances, the rental value of land (Currie, 1981) is taken in an area with a fairly widespread and competitive rental market. Inevitably, however, there will be instances in which neither the purchase price nor the rental value will serve as a good estimate (Murray, 1973). In this case a direct estimate of the productive capability of the land is made. In the case of Lesotho most land is idle and the tenure system does not allow land to be sold. But without putting up the investment, the land will, in effect, have produced no economically valuable output at all. Hence, the net value of production forgone is clearly zero, and no economic value is entered for the land because there is no reduction in national income as a result of shifting its use from jungle to farmland (Currie, 1981).

In other cases, a direct estimate of the net value of production forgone is made. The gross value of the land's output is taken at economic prices and costs of production are deduced. The residual is assigned as the contribution of the land to the production of the output and is taken as the opportunity cost of the land in economic terms (Murray, 1973).

#### 4.5.3.2 The case for land in Lesotho

Land in Lesotho is hardly ever sold, and when it is, considerations of investment security and prestige normally push its price well above what the land could reasonably be expected to contribute to agricultural production. In this case the market purchase prices cannot be accepted as a good estimate of the economic opportunity cost of the land. Instead, land rental is used. While there is no clear policy on land tenure or the land market in Lesotho, there exists considerable and widespread rental market by landowners who are willing to lease fields to agricultural entrepreneurs. For this investigation the highest value of rent per hectare of land should provide a fairly good indication of the net value of production of the land and, hence, of the opportunity cost of the land should it be utilized for something else.

## 4.6 Discounting methods

The Net Present Value (NPV) method is used to account for the timing of expenditure and returns over the life cycle of each enterprise in this study. The Net Present Value (NPV) takes into account the principle upon which discounted cash flow evaluation is based, that money has a time value, i.e. money received now is worth more than that received in a year's time.

The procedure is to specify all the expected inputs and outputs of each enterprise spaced over time, from the inception of planning to the economic life

of the enterprise. The first step is to record and calculate present value year by year throughout the expected life of the enterprise (in this insistence 20 years). Next, all expected expenditure payments for goods and services for each enterprise, including capital expenditures, and all expected receipts from each enterprise, are converted to economic terms by revaluing the appropriate entries at their shadow prices.

The next step is to sum up the discounted future cash flows to represent present values for each enterprise. For this purpose, the discount rate to be used for calculating the net present worth was eight per cent.

### *4.6.1 Choice of the discounting rate*

The discounting rate to be used for calculating present worth of expenditures is selected on the basis of whether the analysis is a financial or an economic analysis. The interest rate that is more or less similar to the rate at which the firm could borrow after allowing for risk (Gittinger, 1982), could be used. Consequently it follows that the profitability of an enterprise is a good measure of social benefit only in so far as the rate at which the firm could borrow is the same as the rate at which society ought to discount future consumption (Little and Mirlees, 1974).

Three discounts rates could be used for economic analysis. The best discount to use is the opportunity cost of capital, although this can be difficult to apply as a practical working tool as the opportunity cost of capital is unknown. It would be the return on the last or marginal investment made that uses up the last of the available capital.

In most developing countries the discounting rate is assumed to be between eight and fifteen per cent in real terms. In most cases analysis in these countries uses twelve per cent (Gittinger, 1982). A second discount rate is the borrowing

rate that the nation must pay to finance the project. This rate is commonly proposed when the country expects to borrow abroad for investment (Mashayekho, 1980). Using the borrowing rate, however, has the disadvantage that if investments are to be chosen, selection will be based on the financial terms available, not solely on the relative contribution of an investment to national income.

Social time preference rate is the third rate that is sometimes proposed (Gittinger, 1982). This idea originates from the fact that future returns by society as a whole differ from the discount individuals would use. Therefore it is felt that the society has a longer time horizon, so that its discount rate would be lower, implying that a different, generally lower discount rate would apply to public and to private enterprises. This gives rise to allocation problems, both in theory and in application. In accounting for the timing of expenditures and returns, therefore, the opportunity cost of capital is used because it derives from both public and private investment activities and gives the same weight to future returns from both kinds of activities (Mashyekhi, 1980).

Theoretically, using too low a rate of interest to discount social profits would lead the economy to attempt to invest too much, with inflationary effects. But too high a rate could leave savings unutilised and cause excessive unemployment. A good planning system would maintain some kind of balance between investment and investment resources.

## 4.7 Conclusion

This chapter elaborated on the methodologies used to analyse the comparative economic advantage in terms of social prices or the opportunity cost theory that will be applied in Chapter 6. In deriving the RCR coefficients the cost of traded inputs into tradable and non-tradable components will be decomposed. The contribution of labour, capital, and other non-traded factors to the value of

variable machinery and other services is then added to the cost of domestic resources. The RCR ratios will then be calculated for the competing crop enterprises using the NPV method.

# CHAPTER 5

## AGRO-ECOLOGICAL ZONE DELINEATION

## 5.1 Factors affecting land use

In order to conduct the CEA analysis, Lesotho was divided into four agro-ecological zones. For the purpose of this study, the term 'agro-ecological zone' is adopted. An agro-ecological region can be defined as that area of land that is through its physical, biological, economical and historical characteristics more or less homogeneous. In general, it can be stated that although a number of factors may influence a certain region, only a few or only one will determine the dominant characteristics of a specific land area, mostly referred to as a region (Department of Agriculture, 1947).

In order to determine relatively homogeneous agro-ecological zones it is necessary to know which factors, according to FAO (1994) cause major differences between regions and make them suitable for the production of specific commodities.

## 5.2 Factors determining agro-ecological zone delineation

As mentioned decisions that are to be taken on agricultural land use need to be first analysed on the basis of natural land resources, technology of resource use, economics and social acceptance. It is therefore necessary to discuss and consider the important factors that mainly determine CEA before the CEA for commodities are analysed (Ward and Deren, 1991).

### *5.2.1 Biophysical conditions*

Biophysical conditions include topography, soil, temperature regime, moisture availability and rainfall. Light, radiation regime, drought hazard, oxygen

availability to roots and nutrient availability and nutrient retention are other important biophysical factors in delineating a country into agro-ecological zones. By using these elements zones can be defined on the basis of combinations of soil, landform and climatic characteristics (National Research Council, 1976).

#### 5.2.1.1 Topography

Topography is an invariable feature of the physical landscape, which is described by altitude *per se*, as well as the rate of change of altitude over distance (Berding, 1985). As such, altitude exerts major influences on features of climate and hence on hydrological and agricultural responses. Altitude can act as a barrier to rain-bearing air masses. Alternatively, it can force moist air to rise by orographic lifting, resulting in windward facing slopes experiencing not only more total rainfall (United States Department of Agriculture, 1941), but also more rain-days and, often, more rainfall per rain-day.

With regard to temperatures, higher altitudes are generally the major cause of lowered temperatures, although the lapse rate of temperature varies with region, season and whether maximum or minimum temperatures are considered (Berding, 1985). Changes in altitude can, under given conditions of atmospheric stability in the cooler months, result in cold air drainage into valleys at night, thereby increasing, for example, the incidence of frost. It is also the increase in altitude, linked with reduced atmospheric pressure that can act as a direct factor in enhancing the transmission of solar radiation (University of Tokyo, 1976).

Topography causes local increases in rainfall by other mechanisms than the simple lifting of air as it blows over rising ground. According to Mckay and Allsopp (1977) slight obstructions like patches of forest or slightly higher ground can cause large increases in 12-hour rainfall (up to 200% more than that on the surrounding plain) when the air stream is moist and stable.

#### 5.2.1.2 Soil

Climate and vegetation play a major role in determining the broad soil pattern of the earth, though other factors may be more important. For example, the kind and amount of organic matter available for soil building depends on the prevailing vegetation for a particular agro-ecological zone. Mckay and Allsopp (1982) state that the soil's rate of decay, and also the rate of chemical change in the soil, depends on radiation regimes, temperature regimes, drought hazards and oxygen availability to roots, nutrient availability and retention, and moisture availability. Whether chemicals are leached out of the upper soil layers and where and how they accumulate lower down, depend on moisture. According to USDA (1941), the character of a given soil depends on a combination of these effects.

#### 5.2.1.3 Temperature regime

Air temperature is another common climate determinant of agriculture and it is probably the most widely used atmospheric indicator of both short-and long-term climate fluctuations (Ministry of Natural Resources, 2000). Temperature influences every chemical and physical process in plants and determines the production belts for various crops. Temperature affects the flux of water vapour and thus the reason it is important to plant water status, soil drying and irrigation practices (Westwood, 1993). Temperature variations related to topography have particular practical significance in areas where late or early frost threatens the success of crops (Teskey and Shoemaker, 1978). Temperature variations related to topography are more significant near the polar limits of a crop, where favourable topographic position is required to ensure sufficient warmth (degree-days) for the crop to mature during the normal frost–free season.

#### 5.2.1.4 Rainfall

Agricultural production is greatly influenced by the amount, intensity and distribution of rainfall. Surface erosion as a natural process that occurs regardless of land use, is accelerated by intense excess rainfall. When rainfall occurs slowly, many soils are capable of absorbing the water without runoff and erosion. In Lesotho, like in other subtropical countries, precipitation is usually concentrated in one or two periods of the year, which is from the month of October to April, averaging 700 mm per month (Cunningham, 1996). Accordingly the high altitude areas record the highest average rainfall while low altitude areas record lower rainfall.

#### 5.2.1.5 Moisture availability

The ability of soils to retain moisture is highly correlated to soil structure. According to FAO (1994), soil with the right structure will often hold enough available water to mature a crop even if there is no rain throughout the entire growth period.

Two characteristics have been determined for the assessment of moisture availability in Lesotho soils (Berding, 1984).

- Length of growing period as affected by the ratio between rainfall and potential evapo-transpiration.
- Total rainfall during growing season with specified confidence limits.

#### 5.2.1.6 Light

Light has effects as fundamental as those of temperature and moisture (Berding, 1984). The less light, the more a plant grows in length, hence growth speeds up at night and slows down in the daytime. For many plants day length rather than

temperature sets the time of maturity, i.e. plants will flower and produce seed only when the days are of the right length – some requiring long days, others short days.

#### 5.2.1.7 Radiation regime

Variations in incoming solar radiation due to topography are also of major importance. The steepness of a slope to a large extent determines whether specific crops such as grapes and other deciduous fruits, flowers, and vegetables can be grown. This quality of radiation may be expressed by either of two characteristics, total short-wave radiation or sunshine hours. The monthly mean percentage of possible sunshine hours has been determined for a number of weather stations in Lesotho. The percentage of possible sunshine hours, according to Berding (1984), practically always exceeds 50% during the growing period (October - March/April) and generally exceeds 75% during the winter months (April/May - September). This characteristic is therefore not considered to be a limitation anywhere in Lesotho and therefore does not enter the land evaluation procedure.

#### 5.2.1.8 Drought hazard

According to Wilkinson, Fidell and Gomes (1999), drought had always been perceived by the majority of farmers as a major hazard throughout Lesotho, but is recognised as a major hazard more often in the Southern Lowlands than in the Northern Lowlands and certain Mountain regions. It is also recognised that soils with good moisture retention properties and with good rooting conditions obviously offer better protection against drought hazards than do the shallow soils or soils with a low moisture retention capacity.

## 5.3 Lesotho's agro-ecological zoning

Lying west of the watershed of the Drakensberg, Lesotho forms part of the eastern escarpment of the Southern African Plateau. Its geology derives from Karoo sedimentation, which began around the carboniferous to the middle of the Jurassic period (Ministry of Natural Resource, 2000). Although much of this sedimentation has been lowered by erosion (which began during the Jurassic period) to form the Karoo basin, Lesotho remains the highest remnants of the plateau surface. The latter has been extensively dissected by the headwaters of the Orange (Senqu) River and its tributaries, which drain in a north-south direction, and, together with an extensive network of mountain wetlands, today plays an important role in the Southern African region's water resources.

Two important factors characterize the formation of distinct agro-ecological zones in Lesotho. The first is the high altitude plateau, which intrudes into Western Lesotho at an altitude of roughly 1 500m along the western and south-western borders, forming a narrow strip known as the Lowlands. Altitude then increases through the Foothills to an elevation of 2 000 – 2 500m, and then finally rises to the eastern escarpment where substantial areas of Lesotho exceed an altitude of 3 000 m.

The second factor is the tapering of the African subcontinent, which exposes the interior to significant airflow from both the Indian and Atlantic Oceans (Berding, 1982). The two ocean masses have considerable temperature differences, a phenomenon which has a marked effect on inland weather patterns. These factors combine to modify the usual conditions that are created by the annual movements of the inter-tropical convergence zone, thereby determining the suitability of land for agricultural activities (Department of Conservation, Land Use Planning and Soils, 1984). It limits the cultivable area, as well as the duration of the growing season, and hence limits the potential land productivity. These factors also influence the adaptability and distribution of different types of

crops as well as different varieties within each crop type. For example, rainfall and temperature regimes combine to restrict agricultural activity throughout the country during the winter season.

The Division of Land Use Planning of the Ministry of Agriculture generated agro-ecological zones using a geographic information system (GIS), by overlaying a climatic map with a generalised soil map. The GIS assisted in capturing a crop's biophysical requirements with corresponding areas on the agro-ecological zone map. According to different factors that are mentioned above, Figure 5.1 shows different agro-ecological zones of Lesotho. Lesotho is divided into 4 agro-ecological regions, namely the Lowlands, the Foothills, the Senqu River Valley and the Mountains.

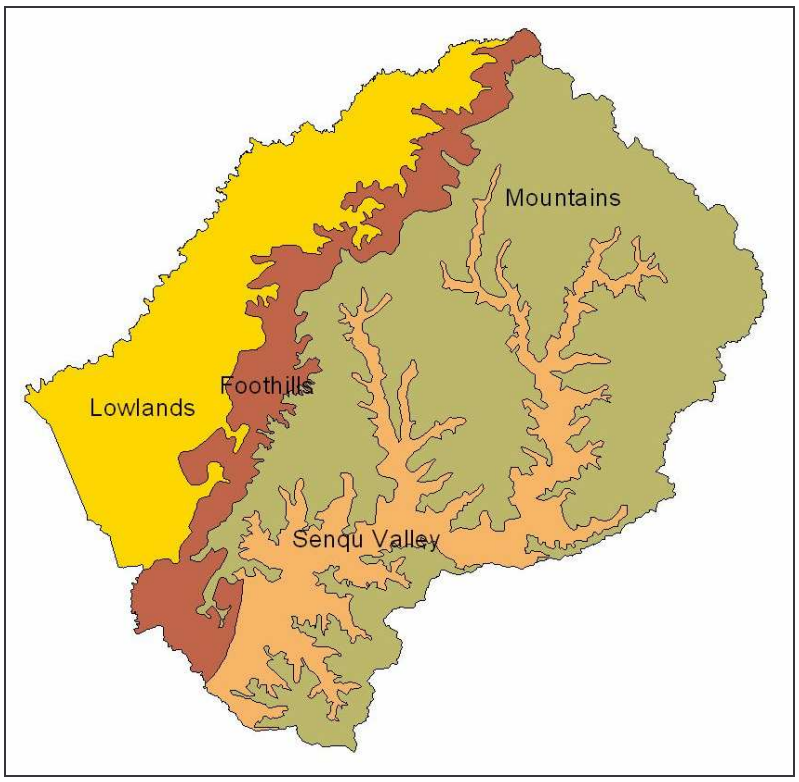


**Figure 5.1: Different agro-ecological zones of Lesotho**

- **Lowlands (agro-ecological zone 1)**

The Lowlands region, which comprises the northern, central and southern region, covers an area of 5 200 $km^2$ or 17% of Lesotho's total surface area. It consists of a narrow belt of land that lies 1 800m above sea level along the western border. The width of this belt ranges between 10 and 65 km. The large deposits of rich volcanic soils characterize the northern and central Lowlands, while poor soils and low rainfall characterize the southern or “border” Lowlands.

- **Foothills (agro-ecological zone 2)**

The foothills comprise 4 588 $km^2$ of a strip of land that lies between 1 800 and 2 000m above sea level (between the lowlands and the western watershed of the Drakensberg Mountains), and forms 15% of the total land area. The foothills consist of very fertile land that is associated with high agricultural productivity.

- **Mountains (agro-ecological zone 3)**

The largest ecological region, the mountains, covers an area of 18 047 $km^2$ of the Drakensberg range, with many high altitude plateaus, bare rock outcrops and deep river valleys and wetlands. The area is the source of many rivers, which drain towards both the Indian and Atlantic Oceans. The drainage pattern of the mountain region, however, has produced deep river valleys, gorges and gullies that, in general, make human habitation difficult and environmental degradation rife. The mountain region forms the main livestock grazing area in Lesotho.

- **Senqu River Valley (agro-ecological zone 4)**

The Senqu River Valley, is a narrow strip of land that flanks the banks of the Senqu River and penetrates deep into the Drakensberg range, reaching lower parts of the main tributaries of this river. This region covers 9% of Lesotho’s total

surface area. The soils of the Senqu River Valley vary from rich to very poor, making this the most unproductive region in the country.

**Table 5.1: Summary of the characteristics of agro-ecological zones of Lesotho**

| Parameter | Mountains | Lowlands | Foothills | Senqu River Valley |
|---|---|---|---|---|
| Topography | Very steep bare rock outcrops and gentle rolling valleys | Flat to gentle rolling valleys | Steeply rolling valleys | Steeply rolling valleys |
| Topographic elevation | 2 200-3 480 | 1 530-1 830 | 1 830-2 290 | 1 740-2 000 |
| Soils | Fragile, thin horizon of rich black loam, except on valley bottoms | Sandy textured, red to brown in the north, clayey in the south. | Rich, alluvial along valleys, thin and thick rock on slopes | Calcarious clayey red soils with poor penetration by rainfall |
| Climate | Cold, moist | Moist in the north, moderately dry in the south | Moist, sheltered | Dry |
| Rainfall(mm) | 600-1000 | 500-800 | 700-1000 | 500-1200 |
| Temperature: ℃<br>Winter mean<br>Oct – April mean | 22.1<br>-0.6 - -3.0<br>7.3 | 25.7<br>-0.2 - -0.1<br>11.9 | 24.9<br>-1.1 - -1.5<br>10.8 | 24.5<br>1.0 - -1.8<br>11.5 |
| Frost free season (days) | 80-130 | 130 | 120 | 120 |
| Risks | Long period of frost, snow, hail, high soil erodibility | Parching sun strong winter winds, hail, periodic droughts, high soil erodibility | Floods, high soil erodibility | Severe drought, moderate soil erodibility |
| Altitude (meters) | 2 000 – 3 482 | 1 388 – 1 800 | 1 800 – 2 000 | 1 388 – 2 000 |
| Area ($km^2$)<br>Percentage | 18 047<br>59 | 5 200<br>17 | 4 588<br>15 | 2 753<br>9 |
| Vegetation | Denuded grassland, indigenous shrubs in some river valleys, stunted peach trees near homesteads | Crop stubble, reforestation on some hills, fruit trees near homesteads | Poplar and willow trees along streams and gullies, crop stubble, many fruit trees near homesteads | Denuded dry shrubs, bush, few trees in valley |
| Summer grazing | High mountain cattle posts | Grazing around villages | Grazing around villages | Unsuitable, too dry |

Table 5.2 shows the land suitability of crops relevant for this study in different regions.

**Table 5.2: Land suitability for selected crops**

| Crop | Lowlands (zone1) | Foothills (zone 2) | Mountains (zone 3) | Senqu River Valley (zone 4) |
|---|---|---|---|---|
| Apples | Suitable | Suitable | Suitable | Suitable |
| Peaches | Suitable | Suitable | Temperature, frost limiting - unsuitable | Suitable |
| Asparagus | Suitable | Soils limiting | Soils limiting | Soils limiting |
| Cherries | Suitable | Suitable | Soils, temperature limiting | Temperature, location with regard to central market limiting |

## 5.4 Conclusion

The analysis of Lesotho's agro-ecological characteristics indicates that its variability places critical constraints on crop production in the country. While sunlight is not a limiting factor, water supply, together with soil/terrain characteristics and the climate regime are major factors. On the basis of these factors, but predominantly terrain characteristics four agro-ecological zones were identified.

# CHAPTER 6

## DOMESTIC RESOURCE COST RESULTS AND SENSITIVITY ANALYSIS

## 6.1 Introduction

In this chapter, the private and economic profitability of different zones, as identified in Chapter 5, are analysed. On the one hand, the term 'private' refers to the observed revenues and costs, reflecting actual market prices received or paid by farmers, traders or processors, and thus incorporates the underlying economic costs and valuations plus the effects of all policies and market failures. On the other hand, the term 'economic' profits measure the true economic value of goods and services by removing market and policy distortions. Valuations based on social prices measure comparative advantage or efficiency in an agricultural activity, since inputs and output are valued in prices that reflect scarcity values or social opportunity costs.

In addition to the above the chapter also investigates the comparative advantage of the products under investigation by using the RCR method. Sensitivity analysis is also conducted.

## 6.2 Private and economic profitability

In this section the net private (market) and net economic profitability of different fruit enterprises in all agro-ecological zones of Lesotho are compared. The discrepancies that exist between market and economic prices are normally those that cause farmers to diverge their interests to some investments, which seem to be more profitable. Hence, the importance of comparing private profitability with economic profitability to enable measurement of the overall effects of government policies that distort the market.

The effective protection coefficient (EPC), the nominal protection ratio (NPR) and total net policy effect (NPE), which are measures of policy distortions at the economic exchange rate, are also presented. The EPC is the ratio of value-added in private prices to value-added in world prices. This coefficient measures the degree of policy transfer from product market-output and tradable-input-policies. An EPC of higher than one indicates that the private profit is higher than what it should have been without any commodity policies in place. The NPR indicates the impact of policy that causes a divergence between the market price and the social price of a commodity. The NPR on tradable outputs, in this case, indicates the degree of output transfer, for example, an NPR greater than one show that policies were increasing the market price to a level higher than the social price.

### *6.2.1 Results of net private and economic profitability using the NPV approach*

Net private and economic profitability for each crop in all agro-ecological zones is shown in Table 6.1. Table 6.2 shows NPE, EPC and NPR for the different crops relevant to this study in each agro-ecological zone.

The results show that all enterprises that were analysed have higher private than economic profitability. Thus, should economic values of inputs and outputs prevail farmers would receive lower returns. The NPE, EPR, and NPR results in Table 6.2 confirm this. The results show that the crops are effectively subsidised.

One of the main reasons for this state of affairs can be traced back to the fact that the shadow exchange rate used to calculate shadow returns revealed that the Maloti was undervalued. An undervalued currency could stimulate investments, but the question arises whether returns on such investments can be sustained if the Maloti regain strength. The danger of an undervalued exchange coupled with the expectation that it will remain undervalued, could result in

expansion of production that may not be sustainable when the currency strengthens.

**Table 6.1: Private and economic profitability using NPV**

| Item | Lowlands | Foothills | Senqu River Valley | Mountains |
|---|---|---|---|---|
| **Net private returns to land** | | | | |
| Apples | 971608 | 768423 | 739041 | 854275 |
| Asparagus | 160515 | - | - | - |
| Cherries | 336573 | - | - | - |
| Peaches | 836987 | 525672 | 374417 | - |
| **Net economic returns to land** | | | | |
| Apples | 784152 | 602382 | 565271 | 532262 |
| Asparagus | 152117 | - | - | - |
| Cherries | 263131 | - | - | - |
| Peaches | 700176 | 413107 | 289814 | - |

**Table 6.2: Net Policy Effect, Effective Protection Ratio and Nominal Protection Ratio**

| Item | Lowlands | Foothills | Senqu River Valley | Mountains |
|---|---|---|---|---|
| **NPE** | | | | |
| Apple | 187455 | 166043 | 173771 | 322013 |
| Asparagus | 8398 | - | - | - |
| Cherries | 73442 | - | - | - |
| Peaches | 136811 | 112565 | 84603 | - |
| **EPR** | | | | |
| Apple | 1.19 | 1.20 | 1.20 | 1.23 |
| Asparagus | 1.11 | - | - | - |
| Cherries | 1.19 | - | - | - |
| Peaches | 1.17 | 1.17 | 1.19 | - |
| **NPR** | | | | |
| Apple | 1.22 | 1.25 | 1.28 | 1.61 |
| Asparagus | 1.06 | - | - | - |
| Cherries | 1.22 | - | - | - |
| Peaches | 1.20 | 1.24 | 1.23 | - |

## 6.3 The domestic resource cost analysis

The Resource Cost Ratio is an alternative measure of economic efficiency, which will be used in this section to calculate the comparative advantage of the

respective crops for each agro-ecological zone derived in Chapter 5. The RCR also indicates the efficiency of production of the enterprises in question in using capital and labour to earn a unit of foreign exchange. A RCR with a value of lower than one shows that a product has a comparative economic advantage, while a value of higher than one indicates a comparative disadvantage. Similar to the analysis in the previous section, the RCR will be calculated using the NPV methodology. The result of the analysis is reported in Table 6.3 and summarised below:

- In the Lowlands zone all products have a RCR of lower than one indicating a comparative advantage. Cherries production has a relative weak comparative advantage compared with the other products investigated in this zone. Peaches show the strongest comparative advantage.

- In the Foothills only apples and peaches were investigated, and both show a comparative advantage of equal strength which implies, amongst other things, that these crops are ideally suited for diversification.

- In the Senqu River Valley the result for apples and peaches are mixed, i.e. apples show a comparative advantage, whilst peaches show a comparative disadvantage. Moreover, peaches should not be produced in this zone since it extracts more value from the zone than it earns.

In the Mountain zone, only apple production was analysed. The results show that this region has comparative advantage in producing apples. In other words the cost of domestic resources used to produce a kilogram of apples is less than the value added per kilogram of apples.

**Table 6.3: Resource cost ratios using NPV**

| Product | Lowlands | Foothills | Senqu River Valley | Mountains |
|---|---|---|---|---|
| Apples | 0.24 | 0.36 | 0.36 | 0.35 |
| Asparagus | 0.20 | - | - | - |
| Cherries | 0.85 | - | - | - |
| Peaches | 0.13 | 0.36 | 1.33 | - |

## 6.4 Sensitivity Analysis

The analysis in the previous sections showed that the differences in private and economic profitability can mainly be explained by the difference that exist between the actual and shadow exchange rate. Distortions in the input side only contributed marginally differences between private and economic profitability. However, cognisance should be taken that cost related to water and land was excluded from the analysis thus far due to current policy regimes pertaining to these to production factors. Hence, in this section the sensitivity of the RCR to changes in the exchange rate, introduction of land and water costs and the threshold price of products to remain efficient will be calculated.

### *6.4.1 The effect of the foreign exchange changes on comparative advantage*

Table 6.4 shows the RCRs for the products under investigation if the exchange rate depreciates by 20 per cent. As expected all products show improved RCR, i.e. a depreciation in the exchange rate improved the comparative advantage of the crops considered in the analysis; peaches that showed a comparative disadvantage in the previous section now has comparative advantage too. Also important to note is that the current analysis excludes the effect of changes in the exchange rate on input prices due to a lack of information related to the interaction between input prices and changes in the exchange rate. One could however expect that the effects will be lagged in nature, and the magnitude of the effect will be dependent on the amount of inputs (or its components/ingredients)

that is imported. Finally, the results show that exchange rate policies will influence the comparative advantage of high value crops in Lesotho.

**Table 6.4: Effect of exchange rate**

| Commodity | Lowlands | Foothills | Senqu River Valley | Mountains |
|---|---|---|---|---|
| Apples | 0.16 | 0.21 | 0.20 | 0.19 |
| Asparagus | 0.15 | - | - | - |
| Cherries | 0.44 | - | - | - |
| Peaches | 0.09 | 0.22 | 0.57 | - |

### *6.4.2 Effect of changes in product price on comparative advantage*

All products under investigation were tested for threshold sensitivity if the world prices decrease, with all other factors remaining constant. Table 6.5 shows the decrease in price that can be absorbed for the respective product before they lose their comparative advantage. For example, in the Lowlands zone apples price can decline to up to 32 per cent before it will lose its comparative advantage. Asparagus production has the highest threshold value of the crops under consideration, whilst cherry production can only absorb a marginal decrease in prices. Important to note is that the bigger the share of production that are destined for exports, the higher the sensitivity towards changes in international prices. For example, high threshold value for asparagus can be attributed to the fact that low volumes of asparagus is exported, since most of the production is processed and the rest goes into the domestic market. The implication of this is that the more export orientated an industry is, the more sensitive is the industry to volatility in world market prices. Markets are build and maintained over long periods and hence it is important that an industry are able to withstand volatility in world market prices since it is very difficult to leave and enter markets at will.

**Table 6.5: Effect of a decrease in product prices**

| Commodity | Lowlands | Foothills | Senqu River Valley | Mountains |
|---|---|---|---|---|
| Apples | -33% | -19% | -16% | -17% |
| Asparagus | -82% | - | - | - |
| Cherries | -3% | - | - | - |
| Peaches | -45% | -21% | 5% | - |

### *6.4.3 The effect of land prices on comparative advantage*

In this section land prices was assumed to be R2 000 per hectare. This is the market price for agricultural bare land in the neighbouring Eastern Free State where a market for different land types exists. For the purpose of the sensitivity analysis this price is assumed to be the same across all agro-ecological zones of Lesotho. The RCRs were therefore recalculated for an alternative price. Table 6.6 shows the results if the cost of land is included in the RCR analysis. All the crops experience a decline in comparative advantage; in fact where cherries showed a comparative advantage in Table 6.3 it now has a comparative disadvantage. Since the land price included in this study could be an under estimation of the actual land prices (due to a general paucity of information pertaining to the issue) the results holds important implications for policy makers in Lesotho when reforming the land market in Lesotho. It is not the purpose of this study to provide policy directions, but rather to show the possible impact of increased land prices on the comparative advantage of crops that are perceived to contribute to the problems discussed earlier in rural areas. Hence, this is an area that needs further in depth investigation.

**Table 6.6: Effect of land prices**

| Commodity | Lowlands | Foothills | Senqu River Valley | Mountains |
|---|---|---|---|---|
| Apples | 0.28 | 0.45 | 0.47 | 0.45 |
| Asparagus | 0.36 | - | - | - |
| Cherries | 1.95 | - | - | - |
| Peaches | 0.17 | 0.53 | 3.28 | - |

### 6.4.4 The effect of water prices on efficiency ratios

Assuming that irrigation water in Lesotho might be paid for in future, the sensitivity analysis in this section will show the effect of water on the comparative advantage of the irrigated crops investigated. The analysis uses the scarcity value of water according to the methodology explained in Chapter 4, by keeping the returns to land constant in order to test the efficiency of each crop. The results from the sensitivity analysis in Table 6.7 show that cherries in the Lowlands and peaches in the Senqu River Valley will not be efficient if Lesotho farmers pay for irrigation water.

**Table 6.7: Effect of water prices**

| Commodity | Lowlands | Foothills | Senqu River Valley | Mountains |
|---|---|---|---|---|
| Apples | 0.28 | 0.45 | 0.48 | 0.46 |
| Asparagus | - | - | - | - |
| Cherries | 3.33 | - | - | - |
| Peaches | 0.20 | 0.80 | 10.03 | - |

## 6.5 Conclusion

In this chapter the extent of policy intervention on five high value crops was investigated. The results show that in general producers receive higher returns than would have been the case without any policy intervention. Of particular importance is the impact of the exchange rate since it is in large a non controllable factor for Lesotho since Lesotho is part of the Common Monetary Area, and as a result the Maloti are fixed to the South African Rand. This entails that economical and political issues, as well as exchange rate policy, in South Africa will directly affect the value of the Maloti. In this regard is important to take note that the South African economy is much more advanced than the Lesotho economy which might require different monetary incentives to grow.

The analysis also revealed that policies pertaining to land and water could have a significant impact on crops that could act as engines to reduce poverty and improve livelihoods in rural Lesotho.

Although the analysis did not investigate competitiveness per se, it revealed the status of comparative advantage that exists. This analysis could therefore serve as the basis for further analysis into the value chains of the crops that showed comparative advantages in order to point out interventions needed to improve their competitiveness locally and internationally.

# CHAPTER 7

## SUMMARY AND CONCLUSION

## 7.1 Introduction

This study evaluated the comparative economic advantage of selected high value crops, in particular apples, cherries, peaches and asparagus, in Lesotho. The analysis also includes an investigation into the structure and development of inter and intra industrial trade. This chapter gives a summary of the findings of the study as a whole. The conclusions, findings and recommendations should assist decision-makers in Lesotho, as well as in international research and funding agencies, to allocate research and production resources to its most optimal use in so far as fruit production in Lesotho is concerned.

## 7.2 Summary and the findings of the study

As a result of altitude and latitude, Lesotho has a temperate climate and well-marked seasons (Ministry of Natural Resources, 2000). About 80 to 85 per cent of the annual rainfall, averaging 700 mm, falls in the seven months from October to April, with the highest rainfall averaging 1200 mm (Ministry of Natural Resources, 2000). The volume, timeliness and distribution of rain in Lesotho are subject to extremely wide variance that causes significant variation in the level and composition of agricultural output.

Lesotho is landlocked and depends almost entirely on road and air transport for internal and external movements of agricultural goods and services. There are no navigable waters or railways except a short 2 km rail spur connecting Maseru (the capital city) to the South African rail system.

As a result of the high population density and mainly the mountainous country, only 9 per cent of the land is arable and land holdings are typically small. Of the

total population, 81.1 per cent live in the rural areas, while 18.9 per cent of the population resides in urban areas.

The overall socio-economic picture of Lesotho is not impressive. First poverty remains pervasive throughout the country. Unemployment continues to be high at almost 30 per cent (Ministry of Planning and Manpower Development, 2000); about half of the population is considered poor; and income inequality is among the highest in the world (World Bank, 2001). Poverty is concentrated mainly in rural areas. It also appears that the increase in domestic employment has not fully compensated for the losses in employment due to the decline of government production and reduced opportunities for Basotho workers in South African mines (World Bank, 2001).

The macroeconomic importance of Lesotho's agricultural sector is evidenced by the fact that 81.1 per cent of the population reside in rural areas (Bureau of Statistics, 2000) where most agricultural production activities take place. More than 50 per cent of the population derive their livelihood from crop and livestock production, while about 60 per cent of the labour force is employed in this sector (Ministry of Planning, 2000).

Agriculture in Lesotho is predominantly smallholder-based. Only a few products are exported by these farmers. To date asparagus and paprika remain the only crop exports, while wool and mohair is sold to EU and forms a significant contribution towards a GDP. Fruit production is largely a function of the climatic conditions and therefore is confined to the Lowlands, Foothills, the Senqu River Valley and the Mountains.

The most important findings of this study, as summarised in this section, relate to the private and economic pricing of tradable and non-tradable factors for the analysis of domestic resource costs, fruit trade preferences in the SACU with

reference to inter and intra-industrial trade, social and private profitability, domestic resource cost analysis and sensitivity analysis.

### *7.2.1 SACU and fruit trade preferences*

Lesotho is a member of the Southern African Customs Union (SACU). Its participation in the Union determines, to some extent, how it has integrated into global markets, particularly regarding imports and exports. The investigation of trade patterns for the products under consideration by SACU revealed the following:

- Exports and imports of apples, peaches, asparagus and cherries are highly concentrated, i.e. the Gini coefficient for the imports and exports of these crops are high.
- The intra-industrial trade coefficient revealed that SACU is predominantly an exporter of the products considered, i.e. although imports do occur, the products are mainly exported.

A concern is the high volumes of product going to a select few markets. Changes in SPS and other regulations, as well as consumer preferences in these markets could result in market share that is lost with devastating consequences for the local industries.

### *7.2.2 Private and economic profitability*

Private and economic profitability of different agro-economical zones in Lesotho was calculated. These zones were determined by taking into account biological factors such as rainfall, temperature, etc.

The results show that all enterprises that were analysed have higher private than economic profitability. Thus, should economic values of inputs and outputs prevail farmers would receive lower returns. This result was confirmed by calculating NPEs, EPRs, and NPRs for the respective enterprises. The results show that the crops are effectively subsidized.

One of the main reasons for this state of affairs can be traced back to the fact that the shadow exchange rate used to calculate shadow returns revealed that the Maloti was undervalued. An undervalued currency could stimulate investments, but the question arises whether returns on such investments can be sustained if the Maloti regains strength. The danger of an undervalued exchange coupled with the expectation that it will remain undervalued, could result in expansion of production that may not be sustainable when the currency strengthens.

### *7.2.3 Domestic resource cost*

The RCR methodology was used by this study to determine the comparative advantage of the different products in different agro-ecological zones. The comparative advantages calculated were based on the returns to management, land and water in producing the different products. The results can be summarised as follows:

- In the Lowlands zone all products have a RCR of lower than one indicating a comparative advantage with peaches showing the strongest comparative advantage and cherries the lowest. Apples and peaches in the Foothills have a comparative advantage, but in the Senqu River Valley the result for apples and peaches are mixed. Apples show a comparative advantage, whilst peaches show a comparative disadvantage. In the Mountain zone, only apple production was analysed and the results show apples has a comparative advantage.

The sensitivity of the RCR to changes in the exchange rate, introduction of land and water costs and the threshold price of products to remain efficient was calculated and the results can be summarised as follows:

- A depreciation in the exchange rate improved the comparative advantage of the crops considered in the analysis; peaches that showed a comparative disadvantage in the Senqu River Valley has comparative advantage too. Important to note is that the current analysis excludes the effect of changes in the exchange rate on input prices due to a lack of information related to the interaction between input prices and changes in the exchange rate. One could however expect that the effects will be lagged in nature, and the magnitude of the effect will be dependent on the amount of inputs (or its components/ingredients) that is imported. Also importance is the fact that the changes in the exchange rate is in large a non controllable factor for Lesotho since Lesotho is part of the Common Monetary Area, and as a result the Maloti are fixed to the South African Rand. This entails that economical and political issues, as well as exchange rate policy, in South Africa will directly affect the value of the Maloti. In this regard is important to take note that the South African economy is much more advanced than the Lesotho economy which might require different monetary incentives to grow.

- The threshold price analysis revealed mixed results in that some crops can absorb higher variations in international prices than others. The implication of this is that the more export orientated an industry is, the more sensitive is the industry to volatility in world market prices. Markets are build and maintained over long periods and hence it is important that an industry are able to withstand volatility in world market prices since it is very difficult to leave and enter markets at will.

The analysis also revealed that policies pertaining to land and water could have a significant impact on crops that could act as engines to reduce poverty and improve livelihoods in rural Lesotho. It was not the purpose of this study to provide policy directions as far as land and water issues are concerned, but rather to show the possible impact of increased land and water prices on the comparative advantage of crops investigated.

## 7.3 Policy recommendations

The results of this study supports the notion that most of the constraints in Lesotho's agriculture are market and policy related, which jointly ignore incentives for land rehabilitation and encourage the explicit promotion of exploitation of marginal lands. Accordingly, in order to develop agriculture, authorities should formulate policy that concentrates on eliminating the specific bottlenecks restraining agricultural growth, rather than attempt to alter the internal terms of trade or the prices received for exports, relative to the prices paid for imports. According to Griffin (1970) the keystone of an agrarian development program is likely to change inland tenure relations, but to ensure success this measure should be supplemented with a package of supporting policies as follows:

- In order to increase productivity and enhance the efficiency of fruit production, several factors should be addressed. Most importantly, predetermined policies and regulations regarding land tenure that would work towards investment in high value crops should be implemented. The land tenure system of the past does not offer incentives for private sector investments in land improvements. A need has arisen for the implementation of measures that could provide adequate security of tenure for farmers, so that they invest in productivity enhancing land improvements.

- Competitive land markets have failed to emerge and consequently land prices that provide an indication of land value, are non-existent. A major problem for both crop and livestock production is the existing form of land tenure in Lesotho, under which land is communally owned and allocated by the local chief. This provides little incentive for entrepreneurs to enter production. Hence, land reforms must facilitate development of a land market in order to encourage investment in land improvement. The introduction of a land tax could be a potential tool of a "complete land reforms toolbox" to address land related problems. Although land taxation is politically unpopular (Van Schalkwyk, 1995), it is one possibility for raising revenue, since land can be seen as a fixed supply. Newberry and Stern, (1987) and Lewis (1984) state that the impact of land taxes is increased farm marketing, provided that a proper and efficient value chain exists.

- There is a desperate need for infrastructure in Lesotho. For example, the country lacks a cargo port, roads and railway links. The most urgent need is in the rural production areas of Lesotho, where a great number of producers are located, who find it difficult to transport inputs and fresh produce. The absence of infrastructure increases transactions costs which result in very low farm prices.

- Although the analysis did not investigate competitiveness per se, it revealed the status of comparative advantage that exists. This analysis could therefore serve as the basis for further analysis into the value chains of the crops that showed comparative advantages in order to point out interventions needed to improve their competitiveness locally and internationally. For instance, there is a desperate need for infrastructure in Lesotho. For example, the country lacks a cargo port, roads and railway links. The most urgent need is in the rural production areas of Lesotho, where a great number of producers are located, who find it difficult to transport inputs and fresh produce. The absence of infrastructure increases transactions costs which result in very low

farm prices. Moreover, high transport costs lower farmer prices and are a major cause of poor trade both at national level and regional levels. In addition, support services and institutional design will prove to be vital to become competitive. It is therefore important for government to revive extension services, organising producers in formal organisations for the purposes of marketing products and input purchasing in order to lower transaction costs.

A national irrigation policy should be developed as a strategy for enhancing production of horticultural crops that need irrigating. It is acknowledged that the private sector should manage an irrigation system, and government should reduce its direct involvement in its management. Government's role should be that of policy formulation and supervision, and support by advice. Irrigation development should be inclusive of improved land tenure laws.

## 7.4 Recommendation for further studies

### *7.4.1 Comparative economic study for cash crops*

The scope of this study should be expanded to include other long and cash crops. This will assist producers and policy makers to make sound decisions regarding the allocation of scarce resources, ensuring that they produce only those commodities that the country has comparative economic advantage for. In addition, such a study should be complemented by an investigation into the actual competitiveness of the crops.

### 7.4.2 Tradable and non-tradable components of tradable inputs and outputs

For the purpose of this study the tradable and non-tradable composition of goods and services for South Africa was used. It is recommended that a specific study is conducted to determine the tradable and non-tradable composition of goods and services in Lesotho. This will also provide a clearer understanding of the value that are added to products and services in Lesotho.

### 7.4.3 Investigation into the comparative advantage using the Net Terminal Value method (NTV)

In this study the NPV method to discount future earnings was used. An alternative method using past trends in input and output prices could also be used, namely the Net Terminal Value method. This method is however much more data intensive, but could provide insight into whether the NPV or NTV method should be preferred to evaluate investment decisions over the long run.

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# APPENDICES

**Table A.1: Irrigated Apple-Technical Coefficients**

| Item | Unit | Year0 | Year1 | Year2 | Year3 | Year4 | Year5 | Year6 | Year7 | Year8 | Year9 | Year10 | Year11 | Year12 | Year13 | Year14 | Year15 | Year16 | Year17 | Year18 | Year19 | Year20 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Gross Returns:** | | | | | | | | | | | | | | | | | | | | | | |
| APPLES-EXPORT | Kg | 0 | 0 | 0 | 0 | 8450 | 13450 | 18770 | 18770 | 18770 | 18770 | 18770 | 18770 | 18770 | 18770 | 18770 | 18770 | 18770 | 18770 | 13450 | 13450 | 13450 |
| APPLES- DOMESTIC | Kg | 0 | 0 | 0 | 0 | 2500 | 2500 | 5000 | 5000 | 5000 | 5000 | 5000 | 5000 | 5000 | 5000 | 5000 | 5000 | 5000 | 5000 | 2500 | 2500 | 2500 |
| **Purchased Imputs:** | | | | | | | | | | | | | | | | | | | | | | |
| Apple Trees/tree | Tree | 1250 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Eragros.Seed | Kg | 1.50 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Lime | Ton | 5.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Sup.Phosphate 10 | Kg | 1000.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| LAN | Kg | 199.98 | 622.16 | 622.16 | 622.16 | 166.65 | 166.65 | 222.20 | 222.20 | 222.20 | 222.20 | 222.20 | 222.20 | 222.20 | 222.20 | 222.20 | 222.20 | 222.20 | 222.20 | 222.20 | 222.20 | 222.20 |
| Zinc Okside | Kg | 0.28 | 0.83 | 0.83 | 0.83 | | | | | | | | | | | | | | | | | |
| Manganese S. | Kg | 1.95 | 4.45 | 4.45 | 4.45 | 0.33 | 0.33 | 0.33 | 0.33 | 0.33 | 0.33 | 0.33 | 0.33 | 0.33 | 0.33 | 0.33 | 0.33 | 0.33 | 0.33 | 0.33 | 0.33 | 0.33 |
| 3:2:1(25)+ZN | Kg | 0.00 | 0.00 | 0.00 | 0.00 | 222.20 | 222.20 | 333.30 | 333.30 | 333.30 | 333.30 | 333.30 | 333.30 | 333.30 | 333.30 | 333.30 | 333.30 | 333.30 | 333.30 | 333.30 | 333.30 | 333.30 |
| Low Buret | Kg | 4.86 | 11.11 | 11.11 | 11.11 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Tokuthion | l | 0.00 | 0.00 | 0.00 | 0.00 | 0.83 | 0.83 | 0.83 | 0.83 | 0.83 | 0.83 | 0.83 | 0.83 | 0.83 | 0.83 | 0.83 | 0.83 | 0.83 | 0.83 | 0.83 | 0.83 | 0.83 |
| Cupravit | Kg | 0.00 | 0.00 | 0.00 | 0.00 | 4.17 | 4.17 | 4.17 | 4.17 | 4.17 | 4.17 | 4.17 | 4.17 | 4.17 | 4.17 | 4.17 | 4.17 | 4.17 | 4.17 | 4.17 | 4.17 | 4.17 |
| Agral | Kg | 0.00 | 0.00 | 0.00 | 0.00 | 0.10 | 0.10 | 0.10 | 0.10 | 0.10 | 0.10 | 0.10 | 0.10 | 0.10 | 0.10 | 0.10 | 0.10 | 0.10 | 0.10 | 0.10 | 0.10 | 0.10 |
| Demuldex | l | 0.70 | 1.39 | 1.39 | 1.39 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Solubor | Kg | 1.39 | 2.78 | 2.78 | 2.78 | 3.33 | 3.33 | 3.33 | 3.33 | 3.33 | 3.33 | 3.33 | 3.33 | 3.33 | 3.33 | 3.33 | 3.33 | 3.33 | 3.33 | 3.33 | 3.33 | 3.33 |
| Gusathion | Kg | | | | | 0.83 | 0.83 | 0.83 | 0.83 | 0.83 | 0.83 | 0.83 | 0.83 | 0.83 | 0.83 | 0.83 | 0.83 | 0.83 | 0.83 | 0.83 | 0.83 | 0.83 |
| Cascade | l | | | | | 0.83 | 0.83 | 0.88 | 0.88 | 0.88 | 0.88 | 0.88 | 0.88 | 0.88 | 0.88 | 0.88 | 0.88 | 0.88 | 0.88 | 0.88 | 0.88 | 0.88 |
| Killval | l | 0.00 | 0.00 | 0.00 | 0.00 | 2.08 | 2.08 | 2.08 | 2.08 | 2.08 | 2.08 | 2.08 | 2.08 | 2.08 | 2.08 | 2.08 | 2.08 | 2.08 | 2.08 | 2.08 | 2.08 | 2.08 |
| Ultracide | Kg | 0.00 | 0.00 | 0.00 | 0.00 | 1.67 | 1.67 | 1.67 | 1.67 | 1.67 | 1.67 | 1.67 | 1.67 | 1.67 | 1.67 | 1.67 | 1.67 | 1.67 | 1.67 | 1.67 | 1.67 | 1.67 |
| Gramoxone | l | | 8.00 | 8.00 | 8.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 |
| Dithane | Kg | 3.33 | 5.00 | 5.00 | 5.00 | 2.50 | 2.50 | 2.50 | 2.50 | 2.50 | 2.50 | 2.50 | 2.50 | 2.50 | 2.50 | 2.50 | 2.50 | 2.50 | 2.50 | 2.50 | 2.50 | 2.50 |
| Systhane | Kg | 0.84 | 0.50 | 0.50 | 0.50 | 0.75 | 0.75 | 0.75 | 0.75 | 0.75 | 0.75 | 0.75 | 0.75 | 0.75 | 0.75 | 0.75 | 0.75 | 0.75 | 0.75 | 0.75 | 0.75 | 0.75 |
| Insegar | G | 0.00 | 0.00 | 0.00 | 0.00 | 1.33 | 1.33 | 1.33 | 1.33 | 1.33 | 1.33 | 1.33 | 1.33 | 1.33 | 1.33 | 1.33 | 1.33 | 1.33 | 1.33 | 1.33 | 1.33 | 1.33 |
| Sting | l | 0.00 | 0.00 | 0.00 | 0.00 | 3.00 | 3.00 | 3.00 | 3.00 | 3.00 | 3.00 | 3.00 | 3.00 | 3.00 | 3.00 | 3.00 | 3.00 | 3.00 | 3.00 | 3.00 | 3.00 | 3.00 |
| BOX 18KG | Box | 0.00 | 0.00 | 0.00 | 0.00 | 583.00 | 583.00 | 1555.00 | 1555.00 | 1555.00 | 1555.00 | 1555.00 | 1555.00 | 1555.00 | 1555.00 | 1555.00 | 1555.00 | 1555.00 | 1555.00 | 1555.00 | 1555.00 | 1555.00 |
| BOX 10KG | Box | 0.00 | 0.00 | 0.00 | 0.00 | 300.00 | 300.00 | 800.00 | 800.00 | 800.00 | 800.00 | 800.00 | 800.00 | 800.00 | 800.00 | 800.00 | 800.00 | 800.00 | 800.00 | 800.00 | 800.00 | 800.00 |
| Bailing Twine | Kg | 17.35 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Soil Analysis | Ha | 2.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| **Irrigation:** | | | | | | | | | | | | | | | | | | | | | | |
| Electric pump | ha | 1.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Pump housing | ha | 1.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Electicity point | ha | 1.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Irrigation equipment | ha | 1.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| **Machinery:** | | | | | | | | | | | | | | | | | | | | | | |
| diesel | l | 100.20 | 69.31 | 69.31 | 69.31 | 38.50 | 38.50 | 40.23 | 40.23 | 40.23 | 40.23 | 40.23 | 40.23 | 40.23 | 40.23 | 40.23 | 40.23 | 40.23 | 40.23 | 40.23 | 40.23 | 40.23 |
| implements | hour | 40.00 | 56.20 | 56.20 | 56.20 | 60.82 | 60.82 | 61.00 | 61.00 | 61.00 | 61.00 | 61.00 | 61.00 | 61.00 | 61.00 | 61.00 | 61.00 | 61.00 | 61.00 | 61.00 | 61.00 | 61.00 |
| repairs | MM | 80.00 | 170.00 | 170.00 | 170.00 | 210.00 | 210.00 | 390.00 | 390.00 | 390.00 | 390.00 | 390.00 | 390.00 | 390.00 | 390.00 | 390.00 | 390.00 | 390.00 | 390.00 | 390.00 | 390.00 | 390.00 |
| electricity | kw-h | 16100.00 | 16413.68 | 16413.68 | 16413.68 | 17000.00 | 17000.00 | 16413.68 | 16413.68 | 16413.68 | 16413.68 | 16413.68 | 16413.68 | 16413.68 | 16413.68 | 16413.68 | 16413.68 | 16413.68 | 16413.68 | 16413.68 | 16413.68 | 16413.68 |
| **Fixed Cost:-Machinery** | | | | | | | | | | | | | | | | | | | | | | |
| Insurance | Rand | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 |
| Tractor | ha | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 |
| Interest | ha | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 |
| **Labour:** | | | | | | | | | | | | | | | | | | | | | | |
| Lab. Cutt. | Hour | | 6.00 | 6.00 | 6.00 | 160.00 | 160.00 | 360.00 | 360.00 | 360.00 | 360.00 | 360.00 | 360.00 | 360.00 | 360.00 | 360.00 | 360.00 | 360.00 | 360.00 | 360.00 | 360.00 | 360.00 |
| Lab.Cultivate | Hour | 48.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Lab.Making Spar | Hour | | 72.00 | 72.00 | 72.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Lab. Thin out | Hour | | | | | 160.00 | 160.00 | 360.00 | 360.00 | 360.00 | 360.00 | 360.00 | 360.00 | 360.00 | 360.00 | 360.00 | 360.00 | 360.00 | 360.00 | 360.00 | 360.00 | 360.00 |
| Lab.Fert. | Hour | 6.00 | 14.00 | 14.00 | 14.00 | 5.50 | 5.50 | 7.00 | 7.00 | 7.00 | 7.00 | 7.00 | 7.00 | 7.00 | 7.00 | 7.00 | 7.00 | 7.00 | 7.00 | 7.00 | 7.00 | 7.00 |
| Lab. Holes & Plan | Hour | 80.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Lab.tree form | Hour | 38.00 | 32.00 | 32.00 | 32.00 | | | | | | | | | | | | | | | | | |
| Labour harvesting | Hour | 0.00 | 0.00 | 0.00 | 0.00 | 160.00 | 160.00 | 424.00 | 424.00 | 424.00 | 424.00 | 424.00 | 424.00 | 424.00 | 424.00 | 424.00 | 424.00 | 424.00 | 424.00 | 424.00 | 424.00 | 424.00 |
| Irrigation Labour | Hour | 24.00 | 51.00 | 51.00 | 51.00 | 51.00 | 51.00 | 58.50 | 58.50 | 58.50 | 58.50 | 58.50 | 58.50 | 58.50 | 58.50 | 58.50 | 58.50 | 58.50 | 58.50 | 58.50 | 58.50 | 58.50 |
| Machine Crew Labour | Hour | 6.04 | 1.49 | 1.49 | 1.49 | 1.49 | 1.49 | 1.49 | 1.49 | 1.49 | 1.49 | 1.49 | 1.49 | 1.49 | 1.49 | 1.49 | 1.49 | 1.49 | 1.49 | 1.49 | 1.49 | 1.49 |
| Machine | Hour | 0.00 | 0.00 | 0.00 | 0.00 | 1.86 | 1.86 | 5.00 | 5.00 | 5.00 | 5.00 | 5.00 | 5.00 | 5.00 | 5.00 | 5.00 | 5.00 | 5.00 | 5.00 | 5.00 | 5.00 | 5.00 |
| Packaging | Hour | 0.00 | 0.00 | 0.00 | 0.00 | 200.00 | 200.00 | 520.00 | 520.00 | 520.00 | 520.00 | 520.00 | 520.00 | 520.00 | 520.00 | 520.00 | 520.00 | 520.00 | 520.00 | 520.00 | 520.00 | 520.00 |

**Table A.2: Irrigated Apple-Costs and Prices**

| Item | Unit/ha | cost/price |
|---|---|---|
| **Gross Returns:** | | |
| Apples - Export | Kg | 6.26 |
| Apples - Domestic | Kg | 3.24 |
| **Purchased Imputs:** | | |
| Apple Trees | Tree | 11.79 |
| Eragros.Seed | Kg | 17.14 |
| Lime | Ton | 194.06 |
| Sup.Phosphate 10 | Kg | 1.08 |
| LAN | Kg | 1.39 |
| Zinc Oxide | Kg | 11.16 |
| Manganese S. | Kg | 4.08 |
| 3:2:1(25)+ZN | Kg | 1.52 |
| Low Buret | Kg | 2.77 |
| Tokuthion | L | 125.06 |
| Cupravit | Kg | 11.28 |
| Agral | Kg | 25.50 |
| Demuldex | L | 18.32 |
| Solubor | kg | 1.57 |
| Gusathion | Kg | 88.59 |
| Cascade | L | 368.12 |
| Killval | L | 115.53 |
| Ultracide | Kg | 125.51 |
| Gramoxone | L | 0.09 |
| Dithane | Kg | 22.04 |
| Systhane | Kg | 838.54 |
| Insegar | G | 4.16 |
| Sting | L | 24.00 |
| BOX 18KG | Box | 6.96 |
| BOX 10KG | Box | 5.48 |
| Bailing Twine | Kg | 14.68 |
| Soil Analysis | Ha | 21.15 |
| **Irrigation:** | | |
| Electric pump | | 1636.36 |
| Pump housing | | 250.00 |
| Electicity point | | 1750.00 |
| Irrigation equipment | | 5120.91 |
| **Machinery:** | | |
| Diesel | l | 2.81 |
| Implements | Hour | 43.80 |
| Repairs | MM | 0.06 |
| Electricity | kw-h | 0.41 |
| **Fixed Cost:-Machinery** | | |
| Insurance | Rand | 17.03 |
| Tractor | Ha | 46.45 |
| Interest | Ha | 40.88 |
| **Labour:** | | |
| Lab. Cutt. | Hour | 2.50 |
| Lab.Cultivate | Hour | 2.50 |
| Lab.Making Spar | Hour | 2.50 |
| Lab. Thin out | Hour | 2.50 |
| Lab.Fert. | Hour | 2.50 |
| Lab. Holes & Plan | Hour | 2.73 |
| Lab.tree form | Hour | 2.73 |
| Lab. Harvest | Hour | 2.73 |
| Irrigation Labour | Hour | 4.00 |
| Machine Crew Labour | Hour | 4.00 |
| Machinery Labour | Hour | 4.00 |
| Packaging | Hour | 4.00 |

**Table A.2: Dryland asparagus enterprise-Technical Coefficients in the Lowlands**

| Item | Unit | Year0 | Year1 | Year2 | Year3 | Year4 | Year5 | Year6 | Year7 | Year8 | Year9 | Year10 | Year11 | Year12 | Year13 | Year14 | Year15 | Year16 | Year17 | Year18 | Year19 | Year20 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Gross Returns:** | | | | | | | | | | | | | | | | | | | | | | |
| Export | Kg | 0 | 400 | 400 | 700 | 700 | 700 | 700 | 700 | 700 | 700 | 700 | 700 | 700 | 700 | 700 | 700 | 700 | 700 | 700 | 700 | 700 |
| Asparagus canning | Kg | 0 | 300 | 300 | 600 | 2000 | 2000 | 2000 | 2000 | 2000 | 2000 | 2000 | 2000 | 2000 | 2000 | 2000 | 2000 | 2000 | 2000 | 2000 | 2000 | 2000 |
| Asparagus- Domestic | Kg | 0 | 535 | 535 | 1505 | 1505 | 1505 | 1505 | 1505 | 1505 | 1505 | 1505 | 1505 | 1505 | 1505 | 1505 | 1505 | 1505 | 1505 | 1505 | 1505 | 1505 |
| **Purchased Inputs:** | | | | | | | | | | | | | | | | | | | | | | |
| SP 10.5 | Kg | 300.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Lime | T | 3.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| KCl | Kg | 100.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 3:2:1 (25) | Kg | 250.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 5:1:5(36) | Kg | | 600.00 | 600.00 | 600.00 | 600.00 | 600.00 | 600.00 | 600.00 | 600.00 | 600.00 | 600.00 | 600.00 | 600.00 | 600.00 | 600.00 | 600.00 | 600.00 | 600.00 | 600.00 | 600.00 | 600.00 |
| KAN (28) | Kg | 150.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Durban | l | 1.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Sencor | l | 1.50 | 1.50 | 1.50 | 1.50 | 1.50 | 1.50 | 1.50 | 1.50 | 1.50 | 1.50 | 1.50 | 1.50 | 1.50 | 1.50 | 1.50 | 1.50 | 1.50 | 1.50 | 1.50 | 1.50 | 1.50 |
| Duel | l | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 |
| Fenon | l | 0.07 | 0.07 | 0.07 | 0.07 | 0.07 | 0.07 | 0.07 | 0.07 | 0.07 | 0.07 | 0.07 | 0.07 | 0.07 | 0.07 | 0.07 | 0.07 | 0.07 | 0.07 | 0.07 | 0.07 | 0.07 |
| Bavistan | l | 1.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Crowns | Ea. | 16000.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Registration | Ea. | 0.00 | 3.75 | 3.75 | 3.75 | 3.75 | 3.75 | 3.75 | 3.75 | 3.75 | 3.75 | 3.75 | 3.75 | 3.75 | 3.75 | 3.75 | 3.75 | 3.75 | 3.75 | 3.75 | 3.75 | 3.75 |
| Food (harvesting) | Day | 0.00 | 44.00 | 44.00 | 80.00 | 80.00 | 80.00 | 80.00 | 80.00 | 80.00 | 80.00 | 80.00 | 80.00 | 80.00 | 80.00 | 80.00 | 80.00 | 80.00 | 80.00 | 80.00 | 80.00 | 80.00 |
| Food (process. Export) | Day | 0.00 | 44.00 | 44.00 | 80.00 | 80.00 | 80.00 | 80.00 | 80.00 | 80.00 | 80.00 | 80.00 | 80.00 | 80.00 | 80.00 | 80.00 | 80.00 | 80.00 | 80.00 | 80.00 | 80.00 | 80.00 |
| Transport | Each | 0.00 | 3.75 | 3.75 | 3.75 | 3.75 | 3.75 | 3.75 | 3.75 | 3.75 | 3.75 | 3.75 | 3.75 | 3.75 | 3.75 | 3.75 | 3.75 | 3.75 | 3.75 | 3.75 | 3.75 | 3.75 |
| Equipment (harvest) | Each | 0.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 |
| Equipment (process-export) | Each | 0.00 | 0.75 | 0.75 | 0.75 | 0.75 | 0.75 | 0.75 | 0.75 | 0.75 | 0.75 | 0.75 | 0.75 | 0.75 | 0.75 | 0.75 | 0.75 | 0.75 | 0.75 | 0.75 | 0.75 | 0.75 |
| Containers-4kg | Each | 0.00 | 180.00 | 180.00 | 248.00 | 248.00 | 248.00 | 248.00 | 248.00 | 248.00 | 248.00 | 248.00 | 248.00 | 248.00 | 248.00 | 248.00 | 248.00 | 248.00 | 248.00 | 248.00 | 248.00 | 248.00 |
| Pannets (500g) | Each | 0.00 | 1440.00 | 1440.00 | 1980.00 | 1980.00 | 1980.00 | 1980.00 | 1980.00 | 1980.00 | 1980.00 | 1980.00 | 1980.00 | 1980.00 | 1980.00 | 1980.00 | 1980.00 | 1980.00 | 1980.00 | 1980.00 | 1980.00 | 1980.00 |
| Wrapping Material | Each | 0.00 | 1440.00 | 1440.00 | 1980.00 | 1980.00 | 1980.00 | 1980.00 | 1980.00 | 1980.00 | 1980.00 | 1980.00 | 1980.00 | 1980.00 | 1980.00 | 1980.00 | 1980.00 | 1980.00 | 1980.00 | 1980.00 | 1980.00 | 1980.00 |
| Labels | Each | 0.00 | 1440.00 | 1440.00 | 1980.00 | 1980.00 | 1980.00 | 1980.00 | 1980.00 | 1980.00 | 1980.00 | 1980.00 | 1980.00 | 1980.00 | 1980.00 | 1980.00 | 1980.00 | 1980.00 | 1980.00 | 1980.00 | 1980.00 | 1980.00 |
| **Machinery:** | | | | | | | | | | | | | | | | | | | | | | |
| Implements Repairs | Ha | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 |
| Diesel | l | 70.98 | 135.35 | 135.35 | 140.11 | 140.11 | 140.11 | 140.11 | 140.11 | 140.11 | 140.11 | 140.11 | 140.11 | 140.11 | 140.11 | 140.11 | 140.11 | 140.11 | 140.11 | 140.11 | 140.11 | 140.11 |
| **Fixed Cost: Machinery** | | | | | | | | | | | | | | | | | | | | | | |
| Short Term Insurance Assets | R | 51.52 | 28.01 | 28.01 | 64.53 | 65.53 | 65.53 | 65.53 | 65.53 | 65.53 | 65.53 | 65.53 | 65.53 | 65.53 | 65.53 | 65.53 | 65.53 | 65.53 | 65.53 | 65.53 | 65.53 | 65.53 |
| Interest(production loan) | R | 608.63 | 723.90 | 723.90 | 946.48 | 946.48 | 946.48 | 946.48 | 946.48 | 946.48 | 946.48 | 946.48 | 946.48 | 946.48 | 946.48 | 946.48 | 946.48 | 946.48 | 946.48 | 946.48 | 946.48 | 946.48 |
| **Labour:** | | | | | | | | | | | | | | | | | | | | | | |
| Weeding | Hour | 144.00 | 48.00 | 48.00 | 32.00 | 32.00 | 32.00 | 32.00 | 32.00 | 32.00 | 32.00 | 32.00 | 32.00 | 32.00 | 32.00 | 32.00 | 32.00 | 32.00 | 32.00 | 32.00 | 32.00 | 32.00 |
| Fire Break | Hour | 0.00 | 8.00 | 8.00 | 8.00 | 8.00 | 8.00 | 8.00 | 8.00 | 8.00 | 8.00 | 8.00 | 8.00 | 8.00 | 8.00 | 8.00 | 8.00 | 8.00 | 8.00 | 8.00 | 8.00 | 8.00 |
| Selection of crowns | Hour | 48.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Planting | Hour | 48.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Reg.Controller-harvest & export | Hour | 0.00 | 352.00 | 352.00 | 640.00 | 640.00 | 640.00 | 640.00 | 640.00 | 640.00 | 640.00 | 640.00 | 640.00 | 640.00 | 640.00 | 640.00 | 640.00 | 640.00 | 640.00 | 640.00 | 640.00 | 640.00 |
| Field Foreman | Hour | 0.00 | 352.00 | 352.00 | 640.00 | 640.00 | 640.00 | 640.00 | 640.00 | 640.00 | 640.00 | 640.00 | 640.00 | 640.00 | 640.00 | 640.00 | 640.00 | 640.00 | 640.00 | 640.00 | 640.00 | 640.00 |
| Reapers | Hour | 0.00 | 352.00 | 352.00 | 640.00 | 640.00 | 640.00 | 640.00 | 640.00 | 640.00 | 640.00 | 640.00 | 640.00 | 640.00 | 640.00 | 640.00 | 640.00 | 640.00 | 640.00 | 640.00 | 640.00 | 640.00 |
| Food Controller-harvest, process & export | Hour | 0.00 | 352.00 | 352.00 | 640.00 | 640.00 | 640.00 | 640.00 | 640.00 | 640.00 | 640.00 | 640.00 | 640.00 | 640.00 | 640.00 | 640.00 | 640.00 | 640.00 | 640.00 | 640.00 | 640.00 | 640.00 |
| Chef | Hour | 0.00 | 352.00 | 352.00 | 640.00 | 640.00 | 640.00 | 640.00 | 640.00 | 640.00 | 640.00 | 640.00 | 640.00 | 640.00 | 640.00 | 640.00 | 640.00 | 640.00 | 640.00 | 640.00 | 640.00 | 640.00 |
| Food Preparers | Hour | 0.00 | 352.00 | 352.00 | 640.00 | 640.00 | 640.00 | 640.00 | 640.00 | 640.00 | 640.00 | 640.00 | 640.00 | 640.00 | 640.00 | 640.00 | 640.00 | 640.00 | 640.00 | 640.00 | 640.00 | 640.00 |
| Lab. Process.Factory & export | Hour | 0.00 | 352.00 | 352.00 | 640.00 | 640.00 | 640.00 | 640.00 | 640.00 | 640.00 | 640.00 | 640.00 | 640.00 | 640.00 | 640.00 | 640.00 | 640.00 | 640.00 | 640.00 | 640.00 | 640.00 | 640.00 |
| Driver | Hour | 0.00 | 352.00 | 352.00 | 640.00 | 640.00 | 640.00 | 640.00 | 640.00 | 640.00 | 640.00 | 640.00 | 640.00 | 640.00 | 640.00 | 640.00 | 640.00 | 640.00 | 640.00 | 640.00 | 640.00 | 640.00 |

**Table A.4: Dryland Asparagus enterprise- Cost and Prices in the Lowlands**

| Item | Unit | Cost/Unit |
|---|---|---|
| **Gross Returns:** | | |
| Export(40%) | Kg | 6.39 |
| Asparagus canning(60%) | Kg | 3.70 |
| Asparagus-Domestic | Kg | 6.45 |
| **Purchased Inputs:** | | |
| SP 10.5 | Kg | 1.28 |
| Lime | T | 200.00 |
| KCl | Kg | 2.18 |
| 3:2:1 (25) | Kg | 1.55 |
| 5:1:5(36) | Kg | 1.81 |
| KAN (28) | Kg | 1.38 |
| Durban | l | 64.00 |
| Sencor | l | 106.00 |
| Duel | l | 130.00 |
| Fenon | l | 230.00 |
| Bavistan | l | 100.00 |
| Crowns | Ea. | 0.18 |
| Registration | Ea. | 10.00 |
| Food(harvesting) | Day | 9.00 |
| Food(process. Export) | Day | 2.25 |
| Transport | Each | 10.00 |
| Equipment(harvest) | Each | 34.00 |
| Equipment(process-export) | Each | 25.00 |
| Containers-4kg | Each | 3.00 |
| Pannets (500g) | Each | 0.15 |
| Wrapping Material | Each | 0.05 |
| Labels | Each | 0.04 |
| **Machinery:** | | |
| Implements Repairs | R | 1.00 |
| Diesel | l | 2.81 |
| **Fixed Cost: Machinery** | | |
| Short Term Insurance Assets | R | 1.00 |
| Interest(production loan) | R | 0.08 |
| **Labour:** | | |
| Weeding | Hour | 1.25 |
| Fire Break | Hour | 1.25 |
| Selection of crowns | Hour | 1.25 |
| Planting | Hour | 1.25 |
| Reg.Controller-harvest & export | Hour | 0.01 |
| Field Foreman | Hour | 0.21 |
| Reapers | Hour | 2.50 |
| Food Controller-harvest, process & export | Hour | 0.03 |
| Chef | Hour | 0.12 |
| Food Preparers | Hour | 0.03 |
| Lab. Process.Factory & export | Hour | 1.29 |
| Driver | Hour | 0.30 |

**Table A.5: Irrigated cherry enterprise-Technical Coefficients in the Lowlands**

| Item | Units/ha | year 0 | year 1 | year 2 | year 3 | year 4 | year 5 | year 6 | year 7 | year 8 | year 9 | year 10 | year 11 | year 12 | year 13 | year 14 | year 15 | year 16 | year 17 | year 18 | year 19 | year 20 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Gross Returns:** | | | | | | | | | | | | | | | | | | | | | | |
| Cherries- Export | Kg | 0 | 0 | 0 | 0 | 851 | 851 | 851 | 851 | 851 | 851 | 851 | 2267 | 2267 | 2267 | 2267 | 2267 | 2267 | 2267 | 2267 | 2267 | 2267 |
| Cherries-Domestic | Kg | 0 | 0 | 0 | 0 | 151 | 151 | 151 | 151 | 151 | 151 | 151 | 400 | 400 | 400 | 400 | 400 | 400 | 400 | 400 | 400 | 400 |
| **Purchased Inputs:** | | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Cherry Trees | Tree | 1250 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Eragros.Seed | Kg | 3.33 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Lime/TON | Ton | 5 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Sup.Phosphate 10 | Kg | 1000 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 5:1:5(45) | Kg | 0 | 0 | 0 | 0 | 167 | 167 | 167 | 167 | 167 | 167 | 167 | 250 | 250 | 250 | 250 | 250 | 250 | 250 | 250 | 250 | 250 |
| Thiodan | Kg | 0.167 | 1.002 | 1.002 | 1.002 | | | | | | | | | | | | | | | | | |
| Nogos/ml | l | 0.25 | 1.002 | 1.002 | 1.002 | 1.336 | 1.336 | 1.336 | 1.336 | 1.336 | 1.336 | 1.336 | 1.67 | 1.67 | 1.67 | 1.67 | 1.67 | 1.67 | 1.67 | 1.67 | 1.67 | 1.67 |
| Gramoxone | l | 0 | 0 | 0 | 0 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 |
| Bacseal | Kg | 0.5 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Demuldex | Kg | 0 | 8.016 | 8.016 | 8.016 | 10.68 | 10.68 | 10.68 | 10.68 | 10.68 | 10.68 | 10.68 | 13.36 | 13.36 | 13.36 | 13.36 | 13.36 | 13.36 | 13.36 | 13.36 | 13.36 | 13.36 |
| Tokuthion | l | 0 | 0.501 | 0.501 | 0.501 | 0.668 | 0.668 | 0.668 | 0.668 | 0.668 | 0.668 | 0.668 | 0.835 | 0.835 | 0.835 | 0.835 | 0.835 | 0.835 | 0.835 | 0.835 | 0.835 | 0.835 |
| Sting | l | 0 | 0 | 0 | 0 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 |
| Boxes | Boxes | 0 | 0 | 0 | 0 | 153 | 153 | 153 | 153 | 153 | 153 | 153 | 409 | 409 | 409 | 409 | 409 | 409 | 409 | 409 | 409 | 409 |
| Shade Nett | Coil | 2.766 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Pole | Pole | 1250 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Soil Analysis | Sample | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| **Irrigation:** | | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Electric pump | Ha | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Pump housing | Ha | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Electicity point | Ha | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Irrigation equipment | Ha | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| **Machinery:** | | | | | | | | | | | | | | | | | | | | | | |
| Diesel | l | 100.2 | 16.5 | 16.5 | 16.5 | 100.2 | 100.2 | 100.2 | 100.2 | 100.2 | 100.2 | 100.2 | 100.2 | 100.2 | 100.2 | 100.2 | 100.2 | 100.2 | 100.2 | 100.2 | 100.2 | 100.2 |
| Implements | Hour | 16.5 | 80 | 80 | 80 | 16.5 | 16.5 | 16.5 | 16.5 | 16.5 | 16.5 | 16.5 | 16.5 | 16.5 | 16.5 | 16.5 | 16.5 | 16.5 | 16.5 | 16.5 | 16.5 | 16.5 |
| Repairs | MM | 80 | 4000 | 4000 | 4000 | 80 | 80 | 80 | 80 | 80 | 80 | 80 | 80 | 80 | 80 | 80 | 80 | 80 | 80 | 80 | 80 | 80 |
| Electricity | Kw-h | 4000 | 4000 | 4000 | 4000 | 4000 | 4000 | 4000 | 4000 | 4000 | 4000 | 4000 | 4000 | 4000 | 4000 | 4000 | 4000 | 4000 | 4000 | 4000 | 4000 | 4000 |
| **Fixed Cost: Machinery** | | | | | | | | | | | | | | | | | | | | | | |
| Depreciation | Ha | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| Insurance | Ha | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| Interest | Ha | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| **Labour:** | | | | | | | | | | | | | | | | | | | | | | |
| Lab. Fert. | Hour | 0 | 0 | 0 | 0 | 2.6 | 2.6 | 2.6 | 2.6 | 2.6 | 2.6 | 2.6 | 2.6 | 2.6 | 2.6 | 2.6 | 2.6 | 2.6 | 2.6 | 2.6 | 2.6 | 2.6 |
| Lab.Making Netts | Hour | 72 | 0 | 0 | 0 | 0 | 0 | | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | 0 | | 0 | | 0 | |
| Lab. Mark. | Hour | 48 | 0 | 0 | 0 | 0 | 0 | | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | 0 | | 0 | | 0 | |
| Lab. Holes & Plan | Hour | 48 | 0 | 0 | 0 | 0 | 0 | | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | 0 | | 0 | | 0 | |
| Lab. Cutt Tree | Hour | 2.6 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Lab. Cultivate | Hour | 480 | 480 | 480 | 480 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Packaging | Hour | 0 | 0 | 0 | 0 | 60 | 60 | 60 | 60 | 60 | 60 | 60 | 160 | 160 | 160 | 160 | 160 | 160 | 160 | 160 | 160 | 160 |
| Machine Crew Labour | Hour | 0 | 0 | 0 | 0 | 1.344 | 1.344 | 1.344 | 1.344 | 1.344 | 1.344 | 1.344 | 1.344 | 1.344 | 1.344 | 1.344 | 1.344 | 1.344 | 1.344 | 1.344 | 1.344 | 1.344 |
| Machinery Labour | Hour | 15.19 | 3.68 | 3.68 | 3.68 | 4.47 | 4.47 | 4.47 | 4.47 | 4.47 | 4.47 | 4.47 | 4.47 | 4.47 | 4.47 | 4.47 | 4.47 | 4.47 | 4.47 | 4.47 | 4.47 | 4.47 |
| Lab. Harvesting | Hour | 0 | 0 | 0 | 0 | 150 | 150 | 150 | 150 | 150 | 150 | 150 | 400 | 400 | 400 | 400 | 400 | 400 | 400 | 400 | 400 | 400 |

**Table A.6: Irrigated cherry enterprise -Cost and Prices in the Lowlands (Maloti/Unit)**

| Item | | Units/ha |
|---|---|---|
| Gross Returns: | | |
| Cherries- Export | Kg | 31.75 |
| Cherries-Market | Kg | 21.88 |
| **Purchased Inputs:** | | |
| Cherry Trees | Tree | 10.69 |
| Eragros.Seed | Kg | 14.57 |
| Lime | Ton | 165.78 |
| Sup.Phosphate 10 | Kg | 0.84 |
| 5:1:5(45) | Kg | 1.65 |
| Thiodan | Kg | 41.77 |
| Nogos | l | 52.09 |
| Gramoxone | l | 19.14 |
| Bacseal | Kg | 16.00 |
| Demuldex | Kg | 15.58 |
| Tokuthion | l | 106.81 |
| Sting | l | 20.43 |
| Boxes | Box | 2.87 |
| Shade Nett | Coil | 850.00 |
| pole | Pole | 2.64 |
| Soil Analysis | Sample | 18.00 |
| **Irrigation:** | | |
| Electric pump | ha | 1800.00 |
| Pump housing | ha | 250.00 |
| Electicity point | ha | 1750.00 |
| Irrigation equipment | ha | 5633.00 |
| **Machinery:** | | |
| Diesel | l | 2.81 |
| Implements | Hour | 43.86 |
| Repairs | MM | 0.06 |
| Electricity | kw.h | 0.41 |
| **Fixed Cost: Machinery** | | |
| Depreciation | Ha | 46.45 |
| Insurance | Ha | 17.03 |
| Interest | Ha | 40.88 |
| **Labour:** | | |
| Lab. Fert. | Hour | 2.25 |
| Lab.Making Netts | Hour | 2.25 |
| Lab. Mark. | Hour | 1.13 |
| Lab. Holes & Plan | Hour | 2.25 |
| Lab. Cutt Tree | Hour | 2.25 |
| Lab. Cultivate | Hour | 1.13 |
| Packaging | Hour | 4.00 |
| Machine Crew Labour | Hour | 2.70 |
| Machinery Labour | Hour | 3.38 |
| Lab. Harvesting | Hour | 2.25 |

**Table A.7: Irrigated apples -Technical Coefficients in the Lowlands**

| Item | | Year0 | Year1 | Year2 | Year3 | Year4 | Year5 | Year6 | Year7 | Year8 | Year9 | Year10 | Year11 | Year12 | Year13 | Year14 | Year15 | Year16 | Year17 | Year18 | Year19 | Year20 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Gross Returns:** | | | | | | | | | | | | | | | | | | | | | | |
| Apples-Export | Kg | 0 | 0 | 0 | 0 | 11000 | 15000 | 20000 | 20000 | 20000 | 20000 | 20000 | 20000 | 20000 | 20000 | 20000 | 20000 | 20000 | 20000 | 15000 | 15000 | 15000 |
| Apples-Domestic | Kg | 0 | 0 | 0 | 0 | 3000 | 3000 | 6000 | 6000 | 6000 | 6000 | 6000 | 6000 | 6000 | 6000 | 6000 | 6000 | 6000 | 6000 | 3000 | 3000 | 3000 |
| **Purchased Inputs:** | | | | | | | | | | | | | | | | | | | | | | |
| Apple Trees | Tree | 1250 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Eragros.Seed | Kg | 1.5 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Lime | Ton | 5 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Sup.Phosphate 10 | Kg | 1000 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| LAN | Kg | 199.98 | 622.16 | 622.16 | 622.16 | 166.65 | 166.65 | 222.2 | 222.2 | 222.2 | 222.2 | 222.2 | 222.2 | 222.2 | 222.2 | 222.2 | 222.2 | 222.2 | 222.2 | 222.2 | 222.2 | 222.2 |
| Zinc Oxide | Kg | 0.278 | 0.833 | 0.833 | 0.833 | | | | | | | | | | | | | | | | | |
| Manganese S. | Kg | 1.945 | 4.445 | 4.445 | 4.445 | 0.333 | 0.333 | 0.333 | 0.333 | 0.333 | 0.333 | 0.333 | 0.333 | 0.333 | 0.333 | 0.333 | 0.333 | 0.333 | 0.333 | 0.333 | 0.333 | 0.333 |
| 3:2:1(25)+ZN | Kg | 0 | 0 | 0 | 0 | 222.2 | 222.2 | 333.3 | 333.3 | 333.3 | 333.3 | 333.3 | 333.3 | 333.3 | 333.3 | 333.3 | 333.3 | 333.3 | 333.3 | 333.3 | 333.3 | 333.3 |
| Low Buret | Kg | 4.861 | 11.11 | 11.11 | 11.11 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Tokuthion | l | 0 | 0 | 0 | 0 | 0.833 | 0.833 | 0.833 | 0.833 | 0.833 | 0.833 | 0.833 | 0.833 | 0.833 | 0.833 | 0.833 | 0.833 | 0.833 | 0.833 | 0.833 | 0.833 | 0.833 |
| Cupravit | Kg | 0 | 0 | 0 | 0 | 4.166 | 4.166 | 4.166 | 4.166 | 4.166 | 4.166 | 4.166 | 4.166 | 4.166 | 4.166 | 4.166 | 4.166 | 4.166 | 4.166 | 4.166 | 4.166 | 4.166 |
| Agral | l | 0 | 0 | 0 | 0 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 |
| Demuldex | Kg | 0.695 | 1.389 | 1.389 | 1.389 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Solubor | Kg | 1.389 | 2.778 | 2.778 | 2.778 | 3.334 | 3.334 | 3.334 | 3.334 | 3.334 | 3.334 | 3.334 | 3.334 | 3.334 | 3.334 | 3.334 | 3.334 | 3.334 | 3.334 | 3.334 | 3.334 | 3.334 |
| Gusathion | Kg | 0 | 0 | 0 | 0 | 0.833 | 0.833 | 0.833 | 0.833 | 0.833 | 0.833 | 0.833 | 0.833 | 0.833 | 0.833 | 0.833 | 0.833 | 0.833 | 0.833 | 0.833 | 0.833 | 0.833 |
| Cascade | l | 0 | 0 | 0 | 0 | 0.833 | 0.833 | 0.883 | 0.883 | 0.883 | 0.883 | 0.883 | 0.883 | 0.883 | 0.883 | 0.883 | 0.883 | 0.883 | 0.883 | 0.883 | 0.883 | 0.883 |
| Killval | l | 0 | 0 | 0 | 0 | 2.083 | 2.083 | 2.083 | 2.083 | 2.083 | 2.083 | 2.083 | 2.083 | 2.083 | 2.083 | 2.083 | 2.083 | 2.083 | 2.083 | 2.083 | 2.083 | 2.083 |
| Ultracide | Kg | 0 | 0 | 0 | 0 | 1.667 | 1.667 | 1.667 | 1.667 | 1.667 | 1.667 | 1.667 | 1.667 | 1.667 | 1.667 | 1.667 | 1.667 | 1.667 | 1.667 | 1.667 | 1.667 | 1.667 |
| Gramoxone | l | 0 | 8 | 8 | 8 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 |
| Dithane | Kg | 3.333 | 5 | 5 | 5 | 2.5 | 2.5 | 2.5 | 2.5 | 2.5 | 2.5 | 2.5 | 2.5 | 2.5 | 2.5 | 2.5 | 2.5 | 2.5 | 2.5 | 2.5 | 2.5 | 2.5 |
| Systhane | Kg | 0.836 | 0.5 | 0.5 | 0.5 | 0.75 | 0.75 | 0.75 | 0.75 | 0.75 | 0.75 | 0.75 | 0.75 | 0.75 | 0.75 | 0.75 | 0.75 | 0.75 | 0.75 | 0.75 | 0.75 | 0.75 |
| Insegar | g | 0 | 0 | 0 | 0 | 1.333 | 1.333 | 1.333 | 1.333 | 1.333 | 1.333 | 1.333 | 1.333 | 1.333 | 1.333 | 1.333 | 1.333 | 1.333 | 1.333 | 1.333 | 1.333 | 1.333 |
| Sting | l | 0 | 0 | 0 | 0 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 |
| 18.5 kg Boxes | Box | 0 | 0 | 0 | 0 | 883 | 883 | 2355 | 2355 | 2355 | 2355 | 2355 | 2355 | 2355 | 2355 | 2355 | 2355 | 2355 | 2355 | 2355 | 2355 | 2355 |
| Bailing Twine | Kg | 17.35 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Soil Analysis | Sample | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| **Irrigation:** | | | | | | | | | | | | | | | | | | | | | | |
| Electric pump | | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Pump housing | | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Electicity point | | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Irrigation equipment | | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| **Machinery:** | | | | | | | | | | | | | | | | | | | | | | |
| Diesel | l | 100.2 | 69.31 | 69.31 | 69.31 | 38.5 | 38.5 | 40.23 | 40.23 | 40.23 | 40.23 | 40.23 | 40.23 | 40.23 | 40.23 | 40.23 | 40.23 | 40.23 | 40.23 | 40.23 | 40.23 | 40.23 |
| Implements | Hour | 40 | 56.2 | 56.2 | 56.2 | 60.82 | 60.82 | 61 | 61 | 61 | 61 | 61 | 61 | 61 | 61 | 61 | 61 | 61 | 61 | 61 | 61 | 61 |
| Repairs | MM | 80 | 170 | 170 | 170 | 210 | 210 | 390 | 390 | 390 | 390 | 390 | 390 | 390 | 390 | 390 | 390 | 390 | 390 | 390 | 390 | 390 |
| Electricity | kw-h | 16100 | 16413.68 | 16413.68 | 16413.68 | 17000 | 17000 | 16413.68 | 16413.68 | 16413.68 | 16413.68 | 16413.68 | 16413.68 | 16413.68 | 16413.68 | 16413.68 | 16413.68 | 16413.68 | 16413.68 | 16413.68 | 16413.68 | 16413.68 |
| **Fixed Cost: Machinery:** | | | | | | | | | | | | | | | | | | | | | | |
| Hail Insurance | Ha | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| Tractor | Ha | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| Interest | Ha | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| **Labour:** | | | | | | | | | | | | | | | | | | | | | | |
| Lab. Holes & Plan | Hour | 80 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Lab.tree form | Hour | 38 | 32 | 32 | 32 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Lab. Cutt. | Hour | 5.5 | 6 | 6 | 6 | 160 | 160 | 360 | 360 | 360 | 360 | 360 | 360 | 360 | 360 | 360 | 360 | 360 | 360 | 360 | 360 | 360 |
| Lab.Cultivate | Hour | 48 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Lab.Making Spar | Hour | 0 | 72 | 72 | 72 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Lab. Thin out | Hour | 0 | 0 | 0 | 0 | 160 | 160 | 360 | 360 | 360 | 360 | 360 | 360 | 360 | 360 | 360 | 360 | 360 | 360 | 360 | 360 | 360 |
| Lab.Fert. | Hour | 6 | 14 | 14 | 14 | 5.5 | 5.5 | 7 | 7 | 7 | 7 | 7 | 7 | 7 | 7 | 7 | 7 | 7 | 7 | 7 | 7 | 7 |
| Machinery labour | Hour | 11.603 | 4.813 | 4.813 | 4.813 | 5.62 | 5.62 | 5.418 | 5.418 | 5.418 | 5.418 | 5.418 | 5.418 | 5.418 | 5.418 | 5.418 | 5.418 | 5.418 | 5.418 | 5.418 | 5.418 | 5.418 |
| Machine Crew Labour | Hour | 6.038 | 1.494 | 1.494 | 1.494 | 1.494 | 1.494 | 1.494 | 1.494 | 1.494 | 1.494 | 1.494 | 1.494 | 1.494 | 1.494 | 1.494 | 1.494 | 1.494 | 1.494 | 1.494 | 1.494 | 1.494 |
| Irrigation labour | Hour | 24 | 51 | 51 | 51 | 51 | 51 | 58.5 | 58.5 | 58.5 | 58.5 | 58.5 | 58.5 | 58.5 | 58.5 | 58.5 | 58.5 | 58.5 | 58.5 | 58.5 | 58.5 | 58.5 |
| Labour harvesting | Hour | 0 | 0 | 0 | 0 | 160 | 160 | 424 | 424 | 424 | 424 | 424 | 424 | 424 | 424 | 424 | 424 | 424 | 424 | 424 | 424 | 424 |
| Packaging | Hour | 0 | 0 | 0 | 0 | 200 | 200 | 520 | 520 | 520 | 520 | 520 | 520 | 520 | 520 | 520 | 520 | 520 | 520 | 520 | 520 | 520 |

**Table A.8: Irrigated Apples enterprise- Costs and Prices in the Lowlands**

| **Gross Returns:** | **Unit** | **Price/unit** |
|---|---|---|
| Apples-Export | Kg | 6.50 |
| Apples-Domestic | Kg | 3.24 |
| Total Receipts: | | |
| **Purchased Inputs:** | | |
| Apple Trees/tree | Tree | 11.81 |
| Eragros.Seed | Kg | 14.57 |
| Lime/TON | Ton | 165.78 |
| Sup.Phosphate 10 | Kg | 0.84 |
| LAN/KG | Kg | 1.11 |
| Zinc Oxide | Kg | 9.46 |
| Manganese S. | Kg | 3.41 |
| 3:2:1(25)+ZN | Kg | 1.22 |
| Low Buret | Kg | 2.03 |
| Tokuthion | l | 106.81 |
| Cupravit | Kg | 9.56 |
| Agral | l | 21.71 |
| Demuldex | Kg | 15.58 |
| Solubor | Kg | 1.26 |
| Gusathion | Kg | 75.63 |
| Cascade | l | 314.55 |
| Killval | l | 98.66 |
| Ultracide | Kg | 107.19 |
| Gramoxone | l | 19.14 |
| Dithane | Kg | 18.75 |
| Systhane | Kg | 716.63 |
| Insegar | g | 3.48 |
| Sting | l | 20.43 |
| 18.5 kg Boxes | Box | 5.87 |
| Bailing Twine | Kg | 19.07 |
| Soil Analysis | Sample | 18.00 |
| **Irrigation** | | |
| Electric pump | | 1800.00 |
| Pump housing | | 250.00 |
| Electicity point | | 1750.00 |
| Irrigation equipment | | 5633.00 |
| **Machinery:** | | |
| Diesel | l | 2.81 |
| Implements | Hour | 43.80 |
| Repairs | MM | 0.06 |
| Electricity | Kw-h | 0.41 |
| **Fixed Cost: Machinery:** | | |
| Insurance | Ha | 17.03 |
| Depreciation | Ha | 46.45 |
| Interest | Ha | 40.88 |
| **Labour:** | | |
| Lab. Holes & Plan | Hour | 2.25 |
| Lab.tree form | Hour | 2.25 |
| Lab. Cutt. | Hour | 2.25 |
| Lab.Cultivate | Hour | 2.25 |
| Lab.Making Spar | Hour | 2.25 |
| Lab. Thin out | Hour | 2.25 |
| Lab.Fert. | Hour | 2.25 |
| Machinery labour | Hour | 3.36 |
| Machine Crew Labour | Hour | 2.70 |
| Irrigation labour | Hour | 2.70 |
| Labour harvesting | Hour | 2.25 |
| Packaging | Hour | 2.25 |

**Table A.9: Irrigated Apple enterprise - Technical Coefficients in the Mountains**

| Item | Unit/ha | Year 0 | Year1 | Year2 | Year3 | Year4 | Year5 | Year6 | Year7 | Year8 | Year9 | Year10 | Year11 | Year12 | Year13 | Year14 | Year15 | Year16 | Year17 | Year18 | Year19 | Year20 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Gross Returns:** | | | | | | | | | | | | | | | | | | | | | | |
| Apples- Export | Kg | 0 | 0 | 0 | 0 | 8000 | 11300 | 18000 | 18000 | 18000 | 18000 | 18000 | 18000 | 18000 | 18000 | 18000 | 18000 | 18000 | 18000 | 11300 | 11300 | 11300 |
| Apples- Domestic | Kg | 0 | 0 | 0 | 0 | 2500 | 2500 | 5000 | 5000 | 5000 | 5000 | 5000 | 5000 | 5000 | 5000 | 5000 | 5000 | 5000 | 5000 | 2500 | 2500 | 2500 |
| **Purchased Imputs:** | | | | | | | | | | | | | | | | | | | | | | |
| Apple Trees | Tree | 1250 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Eragros.Seed | Kg | 1.50 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Lime | Ton | 5.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Sup.Phosphate 10 | Kg | 1000.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| LAN | Kg | 199.98 | 622.16 | 622.16 | 622.16 | 166.65 | 166.65 | 222.20 | 222.20 | 222.20 | 222.20 | 222.20 | 222.20 | 222.20 | 222.20 | 222.20 | 222.20 | 222.20 | 222.20 | 222.20 | 222.20 | 222.20 |
| Zinc Okside | Kg | 0.28 | 0.83 | 0.83 | 0.83 | | | | | | | | | | | | | | | | | |
| Manganese S. | Kg | 1.95 | 4.45 | 4.45 | 4.45 | 0.33 | 0.33 | 0.33 | 0.33 | 0.33 | 0.33 | 0.33 | 0.33 | 0.33 | 0.33 | 0.33 | 0.33 | 0.33 | 0.33 | 0.33 | 0.33 | 0.33 |
| 3:2:1(25)+ZN | Kg | | | | | 222.20 | 222.20 | 333.30 | 333.30 | 333.30 | 333.30 | 333.30 | 333.30 | 333.30 | 333.30 | 333.30 | 333.30 | 333.30 | 333.30 | 333.30 | 333.30 | 333.30 |
| Low Buret | Kg | 4.86 | 11.11 | 11.11 | 11.11 | | | | | | | | | | | | | | | | | |
| Tokuthion | l | | | | | 0.83 | 0.83 | 0.83 | 0.83 | 0.83 | 0.83 | 0.83 | 0.83 | 0.83 | 0.83 | 0.83 | 0.83 | 0.83 | 0.83 | 0.83 | 0.83 | 0.83 |
| Cupravit | Kg | | | | | 4.17 | 4.17 | 4.17 | 4.17 | 4.17 | 4.17 | 4.17 | 4.17 | 4.17 | 4.17 | 4.17 | 4.17 | 4.17 | 4.17 | 4.17 | 4.17 | 4.17 |
| Thiram | Kg | | | | | | | | | | | | | | | | | | | | | |
| Agral | Kg | | | | | 0.10 | 0.10 | 0.10 | 0.10 | 0.10 | 0.10 | 0.10 | 0.10 | 0.10 | 0.10 | 0.10 | 0.10 | 0.10 | 0.10 | 0.10 | 0.10 | 0.10 |
| Lebaycide | l | | | | | | | | | | | | | | | | | | | | | |
| Demuldex | l | 0.70 | 1.39 | 1.39 | 1.39 | | | | | | | | | | | | | | | | | |
| Solubor | Kg | 1.39 | 2.78 | 2.78 | 2.78 | 3.33 | 3.33 | 3.33 | 3.33 | 3.33 | 3.33 | 3.33 | 3.33 | 3.33 | 3.33 | 3.33 | 3.33 | 3.33 | 3.33 | 3.33 | 3.33 | 3.33 |
| Gusathion | Kg | | | | | 0.83 | 0.83 | 0.83 | 0.83 | 0.83 | 0.83 | 0.83 | 0.83 | 0.83 | 0.83 | 0.83 | 0.83 | 0.83 | 0.83 | 0.83 | 0.83 | 0.83 |
| Cascade | l | | | | | 0.83 | 0.83 | 0.88 | 0.88 | 0.88 | 0.88 | 0.88 | 0.88 | 0.88 | 0.88 | 0.88 | 0.88 | 0.88 | 0.88 | 0.88 | 0.88 | 0.88 |
| Killval | | | | | | 2.08 | 2.08 | 2.08 | 2.08 | 2.08 | 2.08 | 2.08 | 2.08 | 2.08 | 2.08 | 2.08 | 2.08 | 2.08 | 2.08 | 2.08 | 2.08 | 2.08 |
| Ultracide | Kg | | | | | 1.67 | 1.67 | 1.67 | 1.67 | 1.67 | 1.67 | 1.67 | 1.67 | 1.67 | 1.67 | 1.67 | 1.67 | 1.67 | 1.67 | 1.67 | 1.67 | 1.67 |
| Gramoxone | l | | 8.00 | 8.00 | 8.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 |
| Dithane | Kg | 3.33 | 5.00 | 5.00 | 5.00 | 2.50 | 2.50 | 2.50 | 2.50 | 2.50 | 2.50 | 2.50 | 2.50 | 2.50 | 2.50 | 2.50 | 2.50 | 2.50 | 2.50 | 2.50 | 2.50 | 2.50 |
| Systhane | Kg | 0.84 | 0.50 | 0.50 | 0.50 | 0.75 | 0.75 | 0.75 | 0.75 | 0.75 | 0.75 | 0.75 | 0.75 | 0.75 | 0.75 | 0.75 | 0.75 | 0.75 | 0.75 | 0.75 | 0.75 | 0.75 |
| Insegar | G | | | | | 1.33 | 1.33 | 1.33 | 1.33 | 1.33 | 1.33 | 1.33 | 1.33 | 1.33 | 1.33 | 1.33 | 1.33 | 1.33 | 1.33 | 1.33 | 1.33 | 1.33 |
| Sting | l | | | | | 3.00 | 3.00 | 3.00 | 3.00 | 3.00 | 3.00 | 3.00 | 3.00 | 3.00 | 3.00 | 3.00 | 3.00 | 3.00 | 3.00 | 3.00 | 3.00 | 3.00 |
| Box 18Kg | Box | | | | | 583.00 | 583.00 | 1555.00 | 1555.00 | 1555.00 | 1555.00 | 1555.00 | 1555.00 | 1555.00 | 1555.00 | 1555.00 | 1555.00 | 1555.00 | 1555.00 | 1555.00 | 1555.00 | 1555.00 |
| Box 10Kg | Box | | | | | 300.00 | 300.00 | 800.00 | 800.00 | 800.00 | 800.00 | 800.00 | 800.00 | 800.00 | 800.00 | 800.00 | 800.00 | 800.00 | 800.00 | 800.00 | 800.00 | 800.00 |
| Bailing Twine | Kg | 17.35 | | | | | | | | | | | | | | | | | | | | |
| Soil Analysis | Maloti | 2.00 | | | | | | | | | | | | | | | | | | | | |
| **Irrigation** | | | | | | | | | | | | | | | | | | | | | | |
| Electric pump | ha | 1.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Pump housing | ha | 1.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Electicity point | ha | 1.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Irrigation equipment | ha | 1.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| **Machinery:** | | | | | | | | | | | | | | | | | | | | | | |
| Diesel | l | 100.20 | 69.31 | 69.31 | 69.31 | 38.50 | 38.50 | 40.23 | 40.23 | 40.23 | 40.23 | 40.23 | 40.23 | 40.23 | 40.23 | 40.23 | 40.23 | 40.23 | 40.23 | 40.23 | 40.23 | 40.23 |
| Implements | Hour | 40.00 | 56.20 | 56.20 | 56.20 | 60.82 | 60.82 | 61.00 | 61.00 | 61.00 | 61.00 | 61.00 | 61.00 | 61.00 | 61.00 | 61.00 | 61.00 | 61.00 | 61.00 | 61.00 | 61.00 | 61.00 |
| Repairs | MM | 80.00 | 170.00 | 170.00 | 170.00 | 210.00 | 210.00 | 390.00 | 390.00 | 390.00 | 390.00 | 390.00 | 390.00 | 390.00 | 390.00 | 390.00 | 390.00 | 390.00 | 390.00 | 390.00 | 390.00 | 390.00 |
| Electricity | kw-h | 16100.00 | 16413.68 | 16413.68 | 16413.68 | 17000.00 | 17000.00 | 16413.68 | 16413.68 | 16413.68 | 16413.68 | 16413.68 | 16413.68 | 16413.68 | 16413.68 | 16413.68 | 16413.68 | 16413.68 | 16413.68 | 16413.68 | 16413.68 | 16413.68 |
| **Fixed Cost:-Machinery** | | | | | | | | | | | | | | | | | | | | | | |
| Insurance | Rand | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 |
| Tractor | ha | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 |
| Interest | ha | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 |
| **Labour:** | | | | | | | | | | | | | | | | | | | | | | |
| Lab. Cutt. | Hour | | 6.00 | 6.00 | 6.00 | 160.00 | 160.00 | 360.00 | 360.00 | 360.00 | 360.00 | 360.00 | 360.00 | 360.00 | 360.00 | 360.00 | 360.00 | 360.00 | 360.00 | 360.00 | 360.00 | 360.00 |
| Lab.Cultivate | Hour | 48.00 | | | | | | | | | | | | | | | | | | | | |
| Lab.Making Spar | Hour | | 72.00 | 72.00 | 72.00 | | | | | | | | | | | | | | | | | |
| Lab. Thin out | Hour | | | | | 160.00 | 160.00 | 360.00 | 360.00 | 360.00 | 360.00 | 360.00 | 360.00 | 360.00 | 360.00 | 360.00 | 360.00 | 360.00 | 360.00 | 360.00 | 360.00 | 360.00 |
| Lab.Fert. | Hour | 6.00 | 14.00 | 14.00 | 14.00 | 5.50 | 5.50 | 7.00 | 7.00 | 7.00 | 7.00 | 7.00 | 7.00 | 7.00 | 7.00 | 7.00 | 7.00 | 7.00 | 7.00 | 7.00 | 7.00 | 7.00 |
| Lab. Holes & Plan | Hour | 80.00 | | | | | | | | | | | | | | | | | | | | |
| Lab.tree form | Hour | 38.00 | 32.00 | 32.00 | 32.00 | | | | | | | | | | | | | | | | | |
| Lab. Harvest | Hour | | | | | 160.00 | 160.00 | 424.00 | 424.00 | 424.00 | 424.00 | 424.00 | 424.00 | 424.00 | 424.00 | 424.00 | 424.00 | 424.00 | 424.00 | 424.00 | 424.00 | 424.00 |
| Irrigation Labour | Hour | 24.00 | 51.00 | 51.00 | 51.00 | 51.00 | 51.00 | 58.50 | 58.50 | 58.50 | 58.50 | 58.50 | 58.50 | 58.50 | 58.50 | 58.50 | 58.50 | 58.50 | 58.50 | 58.50 | 58.50 | 58.50 |
| Machine Crew Labour | Hour | 6.04 | 1.49 | 1.49 | 1.49 | 1.49 | 1.49 | 1.49 | 1.49 | 1.49 | 1.49 | 1.49 | 1.49 | 1.49 | 1.49 | 1.49 | 1.49 | 1.49 | 1.49 | 1.49 | 1.49 | 1.49 |
| Machinery Labour | Hour | 0.00 | 0.00 | 0.00 | 0.00 | 1.86 | 1.86 | 5.001 | 5.001 | 5.001 | 5.001 | 5.001 | 5.001 | 5.001 | 5.001 | 5.001 | 5.001 | 5.001 | 5.001 | 5.001 | 5.001 | 5.001 |
| Packaging | Hour | 0.00 | 0.00 | 0.00 | 0.00 | 200 | 200 | 520 | 520 | 520 | 520 | 520 | 520 | 520 | 520 | 520 | 520 | 520 | 520 | 520 | 520 | 520 |

**Table A.10: Irrigated Apple enterprise - Costs and Prices in the Mountains**

| Item | Unit/ha | Prices |
|---|---|---|
| **Gross Returns:** | | **Maloti/Unit** |
| Apples- Export | Kg | 6.26 |
| Apples- Domestic | Kg | 3.24 |
| **Purchased Imputs:** | | |
| Apple Trees | Tree | 11.84 |
| Eragros.Seed | Kg | 20.19 |
| Lime | Ton | 227.19 |
| Sup.Phosphate 10 | Kg | 1.40 |
| LAN | Kg | 1.77 |
| Zinc Okside | Kg | 13.20 |
| Manganese S. | Kg | 4.92 |
| 3:2:1(25)+ZN | Kg | 1.92 |
| Low Buret | Kg | 3.38 |
| Tokuthion | l | 146.46 |
| Cupravit | Kg | 13.34 |
| Thiram | Kg | 0.25 |
| Agral | Kg | 29.97 |
| Lebaycide | l | 0.25 |
| Demuldex | l | 21.58 |
| Solubor | Kg | 1.98 |
| Gusathion | Kg | 103.78 |
| Cascade | l | 430.84 |
| Killval | | 135.31 |
| Ultracide | Kg | 146.98 |
| Gramoxone | l | 0.25 |
| Dithane | Kg | 25.92 |
| Systhane | Kg | 981.24 |
| Insegar | G | 5.01 |
| Sting | l | 28.22 |
| Box 18Kg | Box | 8.29 |
| Box 10Kg | Box | 6.55 |
| Bailing Twine | Kg | 17.31 |
| Soil Analysis | Maloti | 24.89 |
| **Irrigation:** | | |
| Electric pump | Ha | 1800.00 |
| Pump housing | Ha | 250.00 |
| Electicity point | Ha | 1750.00 |
| Irrigation equipment | Ha | 5633.00 |
| **Machinery:** | | |
| Diesel | l | 2.81 |
| Implements | Hour | 43.80 |
| Repairs | MM | 0.06 |
| Electricity | Kw-h | 0.41 |
| **Fixed Cost:-Machinery** | | |
| Insurance | Rand | 22.68 |
| Tractor | Ha | 61.85 |
| Interest | Ha | 36.28 |
| **Labour:** | | |
| Lab. Cutt. | Hour | 2.50 |
| Lab.Cultivate | Hour | 2.50 |
| Lab.Making Spar | Hour | 2.50 |
| Lab. Thin out | Hour | 2.50 |
| Lab.Fert. | Hour | 2.50 |
| Lab. Holes & Plan | Hour | 2.70 |
| Lab.tree form | Hour | 2.70 |
| Lab. Harvest | Hour | 2.70 |
| Irrigation Labour | Hour | 3.25 |
| Machine Crew Labour | Hour | 3.25 |
| Machinery Labour | Hour | 4.04 |
| Packaging | Hour | 4.00 |

**Table A.11: Irrigated Peach - Technical Coefficients**

| Item | Unit | Year 0 | Year 1 | Year 2 | Year 3 | Year 4 | Year 5 | Year 6 | Year 7 | Year 8 | Year 9 | Year 10 | Year 11 | Year 12 | Year 13 | Year 14 | Year 15 | Year 16 | Year 17 | Year 18 | Year 19 | Year 20 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Gross Returns:** | | | | | | | | | | | | | | | | | | | | | | |
| Peaches- Domestic | Kg | 0 | 0 | 0 | 1000 | 1000 | 3000 | 3000 | 3000 | 5000 | 5000 | 5000 | 5000 | 5000 | 5000 | 5000 | 5000 | 5000 | 5000 | 3000 | 3000 | 3000 |
| Peaches- Export | Kg | 0 | 0 | 0 | 1500 | 2500 | 7500 | 7500 | 7500 | 12000 | 12000 | 12000 | 12000 | 12000 | 12000 | 12000 | 12000 | 12000 | 12000 | 7500 | 7500 | 7500 |
| **Purchased Imputs:** | | | | | | | | | | | | | | | | | | | | | | |
| Peach Trees | Tree | 1250 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Eragros.Seed | Kg | 3.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Lime | Ton | 3.50 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Sup.Phosphate 10 | Kg | 0.50 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| LAN | Kg | 60.00 | 120.00 | 100.00 | 100.00 | 150.00 | 150.00 | 150.00 | 150.00 | 150.00 | 150.00 | 150.00 | 150.00 | 150.00 | 150.00 | 150.00 | 150.00 | 150.00 | 150.00 | 150.00 | 150.00 | 150.00 |
| Zinc Okside | Kg | 0.50 | 0.50 | 0.63 | 0.63 | 0.75 | 0.75 | 0.75 | 0.75 | 0.75 | 0.75 | 0.75 | 0.75 | 0.75 | 0.75 | 0.75 | 0.75 | 0.75 | 0.75 | 0.75 | 0.75 | 0.75 |
| Manganese S. | Kg | 2.00 | 2.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 3:2:1(25)+ZN | Kg | 0.00 | 50.00 | 150.00 | 150.00 | 375.00 | 375.00 | 375.00 | 375.00 | 375.00 | 375.00 | 375.00 | 375.00 | 375.00 | 375.00 | 375.00 | 375.00 | 375.00 | 375.00 | 375.00 | 375.00 | 375.00 |
| Low Buret | Kg | 2.50 | 5.00 | 6.25 | 6.25 | 7.50 | 7.50 | 7.50 | 7.50 | 7.50 | 7.50 | 7.50 | 7.50 | 7.50 | 7.50 | 7.50 | 7.50 | 7.50 | 7.50 | 7.50 | 7.50 | 7.50 |
| Thiodan | l | 0.00 | 0.00 | 1.25 | 1.25 | 1.50 | 1.50 | 1.50 | 1.50 | 1.50 | 1.50 | 1.50 | 1.50 | 1.50 | 1.50 | 1.50 | 1.50 | 1.50 | 1.50 | 1.50 | 1.50 | 1.50 |
| Baycor | l | 0.00 | 0.00 | 0.50 | 0.50 | 0.60 | 0.60 | 0.60 | 0.60 | 0.60 | 0.60 | 0.60 | 0.60 | 0.60 | 0.60 | 0.60 | 0.60 | 0.60 | 0.60 | 0.60 | 0.60 | 0.60 |
| Tokuthion | Kg | 0.00 | 0.25 | 0.50 | 0.50 | 0.75 | 0.75 | 0.75 | 0.75 | 0.75 | 0.75 | 0.75 | 0.75 | 0.75 | 0.75 | 0.75 | 0.75 | 0.75 | 0.75 | 0.75 | 0.75 | 0.75 |
| Thiram | Kg | 2.50 | 0.75 | 1.50 | 1.50 | 2.25 | 2.25 | 2.25 | 2.25 | 2.25 | 2.25 | 2.25 | 2.25 | 2.25 | 2.25 | 2.25 | 2.25 | 2.25 | 2.25 | 2.25 | 2.25 | 2.25 |
| Agral | l | 0.10 | 0.10 | 0.13 | 0.13 | 0.15 | 0.15 | 0.15 | 0.15 | 0.15 | 0.15 | 0.15 | 0.15 | 0.15 | 0.15 | 0.15 | 0.15 | 0.15 | 0.15 | 0.15 | 0.15 | 0.15 |
| Lebaycide | l | 0.00 | 0.00 | 1.50 | 1.50 | 2.00 | 2.00 | 2.00 | 2.00 | 2.00 | 2.00 | 2.00 | 2.00 | 2.00 | 2.00 | 2.00 | 2.00 | 2.00 | 2.00 | 2.00 | 2.00 | 2.00 |
| Demuldex | l | 0.25 | 2.00 | 6.00 | 6.00 | 8.00 | 8.00 | 8.00 | 8.00 | 8.00 | 8.00 | 8.00 | 8.00 | 8.00 | 8.00 | 8.00 | 8.00 | 8.00 | 8.00 | 8.00 | 8.00 | 8.00 |
| Gramoxone | l | 0.00 | 0.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 |
| Sting | Box | 0.00 | 0.00 | 3.00 | 3.00 | 3.00 | 3.00 | 3.00 | 3.00 | 3.00 | 3.00 | 3.00 | 3.00 | 3.00 | 3.00 | 3.00 | 3.00 | 3.00 | 3.00 | 3.00 | 3.00 | 3.00 |
| Boxes | | 0.00 | 0.00 | 1050.00 | 1150.00 | 3150.00 | 3150.00 | 3150.00 | 3150.00 | 3150.00 | 3150.00 | 3150.00 | 3150.00 | 3150.00 | 3150.00 | 3150.00 | 3150.00 | 3150.00 | 3150.00 | 3150.00 | 3150.00 | 3150.00 |
| Boxes | | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Trelising system | Ha | 1.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Soil Analysis | | 1.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| **Irrigation:** | | | | | | | | | | | | | | | | | | | | | | |
| Electric pump | Ha | 1.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Pump housing | Ha | 1.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Electicity point | Ha | 1.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Irrigation equipment | Ha | 1.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| **Machinery:** | | | | | | | | | | | | | | | | | | | | | | |
| Diesel | l | 120.45 | 23.30 | 38.59 | 38.59 | 38.59 | 38.59 | 38.59 | 38.59 | 38.59 | 38.59 | 38.59 | 38.59 | 38.59 | 38.59 | 38.59 | 38.59 | 38.59 | 38.59 | 38.59 | 38.59 | 38.59 |
| Implements | Hour | 15.10 | 2.80 | 2.80 | 5.60 | 5.60 | 40.50 | 40.50 | 40.50 | 40.50 | 40.50 | 40.50 | 40.50 | 40.50 | 40.50 | 40.50 | 40.50 | 40.50 | 40.50 | 40.50 | 40.50 | 40.50 |
| Repairs | MM | 81.20 | 165.00 | 165.00 | 200.00 | 200.00 | 350.00 | 350.00 | 350.00 | 350.00 | 350.00 | 350.00 | 350.00 | 350.00 | 350.00 | 350.00 | 350.00 | 350.00 | 350.00 | 350.00 | 350.00 | 350.00 |
| Electricity | Kw-h | 3560.00 | 2000.00 | 2000.00 | 2800.00 | 2800.00 | 3650.00 | 3650.00 | 3650.00 | 3650.00 | 3650.00 | 3650.00 | 3650.00 | 3650.00 | 3650.00 | 3650.00 | 3650.00 | 3650.00 | 3650.00 | 3650.00 | 3650.00 | 3650.00 |
| **Fixed Cost: Machinery** | | | | | | | | | | | | | | | | | | | | | | |
| Tractor | Ha | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 |
| Insurance | Ha | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 |
| Interest | Ha | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 |
| **Labour:** | | | | | | | | | | | | | | | | | | | | | | |
| Land preparation | | 1.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Permanent labour | | 1.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Advisors | | 1.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| General | | 1.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Lab. Pickup Roots | Hour | 10.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Lab. Holes & Plan | Hour | 40.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Lab. Cultivate | Hour | 200.00 | 200.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Lab. Fert. | Hour | 16.00 | 0.00 | 1.25 | 1.25 | 8.00 | 8.00 | 8.00 | 8.00 | 8.00 | 8.00 | 8.00 | 8.00 | 8.00 | 8.00 | 8.00 | 8.00 | 8.00 | 8.00 | 8.00 | 8.00 | 8.00 |
| Lab. Cutt. | Hour | 2.00 | 33.00 | 67.00 | 67.00 | 87.50 | 87.50 | 87.50 | 87.50 | 87.50 | 87.50 | 87.50 | 87.50 | 87.50 | 87.50 | 87.50 | 87.50 | 87.50 | 87.50 | 87.50 | 87.50 | 87.50 |
| Lab. Thin out | Hour | 0.00 | 0.00 | 63.00 | 63.00 | 125.00 | 125.00 | 125.00 | 125.00 | 125.00 | 125.00 | 125.00 | 125.00 | 125.00 | 125.00 | 125.00 | 125.00 | 125.00 | 125.00 | 125.00 | 125.00 | 125.00 |
| Irrigation Labour | Hour | 0.00 | 0.00 | 4.50 | 4.50 | 4.50 | 4.50 | 4.50 | 4.50 | 4.50 | 4.50 | 4.50 | 4.50 | 4.50 | 4.50 | 4.50 | 4.50 | 4.50 | 4.50 | 4.50 | 4.50 | 4.50 |
| Machine Crew Labour | Hour | 3.27 | 1.69 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Machinery Labour | Hour | 10.53 | 2.63 | 4.97 | 4.97 | 4.97 | 4.97 | 4.97 | 4.97 | 4.97 | 4.97 | 4.97 | 4.97 | 4.97 | 4.97 | 4.97 | 4.97 | 4.97 | 4.97 | 4.97 | 4.97 | 4.97 |
| Lab. Harvest | Hour | 0.00 | 0.00 | 96.00 | 96.00 | 96.00 | 96.00 | 96.00 | 96.00 | 96.00 | 96.00 | 96.00 | 96.00 | 96.00 | 96.00 | 96.00 | 96.00 | 96.00 | 96.00 | 96.00 | 96.00 | 96.00 |
| Packaging | Hour | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Packaging | Hour | 0.00 | 0.00 | 60.00 | 60.00 | 180.00 | 180.00 | 180.00 | 180.00 | 180.00 | 180.00 | 180.00 | 180.00 | 180.00 | 180.00 | 180.00 | 180.00 | 180.00 | 180.00 | 180.00 | 180.00 | 180.00 |

**Table A.12: Irrigated Peach- Costs and Prices**

| Item | Unit | price/unit |
|---|---|---|
| **Gross Returns:** | | |
| Peaches- Domestic | Kg | 4.00 |
| Peaches- Export | Kg | 6.35 |
| **Purchased Inputs:** | | |
| Peach Trees | Tree | 16.13 |
| Eragros.Seed | KG | 14.57 |
| Lime | Ton | 600.00 |
| Sup.Phosphate 10 | Kg | 1530.00 |
| LAN | Kg | 1.11 |
| Zinc Oxide | Kg | 9.46 |
| Manganese S. | Kg | 3.41 |
| 3:2:1(25)+ZN | Kg | 1.22 |
| Low Buret | Kg | 2.03 |
| Thiodan | l | 15.58 |
| Baycor | l | 18.00 |
| Tokuthion | Kg | 106.81 |
| Thiram | Kg | 19.27 |
| Agral | l | 21.71 |
| Lebaycide | l | 118.83 |
| Demuldex | l | 15.58 |
| Gramoxone | l | 19.14 |
| Sting | Box | 20.43 |
| Boxes | | 2.81 |
| Drainage | | 5000.00 |
| Trelising system | Ha | 5.32 |
| Soil Analysis | Ha | 18.00 |
| **Irrigation:** | | |
| Electric pump | Ha | 1800.00 |
| Pump housing | Ha | 250.00 |
| Electicity point | Ha | 1750.00 |
| Irrigation equipment | Ha | 5633.00 |
| **Machinery:** | | |
| Diesel | l | 2.81 |
| Implements | Hour | 43.86 |
| Repairs | MM | 0.06 |
| Electricity | KW-H | 0.41 |
| **Fixed Cost: Machinery** | | |
| Tractor | Ha | 46.45 |
| Insurance | Ha | 7.74 |
| Interest | Ha | 7.74 |
| **Labour:** | | |
| Land preparation | Hour | 92.80 |
| Permanent labour | Hour | 450.00 |
| Advisors | Hour | 217.00 |
| General | Hour | 2.25 |
| Lab. Pickup Roots | Hour | 2.25 |
| Lab. Holes & Plan | Hour | 2.25 |
| Lab. Cultivate | Hour | 2.25 |
| Lab. Fert. | Hour | 2.60 |
| Lab. Cutt. | Hour | 2.25 |
| Lab. Thin out | Hour | 2.25 |
| Irrigation Labour | Hour | 2.70 |
| Machine Crew Labour | Hour | 2.70 |
| Machinery Labour | Hour | 2.70 |
| Lab. Harvest | Hour | 2.25 |
| Packaging | Hour | 2.25 |
| Packaging | Hour | 2.25 |

**Table A.13: Irrigated peach enterprise-Technical Coefficients in the Lowlands**

| Item | | Year 0 | Year 1 | Year 2 | Year 3 | Year 4 | Year 5 | Year 6 | Year 7 | Year 8 | Year 9 | Year 10 | Year 11 | Year 12 | Year 13 | Year 14 | Year 15 | Year 16 | Year 17 | Year 18 | Year 19 | Year 20 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Gross Returns:** | | | | | | | | | | | | | | | | | | | | | | |
| Peaches Domestic | Kg | 0.00 | 0.00 | 0.00 | 2620.00 | 2685.00 | 3500.00 | 3500.00 | 3500.00 | 4860.00 | 4860.00 | 4860.00 | 4860.00 | 4860.00 | 4860.00 | 4860.00 | 4860.00 | 4860.00 | 4860.00 | 3500.00 | 3500.00 | 3500.00 |
| Peaches Export | | 0.00 | 0.00 | 0.00 | 1500.00 | 4500.00 | 7600.00 | 7600.00 | 7600.00 | 15000.00 | 15000.00 | 15000.00 | 15000.00 | 15000.00 | 15000.00 | 15000.00 | 15000.00 | 15000.00 | 15000.00 | 7600.00 | 7600.00 | 7600.00 |
| **Purchased Inputs:** | | | | | | | | | | | | | | | | | | | | | | |
| Peach Trees | Tree | 1250.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Eragros.Seed | Kg | 3.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Lime | Ton | 3.50 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Sup.Phosphate 10 | Ton | 0.50 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| LAN | Kg | 60.00 | 120.00 | 100.00 | 100.00 | 150.00 | 150.00 | 150.00 | 150.00 | 150.00 | 150.00 | 150.00 | 150.00 | 150.00 | 150.00 | 150.00 | 150.00 | 150.00 | 150.00 | 150.00 | 150.00 | 150.00 |
| Zinc Okside | Kg | 0.50 | 0.50 | 0.63 | 0.63 | 0.75 | 0.75 | 0.75 | 0.75 | 0.75 | 0.75 | 0.75 | 0.75 | 0.75 | 0.75 | 0.75 | 0.75 | 0.75 | 0.75 | 0.75 | 0.75 | 0.75 |
| Manganese S. | Kg | 2.00 | 2.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 3:2:1(25)+ZN | Kg | 0.00 | 50.00 | 150.00 | 150.00 | 375.00 | 375.00 | 375.00 | 375.00 | 375.00 | 375.00 | 375.00 | 375.00 | 375.00 | 375.00 | 375.00 | 375.00 | 375.00 | 375.00 | 375.00 | 375.00 | 375.00 |
| Low Buret | Kg | 2.50 | 5.00 | 6.25 | 6.25 | 7.50 | 7.50 | 7.50 | 7.50 | 7.50 | 7.50 | 7.50 | 7.50 | 7.50 | 7.50 | 7.50 | 7.50 | 7.50 | 7.50 | 7.50 | 7.50 | 7.50 |
| Thiodan | Kg | 0.00 | 0.00 | 1.25 | 1.25 | 1.50 | 1.50 | 1.50 | 1.50 | 1.50 | 1.50 | 1.50 | 1.50 | 1.50 | 1.50 | 1.50 | 1.50 | 1.50 | 1.50 | 1.50 | 1.50 | 1.50 |
| Baycor | l | 0.00 | 0.00 | 0.50 | 0.50 | 0.60 | 0.60 | 0.60 | 0.60 | 0.60 | 0.60 | 0.60 | 0.60 | 0.60 | 0.60 | 0.60 | 0.60 | 0.60 | 0.60 | 0.60 | 0.60 | 0.60 |
| Tokuthion | l | 0.00 | 0.25 | 0.50 | 0.50 | 0.75 | 0.75 | 0.75 | 0.75 | 0.75 | 0.75 | 0.75 | 0.75 | 0.75 | 0.75 | 0.75 | 0.75 | 0.75 | 0.75 | 0.75 | 0.75 | 0.75 |
| Thiram | Kg | 2.50 | 0.75 | 1.50 | 1.50 | 2.25 | 2.25 | 2.25 | 2.25 | 2.25 | 2.25 | 2.25 | 2.25 | 2.25 | 2.25 | 2.25 | 2.25 | 2.25 | 2.25 | 2.25 | 2.25 | 2.25 |
| Agral | Kg | 0.10 | 0.10 | 0.13 | 0.13 | 0.15 | 0.15 | 0.15 | 0.15 | 0.15 | 0.15 | 0.15 | 0.15 | 0.15 | 0.15 | 0.15 | 0.15 | 0.15 | 0.15 | 0.15 | 0.15 | 0.15 |
| Lebaycide | l | 0.00 | 0.00 | 1.50 | 1.50 | 2.00 | 2.00 | 2.00 | 2.00 | 2.00 | 2.00 | 2.00 | 2.00 | 2.00 | 2.00 | 2.00 | 2.00 | 2.00 | 2.00 | 2.00 | 2.00 | 2.00 |
| Demuldex | l | 0.25 | 2.00 | 6.00 | 6.00 | 8.00 | 8.00 | 8.00 | 8.00 | 8.00 | 8.00 | 8.00 | 8.00 | 8.00 | 8.00 | 8.00 | 8.00 | 8.00 | 8.00 | 8.00 | 8.00 | 8.00 |
| Gramoxone | l | 0.00 | 0.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 |
| Sting | l | 0.00 | 0.00 | 3.00 | 3.00 | 3.00 | 3.00 | 3.00 | 3.00 | 3.00 | 3.00 | 3.00 | 3.00 | 3.00 | 3.00 | 3.00 | 3.00 | 3.00 | 3.00 | 3.00 | 3.00 | 3.00 |
| Boxes | Box | 0.00 | 0.00 | 0.00 | 1150.00 | 3150.00 | 3150.00 | 3150.00 | 3150.00 | 3150.00 | 3150.00 | 3150.00 | 3150.00 | 3150.00 | 3150.00 | 3150.00 | 3150.00 | 3150.00 | 3150.00 | 3150.00 | 3150.00 | 3150.00 |
| Trelising system | Ha | 1250.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Drainage | Ha | 1.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Soil Analysis | Ha | 2.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| **Irrigation:** | | | | | | | | | | | | | | | | | | | | | | |
| Electric pump | Ha | 1.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Pump housing | Ha | 1.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Electicity point | Ha | 1.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Irrigation equipment | Ha | 1.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| **Machinery:** | | | | | | | | | | | | | | | | | | | | | | |
| Diesel | l | 120.45 | 23.30 | 38.59 | 38.59 | 38.59 | 38.59 | 38.59 | 38.59 | 38.59 | 38.59 | 38.59 | 38.59 | 38.59 | 38.59 | 38.59 | 38.59 | 38.59 | 38.59 | 38.59 | 38.59 | 38.59 |
| Implements | Hour | 15.10 | 2.80 | 2.80 | 5.60 | 5.60 | 40.50 | 40.50 | 40.50 | 40.50 | 40.50 | 40.50 | 40.50 | 40.50 | 40.50 | 40.50 | 40.50 | 40.50 | 40.50 | 40.50 | 40.50 | 40.50 |
| Repairs | MM | 81.20 | 165.00 | 165.00 | 200.00 | 200.00 | 350.00 | 350.00 | 350.00 | 350.00 | 350.00 | 350.00 | 350.00 | 350.00 | 350.00 | 350.00 | 350.00 | 350.00 | 350.00 | 350.00 | 350.00 | 350.00 |
| Electricity | Kw-h | 3560.00 | 2000.00 | 2000.00 | 2800.00 | 2800.00 | 3650.00 | 3650.00 | 3650.00 | 3650.00 | 3650.00 | 3650.00 | 3650.00 | 3650.00 | 3650.00 | 3650.00 | 3650.00 | 3650.00 | 3650.00 | 3650.00 | 3650.00 | 3650.00 |
| **Fixed Cost: Machinery** | | | | | | | | | | | | | | | | | | | | | | |
| Tractor | Ha | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 |
| Hail Insurance | Ha | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 |
| Interest | Ha | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 |
| **Labour:** | | | | | | | | | | | | | | | | | | | | | | |
| Land preparation | Ha | 1.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Permanent labour | Ha | 1.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Advisors | Hour | 1.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| General | Hour | 1.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Lab. Pickup Roots | Hour | 10.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Lab. Holes & Plan | Hour | 40.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Lab. Cultivate | Hour | 200.00 | 200.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Lab. Fert. | Hour | 16.00 | 0.00 | 1.25 | 1.25 | 8.00 | 8.00 | 8.00 | 8.00 | 8.00 | 8.00 | 8.00 | 8.00 | 8.00 | 8.00 | 8.00 | 8.00 | 8.00 | 8.00 | 8.00 | 8.00 | 8.00 |
| Lab. Cutt. | Hour | 2.00 | 33.00 | 67.00 | 67.00 | 87.50 | 87.50 | 87.50 | 87.50 | 87.50 | 87.50 | 87.50 | 87.50 | 87.50 | 87.50 | 87.50 | 87.50 | 87.50 | 87.50 | 87.50 | 87.50 | 87.50 |
| Lab. Thin out | Hour | 0.50 | 0.00 | 63.00 | 63.00 | 125.00 | 125.00 | 125.00 | 125.00 | 125.00 | 125.00 | 125.00 | 125.00 | 125.00 | 125.00 | 125.00 | 125.00 | 125.00 | 125.00 | 125.00 | 125.00 | 125.00 |
| Irrigation Labour | Hour | 0.00 | 0.00 | 4.50 | 4.50 | 4.50 | 4.50 | 4.50 | 4.50 | 4.50 | 4.50 | 4.50 | 4.50 | 4.50 | 4.50 | 4.50 | 4.50 | 4.50 | 4.50 | 4.50 | 4.50 | 4.50 |
| Machine Crew Labour | Hour | 3.27 | 1.69 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Machinery Labour | Hour | 10.53 | 2.63 | 4.97 | 4.97 | 4.97 | 4.97 | 4.97 | 4.97 | 4.97 | 4.97 | 4.97 | 4.97 | 4.97 | 4.97 | 4.97 | 4.97 | 4.97 | 4.97 | 4.97 | 4.97 | 4.97 |
| Lab. Harvest | Hour | 0.00 | 0.00 | 96.00 | 96.00 | 96.00 | 96.00 | 96.00 | 96.00 | 96.00 | 96.00 | 96.00 | 96.00 | 96.00 | 96.00 | 96.00 | 96.00 | 96.00 | 96.00 | 96.00 | 96.00 | 96.00 |
| Packaging | Hour | 0.00 | 0.00 | 60.00 | 60.00 | 180.00 | 180.00 | 180.00 | 180.00 | 180.00 | 180.00 | 180.00 | 180.00 | 180.00 | 180.00 | 180.00 | 180.00 | 180.00 | 180.00 | 180.00 | 180.00 | 180.00 |

**Table A.14: Costs and Prices for Peaches in the Lowland**

| Item | Unit | price/unit |
|---|---|---|
| **Gross Returns:** | | |
| Peaches Domestic | Kg | 4.00 |
| Peaches-Export | Kg | 7.92 |
| **Purchased Inputs:** | | |
| Peach Trees | Tree | 16.13 |
| Eragros.Seed | Kg | 14.57 |
| Lime | Ton | 600.00 |
| Sup.Phosphate 10 | Ton | 1530.00 |
| LAN | Kg | 1.11 |
| Zinc Okside | Kg | 9.46 |
| Manganese S. | Kg | 3.41 |
| 3:2:1(25)+ZN | Kg | 1.22 |
| Low Buret | Kg | 2.03 |
| Thiodan | Kg | 15.58 |
| Baycor | l | 18.00 |
| Tokuthion | l | 106.81 |
| Thiram | Kg | 19.27 |
| Agral | Kg | 21.71 |
| Lebaycide | l | 118.83 |
| Demuldex | l | 15.58 |
| Gramoxone | l | 19.14 |
| Sting | l | 20.43 |
| Boxes | Box | 2.81 |
| Trelising system | | 5.32 |
| Drainage | | 5000.00 |
| Soil Analysis | Maloti | 18.00 |
| **Irrigation** | | |
| Electric pump | Ha | 1800.00 |
| Pump housing | Ha | 250.00 |
| Electicity point | Ha | 1750.00 |
| Irrigation equipment | Ha | 5633.00 |
| **Machinery:** | | |
| Diesel | l | 2.81 |
| Implements | Hour | 43.86 |
| Repairs | MM | 0.06 |
| Electricity | Kw-h | 0.41 |
| **Fixed Cost: Machinery** | | |
| Tractor | Ha | 46.45 |
| Insurance | Ha | 17.03 |
| Interest | Ha | 40.88 |
| **Labour:** | | |
| Land preparation | | 92.80 |
| Permanent labour | | 450.00 |
| Advisors | | 217.00 |
| General | | 3.61 |
| Lab. Pickup Roots | Hour | 2.25 |
| Lab. Holes & Plan | Hour | 2.25 |
| Lab. Cultivate | Hour | 2.25 |
| Lab. Fert. | Hour | 2.60 |
| Lab. Cutt. | Hour | 2.25 |
| Lab. Thin out | Hour | 2.25 |
| Irrigation Labour | Hour | 2.70 |
| Machine Crew Labour | Hour | 2.70 |
| Machinery Labour | Hour | 2.70 |
| Lab. Harvest | Hour | 2.25 |
| Packaging | Hour | 2.25 |

**Table A.15: Irrigated Apple Enterprise- Technical Coefficients in the Senqu River Valley**

| Item | Unit/Ha | Year0 | Year1 | Year2 | Year3 | Year4 | Year5 | Year6 | Year7 | Year8 | Year9 | Year10 | Year11 | Year12 | Year13 | Year14 | Year15 | Year16 | Year17 | Year18 | Year19 | Year20 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Gross Returns:** | | | | | | | | | | | | | | | | | | | | | | |
| Apples- Export | Kg | 0 | 0 | 0 | | 8400 | 13300 | 18650 | 18650 | 18650 | 18650 | 18650 | 18650 | 18650 | 18650 | 18650 | 18650 | 18650 | 18650 | 13300 | 13300 | 13300 |
| Apples- Domestic | Kg | 0 | 0 | 0 | | 2500 | 2500 | 5000 | 5000 | 5000 | 5000 | 5000 | 5000 | 5000 | 5000 | 5000 | 5000 | 5000 | 5000 | 2500 | 2500 | 2500 |
| **Purchased Imputs:** | | | | | | | | | | | | | | | | | | | | | | |
| Apple Trees | Tree | 1250 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Eragros.Seed | Kg | 1.5 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Lime | Ton | 5 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Sup.Phosphate 10 | Kg | 1000 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| LAN/KG | Kg | 199.98 | 622.16 | 622.16 | 622.16 | 166.65 | 166.65 | 222.2 | 222.2 | 222.2 | 222.2 | 222.2 | 222.2 | 222.2 | 222.2 | 222.2 | 222.2 | 222.2 | 222.2 | 222.2 | 222.2 | 222.2 |
| Zinc Oxide | Kg | 0.278 | 0.833 | 0.833 | 0.833 | | | | | | | | | | | | | | | | | |
| Manganese S. | Kg | 1.945 | 4.445 | 4.445 | 4.445 | 0.333 | 0.333 | 0.333 | 0.333 | 0.333 | 0.333 | 0.333 | 0.333 | 0.333 | 0.333 | 0.333 | 0.333 | 0.333 | 0.333 | 0.333 | 0.333 | 0.333 |
| 3:2:1(25)+ZN | Kg | 0 | 0 | 0 | 0 | 222.2 | 222.2 | 333.3 | 333.3 | 333.3 | 333.3 | 333.3 | 333.3 | 333.3 | 333.3 | 333.3 | 333.3 | 333.3 | 333.3 | 333.3 | 333.3 | 333.3 |
| Low Buret | Kg | 4.861 | 11.11 | 11.11 | 11.11 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Tokuthion | l | 0 | 0 | 0 | 0 | 0.833 | 0.833 | 0.833 | 0.833 | 0.833 | 0.833 | 0.833 | 0.833 | 0.833 | 0.833 | 0.833 | 0.833 | 0.833 | 0.833 | 0.833 | 0.833 | 0.833 |
| Cupravit | Kg | 0 | 0 | 0 | 0 | 4.166 | 4.166 | 4.166 | 4.166 | 4.166 | 4.166 | 4.166 | 4.166 | 4.166 | 4.166 | 4.166 | 4.166 | 4.166 | 4.166 | 4.166 | 4.166 | 4.166 |
| Agral | Kg | 0 | 0 | 0 | 0 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 |
| Demuldex | l | 0.695 | 1.389 | 1.389 | 1.389 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Solubor | Kg | 1.389 | 2.778 | 2.778 | 2.778 | 3.334 | 3.334 | 3.334 | 3.334 | 3.334 | 3.334 | 3.334 | 3.334 | 3.334 | 3.334 | 3.334 | 3.334 | 3.334 | 3.334 | 3.334 | 3.334 | 3.334 |
| Gusathion | Kg | | | | | 0.833 | 0.833 | 0.833 | 0.833 | 0.833 | 0.833 | 0.833 | 0.833 | 0.833 | 0.833 | 0.833 | 0.833 | 0.833 | 0.833 | 0.833 | 0.833 | 0.833 |
| Cascade | l | | | | | 0.833 | 0.833 | 0.883 | 0.883 | 0.883 | 0.883 | 0.883 | 0.883 | 0.883 | 0.883 | 0.883 | 0.883 | 0.883 | 0.883 | 0.883 | 0.883 | 0.883 |
| Killval | | 0 | 0 | 0 | 0 | 2.083 | 2.083 | 2.083 | 2.083 | 2.083 | 2.083 | 2.083 | 2.083 | 2.083 | 2.083 | 2.083 | 2.083 | 2.083 | 2.083 | 2.083 | 2.083 | 2.083 |
| Ultracide | Kg | 0 | 0 | 0 | 0 | 1.667 | 1.667 | 1.667 | 1.667 | 1.667 | 1.667 | 1.667 | 1.667 | 1.667 | 1.667 | 1.667 | 1.667 | 1.667 | 1.667 | 1.667 | 1.667 | 1.667 |
| Gramoxone | l | | 8 | 8 | 8 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 |
| Dithane | Kg | 3.333 | 5 | 5 | 5 | 2.5 | 2.5 | 2.5 | 2.5 | 2.5 | 2.5 | 2.5 | 2.5 | 2.5 | 2.5 | 2.5 | 2.5 | 2.5 | 2.5 | 2.5 | 2.5 | 2.5 |
| Systhane | Kg | 0.836 | 0.5 | 0.5 | 0.5 | 0.75 | 0.75 | 0.75 | 0.75 | 0.75 | 0.75 | 0.75 | 0.75 | 0.75 | 0.75 | 0.75 | 0.75 | 0.75 | 0.75 | 0.75 | 0.75 | 0.75 |
| Insegar | G | 0 | 0 | 0 | 0 | 1.333 | 1.333 | 1.333 | 1.333 | 1.333 | 1.333 | 1.333 | 1.333 | 1.333 | 1.333 | 1.333 | 1.333 | 1.333 | 1.333 | 1.333 | 1.333 | 1.333 |
| Sting | l | 0 | 0 | 0 | 0 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 |
| Box 18Kg | Box | 0 | 0 | 0 | 0 | 583 | 583 | 1555 | 1555 | 1555 | 1555 | 1555 | 1555 | 1555 | 1555 | 1555 | 1555 | 1555 | 1555 | 1555 | 1555 | 1555 |
| Box 10Kg | Box | 0 | 0 | 0 | 0 | 300 | 300 | 800 | 800 | 800 | 800 | 800 | 800 | 800 | 800 | 800 | 800 | 800 | 800 | 800 | 800 | 800 |
| Bailing Twine | Kg | 17.35 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Soil Analysis | Maloti | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Box | Box | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Trelising system | Tree | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Drainage | Ha | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| **Irrigation** | | | | | | | | | | | | | | | | | | | | | | |
| Electric pump | ha | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Pump housing | ha | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Electicity point | ha | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Irrigation equipment | ha | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| **Machinery:** | | | | | | | | | | | | | | | | | | | | | | |
| Diesel | l | 100.2 | 69.31 | 69.31 | 38.5 | 38.5 | 40.23 | 40.23 | 40.23 | 40.23 | 40.23 | 40.23 | 40.23 | 40.23 | 40.23 | 40.23 | 40.23 | 40.23 | 40.23 | 40.23 | 40.23 | 40.23 |
| Implements | hour | 40 | 56.2 | 56.2 | 60.82 | 60.82 | 61 | 61 | 61 | 61 | 61 | 61 | 61 | 61 | 61 | 61 | 61 | 61 | 61 | 61 | 61 | 61 |
| Repairs | MM | 80 | 170 | 170 | 210 | 210 | 390 | 390 | 390 | 390 | 390 | 390 | 390 | 390 | 390 | 390 | 390 | 390 | 390 | 390 | 390 | 390 |
| Electricity | kw-h | 16100 | 16413.68 | 16413.68 | 17000 | 17000 | 16413.68 | 16413.68 | 16413.68 | 16413.68 | 16413.68 | 16413.68 | 16413.68 | 16413.68 | 16413.68 | 16413.68 | 16413.68 | 16413.68 | 16413.68 | 16413.68 | 16413.68 | 16413.68 |
| **Fixed Cost:-Machinery** | | | | | | | | | | | | | | | | | | | | | | |
| Hail Insurance | Rand | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| Tractor | ha | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| Interest | ha | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| **Labour:** | | | | | | | | | | | | | | | | | | | | | | |
| Lab. Holes & Plan | hour | | 6 | 6 | 6 | 160 | 160 | 360 | 360 | 360 | 360 | 360 | 360 | 360 | 360 | 360 | 360 | 360 | 360 | 360 | 360 | 360 |
| Lab.tree form | hour | 48 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Lab. Cutt. | hour | | 72 | 72 | 72 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Lab.Cultivate | hour | | | | | 160 | 160 | 360 | 360 | 360 | 360 | 360 | 360 | 360 | 360 | 360 | 360 | 360 | 360 | 360 | 360 | 360 |
| Lab.Making Spar | hour | 6 | 14 | 14 | 14 | 5.5 | 5.5 | 7 | 7 | 7 | 7 | 7 | 7 | 7 | 7 | 7 | 7 | 7 | 7 | 7 | 7 | 7 |
| Lab. Thin out | hour | 80 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Lab.Fert. | hour | 38 | 32 | 32 | 32 | | | | | | | | | | | | | | | | | |
| Machinery labour | hour | 0 | 0 | 0 | 0 | 160 | 160 | 424 | 424 | 424 | 424 | 424 | 424 | 424 | 424 | 424 | 424 | 424 | 424 | 424 | 424 | 424 |
| Machine Crew Labou | hour | 24 | 51 | 51 | 51 | 51 | 51 | 58.5 | 58.5 | 58.5 | 58.5 | 58.5 | 58.5 | 58.5 | 58.5 | 58.5 | 58.5 | 58.5 | 58.5 | 58.5 | 58.5 | 58.5 |
| Irrigation labour | hour | 6.038 | 1.494 | 1.494 | 1.494 | 1.494 | 1.494 | 1.494 | 1.494 | 1.494 | 1.494 | 1.494 | 1.494 | 1.494 | 1.494 | 1.494 | 1.494 | 1.494 | 1.494 | 1.494 | 1.494 | 1.494 |
| Labour harvesting | hour | 0 | 0 | 0 | 0 | 1.86 | 1.86 | 5.001 | 5.001 | 5.001 | 5.001 | 5.001 | 5.001 | 5.001 | 5.001 | 5.001 | 5.001 | 5.001 | 5.001 | 5.001 | 5.001 | 5.001 |
| Packaging | Hour | 0 | 0 | 0 | 0 | 200 | 200 | 520 | 520 | 520 | 520 | 520 | 520 | 520 | 520 | 520 | 520 | 520 | 520 | 520 | 520 | 520 |

**Table A.16: Irrigated Apple Enterprise- Costs and Prices in the Senqu River**

| Item | Unit/Ha | Cost/Price |
|---|---|---|
| **Gross Returns:** | | |
| Apples- Export | Kg | 6.11 |
| Apples- Domestic | Kg | 3.24 |
| **Purchased Imputs:** | | |
| Apple Trees | Tree | 11.79 |
| Eragros.Seed | Kg | 17.14 |
| Lime | Ton | 194.06 |
| Sup.Phosphate 10 | Kg | 1.08 |
| LAN | Kg | 1.39 |
| Zinc Okside | Kg | 11.16 |
| Manganese S. | Kg | 4.08 |
| 3:2:1(25)+ZN | Kg | 1.52 |
| Low Buret | Kg | 2.77 |
| Tokuthion | L | 125.06 |
| Cupravit | Kg | 11.28 |
| Thiram | Kg | 25.50 |
| Agral | Kg | 18.32 |
| Lebaycide | L | 1.57 |
| Demuldex | L | 88.59 |
| Solubor | Kg | 368.12 |
| Gusathion | Kg | 115.53 |
| Cascade | L | 125.51 |
| Killval | | 0.09 |
| Ultracide | Kg | 22.04 |
| Gramoxone | L | 838.54 |
| Dithane | Kg | 4.16 |
| Systhane | Kg | 24.00 |
| Insegar | G | 6.96 |
| Sting | L | 5.48 |
| Soil Analysis | Maloti | 14.68 |
| Bailing Twine | Kg | 21.15 |
| Box | Box | 7.42 |
| Trelising system | | 5.32 |
| Drainage | | 5000.00 |
| **Irrigation** | | |
| Electric pump | | 1636.36 |
| Pump housing | | 250.00 |
| Electicity point | | 1750.00 |
| Irrigation equipment | | 5120.91 |
| **Machinery:** | | |
| Diesel | l | 2.81 |
| Implements | Hour | 43.80 |
| Repairs | MM | 0.06 |
| Electricity | kw-h | 0.41 |
| **Fixed Cost:-Machinery** | | |
| Insurance | Rand | 17.03 |
| Tractor | Ha | 46.45 |
| Interest | Ha | 40.88 |
| **Labour:** | | |
| Lab. Holes & Plan | Hour | 2.50 |
| Lab.tree form | Hour | 2.50 |
| Lab. Cutt. | Hour | 2.50 |
| Lab.Cultivate | Hour | 2.50 |
| Lab.Making Spar | Hour | 2.50 |
| Lab. Thin out | Hour | 2.73 |
| Lab.Fert. | Hour | 2.73 |
| Machinery labour | Hour | 2.73 |
| Machine Crew Labour | Hour | 4.00 |
| Irrigation labour | Hour | 4.00 |
| Labour harvesting | Hour | 4.00 |
| Packaging | Hour | 4.00 |

**Table A.17: Irrigated Peach -Technical Coefficients in the Senqu River Valley**

| Item | Unit/ha | Year 0 | Year 1 | Year 2 | Year 3 | Year 4 | Year 5 | Year 6 | Year 7 | Year 8 | Year 9 | Year 10 | Year 11 | Year 12 | Year 13 | Year 14 | Year 15 | Year 16 | Year 17 | Year 18 | Year 19 | Year 20 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Gross Receipts:** | | | | | | | | | | | | | | | | | | | | | | |
| Peaches- Domestic | Kg | | | | 1000.00 | 1000.00 | 3000.00 | 3000.00 | 3000.00 | 5000.00 | 5000.00 | 5000.00 | 5000.00 | 5000.00 | 5000.00 | 5000.00 | 5000.00 | 5000.00 | 5000.00 | 3000.00 | 3000.00 | 3000.00 |
| Peaches- Export | Kg | | | | 1300.00 | 2000.00 | 6000.00 | 6000.00 | 6000.00 | 10000.00 | 10000.00 | 10000.00 | 10000.00 | 10000.00 | 10000.00 | 10000.00 | 10000.00 | 10000.00 | 10000.00 | 6000.00 | 6000.00 | 6000.00 |
| **Purchased Imputs:** | | | | | | | | | | | | | | | | | | | | | | |
| Peach Trees | Tree | 1250.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Eragros.Seed | Kg | 3.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Lime | Ton | 3.50 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Sup.Phosphate 10 | Kg | 0.50 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| LAN/KG | Kg | 60.00 | 120.00 | 100.00 | 100.00 | 150.00 | 150.00 | 150.00 | 150.00 | 150.00 | 150.00 | 150.00 | 150.00 | 150.00 | 150.00 | 150.00 | 150.00 | 150.00 | 150.00 | 150.00 | 150.00 | 150.00 |
| Zinc Okside | Kg | 0.50 | 0.50 | 0.63 | 0.63 | 0.75 | 0.75 | 0.75 | 0.75 | 0.75 | 0.75 | 0.75 | 0.75 | 0.75 | 0.75 | 0.75 | 0.75 | 0.75 | 0.75 | 0.75 | 0.75 | 0.75 |
| Manganese S. | Kg | 2.00 | 2.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Low Buret | Kg | 0.00 | 50.00 | 150.00 | 150.00 | 375.00 | 375.00 | 375.00 | 375.00 | 375.00 | 375.00 | 375.00 | 375.00 | 375.00 | 375.00 | 375.00 | 375.00 | 375.00 | 375.00 | 375.00 | 375.00 | 375.00 |
| 3:2:1(25)+ZN | Kg | 2.50 | 5.00 | 6.25 | 6.25 | 7.50 | 7.50 | 7.50 | 7.50 | 7.50 | 7.50 | 7.50 | 7.50 | 7.50 | 7.50 | 7.50 | 7.50 | 7.50 | 7.50 | 7.50 | 7.50 | 7.50 |
| Thiodan | Kg | 0.00 | 0.00 | 1.25 | 1.25 | 1.50 | 1.50 | 1.50 | 1.50 | 1.50 | 1.50 | 1.50 | 1.50 | 1.50 | 1.50 | 1.50 | 1.50 | 1.50 | 1.50 | 1.50 | 1.50 | 1.50 |
| Baycor | l | 0.00 | 0.00 | 0.50 | 0.50 | 0.60 | 0.60 | 0.60 | 0.60 | 0.60 | 0.60 | 0.60 | 0.60 | 0.60 | 0.60 | 0.60 | 0.60 | 0.60 | 0.60 | 0.60 | 0.60 | 0.60 |
| Tokuthion | l | 0.00 | 0.25 | 0.50 | 0.50 | 0.75 | 0.75 | 0.75 | 0.75 | 0.75 | 0.75 | 0.75 | 0.75 | 0.75 | 0.75 | 0.75 | 0.75 | 0.75 | 0.75 | 0.75 | 0.75 | 0.75 |
| Thiram | Kg | 2.50 | 0.75 | 1.50 | 1.50 | 2.25 | 2.25 | 2.25 | 2.25 | 2.25 | 2.25 | 2.25 | 2.25 | 2.25 | 2.25 | 2.25 | 2.25 | 2.25 | 2.25 | 2.25 | 2.25 | 2.25 |
| Agral | Kg | 0.10 | 0.10 | 0.13 | 0.13 | 0.15 | 0.15 | 0.15 | 0.15 | 0.15 | 0.15 | 0.15 | 0.15 | 0.15 | 0.15 | 0.15 | 0.15 | 0.15 | 0.15 | 0.15 | 0.15 | 0.15 |
| Lebaycide | l | 0.00 | 0.00 | 1.50 | 1.50 | 2.00 | 2.00 | 2.00 | 2.00 | 2.00 | 2.00 | 2.00 | 2.00 | 2.00 | 2.00 | 2.00 | 2.00 | 2.00 | 2.00 | 2.00 | 2.00 | 2.00 |
| Demuldex | l | 0.25 | 2.00 | 6.00 | 6.00 | 8.00 | 8.00 | 8.00 | 8.00 | 8.00 | 8.00 | 8.00 | 8.00 | 8.00 | 8.00 | 8.00 | 8.00 | 8.00 | 8.00 | 8.00 | 8.00 | 8.00 |
| Gramoxone | l | 0.00 | 0.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 |
| Sting | l | 0.00 | 0.00 | 3.00 | 3.00 | 3.00 | 3.00 | 3.00 | 3.00 | 3.00 | 3.00 | 3.00 | 3.00 | 3.00 | 3.00 | 3.00 | 3.00 | 3.00 | 3.00 | 3.00 | 3.00 | 3.00 |
| Boxes | Box | 0.00 | 0.00 | 1050.00 | 1150.00 | 3150.00 | 3150.00 | 3150.00 | 3150.00 | 3150.00 | 3150.00 | 3150.00 | 3150.00 | 3150.00 | 3150.00 | 3150.00 | 3150.00 | 3150.00 | 3150.00 | 3150.00 | 3150.00 | 3150.00 |
| Trelising system | Ha | 1250.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Drainage | Ha | 1.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Soil Analysis | Ha | 2.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| **Irrigation:** | | | | | | | | | | | | | | | | | | | | | | |
| Electric pump | | 1.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Pump housing | | 1.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Electicity point | | 1.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Irrigation equipment | | 1.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| **Machinery:** | | | | | | | | | | | | | | | | | | | | | | |
| Diesel | l | 120.45 | 120.45 | 120.45 | 120.45 | 120.45 | 120.45 | 120.45 | 120.45 | 120.45 | 120.45 | 120.45 | 120.45 | 120.45 | 120.45 | 120.45 | 120.45 | 120.45 | 120.45 | 120.45 | 120.45 | 120.45 |
| Implements | Hour | 15.10 | 15.10 | 15.10 | 15.10 | 15.10 | 15.10 | 15.10 | 15.10 | 15.10 | 15.10 | 15.10 | 15.10 | 15.10 | 15.10 | 15.10 | 15.10 | 15.10 | 15.10 | 15.10 | 15.10 | 15.10 |
| Repairs | MM | 81.20 | 81.20 | 81.20 | 81.20 | 81.20 | 81.20 | 81.20 | 81.20 | 81.20 | 81.20 | 81.20 | 81.20 | 81.20 | 81.20 | 81.20 | 81.20 | 81.20 | 81.20 | 81.20 | 81.20 | 81.20 |
| Electricity | kw-h | 3560.00 | 3560.00 | 3560.00 | 3560.00 | 3560.00 | 3560.00 | 3560.00 | 3560.00 | 3560.00 | 3560.00 | 3560.00 | 3560.00 | 3560.00 | 3560.00 | 3560.00 | 3560.00 | 3560.00 | 3560.00 | 3560.00 | 3560.00 | 3560.00 |
| **Fixed Cost:** | | | | | | | | | | | | | | | | | | | | | | |
| Tractor | Ha | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 |
| Insurance | Ha | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 |
| Interest | Ha | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 |
| **Labour:** | | | | | | | | | | | | | | | | | | | | | | |
| Land preparation | Hour | 1.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Permanent labour | Hour | 1.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Advisors | Hour | 1.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| General | Hour | 1.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Lab. Pickup Roots | Hour | 10.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Lab. Holes & Plan | Hour | 40.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Lab. Cultivate | Hour | 200.00 | 200.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Lab. Fert. | Hour | 16.00 | 0.00 | 1.25 | 1.25 | 8.00 | 8.00 | 8.00 | 8.00 | 8.00 | 8.00 | 8.00 | 8.00 | 8.00 | 8.00 | 8.00 | 8.00 | 8.00 | 8.00 | 8.00 | 8.00 | 8.00 |
| Lab. Cutt. | Hour | 2.00 | 33.00 | 67.00 | 67.00 | 87.50 | 87.50 | 87.50 | 87.50 | 87.50 | 87.50 | 87.50 | 87.50 | 87.50 | 87.50 | 87.50 | 87.50 | 87.50 | 87.50 | 87.50 | 87.50 | 87.50 |
| Lab. Thin out | Hour | 0.00 | 0.00 | 63.00 | 63.00 | 125.00 | 125.00 | 125.00 | 125.00 | 125.00 | 125.00 | 125.00 | 125.00 | 125.00 | 125.00 | 125.00 | 125.00 | 125.00 | 125.00 | 125.00 | 125.00 | 125.00 |
| Irrigation Labour | Hour | 0.00 | 0.00 | 4.50 | 4.50 | 4.50 | 4.50 | 4.50 | 4.50 | 4.50 | 4.50 | 4.50 | 4.50 | 4.50 | 4.50 | 4.50 | 4.50 | 4.50 | 4.50 | 4.50 | 4.50 | 4.50 |
| Machine Crew Labour | Hour | 3.27 | 1.69 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Machinery Labour | Hour | 10.53 | 2.63 | 4.97 | 4.97 | 4.97 | 4.97 | 4.97 | 4.97 | 4.97 | 4.97 | 4.97 | 4.97 | 4.97 | 4.97 | 4.97 | 4.97 | 4.97 | 4.97 | 4.97 | 4.97 | 4.97 |
| Lab. Harvest | Hour | 0.00 | 0.00 | 96.00 | 96.00 | 96.00 | 96.00 | 96.00 | 96.00 | 96.00 | 96.00 | 96.00 | 96.00 | 96.00 | 96.00 | 96.00 | 96.00 | 96.00 | 96.00 | 96.00 | 96.00 | 96.00 |
| Packaging | Hour | 0.00 | 0.00 | 60.00 | 60.00 | 180.00 | 180.00 | 180.00 | 180.00 | 180.00 | 180.00 | 180.00 | 180.00 | 180.00 | 180.00 | 180.00 | 180.00 | 180.00 | 180.00 | 180.00 | 180.00 | 180.00 |

**Table A.18: Irrigated Peach Costs and Prices in the Senqu River Valley**

| Item | Unit cost/Price |
|---|---|
| Peaches- Domestic | 4.00 |
| Peaches- Export | 6.51 |
| **Purchased Imputs:** | |
| Peach Trees | 16.13 |
| Eragros.Seed | 14.57 |
| Lime | 600.00 |
| Sup.Phosphate 10 | 1530.00 |
| LAN/KG | 1.11 |
| Zinc Okside | 9.46 |
| Manganese S. | 3.41 |
| Low Buret | 1.22 |
| 3:2:1(25)+ZN | 2.03 |
| Thiodan | 15.58 |
| Baycor | 18.00 |
| Tokuthion | 106.81 |
| Thiram | 19.27 |
| Agral/L | 21.71 |
| Lebaycide | 118.83 |
| Demuldex | 15.58 |
| Gramoxone | 19.14 |
| Sting | 20.43 |
| Boxes | 2.81 |
| Trelising system | 5.32 |
| Drainage | 5000.00 |
| Soil Analysis | 18.00 |
| Irrigation | |
| Electric pump | 1800.00 |
| Pump housing | 250.00 |
| Electicity point | 1750.00 |
| Irrigation equipment | 5633.00 |
| **Machinery:** | |
| Diesel | 2.81 |
| Implements | 43.86 |
| Repairs | 0.06 |
| Electricity | 0.41 |
| **Fixed Cost:** | |
| Tractor | 46.45 |
| Insurance | 7.74 |
| Interest | 40.88 |
| **Labour:** | |
| Land preparation | 92.80 |
| Permanent labour | 450.00 |
| Advisors | 217.00 |
| General | 2.25 |
| Lab. Pickup Roots | 2.25 |
| Lab. Holes & Plan | 2.25 |
| Lab. Cultivate | 2.25 |
| Lab. Fert. | 3.38 |
| Lab. Cutt. | 3.38 |
| Lab. Thin out | 4.00 |
| Irrigation Labour | 92.80 |
| Machine Crew Labour | 3.61 |
| Machinery Labour | 3.61 |
| Lab. Harvest | 2.25 |
| Packaging | 2.70 |