Economic Analysis of Forestry and Commercial Agriculture in the Luvuhvu Catchment

Report on activities in South Africa for DFID Forestry Research Programme Project R7937: Catchment Management and Poverty

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Introduction

Changes in land use and management can impact across whole catchments, because they alter water availability to upstream and downstream users. Alternative land use by stakeholders at one set of locations impacts the water utilisation, economic productivity and livelihood strategies of other groups. Thus, land-use policies must account for hydrological impacts on the whole catchment and for the resultant economic trade-offs among stakeholder groups. A number of previous attempts have been made to develop integrated approaches to modelling natural resources, for example to develop natural resource accounts.

The work outlined in this project builds on this work and takes the process of natural resource accounting a step further by assessing the various land/water use options within a catchment management tool.

Together with staff from CLUWRR and CSIR, CEH staff have developed a simplified catchment scale integrated model in the form of a spreadsheet-based model. This model uses the hydrological data as a structural base on which the economic data and livelihoods components are added. This model will allow CLUWRR to assess how different land use scenarios can impact at catchment level on the hydrological data and consequently on the economic data and livelihoods components.

The aim of the following report is to account for the economic returns associated with the two main land uses in the Luvuhvu catchment: rain-fed plantation forestry and irrigated commercial sub-tropical fruit tree plantations. To achieve this, gross margins for each of two water users have been estimated. In addition to these, employment creation (direct and indirect jobs) by each of these water users has been considered. The results and employment figures have then been used to compare the two water users on economic and social grounds.

As mentioned in the most recent report to FRP, a modified approach has been adopted in developing the economic valuation of hydrological processes. This has been necessary due to scale issues, data availability and the distorting influence of reticulated supplies in the study catchments and more widely in the Limpopo Province. The output is therefore not a Net Rainfall Valuation model *per se* (as mentioned in the original project proposal), but a more replicable methodology for the economic assessment of major land/water uses (commercial forestry and commercial irrigation).

The report starts by focusing on the macro economic situation of the Limpopo province and then of Luvuhvu catchment in particular. This sets the ground for better understanding which are the main drivers affecting the economic situation in the Luvuhvu catchment, and what might be the implication of a water policy option on the local economy.

The report is subdivided into three sections. Section 1 sets the context of the analysis by presenting an overview of the Limpopo province. This is followed by a more specific analysis of the Luvuhvu catchment in section 2. In section 3 the economic and employment implications associated with commercial forestry and commercial agriculture are analysed; and the comparative analysis of the two types of water use is discussed. The report concludes with discussions and policy implications.

1 Macro-economic analysis of the Limpopo province

The Limpopo Province covers an area of about 123,910 km^2, which represents roughly 10.2% of the total land area of South Africa. It was formerly referred to as Northern Province. The population of Limpopo Province is estimated at 5.3 million people (Census 2001). This number represents 12% of the total South African population, making Limpopo province the fourth most populated province after KwaZulu-Natal, Gauteng and Eastern Cape.

Consequently, the population density in Limpopo is 47.1 people per km^2; somewhat higher than the average for the whole country (36.1 per km^2). In addition, the Limpopo province is the province in South Africa with the highest percentage of rural population (86%); and with the highest percentages of black (97%) and female (55%) population.

Table 1 – Socio-economic indicators by province

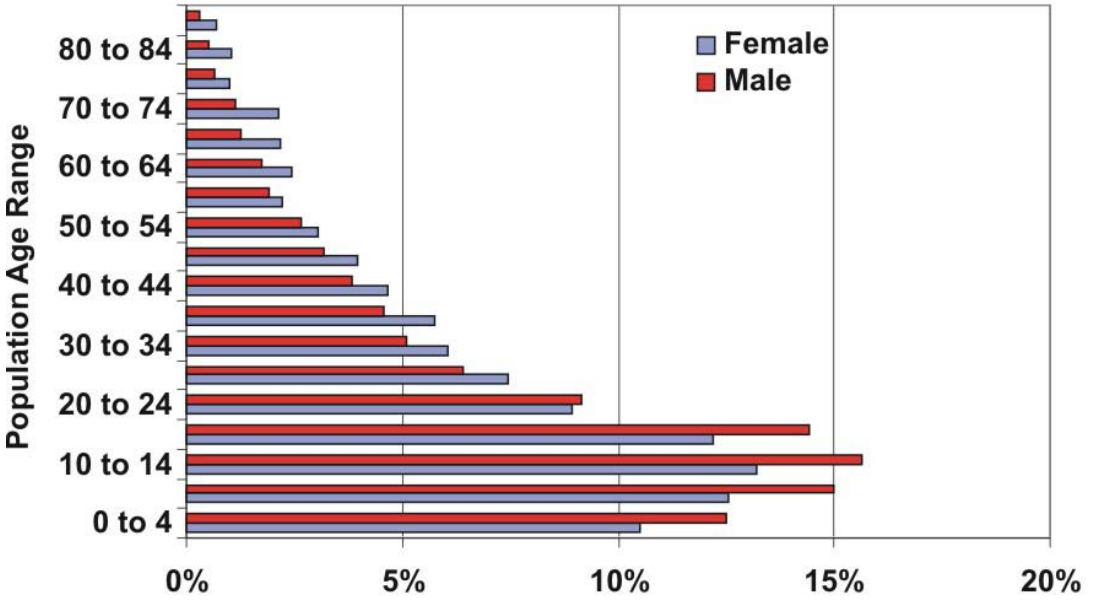
INDICATORS	Year	WC	NC	FS	EC	KZN	MPUM	LP	GAUT	NW	SA
Land Area (%)	2001	10	30	10	14	7	7	10	2	10	100
Population (%)	2001	10	2	6	14	21	7	12	20	8	100
Population Density (p/km^2)	2001	33.7	2.5	21.8	39.0	100.1	37.8	47.1	385.0	30.5	36.1
Population Growth (%)	1999-2001	14.3	-2.1	2.8	2.1	12.0	11.5	7.0	20.3	9.4	10.4
Urban population as % total population	2001	89.5	69.7	71.6	35.2	48.2	42.1	14.2	97.1	38.5	57.9
Non-Urban population as % total population	2001	10.5	30.3	28.4	64.8	51.8	57.9	85.8	2.9	61.5	42.1
Population 0 – 14 yrs (%)	2001	29.4	31.4	30.5	35.5	33.4	35.7	39.4	27.5	32.9	32.9
Population aged 20 and above with no education (%)	2001	5.7	18.2	16.0	22.8	21.9	27.5	33.4	8.4	19.9	17.9
Labour-absorption capacity (%)	1999	81.2	70.0	64.4	46.5	57.1	62.9	51.7	67.5	56.5	62.3
Unemployment rate (%)	1999	18.8	30.0	35.6	53.5	42.9	37.1	48.3	32.5	43.8	37.7
Dependency ratio (no. of people)	1999	1.3	1.7	1.6	3	2.1	2.0	3.5	1	1.8	1.8
Access to water (%)	2001	98.5	96.6	95.7	62.4	73.2	86.7	78	97.5	86.2	84.5
Human development index	1999	0.68	0.56	0.55	0.51	0.55	0.53	0.48	0.69	0.52	0.58
Poverty rate (%)	1999	19.2	39.9	48.2	63.3	53.1	53.6	64.2	27.5	52.7	47.3

Source: Development Information Business Unit Development Bank of Southern Africa

In the period between the 1996 and 2001 censuses, the population of the Limpopo province has grown by 7%; lower than the national average growth rate of 10.4%. In comparison, the population of Gauteng in Western Cape grew by more than 14%. Internal migration of people from rural provinces to more urban provinces may partly explain these different population growths rates.

Figure 1 shows that the Limpopo population is a relatively young, with 39% aged below 14 years. The age distribution of a population is important for many reasons. A young population requires greater education resources, while an elderly population requires more facilities to take care of them. The economy of a country is influenced by the age structure of the population; a relatively small proportion of economically active people (aged between 15 and 64) implies that this group has to support a relatively large proportion of children (in fact Limpopo province has the highest dependency ratio of all South Africa – 3.5).

Figure 1 – Population in five-year age group in Limpopo



Source: Census 2001

One possible reason for the relatively sharp decrease in the number of males between the age ranges 15 – 19 and 25 – 29 might be adult males are particularly likely to move to other provinces in search of job opportunities. Limpopo province has the highest percentage of population with no education (33%). Other indicators such as those related to life expectancy, unemployment, health, water and energy consumption fall far short of overall national average, even for black households. For this reason, the human Development Index (HDI) for the Limpopo Province is the lowest in the country at 0.48; far short of the national average of 0.58 (see table 1). The Limpopo province is the poorest in the country, followed by Eastern Cape. This is shown by their high poverty ratings (64 and 63 respectively). Poverty in South African provinces is uneven distributed; in fact about two-thirds of the poor live in the Eastern Cape, KwaZulu-Natal and Limpopo Province.

1.1 Economic condition of Limpopo province

Economic and social development in the province is poorer than elsewhere. Table 2 shows that, relatively speaking, the Limpopo Province contributes less (6%) towards the domestic economy (as expressed in terms of the GDP) than its share in the national population (12%) and the total land area (10%). The large population relative to the small formal economy results in the lowest level of GDP per capita for the Limpopo province.

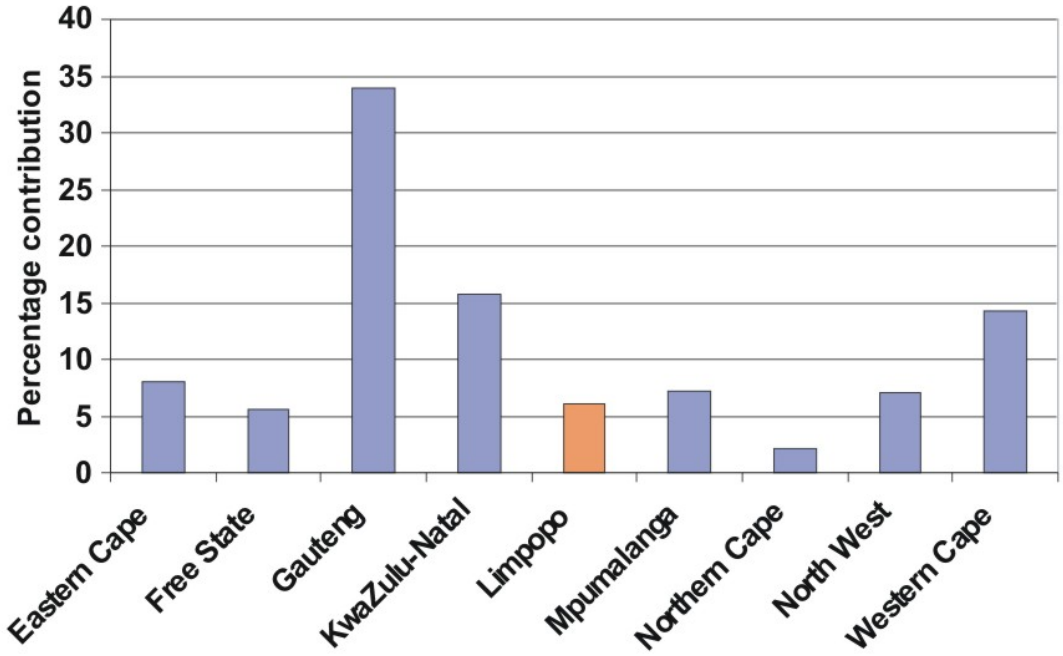
Table 2 - Gross Domestic Product (GDP) for province, 1999

	Population		GDP in R		GDP per capita	
Province	**Thousands**	**% of total**	**Million**	**% of total**	**Rand**	**%**
Eastern Cape	6,769	15.6	64,400	8.0	9,514	5.8
Free State	2,813	6.5	45,108	5.6	16,036	9.7
Gauteng	7,778	18.0	271,728	33.9	34,935	21.2
KwaZulu-Natal	9,003	20.8	126,098	15.7	14,006	8.5
Limpopo	5,310	12.3	48,510	6.1	9,136	5.6
Mpumalanga	3,000	6.9	57,437	7.2	19,146	11.6
Northern Cape	890	2.1	16,604	2.1	18,656	11.3
North West	3,592	8.3	56,524	7.1	15,736	9.6
Western Cape	4,171	9.6	114,331	14.3	27,411	16.7
Total	**43,326**	**100**	**800,740**	**100**	**164,576**	**100**
Provincial average					**18,482**	**11.2**

Source: Development Information Business Unit Development Bank of Southern Africa, Statistics South Africa (2003)

One reason that Limpopo makes such a small contribution to the national GDP is that it is the most rural province. In general, rural economies tend to be less cash-driven than urban ones, as a sizeable portion of the population is involved in the informal and marginal sectors where what they produce is mainly for own consumption.

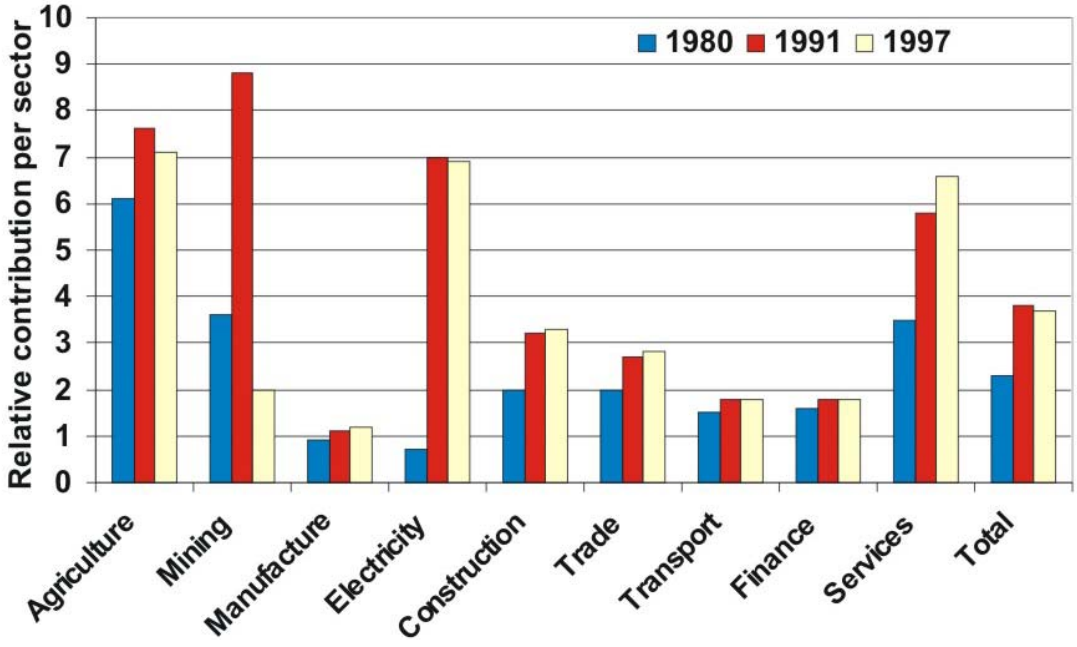
Figure 2 – The relative contribution towards domestic economy per province (1999)



Source: Urban-econ (2000)

Figure 3 shows the relative contribution of the Limpopo province to the domestic economy for each economic sector. The major contributions of the Limpopo province to national production are in terms of agricultural and electricity production.

Figure 3 - Relative Contribution of Limpopo province towards national production per sector (selected years)



Source: Urban-econ (2000)

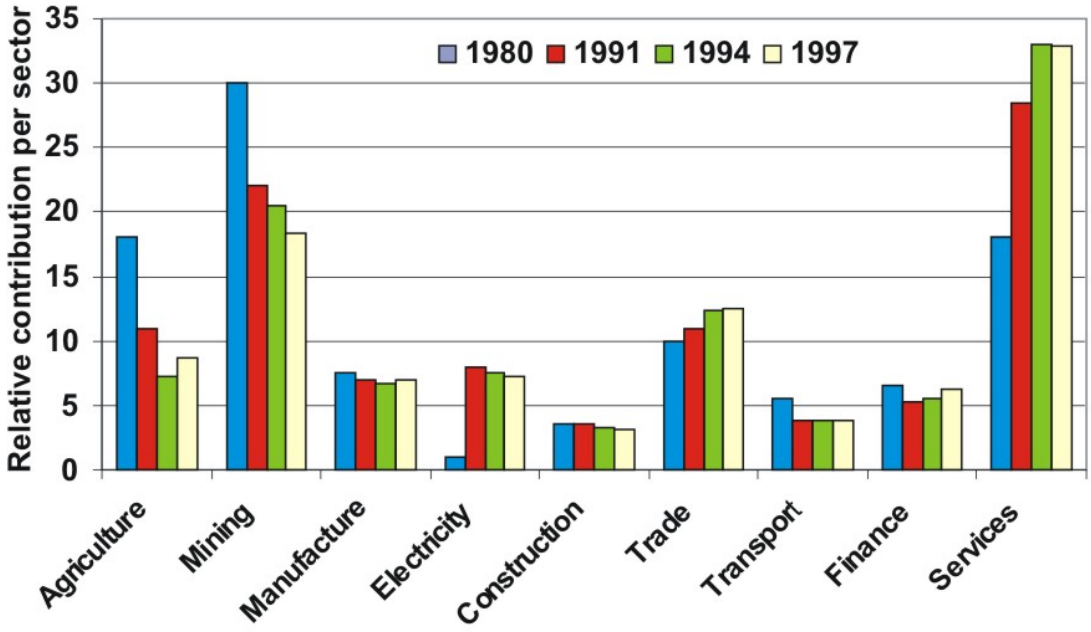
The agricultural economy in the province is driven mainly by horticulture and animal production, contributing about 50% and 35% to the provincial agricultural economy respectively. The Limpopo province produces about 60% of domestic cotton production, 55% of nuts (mostly in the Levubu region), 31% of citrus and 32% of subtropical fruits (*Urban-econ 2000*). Recent observations suggest that there is an increasing trend for farmers in this province to move away from commercial cattle farming to game farming.

The provincial contribution made by the mining sector has fluctuated significantly over the last 20 years, for two main reasons. Firstly, several large mines in the province have been opened and closed during this period. Secondly, there have been drastic variations in international prices of copper and platinum, which are the major minerals abstracted in the region.

Despite a slight increase over the last 20 years, the sector in which Limpopo province is the least competitive with respect to the other provinces is still manufacturing.

Figure 4 shows the relative contribution made to the provincial economy during the last 20 years by each economic sector. It is clear that the Limpopo economy has gone through significant changes. From being driven by primary sectors (mainly mining and agriculture) the economy has moved to a situation where its growth depends exclusively on services. This puts the Limpopo economy not only in a much more vulnerable situation (depending mainly for its growth from only one sector), but also in an artificial one (as the service sector is driven more by political considerations than by economic drivers).

Figure 4 - Relative contribution towards provincial economy per sector



Source: Urban-econ (2000)

Even at the provincial level, manufacturing is one of the sectors that contributes the least to GDP. The small contribution of manufacturing towards the provincial economy is an indicator that most of the primary goods produced in the province are not processed within the province but exported to other provinces to be processed.

This is confirmed by table 3 that shows clearly that only a small proportion (2.8%) of total agricultural production is consumed within the province, whereas the rest is exported.

Table 3 - Final utilisation of goods and services produced within Limpopo province 1985 (%)

Sector	Intermediate consumption		Private consumption		Total Provincial consumption		Provincial exports		International exports	
	Limpopo	Avg.	Limpopo	Avg.	Limpopo	Avg.	Limpopo	Avg.	Limpopo	Avg.
Agriculture	1.4	8.8	1.4	2.7	2.8	11.5	89.1	82.1	8.1	6.4
Mining	0.6	4.7	0.0	0.0	0.6	4.7	87.8	10.8	11.6	84.5
Manufacturing	1.7	16.0	1.5	4.6	3.2	20.6	83.7	65.3	13.1	14.1
Electrical	1.3	17.6	0.3	2.2	1.6	19.8	98.0	79.6	0.4	0.6
Construction	0.7	5.3	0.0	0.0	0.7	5.3	99.3	94.6	0.0	0.1
Trade	0.7	7.5	2.2	14.3	2.9	21.8	88.8	70.5	8.3	7.7
Transportation	0.8	6.9	0.8	6.6	1.6	13.5	67.0	54.1	31.4	32.4
Financial	0.7	13.9	0.9	10.5	1.6	24.4	94.4	71.1	4.0	4.5
Other	1.2	14.7	1.0	11.4	2.2	26.1	97.3	73.4	0.5	0.5
Average	**1.0**	**10.6**	**0.9**	**5.8**	**1.9**	**16.4**	**89.5**	**66.8**	**8.6**	**16.8**

Source: Van Rensburg, 1996: 68; NOTE: Avg. indicates the average for all provinces.

On the other hand, Limpopo is importing a large proportion of good and services; for example, 90% of all agricultural goods consumed or used as intermediary inputs in the Province are imported. Also the other sectors follow the same trend.

Table 4 - Imports of goods and services to the Limpopo province, 1985 (%)

	Imports of goods and services by sector as a percentage of production				Imports of goods and services as a % of total value consumed in province			
Sector	Provincial imports		International imports		Provincial imports		International imports	
	Limpopo	Avg.	Limpopo	Avg.	Limpopo	Avg.	Limpopo	Avg.
Agriculture	39.9	30.8	5.6	4.7	90.7	82.7	4.3	5.2
Mining	31.2	22.1	6.5	4.6	75.9	40.7	12.2	46.2
Manufacturing	59.5	40.1	11.0	15.4	77.4	54.9	21.3	24.0
Electrical	27.5	20.0	8.2	1.6	99.0	80.0	0.0	0.0
Construction	64.9	44.8	5.5	5.0	95.5	67.9	0.6	0.2
Trade	35.1	29.2	2.7	3.1	96.8	75.8	1.4	1.1
Transportation	16.3	22.4	2.3	3.7	88.2	70.2	10.4	10.2
Financial	21.5	14.5	2.1	1.6	94.5	69.3	4.0	4.7
Other	56.5	43.9	6.8	7.9	97.0	73.8	1.5	1.5
Average	**39.2**	**29.8**	**5.6**	**5.3**	**90.6**	**68.4**	**6.2**	**10.4**

Source: Van Rensburg, 1996: 68
Note: Avg. indicates the average for all provinces.

This shows that the formal economy in Limpopo is a very open one. The implication of this outflow of raw primary goods, and the importation of intermediary and final goods, is a loss of added value that could be generated by processing primary products locally; a loss both in terms of potential employment and income. Such change in direction could be achieved by concentrating investment more in the manufacturing sector within Limpopo province.

1.2 Employment in Limpopo

The Limpopo economy has a very low labour absorption capacity (52, see table 1), resulting in the second highest aggregate unemployment rate in South Africa at 48%. Due to this high level of unemployment, people are forced to seek employment outside of the province. In fact the province has 22% fewer men between the ages 15 – 64 (2001 Census data) than would be expected if there were an equal number of males and females in this age group (Figure 1).

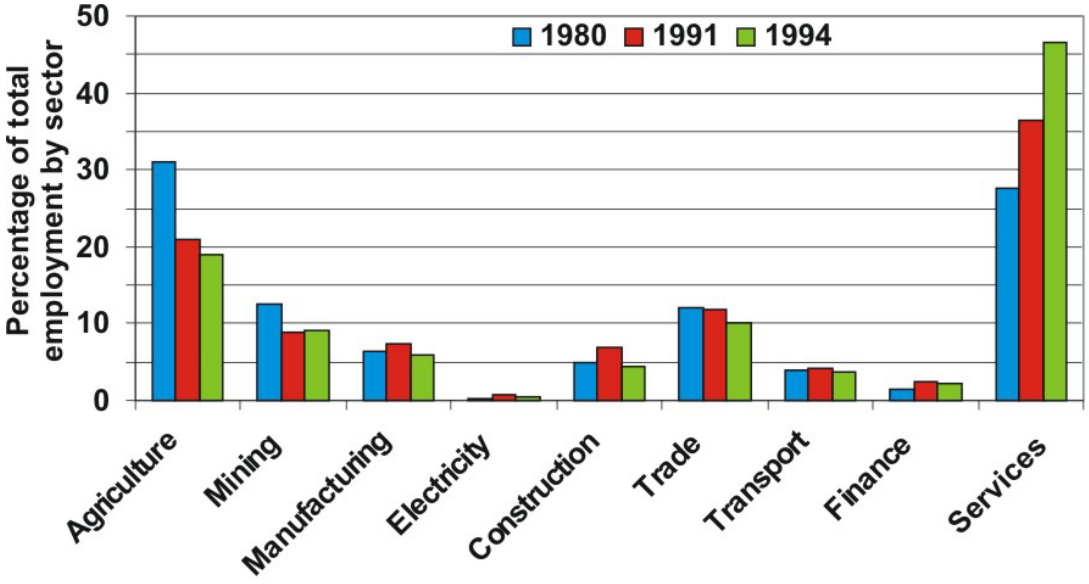
However, there has been a gradual decrease in the level of male absenteeism from 31.7% in 1980 to 24.1% in 1994. This can mainly be attributed to two factors:

- there is a tendency for people to return to their rural origins if they lose their jobs (*e.g.* in the mining sector) as they can survive better in a rural environment than in the urban nodes (*e.g.* in the rural areas they may have access to a garden to plant vegetables, or they may even have some cattle); and

- there is a tendency for the wives and families of the younger age groupings to follow the husband to the urban nodes, as they perceive that they have higher chances of earning a living in the urban areas (*Uran-econ 2000*).

Figure 5 shows that for the Limpopo province, the sectors generating most direct employment opportunities are services and agriculture. Census 2001 confirms that these two sectors are the major employers (18% of formal employment is provided by agriculture and 24% by community, social and personal services[1]; see Table 5).

Figure 5 – Formal employment by type of economic sector (selected years)



By comparing figure 4 with 5 it is possible to identify which sector is more labour intensive. For example, agriculture contributes only 8% towards the formal economy (1994), although it generates about 18% of all formal employment opportunities. In contrast, electricity generation also contributes 8% towards the formal economy, but generates only 0.5% of all formal employment opportunities (1994).

Table 5 – Employment by economic sector in the Limpopo province

Economic sector	Number	Percentage
Agriculture, hunting, forestry and fishing	118,261	18%
Mining	27,883	4%
Manufacturing	43,395	7%
Electricity	7,388	1%
Construction	37,430	6%
Wholesale and retail trade	92,222	14%
Transport	22,874	3%
Financial, insurance	33,572	5%
Community, social and personal services	160,783	24%
Other	26	0%
Private households	72,930	11%
Indeterminate	47,082	7%
Total	**663,846**	**100%**

Source: Census data 2001

In order to understand whether the economic growth in Limpopo has created new job opportunities, it is necessary to compare the economic growth rates with the growth in numbers of people directly employed.

[1] In Census 2001 the category 'services' does not appear and larger number of economic sectors are listed. This could explain why services seem to drop from 46% in 1994 to 24% in 2001.

During the period 1980 – 1994 there has been a net loss in direct employment opportunities in the sectors of agriculture and mining, even though both these sectors have managed positive growth rates in the value of their production. This could be explained by two reasons:

- the agricultural and mining sectors are becoming more mechanised; and
- value of agricultural products per unit of employees has increased over time as farmers have targeted high value crops for export.

On the basis of the annual commercial agricultural survey (1996), 72% of the total employees on commercial farms in the Limpopo Province were employed on a regular basis, while 28% were engaged as casual/seasonal workers. The majority of the reduction in employment on commercial farms was due to a reduction in regular workers; an annual fall of 1.8% of regular workers between the 1995 and 1999, (*Employment trends in Agriculture 2000*). In comparison, employment of seasonal workers increased, especially among farmers engaged in horticulture (up to 17.3% from 1995 to 1999) and field crops (up to 6.3%).

According to Census data (1996), 81% of people employed in agriculture (and hunting sub-sector) in Limpopo Province had monthly incomes in the lowest income category (R0 – R500). In comparison, results from annual commercial agriculture surveys indicate that on commercial farms, 'in-kind' payments constituted a larger proportion of the remuneration. In the Limpopo province 'in-kind' payments were estimated to be 20% of workers' average remuneration in 1996. Employment in agriculture refers to those people that are employed in the formal agriculture sector, and not that associated with subsistence farming.

Generally all sectors have registered higher growth rates in the value of their production than in the number of direct employment opportunities created, with the exception of 'financial'. This tendency would suggest that economic growth in Limpopo has not created an equivalent growth in employment opportunities.

1.3 Sub-regions in Limpopo

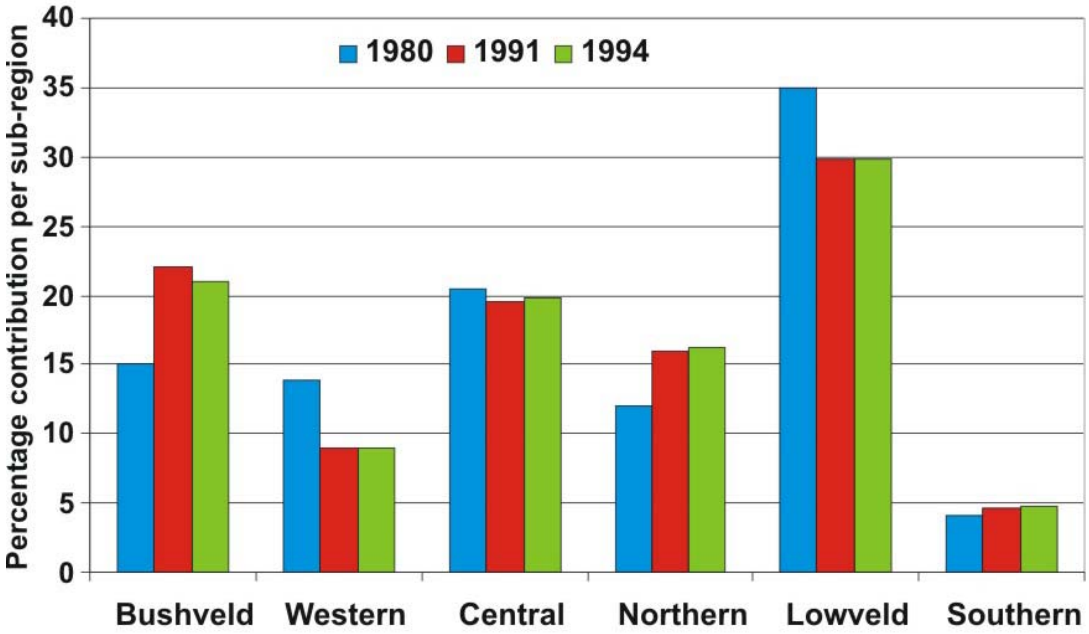
The Limpopo Province has been divided into two regions (*i.e.* the Northern and Bushveld Regions), and further divided into six sub-regions. Two of these sub-regions (Bushveld and Western) fall within the Bushveld Region and four (Lowveld, Central, Northern and Southern) fall within the Northern Region. Each of the sub-regions is further subdivided into magisterial districts. The Northern sub-region has seven magisterial districts: Messina, Mutale, Thohoyandou, Malamulele, Dzanani, Southern and Vuwani. The Luvuhvu catchment falls mainly within the Thohoyandou and Mutale district. Figure 6 shows how each of the sub-regions contributes to the formal economy carried out in the Limpopo province.

The largest contribution to the provincial economy comes from the Lowveld sub-region, followed by the Bushveld and then the Central sub-regions. However, Lowveld contribution has reduced over the period 1980 – 1994, whereas both the Bushveld and the Northern sub-regions have shown a modest increase in their relative contribution towards the provincial economy.

The Bushveld sub-region economy is concentrated in the sectors of 'mining' and 'electricity and water'. By comparison, the economy of the Southern sub-region relies mainly on the services sector. In general, 'services' is an important contributor to all sub-regional economies (with the exception of Bushveld), whereas agriculture generates a relatively small contribution despite being one of the largest employers.

The Northern sub-region does not generate a significant contribution towards the provincial economy (about 16% in 1994 - see Figure 6). There has been some restructuring of the local economy with a gradual decrease in the relative contribution of the agriculture and mining sectors, and a gradual increase from the services sector (from 31.2% in 1980 to 45.7% in 1994). This increase in contribution from the services sector can be partly attributed to the presence of Thohoyandou, which was the capital of the former Venda. However, the centre of trade for this sub-region is Louis Trichardt.

Figure 6 – Relative contribution towards provincial economy per sub-region



A number of irrigation regions are located in the Northern sub-region, including the Luvuhvu, Mogalakwena, Nwanedi, Mutale, Njelelle and the Limpopo Valley. The Agriculture Sector is dominated by animal production (50% of the gross income generated in the sector in 1995), and horticulture (about 42% of gross income generated in the sector in 1995).

In terms of horticulture, the production of macadamia nuts, vegetables and sub-tropical fruit are the most important. Commercial forestry also contributes towards the sector, but further development in this sector is severely constrained by a lack of water (*Urban-econ 2000*).

Mineral production includes diamonds (at the Venitia mine), coking coal (Tshikondeni Mine) and Magnesite (Geocarpo mine). The majority of the population is located in those sub-regions that have large areas of the former homelands, such as the Southern, Northern and Lowveld sub-regions.

2 Economic analysis of Luvuhvu catchment

Luvuhvu catchment covers an area of 5940 km^2, about 5% of the Limpopo region. This area falls within mainly two magisterial districts: Thulamela and Mutale. Thirteen percent of the entire population of the Limpopo region live in these two districts (Census data 2001). The town of Thohoyandou, together with its surrounding villages, is the area of greatest human concentration in the Luvuhvu Catchment; 88% of population lives in the Thulamela municipality.

Over the last five years, the annual population growth in Mutale was 3.1% compared to 1.8% in Thulamela (see Tables 6 and 7). The majority of the people in the Luvuvhu Catchment live in rural villages that are heavily concentrated along the river systems.

Table 6 - Population in Thulamela municipality

Persons	**1996**	**2001**
African	532,091	582,257
Coloured	254	284
Indian	845	1,573
White	484	449
Total Population	**537,454**	**584,563**

Data Source: Statistics South Africa: Census 2001 (Municipal profile 2003)

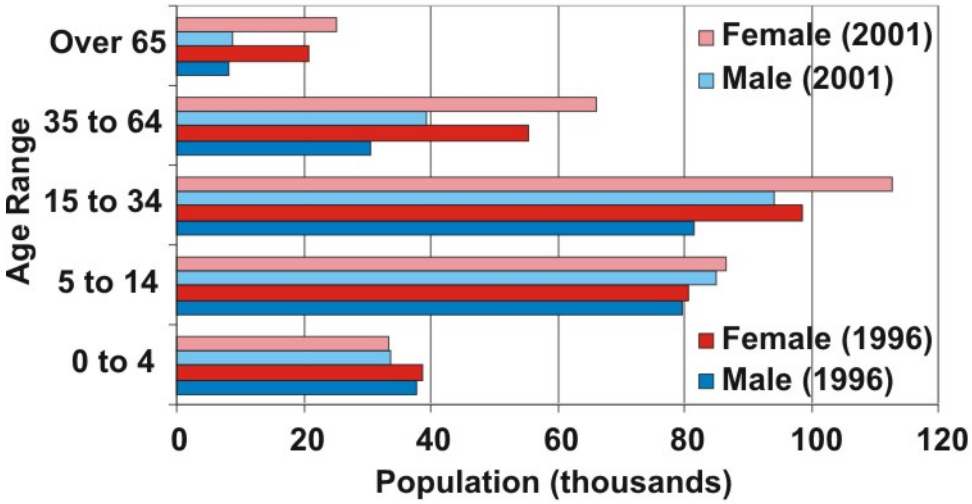
Table 7 - Population in Mutale municipality

Persons	1996	2001
African	68,454	78,456
Coloured	65	29
Indian	36	16
White	214	421
Total Population	**69,313**	**78,922**

Data Source: Statistics South Africa: Census 2001 (Municipal profile 2003)

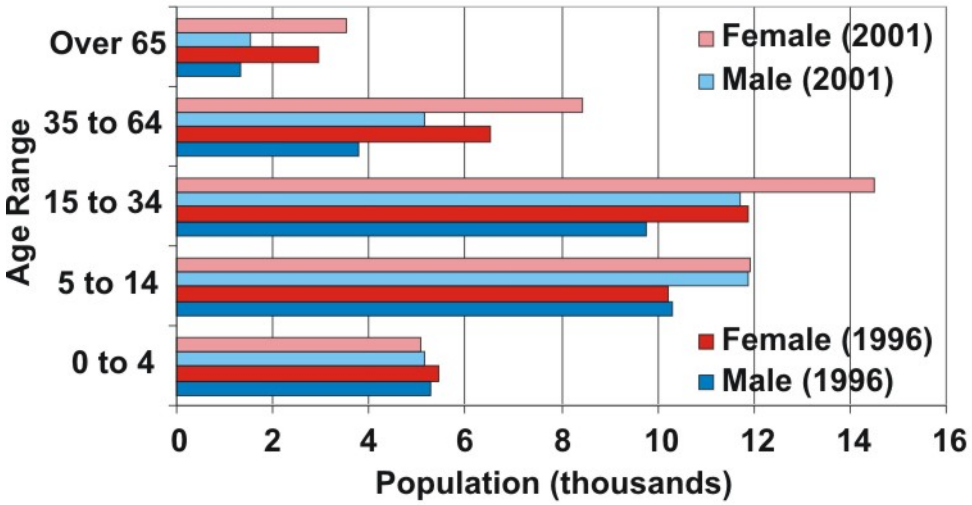
As for the rest of the Limpopo province, the Thulamela and Mutale municipality shows a similar trend in male absenteeism. Figures 8 and 9 show that the male population between age 14 and 64 is much lower in both the districts than the female population. In addition, it is also possible to observe that the population between 0 and 4 has not increased as much the other categories in both the two districts; this may be partly due to the success of programs encouraging birth control and hence lowering the rate of population increase, in what is one of the RSA provinces with the highest population growth rates.

Figure 7 - Gender by age in the Thulamela municipality



Data Source: Statistics South Africa: Census 2001 (Municipal profile 2003)

Figure 8 - Gender by age in the Mutale municipality



Data Source: Statistics South Africa: Census 2001 (Municipal profile 2003)

In general, the level of education is higher in Thulamela than in Mutale. In Mutale a higher proportion of people between 5 and 24 years old do not attend school than in the Thulamela municipality. In contrast, a much higher proportion of people in Thulamela attend University, than in Mutale (see tables 8 and 9).

Table 8 - Education institutions being attended by 5 to 24 year olds in Thulamela municipality

Persons	Number	Percentage
None	56,928	18.61%
Pre-school	5,667	1.85%
School	236,588	77.34%
College	2,031	0.66%
Technikon	757	0.25%
University	3,573	1.17%
Adult Education Centre	164	0.05%
Other	206	0.07%
Total	**305,914**	

Data Source: Statistics South Africa: Census 2001 (Municipal profile 2003)

Table 9 - Education institutions being attended by 5 to 24 year olds in Mutale municipality

Persons	Number	Percentage
None	8,706	21.41%
Pre-school	710	1.75%
School	30,999	76.22%
College	90	0.22%
Technikon	52	0.13%
University	50	0.12%
Adult Education Centre	35	0.09%
Other	26	0.06%
Total	**40,668**	

Data Source: Statistics South Africa: Census 2001 (Municipal profile 2003)

In general, households in Thulamela seem to be better off than in Mutale, with access to better services. For example, in Thulamela 60% of households have access to electricity compared to 38% in Mutale. However, there has been a 600% increase in the number of households in Mutale using electricity instead of paraffin for lighting in the last 5 years.

Table 10 – Sources of energy for lighting in Thulamela municipality (numbers and % of households)

Energy Source	1996		2001	
Electricity	33,870	33.66%	75,238	59.39%
Gas	710	0.71%	231	0.18%
Paraffin	47,655	47.36%	20,029	15.81%
Candles	18,279	18.17%	29,915	23.61%
Solar	-	-	541	0.43%
Other	112	0.11%	735	0.58%
Total	**100,626**		**126,689**	

Data Source: Statistics South Africa: Census 2001 (Municipal profile 2003)

Table 11 – Sources of energy for lighting in Mutale municipality (numbers and % of households)

Energy Source	1996		2001	
Electricity	919	7.21%	6,471	37.49%
Gas	100	0.78%	38	0.22%
Paraffin	8,219	64.47%	4,220	24.45%
Candles	3,510	27.53%	5,839	33.83%
Solar	-	-	571	3.31%
Other	0	0.00%	123	0.71%
Total	**12,748**		**17,262**	

Data Source: Statistics South Africa: Census 2001 (Municipal profile 2003)

The type of water sources that households have access to can provide a clear idea of the state of the welfare of these households. Water and poverty are linked to such an extent, that access to water is often used as a poverty indicator. Data on water supply confirms again that households in Thulamela are better off than those in Mutale.

Table 12 - Water sources in Thulamela

Water Source	Number of households	Percentage
Dwelling	9,984	7.88%
Source inside Yard	40,876	32.26%
Community Stand within 200m	20,799	16.42%
Community stand over 200m away	36,053	28.46%
Borehole	3,662	2.89%
Spring	4,550	3.59%
Rain Storage Tank	154	0.12%
Dam/Pool/Stagnant Water	659	0.52%
River/Stream	4,097	3.23%
Water Vendor	435	0.34%
Other	5,420	4.28%
Total	**126,689**	

Data Source: Statistics South Africa: Census 2001 (Municipal profile 2003)

The proportion of households with water in their dwelling and inside yard in Thulamela is almost twice that in Mutale. Consequently Mutale households have to rely more on other water sources. In particular, the proportion of households that have to rely on rivers as their main water supply in Mutale is twice that in Thulamela.

Table 13 - Water sources in Mutale

Water Source	Number of households	Percentage
Dwelling	543	3.15%
Source inside Yard	3,178	18.41%
Community Stand within 200m	4,074	23.60%
Community stand over 200m away	5,679	32.90%
Borehole	572	3.31%
Spring	810	4.69%
Rain Storage Tank	36	0.21%
Dam/Pool/Stagnant Water	191	1.11%
River/Stream	1,293	7.49%
Water Vendor	9	0.05%
Other	877	5.08%
Total	**17,262**	

Data Source: Statistics South Africa: Census 2001 (Municipal profile 2003)

Data on sanitation reinforce the previous finds. So it is possible to conclude that on average households in Thulamela have better standards of living than in Mutale. However, the difference is not only the standard of living, but also in real differences in income. It is shown later in this report that households in Thulamela have a higher average annual household income than in Mutale.

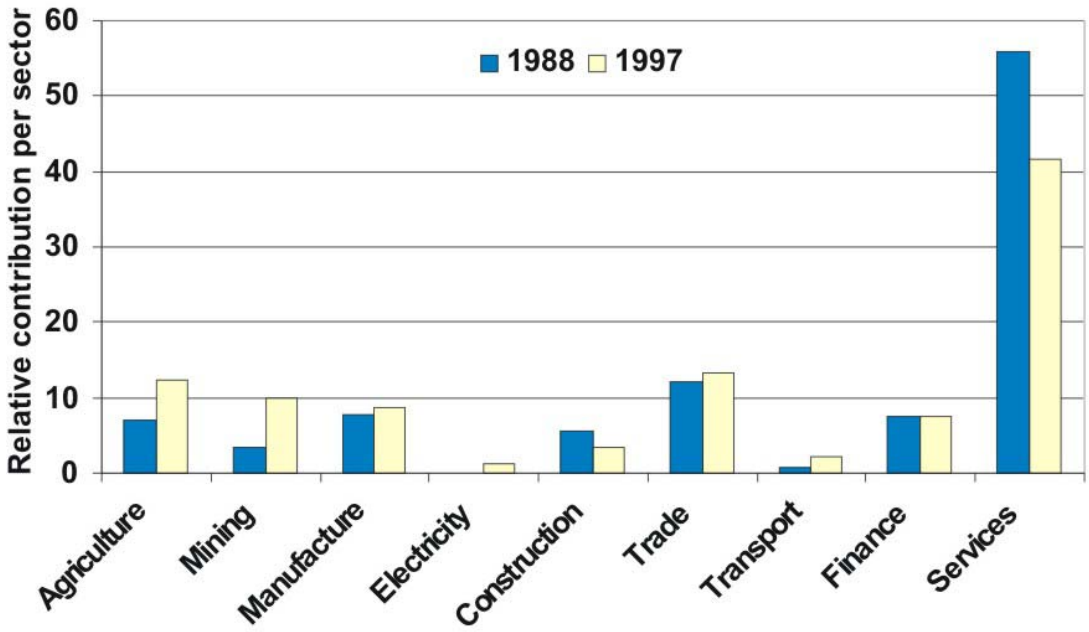
2.1 Economic Profile of Luvuhvu catchment

The economic situation of the Luvuhvu catchment is very similar to the Limpopo province. In fact the sectors in the Luvuhvu catchment that contribute the most to the Gross Geographic Product (GGP, a measure of economic activity in an area) are mainly ‘government’, followed by ‘trade’, ‘agriculture’ and ‘mining’ (see figure 9). In the Luvuhvu catchment, the contribution of the government sector is much higher than any other sector. However, over the last 5 years this contribution has reduced making the economy in the Luvuhvu even more vulnerable and artificial than the Limpopo economy in general.

In particular, mining and the agricultural sector have both seen a significant expansion. Agricultural investment in horticultural production, such as macadamia nuts that have favourable market conditions for export, make this and economically growing sector. However, subsistence farming still plays a major role in the economy of the catchment as it makes up about a third of the total agriculture.

Expectations for economic growth focus on ecotourism, which is regarded as one of the core industries both in the Luvuhvu area and Limpopo Province as a whole.

Figure 9 - Contribution by sector to economy of Luvuhvu/Letaba water management area, 1988 and 1997 (%)



2.1.1 Comparative advantages

A geographic area has a comparative advantage in the production of certain goods and services if it can produce them at a lower cost per unit than other regions, while maintaining the same quality. When this is the case, the production of such goods tends to become relatively more concentrated in the region which has the comparative advantage.

The location quotient is a measure of the relative concentration of economic activities in a region as compared with another region, or as compared with a larger region of which it forms part. A location quotient for an economic sector with a value of more than one implies that the sector contributes a larger percentage to a sub-region's GGP than that sector contributes to the larger area of which the sub-region forms a part. However, the location quotient can not be equated with comparative advantage, and provides only an indication, as it could be that there are constraints that have not jet facilitated the development of a specific sector despite its lower production costs. In fact, the basic lack of infrastructure could be a reason why the manufacturing and transport sectors in the Luvuhvu catchment scored the lowest location quotients, despite the fact that labour costs for both are relatively low.

Based on the location quotients for 1997 (*Urban-econ and Dwaf 2000*), the Luvuhvu/Letaba water management area (WMA) economy is relatively more competitive than the remainder of South Africa in the following economic activities.

- Agriculture: 2.6
- Mining: 1.3
- Government: 2.7
- Construction: 1.1

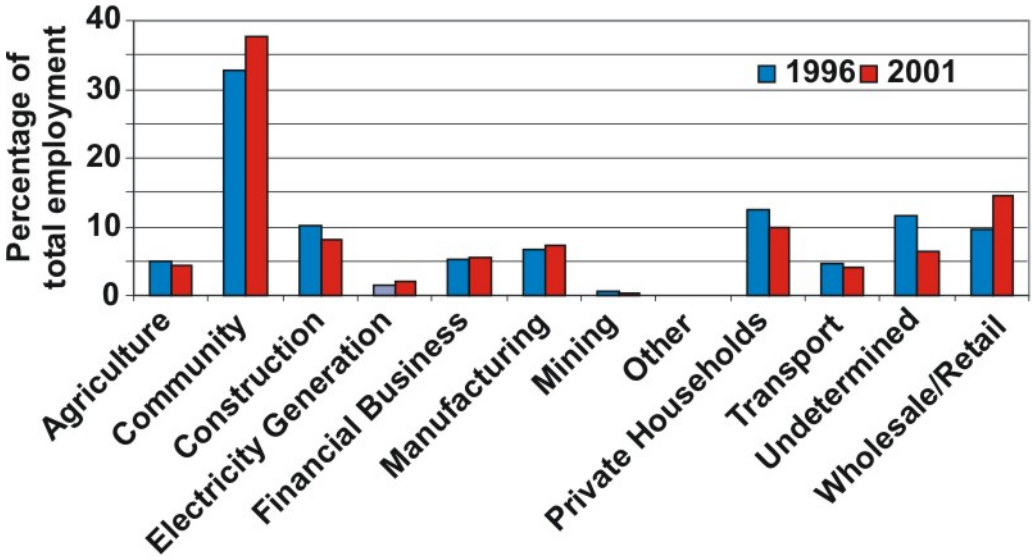
The Government sector has the highest location quotient; however this sector is regulated more by political drivers than economical ones. Therefore, in this case we cannot imply that a high location quotient is equivalent to comparative advantage. In contrast, the high location quotient for the agricultural sector is largely attributed to the variety of products, the good performance of this sector in the Luvuhvu catchment and its relative importance in this catchment. For the mining sector, the diversified mining base contributes to its comparative advantage.

2.2 Employment in Luvuhvu

A large number of people in the Luvuhvu catchment are unemployed. Of the total labour force in the two districts 59% are unemployed (Municipal profile 2003). However, only 10% of the people *with* jobs are employed in Luvuhvu catchments. Many of the employed population are migrant workers, travelling to Johannesburg for work (Urban-econ and Dwaf 2000).

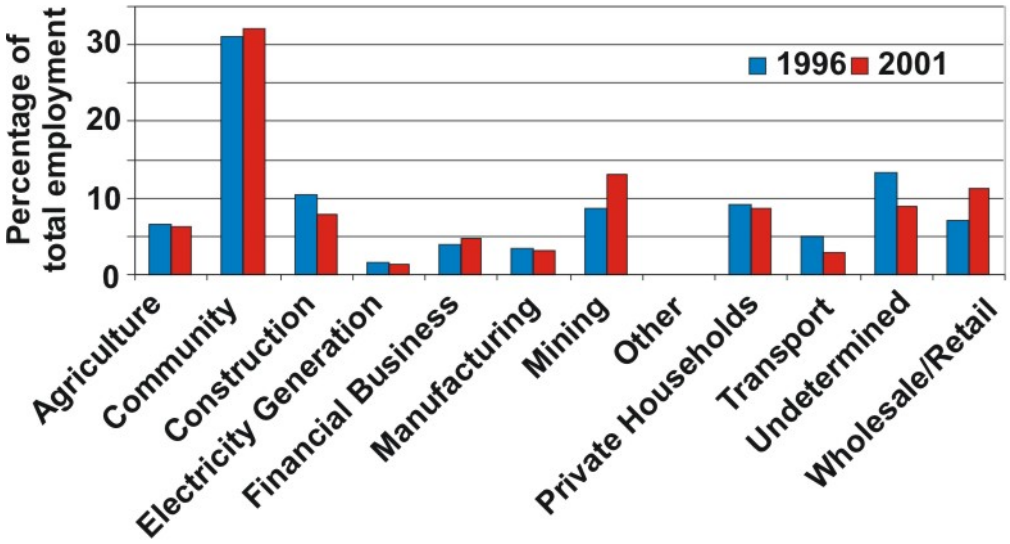
The largest employer in both Thulamela and Mutale districts is the government. In particular, 37% of all formal employment in the Thulamela district is in this sector, due to the fact that Thulamela is the administrative centre of the Northern Region.

Figure 10 – Formal employment by type of economic sector (selected years) in Thulamela



Data Source: Statistics South Africa: Census 2001 (Municipal profile 2003)

Figure 11 – Formal employment by type of economic sector (selected years) in Mutale

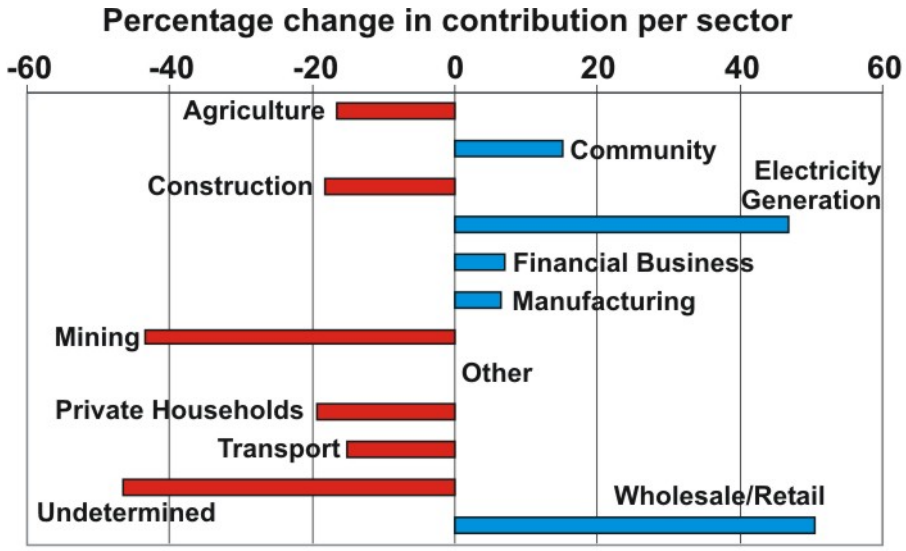


Data Source: Statistics South Africa: Census 2001 (Municipal profile 2003)

The major difference between the two districts in terms of employment is that mining is the second employer in Mutale district but almost non-existent in Thulamela. For Mutale, the mining sector is not only an important creator of employment, but also a generator for growth. The growth of this sector can be expected to continue, due to the variety of minerals and metals found, and the expected growth of demand for coal.

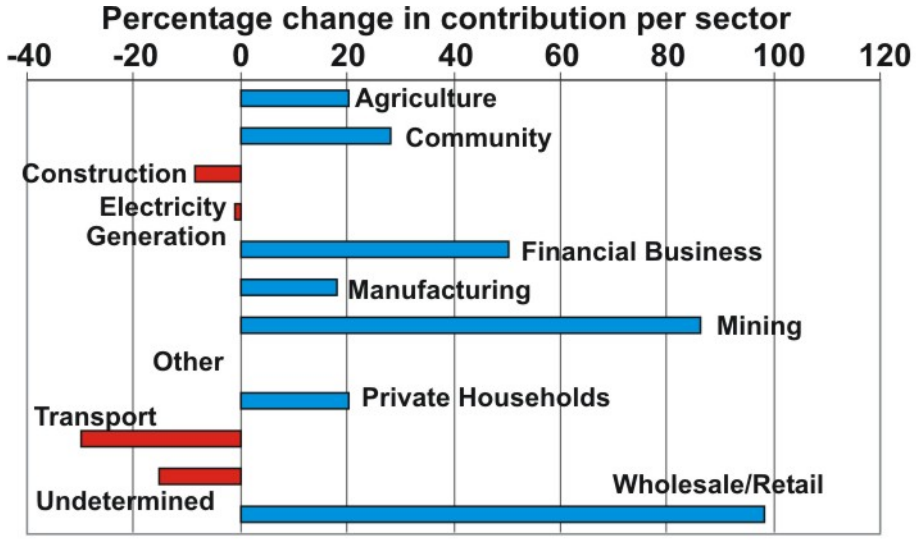
Wholesale/retail is the emerging sector, it is the second and third most important employer in Thulamela and Mutale districts, respectively. This sector has shown a massive growth in employment during the last five years in both the districts (50% in Thulamela and 98% in Mutale, see figures 12 and 13).

Figure 12 - Growth of employment in each economic sector during period 1996 – 2001 in Thohoyandou district



Data Source: Statistics South Africa: Census 2001 (Municipal profile 2003)

Figure 13 - Growth of employment in each economic sector during period 1996 – 2001 in Mutale



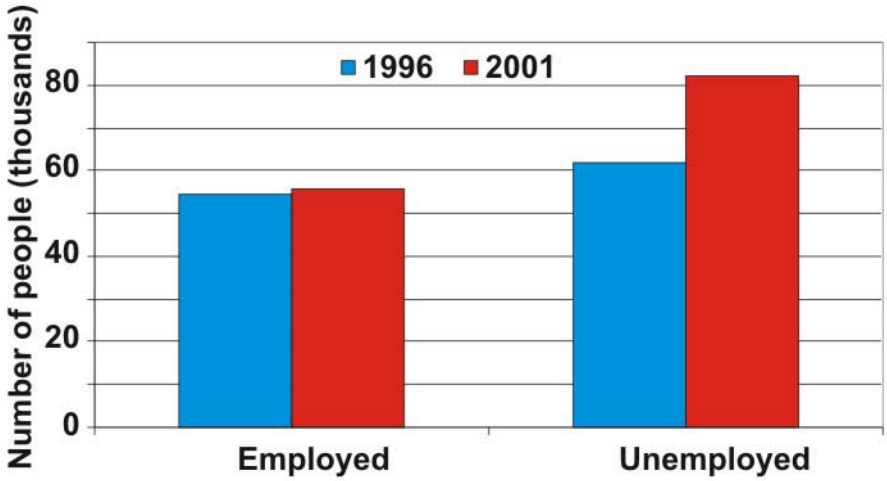
Data Source: Statistics South Africa: Census 2001 (Municipal profile 2003)

Agriculture plays a relatively small role both in Thulamela (4%) and Mutale (6%) in terms of formal employment. However, while in Thulamela formal employment in agriculture reduced by 17% during the last 5 years, in Mutale it increased by 20% (see figures 12 and 13).

In Thulamela more people are formally employed in manufacturing than in agriculture; while in Mutale it is the other way around. However, the number of people employed in this sector has

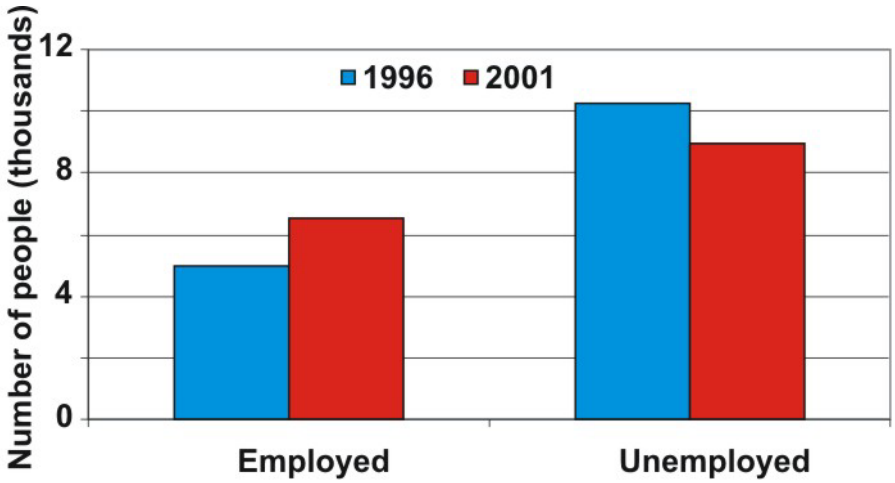
increased in both districts. Figures 12 and 13 show that between 1996 and 2001, there has been a contraction in employment in many more sectors in Thulamela than in Mutale. In fact the unemployment rate in Thulamela has increased over that period where in Mutale has reduced (see figures 14 and 15).

Figure 14 – Employment and unemployment levels for selected years in Thulamela



Data Source: Statistics South Africa: Census 2001 (Municipal profile 2003)

Figure 15 – Employment and unemployment levels for selected years in Mutale



Data Source: Statistics South Africa: Census 2001 (Municipal profile 2003)

Mining is the sector with one of the greatest reductions in employment in Thulamela, whereas if has become one of the largest creators of employment in Mutale. In fact, mining has become one of the most important sectors in Mutale, both in terms of economic growth and employment.

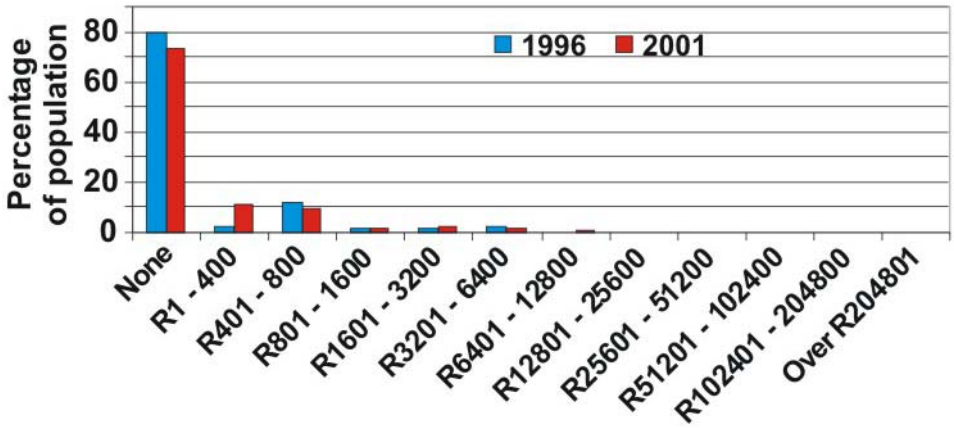
In Thulamela the increase of employment in wholesale/retail, electricity, community, financial business and manufacturing was not enough to compensate for the reduction in sectors such as mining, undetermined, private households, construction, agriculture and transport, all of which have contributed to an increase in unemployment.

The reduction in employment in Mutale can be attributed to the following sectors, in decreasing order of importance: wholesale/retail, mining, financial business, community, agriculture, private households, and manufacturing (see figure 13). Up until now, it has been shown how formal employment is distributed across the different economic sectors. However, a far greater proportion of people earn a living outside the formal economy. In 2001 in Thulamela, 55,670 people were formally employed but 156,300 people reported that they earned a monthly income. This implies that only 36% of all people earning an income are

employed in the formal sector. The rest earn an income from the informal sector, or get a pension or/and remittance. However, most of the households surviving outside the formal sectors earn the lowest monthly income.

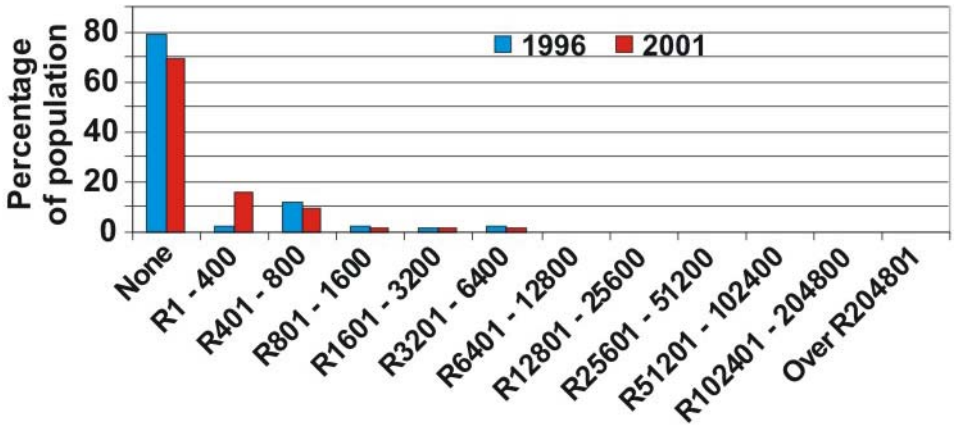
The weighted average of individual monthly income in the two districts has been estimated to be R380 including the category 'none', and R1,330 when excluding the category 'none'. The largest proportion of individuals earns an income that is below R800 at month.

Figure 16 – Individual monthly income in selected years in Thulamela district



Data Source: Statistics South Africa: Census 2001 (Municipal profile 2003)

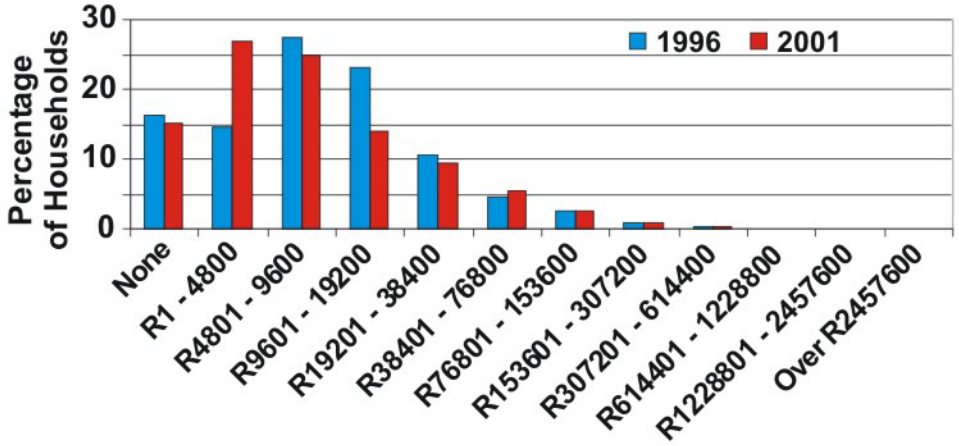
Figure 17 – Individual monthly income in selected years in Mutale district



Data Source: Statistics South Africa: Census 2001 (Municipal profile 2003)

In Thulamela the proportion of households with no income is higher than in Mutale, where the proportion of households with no income dropped to less than 5% by 2001. In Thulamela the actual number of households without income has increased in the last 5 years. The fact that unemployment has reduced in Mutale and has increased in Thulamela can explain these figures.

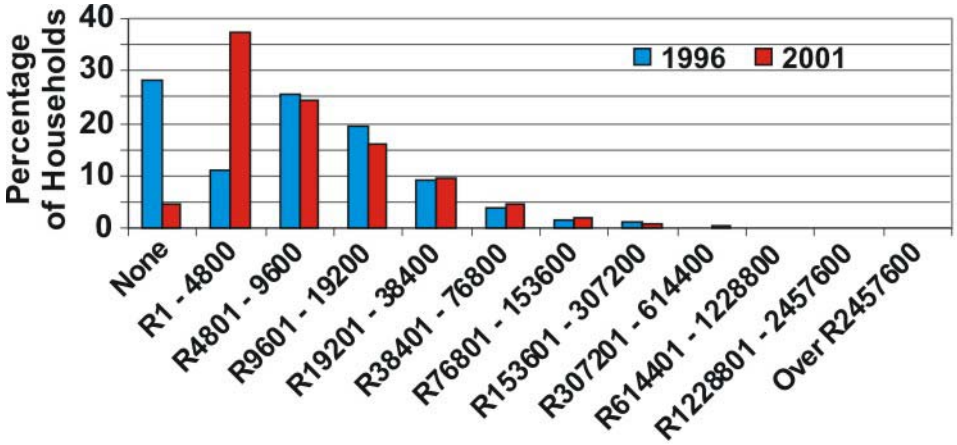
Figure 18 – Household annual income in selected years in Thulamela district



Data Source: Statistics South Africa: Census 2001 (Municipal profile 2003)

The weighted average household annual income in the two districts has been calculated to be R20,430 including the category 'none' and 22,770 when excluding the category 'none'. 81% of households in the two districts earn an annual income below R19,200.

Figure 19 – Household annual income in selected years in Mutale district



Data Source: Statistics South Africa: Census 2001 (Municipal profile 2003)

3 Economic analysis of main sectors using water

As water is the emphasis of this project as a possible mean to poverty alleviation the focus will be directed mainly towards those sectors that by their nature use more water, these being forestry and irrigated agriculture. Forestry and agriculture correspond respectively to 11 and 20% of the total land use activity in the catchment. The upper catchment is dominated by forestry plantations (pines and eucalyptus).Forestry plantations cover 44% of the upper reaches of the Luvuhvu River, but it decreases to less than 10% towards the Albasitni Dam. However, based on a recent evaluation carried out by FES (2003) the Luvuhvu catchment is an area that is too dry to support further commercial plantation forestry development. The Levubu agricultural area in the Luvuhvu catchment produces citrus, mangos, bananas and macadamias, while further downstream in the Luvuhvu Catchment, the Mutshindudi and the Mutale River catchments are dominated by rural community gardens, cattle and goats. Land-use development is likely to occur in the Luvuhvu catchment, but it is likely to be limited to the agricultural and residential sectors. Development in the semi-arid and more remote parts of the catchment is likely to be limited, as further forestry development in the mountainous region of the catchment is limited.

In order to compare forestry and irrigated agriculture on the basis of their contribution towards economic growth and employment generation per unit of water usage, the gross margins and labour requirement for each of these two sectors have been derived. Gross Margin is a common approach used in decision making and planning by the manager; it is used a tool to assess the financial performance of an enterprise. The Gross Margin of an enterprise can be defined as the output of an enterprise minus its variable costs. The most important element of enterprise output is the market value of produce, including the value of produce retained on the farm. The main items of variable costs are: seed, agro-chemicals, labour, and contractor specific (*e.g.* transport) to the crop.

$$GM = R - VC$$

Where GM is Gross Margins, R is Revenue and VC is Variable costs.

Gross margins for each year of the rotation area calculated. These values are then used to take account of time and to obtain an average annual gross marginal value that can be used to compare the different types of plantation.

The approaches to derive annual gross margins associated with each type of plantations are mainly two: the annualised benefits and the net present value.

The first approach derives the annual benefit by dividing the total gross margins over the production cycle by the length of the rotation in years. However, this approach does not consider the timing of the expenditures and revenues that usually do not occur at the same time. Therefore this could lead to a biased estimation of the annual benefits. This bias depends on how long it takes to gain the first returns from the plantation. For example, forestry plantations have a long rotation and the harvest occurs only at the end of the rotation compared to fruit crops where harvests starts few years after plantation and carries on till at the end of the rotation.

The second approach (the NPV) takes account of the timing by discounting the cash flow over the entire crop rotation. The NPV estimates the present worth of a crop that will be harvested in the future. This value is then divided by the number of years in the rotation. Due to lack of information about the future trends in prices, the NPV can be calculated by either using constant prices or projection trends derived observing the past; these are strong assumptions.

Therefore both approaches have their limits. However, in light of the fact that often in commercial farming tree crops (fruit and timber trees) are usually managed in optimal rotation, the ‘annualised benefit’ approached was chosen. Although perennial crops (forestry plantation and orchards) are harvested at maturity, which occurs after few or many years after they have planted, they are typically managed in an optimal rotation where some level of output is harvested annually. So when a farming system is managed with optimal rotation, a

stable harvest is taken every year. In the sections that follow, first the commercial forestry and then the commercial agriculture sectors are analysed.

3.1 Commercial forestry

This section focuses on the economic analysis of commercial forestry in the Limpopo province as we did not have data specific to the Luvuhvu. This analysis is based on data provided by Forestry Economic Services (FES)[2], Forestry South Africa (FSA) and DWAF (forestry directorate). As the financial and physical data for commercial forestry provided by FES and FSA refer to the Limpopo province only, to extrapolate the data to the Luvuhvu catchment it is assumed that the plantations in the Luvuhvu catchment have the same tree species distribution and unit costs as those in the Limpopo province.

Commercial forestry in the Limpopo province

In 2002 the total commercial timber plantation area in South Africa was 1,351,402 hectares, Limpopo province had one of the smallest proportions (4.9 %); in fact most of the plantations are concentrated in Mpumalanga, KwaZulu-Natal and Eastern Cape.

Table 14 – Plantation area per province

Province	2002	
	Plantation area	
	Hectares	**%**
Limpopo Province	66,840	4.9
Mpumalanga	545,747	40.4
North West Province	107	0.0
Free State	-	-
KwaZulu-Natal	529,433	39.2
Eastern Cape	146,996	10.9
Western Cape	62,279	4.6
Total	1,351,402	100

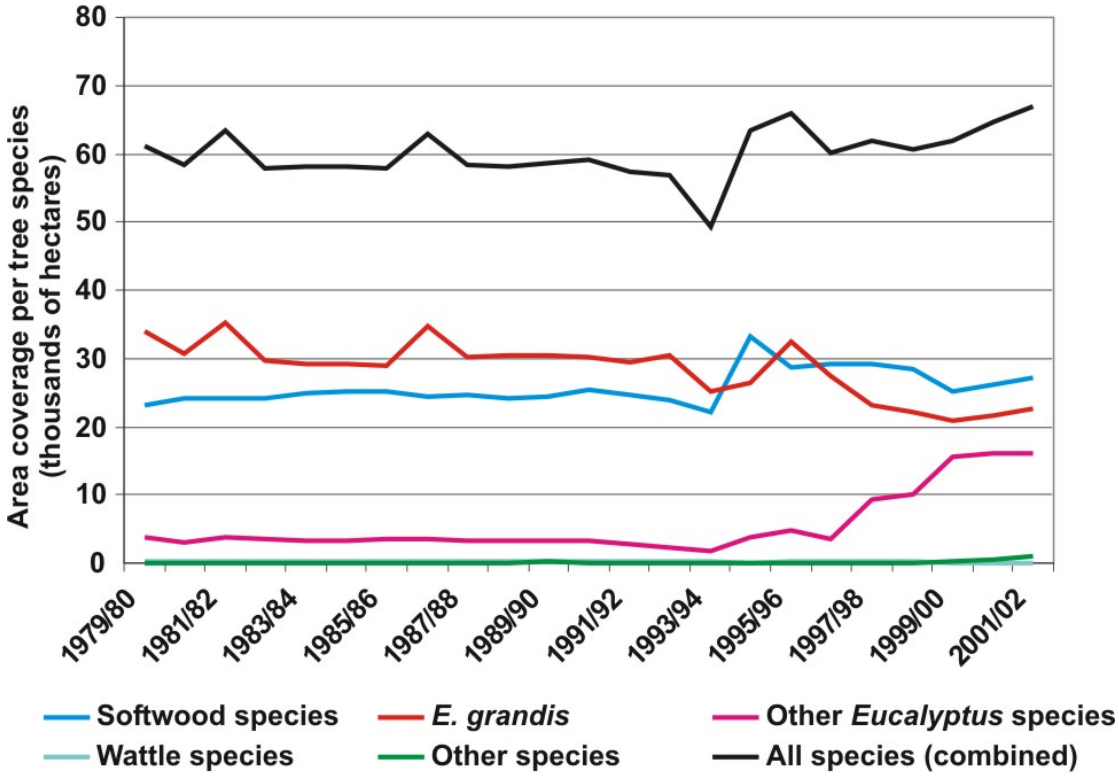
Source: FES 2002

The majority of plantations in the Limpopo province are privately owned (60%); however, the Limpopo province has the largest proportion of publicly owned plantations compared to the other South African province with exception of the southern regions (Eastern and Western Cape). The overall plantation coverage in the Limpopo Province has not changed significantly over the last 20 years (see figure 20), with an average total plantation of 60,000 hectares. However there have been changes in the tree distribution. Before 1994, *Eucalyptus grandis* was the tree species most common in the province, but now it has been overtaken by softwood species. *Eucalyptus grandis* have been also substituted with other eucalypt species that have shorter rotations, and are more suitable for pulp production. All together, Eucalyptus species are still the most common species in the Limpopo province.

In the Limpopo province, softwood species are planted mainly for production of saw logs. *E. grandis* is a more versatile tree species as it is used either for saw logs, mining timber, poles and pulpwood. Other eucalyptus species are planted mainly for pulpwood production. Of the total forest area, 51% is used for saw logs and for pulpwood production. In the last few years it has been a tendency to plant more hectares for pulpwood. Between 1999 and 2002 there have been an increase of 31% in pulpwood (hectares) and a decrease of 3% in hectares used for saw logs. In particular, more softwood has been planted for pulpwood in 2001/02 than in the past (in 1999/00 there were no hectare of softwood planted for production of pulpwood). Due to fluctuation of market conditions, there has been more softwood that has been sold for pulpwood than previous years, and this also applies to gum species (see table below). In addition all the softwood that has been sold for pulpwood was from privately owned plantations, and none form state plantations.

[2] The Forest Economic Services (FES) is the main source of data on forest plantations' yields and production costs in South Africa.

Figure 20 – Hectare per tree species in the Limpopo province



Data source: FES 2002

Table 15 - Area according to main purposes for which trees are grown (2001/02)

	Saw logs	Poles and Droppers	Mining timber	Pulpwood	Other products	Total
	ha	ha	ha	ha	ha	ha
Softwoods	26,179	35	0	952	0	27,166
E. grandis	7,722	3,208	7,703	2,973	931	22,537
Other eucalyptus	17	1,938	3,491	10,287	486	16,219
Wattle	0	0	0	0	33	33
Other hardwood	109	0	1	4	771	885
	34,027	5,181	11,195	14,216	2,221	66,840

The table below shows that about 54% of the timber harvested in Limpopo province in 2002 was sold as saw logs and veneer, while another 15% went to pulpwood and 14% to mining timber. The rest went to poles (7%) and charcoal manufacturing (4%). From 1999/00 there has been an increase of saw logs sold (41%) and a decrease of pulpwood (-18%) and mining timber (-16%).

Table 16 – Timber products sold from plantation in the Limpopo Province 2001/02

	Sawlogs & veneer	poles & Droppers	mining timber	pulpwood	charcoal	other product	Total
	m^3	m^3	m^3*	m^3*	m^3*	m^3*	m^3
Softwoods	251,793	1,930		84,928	9,250	4,924	352,825
E. grandis	108,545	36,319	39,755		14,813	27,264	226,696
Other eucalyptus	747	6,056	55,876	13,824	2,935	2,520	81,958
Wattle	-	-	-	48	24	7	79
Other hardwood	400	1,867	-	-	1,975	-	4,242
Total hardwood	109,692	44,242	95,631	13,871	19,747	29,791	312,975
Total	**361,485**	**46,172**	**95,631**	**98,799**	**28,997**	**34,715**	**665,800**
	54%	7%	14%	15%	4%	5%	100%

* These values were in tonnes and have been converted to m^3 using the industry conversion factors.

The average value (Rand/m^3) of roundwood per type of use at plantation has been derived by dividing the total value of roundwood sold by the total volume sold. In comparison, the average value of products sold from primary processes is obtained by dividing the total value of sale of each product by the volume sold (data from in fact 2001/02). Figures 21 and 22 show that the values of timber at plantation and of timber from primary processing have both slightly increased over the last 20 years. However, such increases are due mainly to the inflation rate.

Figure 21 – Roundwood value from plantations in nominal terms

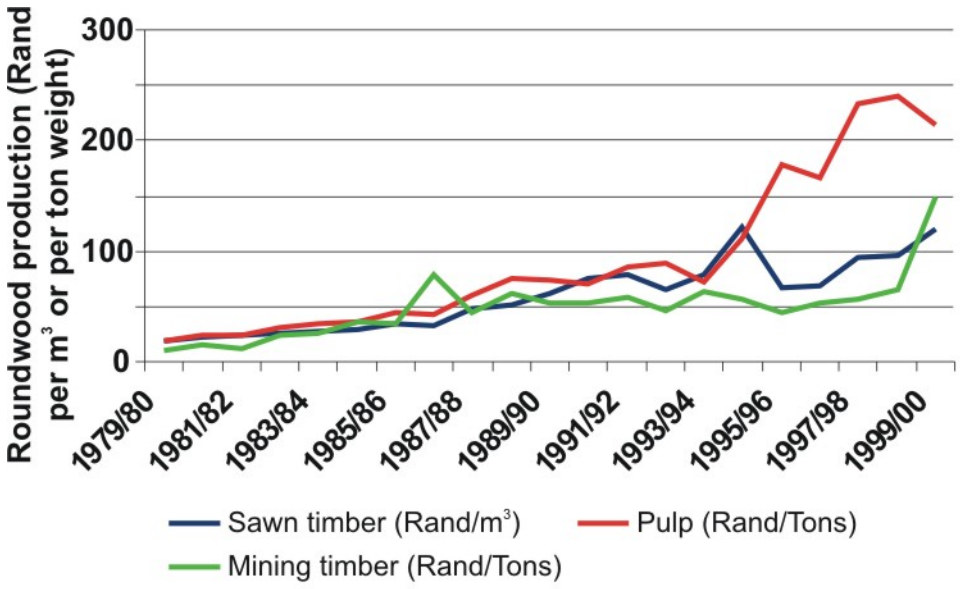
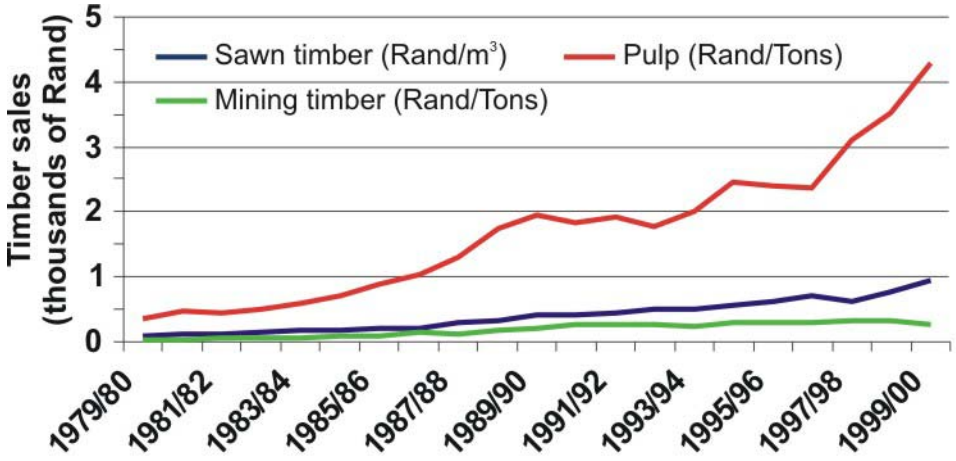
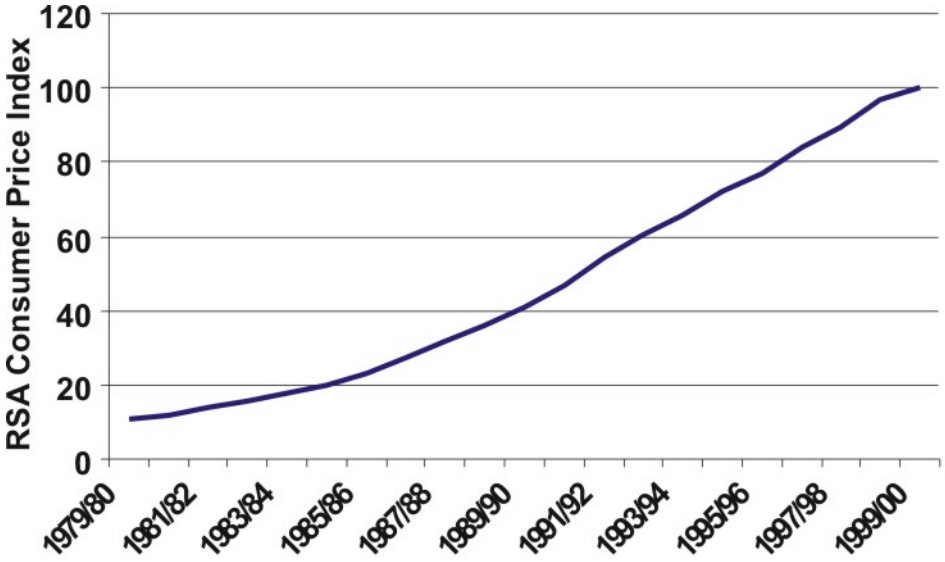


Figure 22 – Sale of timber from primary processors in nominal terms



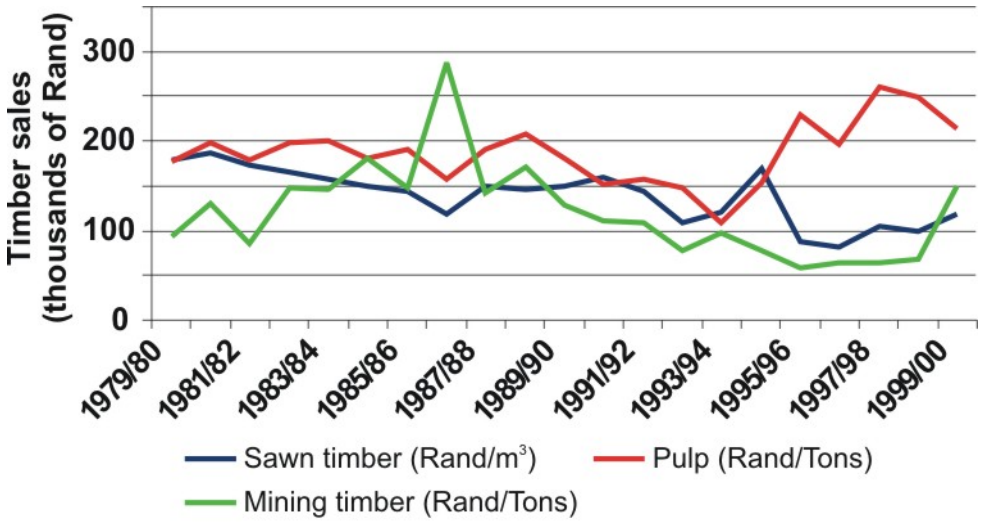
By deflating the nominal value using the CPI shown in Figure 23, the real value of timber for pulp, mining timber and saw logs at plantation and after primary processing can be obtained (see figures 24 and 25).

Figure 23 – Consumer Price Index in South Africa for the last 20 years



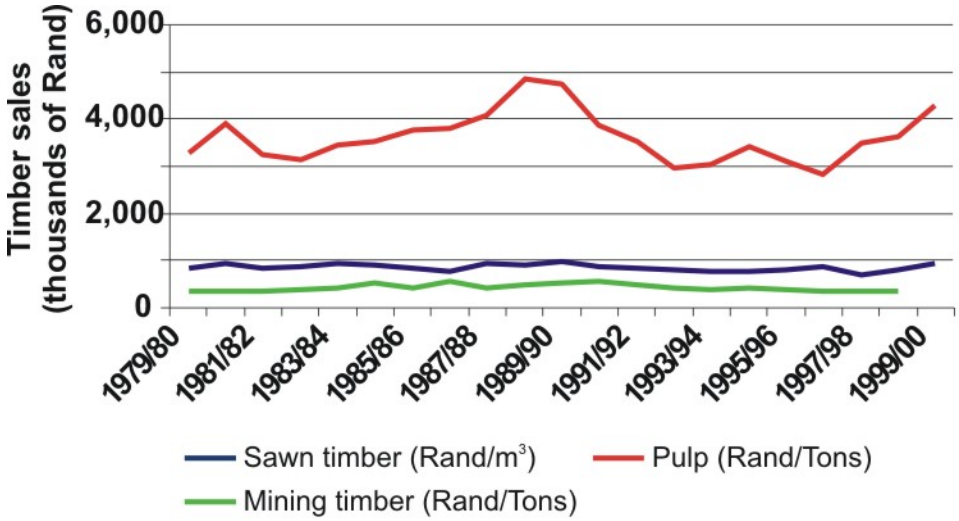
The real values of roundwood timber for pulp, mining timber and saw logs have been fluctuating over the last 20 years, but such fluctuations have been mainly around the mean (see figure below). However, in the last few years the gap between the value of sawn timber and pulp has increased.

Figure 24 - Roundwood value from plantations in real terms



Also the real values of timber after primary processing (see figure 6) have been fluctuating around the mean, although the fluctuation are less than the roundwood and no trend can be observed.

Figure 25 – Sale of timber from primary processors in real terms



In the Limpopo province the most common softwood species are *Pinus* species, which are mainly grown on an (average) 25-year rotation[3]. The roundwood had an average price of R138/m^3 (R90 – R314/m^3 for different log classes) in 1998 (Olbrich 2001). In comparison, the Eucalyptus species are mostly grown on a short 10-year rotation[4], and sold for an average price of R100/m^3 (R35 – R190/m^3 for the different log classes) according to 1998 figures (Olbrich 2001).

The Gross margins based on a sustainable annual rotation including the cost of road maintenance have been estimated to be (data refer to the year 2001) for:

pine (25 year rotation)	R1119/ha/year
eucalyptus (22 year rotation)	R 777/ha/year
eucalyptus (10 year rotation)	R 364/ha/year

Source: FES, 2003

Water use by forestry plantations

The data used to estimate the forestry plantation water usage were output from ACRU model runs simulating tree growth (for pine and eucalyptus) and evapotranspiration (a proxy for water use) on several (upper) quaternary catchments within the Luvuhvu catchment.

Table 17 - Long-term averages (44 years) of rainfall, and evapotranspiration (proxy for water use) values for Pine and Eucalypt plantations (M litres ha^{-1} yr^{-1})

Catchment	Rainfall	Pine water use (AET)	Eucalypt water use (AET)
A91A	7.099 ± 2.202	4.596 ± 1.377	5.114 ± 1.429
A91B	6.080 ± 1.924	3.770 ± 0.963	4.215 ± 1.049
A91C	8.620 ± 3.305	5.177 ± 1.702	5.728 ± 1.791
A91D	12.590 ± 4.388	7.505 ± 1.837	7.990 ± 1.897
A91E	9.410 ± 3.101	5.896 ± 1.433	6.311 ± 1.511
A91F	6.169 ± 1.913	3.614 ± 1.124	4.093 ± 1.198
A91G	8.432 ± 2.195	4.945 ± 1.087	5.618 ± 1.143
A91H	6.605 ± 2.054	3.825 ± 1.194	4.334 ± 1.271
A92A	6.080 ± 1.924	3.770 ± 0.963	5.476 ± 1.575
A92B	6.444 ± 1.968	3.919 ± 1.184	4.381 ± 1.253
Average	**7.753 ± 2.227**	**4.701 ± 1.091**	**5.326 ± 1.207**

The data consisted of daily rainfall (RFL) evapotranspiration (AET) and runoff (CELRUN) values. The AET values were summed to give annual total evapotranspiration from the

[3] When pine is grown for saw logs, the rotation is 26 years, when it is planted for pulpwood the rotation is 16 years and when it is for poles the rotation is 20 years.
[4] When eucalyptus is planted for 10 year rotation it is mainly for pulpwood.

forested areas in mm water per year. For purposes of comparison with other datasets, the values were converted into volumetric data – *i.e.* mm yr-1 to millions of litres per hectare per year (Ml ha^{-1} yr^{-1}).

Annual evapotranspiration values from each quaternary catchment were compared graphically to see if there were any consistent differences between sub-catchment. The long-term (44 year) average values for each catchment were calculated.

Figure 26: Annual variation in total water use (AET) by Pine plantations over a 44 year model run.

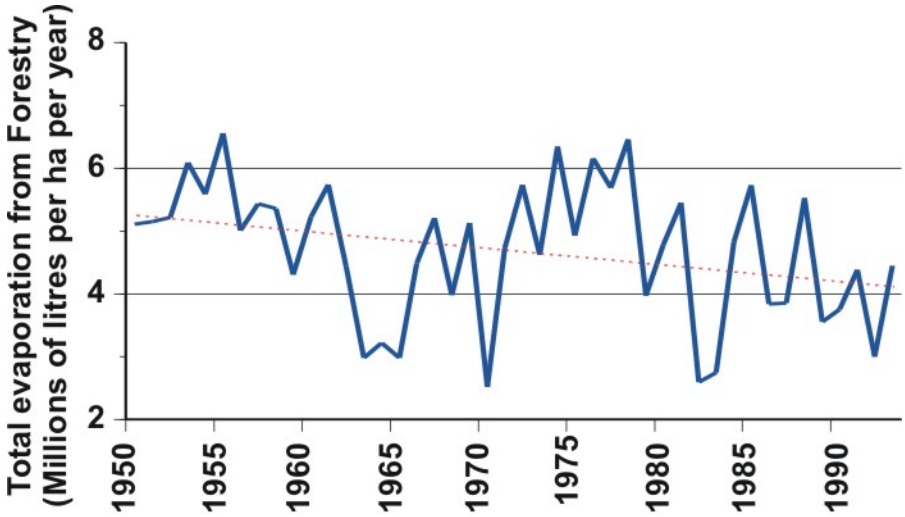
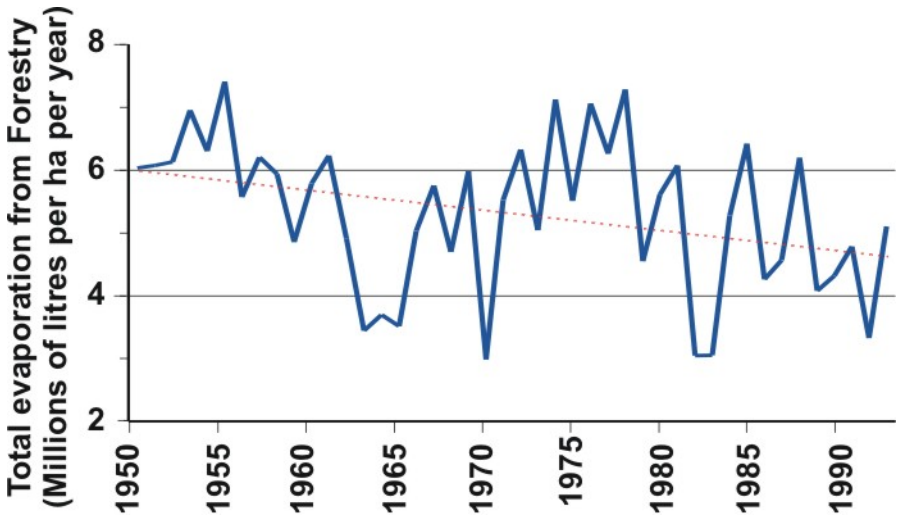


Figure 27: Annual variation in total water use (AET) by Eucalypt plantations over a 44 year model run.



Forestry product chain

Forestry outputs (roundwood and logs) later become inputs for a number of secondary conversion industries such as saw milling, pulp and paper mills. Saw mills purchase mostly roundwood pine and convert it to timber for various uses, from packaging and building materials, to furniture. Pulp and paper mills purchase pine and eucalypt roundwood for conversion to pulp and paper products. Wood fibre can be sold either in pulp form, or in paper form. Paper can be sold in different classes ranging from newspaper to fine paper. Mining timber mills exclusively purchase eucalypt roundwood for conversion to mine support packs. Pole manufactures purchase mostly eucalypt roundwood for conversion to telephone, transmission and fencing poles. Charcoal manufacturers mainly use high-density eucalypt species.

This output-input flow from a primary to a secondary industry is known as the *product flow*. The *product flow* for forestry in Limpopo is presented in table below; the data used to create this table refer to values for the year 2001/02 (FES 2001/02) and the conversion factors used to derive the roundwood from each of the wood processing activities have been derived by calculating the average over the last 20 years for the ratio between the volume of timber from plantation by the volume of timber products after primary processing. For example, on average 4 tonnes of wood at plantation are required to obtain a tonne of pulp.

Table 18 - Product flows from forestry in Limpopo Province (2001/02)

	Forest output		Wood product output				
	Softwood	Hardwood	Saw-milling	Mining timber	Pole	Charcoal	Pulp
	m^3	m^3	m^3	Tonnes	m^3	Tonnes	Tonnes
Roundwood in			368,680	18,348	26,564	100,620	96,911
Roundwood out	352,825	312,975	155,225	7,400	20,207	10,619	16,121

Other products have not been included as it was not possible to derive the conversion factor for this sector/sectors. The profit generated by these timber-based economic activities is considered an indirect benefit of timber farming. These indirect benefits have been calculated in terms of revenue for roundwood once this has been processed into the pulp, mining timber and saw logs. As these indirect benefits calculated here are based only on the revenue, they represent the upper bound of the indirect benefits as neither variable or fixed costs have been included due to lack of available data.

The estimations of the indirect benefits shown in tables 19, 20 and 21 are based on the following assumptions: the species tree planted is *Eucalyptus grandis*, with a rotation age of 8 years and MAI of 22, providing 176 tonne of roundwood per hectare (FSA 2003). Part A in tables 19, 20 and 21 represents the revenue from a hectare planted with Eucalyptus grandis. Part B is the calculated revenue generated by the processing plants. Part C is the derived value addition ratio, which indicates that for each Rand generated per hectare planted with *Eucalyptus grandis*, X Rand are generated by the secondary industries. The different columns in part A and B have been generated assuming different value for:

- the sale price for roundwood;
- the conversion factor from tonnes of timber intake to tonnes of processed outputs (*e.g.* number of tons to make 1 ton of pulp); and
- the sale price of final products from the processed plants.

The values used in column 'average' have been obtained by averaging the values in the 'Forestry Industrial Facts' for the last 20 years. The values used in column '2001/02' refer specifically to the year 2001/02 and are based on Industrial Facts for that year. The values in the FSA column have been provided by FSA for the pulp industry alone (FSA 2003).

Table 19 - Value of production per hectares (when in rotation) for PULP Industry

A. Ex Plantations	**2001/02**	**average**	**FSA**	**Unit**
Area felled	1	1	1	Ha
Tonnage per hectare	176	176	176	Tons/ha
Total tons produced	176	176	176	Tons
Value per tons	240	214	223	R/tons
Value of production	R42,230	R37,586	R39,248	R
B. Value addition				
Tonnage Intake	176	176	176	t/ha
No of tons to make 1 ton of pulp	4.6	3.4	4	
Pulp production (tons)	39	52	44	t/ha
Value of timber after processing(R/t)	3,933	3,774	6,000	R/tons
Value of production (R)	R151,753	R196,443	R264,000	R
C. Value addition ratio	**3.6**	**5.2**	**6.7**	

The average of the three value addition ratios for the pulp production shown in the table above is 5.2. So for each Rand generated in the primary sector producing roundwood, an additional value of R 5.2 will be generated in the secondary sector of pulp production.

Table 20 - Value of production per hectares (when in rotation) for SAWLOGS

A. Ex Plantations	**2001/02**	**average**	**Unit**
Area felled	1	1	Ha
Tonnage per hectare	176	176	Tons/ha
Total tons produced	176	176	Tons
Value per tons	138.6	138.7	R/tons
Value of production	R24,394	R24,411	R
B. Value addition			
Tonnage Intake	176	176	t/ha
No of tons to make 1 ton of saw logs	2.6	2.8	
Saw logs production (tons)	67.7	62.9	t/ha
Value of timber after processing(R/t)	958	906	R/tons
Value of production (R)	R 64,849	R 56,949	R
C. Value addition ratio	**2.3**	**2.7**	

The average of the two value addition ratios for saw logs production shown in the table above is 2.5. So for each Rand generated in the primary sector producing roundwood, an additional value of R 2.5 will be generated in the secondary sector of saw logs production.

Table 21 - Value of production per hectares (when in rotation) for MINING TIMBER

A. Ex Plantations	**2001/02**	**average**	**Unit**
Area felled	1	1	Ha
Tonnage per hectare	176	176	Tons/ha
Total tons produced	176	176	Tons
Value per tons	106.2	113.5	R/tons
Value of production	R18,691	R19,976	R
B. Value addition			
Tonnage Intake	176	176	t/ha
No of tons to make 1 ton of mining timber	1.1	1.7	
Mining timber production (tons)	126	104	t/ha
Value of timber after processing(R/t)	258	336	R/tons
Value of production (R)	R32,434	R34,786	R
C. Value addition ratio	**1.7**	**1.7**	

The average of the three value addition ratios for mining timber production shown in the table above is 1.7. So for each Rand generated in the primary sector producing roundwood, an additional value of R1.7 will be generated in the secondary sector of mining timber production.

If a comparison between saw mills, pulp mills and mining timber mills was wished to be made, on the grounds of their additional returns generated per unit of roundwood taken in, pulp mills would come out to be the one adding more returns. However, the processed outputs from thee secondary industries will become outputs for other industries, pulp will be used in paper mills to produce paper; saw logs will be used in a range of industries such as furniture and building; while mining timber will be ready for assembly. So to assess the total indirect returns generated by each tonne of roundwood produced, the returns from paper, furniture and building production have to be included. However, due to lack of data, these returns were not calculated.

However, by knowing how many processing plants are available in Luvuhvu and Limpopo it is possible to estimate the proportion of the roundwood produced in these areas that can be processed within Luvuhvu and Limpopo, and therefore how much is exported outside. As in the Luvuhvu catchment there are no processing plants (see table below) this means that all the added value associated with pulp and paper mills, sawmills and furniture plants is generated outside the catchment. Limpopo is able to retain only a proportion (55%) of the added value associated with sawmills. However the province is not able to retain any of the added values from either pulp and paper mills or furniture plants. So Limpopo retains only a small proportion of the total added value associated with roundwood production, as the highest added values, generated by pulp and paper mills and furniture plants, is exported out of the province.

Table 22 – Number of processing plants

	Luvuhvu catchment	Limpopo Province
Number of pulp and paper mills	NIL	NIL
Number of sawmills	NIL	20
Number of furniture plants	N/A	N/A

Source: FES 2003

The province is not growing enough timber for pulp production to justify the construction of a pulp mill in the area. It is more economical for the industry to expand the existing pulp and paper mills (this is actually what is currently happening).

However, in the province there would be scope to invest in low tech processes such as fencing, pole and furniture production that would have the positive impact to retain part of the added value and create new employment. Currently this is happening in the Limpopo province to some degree, as most of the roundwood is not exported directly to pulp mills. It is first debarked and then shipped out of the province. This process is quite labour intensive and low tech, and so it is economical to carry it out where the labour is cheaper.

This explains why 87% of Eucalyptus with 10 years rotation is utilised within the Limpopo province when we know that 69% of this type of tree is used for pulpwood (see table 23). In other words, the roundwood receives a certain level of processing (utilisation). In the case of the Eucalyptus with 10 years rotation, this is debarking and then export for further processing. However, this process is only part of the additional processing that could be carried our in the Limpopo region, which could reduce unemployment and increase economic growth.

Table 23 - Internal and External Markets

	Pine (25 yrs)	Euc (22 yrs)	Euc (10 yrs)
Utilised in Limpopo Province	70%	21%	87%
Exported out of Limpopo Province	30%	79%	13%

Source: FES 2003

Table 24 - Wood Markets

	Pine (25 yrs)	Euc (22 yrs)	Euc (10 yrs)
Saw logs	72%	67%	3%
Poles	-	5%	5%
Mining Timber	-	8%	17%
Pulpwood	27%	11%	69%
Firewood	-	1%	1%
Other Products	1%	8%	5%

Source: FES 2003

In the Limpopo province the majority of the timber products sold from the publicly owned plantations are saw logs and veneer logs, followed by poles, droppers and charcoal. None goes to pulpwood production. In comparison, the privately owned plantations are targeted towards pulpwood and mining timber production, in addition to saw logs production. Overall, the privately owed plantations are generating a larger added value than the publicly owned ones. In comparison, publicly owned plantations generate a larger proportion of added value that remain within the province. It is not possible to differentiate between the two types of

ownerships in terms of job generation, as the data provided for the employment were average values, although a few sources stated that the public owned plantations employ, on average, a larger number of employees than the privately owned plantations.

Employment in commercial forestry
The associated Man Days required per hectare per year for a plantation in rotation have been estimated to be:

5.8 man days/ha/year	pine (25 year rotation)
7.1 man days/ha/year	eucalyptus (22 year rotation)
10.9 man days/ha/year	eucalyptus (10 year rotation)

Source: FES 2003

These data can be converted to jobs per hectare per year based on 218 MD per man year as a proxy of a full-time job:

0.027 persons/ha	Pine (25 year rotation)
0.033 persons/ha	eucalyptus (22 year rotation)
0.050 persons/ha	eucalyptus (10 year rotation)

This means that total employment benefits from the cultivation of 25,255 hectares of pine in Limpopo province amount to 146,479 MD, which is equivalent to 672 employees. Given the total areas under pine and gum in the province, these estimates indicate that in 1999, forest plantations in Limpopo contributed directly to about 2,405 jobs (see table below).

Table 25 - Number of jobs directly created in 1999/00

	Average employment per ha	Total ha	Number Employees
Softwood	0.027	25,255	672
Eucalyptus	0.05[5]	36,361	1,728
Wattle	0.09[6]	55	5
Total		61,671	**2,405**

If it is assumed that for each job created, there are 4 dependent people (source: Roger 2003), then the total number of people dependent on jobs directly created in the forestry sector (using data from table 24) are the following:

Table 26 – Number of dependents per direct job created

Number of employees	Average no. of dependents per worker	Total dependents
672	4	2,688
1,728	4	6,912
5	4	20
2,405		**9,620**

For each job created in the forestry sector there are 6 other jobs created in other related sectors such as pulp and paper mills and saw logs mills (source: Roger 2003). The total number of indirect jobs created is the following:

Table 27 – Number of indirect jobs created

Number of direct jobs	Job multiplier	Number of indirect jobs
672	6.0	4,032
1,728	6.0	10,368
5	6.0	30
2,405		**14,429**

[5] This has been calculated averaging the value for the eucalyptus (22 year) (0.033) and eucalyptus (10 years) (0.05) and data provided by FSA (2003) (0.06).
[6] Data provided by FSA (2003).

By assuming that for each indirect job created there are 3 dependents (source: Roger 2003), the total number of dependents from indirect jobs is:

Table 28 – Number of dependent per indirect job created

Number of indirect jobs	No. dependents per indirect job	Total dependents from indirect jobs
4,032	3	12,095
10,368	3	31,104
30	3	90
14,429		**43,288**

So the total number of direct and indirect jobs (16,834) created by commercial plantations in Limpopo Province, plus the respective dependents (52,904), is approximately 70,000 people.

Table 29 – Total number of jobs created and dependent people involved.

Total direct and indirect jobs	Total dependents	Grand total
4,703	14,782	19,486
12,096	38,016	50,111
35	110	144
16,834	**52,907**	**69,742**

However only a small proportion of total indirect jobs created are located within the Limpopo province, as no pulp and paper mills and furniture plants are located within this province. A large proportion of softwood (pine) is processed within the province (70% - table 23), mainly for saw logs production (table 24). Therefore, despite the fact that pine plantations create less than half the number of jobs than are created by eucalyptus plantations (table 25), a higher proportion of the jobs are retained within the province.

3.2 Commercial Agriculture in the Luvuhvu Catchment

The Levubu agricultural area in the Luvuhvu catchment produces citrus, mangos, bananas and macadamias, while further downstream in the Luvuhvu catchment, the Mutshindudi and the Mutale River catchments are dominated by rural community gardens, cattle and goats.

As the land-use development likely to occur in the Luvuhvu catchment is limited to the agricultural and residential sectors it is important to understand the dynamics and market conditions of agricultural products grown in the catchment.

The data used for the economic analysis of the commercial agriculture in the Luvuhvu catchment were:

- Farmer survey carried out by Alet Visser – CSIR (2003)
- COMBUD[7] data (2002 and 1994)
- Abstracts of Agriculture statistics (2002)
- Employment trends in Agriculture (2000)
- Data from product growers associations (2002/2003)

A farmers' survey has been conducted in the study area during the year 2003 to collect primary information on sub-tropical fruit production. The qualitative survey was carried out by Alet Visser (CSIR) among farmers in Louis Trichardt providing valuable data about commercial farmers in this area.

The farmers in the Luvuhvu catchment are divided into two farmers' societies, namely the Louis Trichardt Boerevereniging and the Levubu Boerevereniging. The Levubu Boerevereniging had recently carried out a survey across its members about the size and type of their cultivars; the data collected covered 45% of all the farmers belonging to this association.

In the sections below a separate economic analysis has been carried out for each of the main agricultural products produced in the area: banana, macadamia nuts, avocado, litchis, guavas, mangos and Valencia oranges. For each of these products an overview of the market conditions in South Africa it is given first, followed by data from the farmers' survey, and finally by the estimated gross margins and labour requirements per hectare obtained using the COMBUD data.

Like timber, fruit trees are managed in optimal rotations allowing for regular annual harvest of mature produce. Accordingly, to take account of time the same annualised benefits method has been also applied to the fruit trees crops. Therefore, similarly to the case of plantation forestry, yields and gross margins used in the analysis represent the average over the entire production cycle and not at maturity. The annualised gross margins are derived by averaging the annual gross margins across the entire rotation period.

The discounted average gross margins are presented only to show the impact that a discounting rate have on a long rotation crop and representing in this way those farmers not managing their crops in optimal rotations. The discounted average gross margins has been calculated by discounting the annual gross margins and then by averaging them across the entire rotation period. The discount rate used to calculate the discounted gross margins was 4%.

[7] COMBUD (Computerized enterprise budgets for livestock and cash crop) promotes the keeping of farm and financial records (Finrec); compiles and updates of enterprise budgets for all crops and livestock for the province; revises and updates machinery, irrigation and labour cost standards; maintains and develops crop and livestock budgets necessary in different farming systems; and advises districts on agricultural enterprises and macro/ microeconomics.

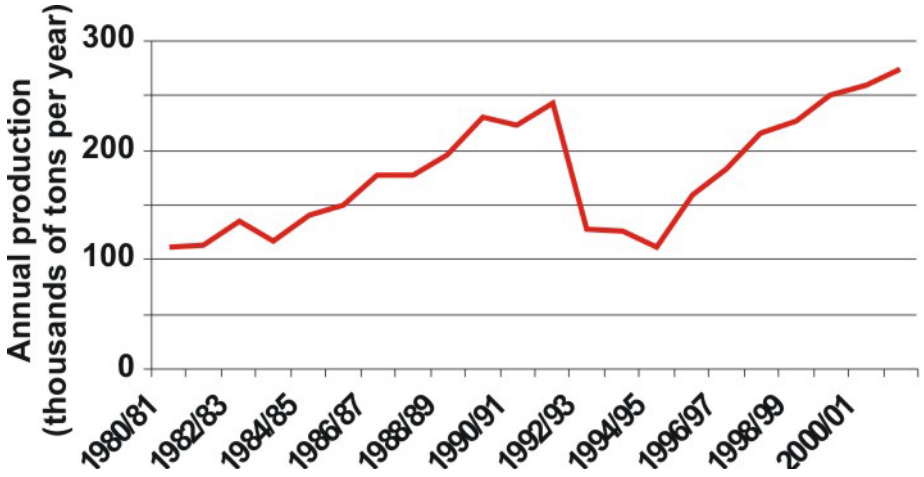
3.2.1 Banana production

Overview of the market conditions for banana production in South Africa

South Africa's banana industry is worth about R 550 million a year. There are at least 350 farmers in six sub-tropical production areas. Production areas are Levubu near Louis Trichardt (1100 ha), Letaba at Tzaneen (1000 ha), Hazyview (2600 ha), Sabie, Onderberg around Malelane and Komatipoort (4800 ha), Natal South Coast (2000 ha) and Natal North Coast (700 ha).

Technological advances and management development over the past five years have enabled the banana industry to almost double its production. It has increased from an industry average of 16 tons a hectare in the early 90's to 30 tons a hectare. (Banana growers Association, 2003). The demand for better quality fruit has urged the industry to invest capital in the improvement of packing and refrigeration facilities to overcome the reduction in the total annual production (tonnage) in the early 90's (see figure below).

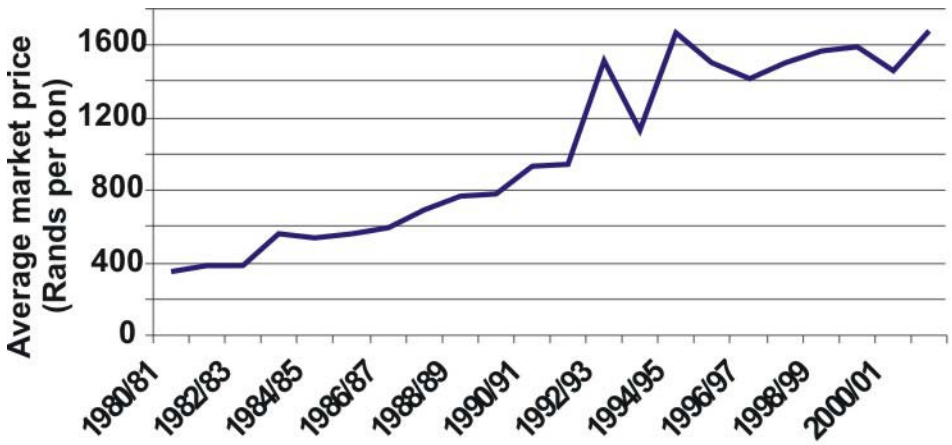
Figure 28 – Banana annual total production



Source: Abstract of Agriculture statistics (2002)

The average price of bananas sold on national markets in 1981/82 was R386/ton, whereas in 2001/02 it was R1,677/ton. There has been almost a constant increase in the average price of banana in the last two decades, an increase higher than the inflation rate.

Figure 29 – Average price of banana sold on national fresh produce markets



Source: Abstract of Agriculture statistics (2002)

Bananas are mainly sold nationally, with small volumes exported to Botswana. Despite worldwide oversupply making entry to other world markets difficult, South Africa's only marginal price competitiveness, compared to other producing countries, could prove to be a

bar to entry into international markets. In addition, South Africa's peripheral geographical location is a problem considering short shelf life of bananas.

Bananas are a tropical crop planted in a rather dry subtropical area, which require very sophisticated and costly irrigation systems. Except for the areas already identified for banana growing, there is little scope for further banana planting in South Africa.

Planting costs have raised dramatically - fertilizer by 35%, carton prices by more than 30% and the increase of fuel prices pose a threat to profit margins. The industry is labour-intensive with salaries contributing to 50% of production costs and so an increase in the labour costs could have a drastic impact on the profit margins (Banana Growers Association).

Banana production in the Luvubu catchment (data from farmers' survey)

Bananas are the biggest commodity in the Levubu district and covers approximately 1,200 ha. All the bananas produced in the district are sold within South Africa. The main biophysical characteristics of this crop as reported in the farmer survey are the following:

- The yield estimated at 35 ton/ha;
- Water usage estimated at 40,000 litres per ha per week;
- High tree density in a banana orchard; 1,200 – 1,500 trees are planted per hectare in contrast with 200 trees per hectare for macadamias, avocados and mangos.

Gross margins and labour requirements for banana production

The gross margins have been calculated using COMBUD data for the Levubu farming area of year 2002. The COMBUD data assumes a tree density of 2,000 trees/ha and a rotation period of 10 years. In COMBUD the price of the bananas of grade 1 for the local market has been set at R29.2 per box and R24 per box for hawkers (Bananas Singles); the hourly wage was set at R2.2/hr. The estimations below are based on such data.

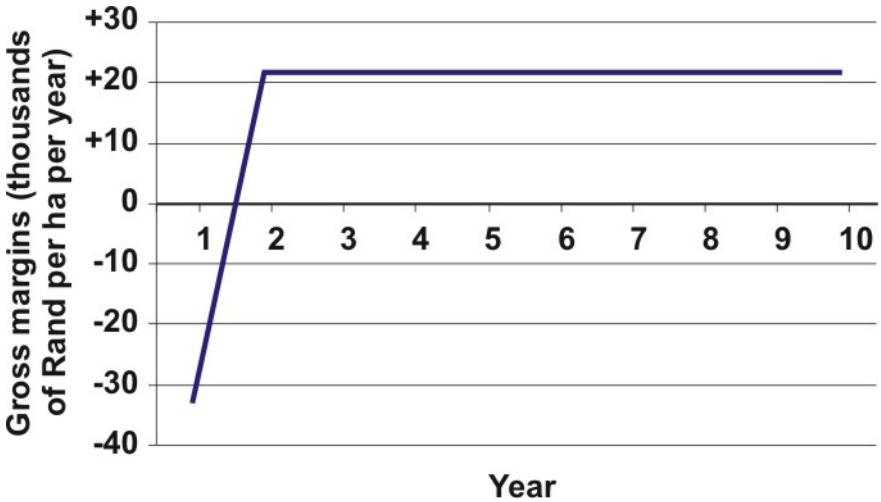
Table 30 – Gross margins for banana production

Annualised gross margins (R/ha/yr)	Discounted gross margins (R/ha/yr)
16,111	12,733

There is not a big difference between the annualised gross margins and the discounted gross margins as the rotation period is not too long (10 years), and because banana trees are able to generate returns already by the second year after planting.

The figure below shows the gross margins for each year of the rotation.

Figure 30 – Banana annual gross margins (R/ha/yr)



The establishing costs of banana orchards have been estimated to be between R23,000/ha (from Alet Visser's survey 2003) and R33,000/ha (using COMBUD data 2002). A quarter of these costs are due to the installation of a irrigation system (micro spray system).

The yield shown in table below has been obtained by averaging the annual yield occurring over the 10 year rotation. The yield data in COMBUD was expressed in terms of boxes and not in terms of tonnes. If it is assumed that on average a box is designed to carry 25kgs, by multiplying 1,310 boxes by 25 kgs the yield in tons is 32.7, which is exactly between 30 ton/ha (estimation provided from the banana grower association) and 35 ton/ha (the response from the farmer survey).

Table 31 – Annualised yield of banana production

yield (box/ha)
1,310

From the COMBUD data labour costs resulted to be 12% of total variable costs when hourly wage is R2.2/hr and this proportion would grow to 20% when the hourly wage is set at R3.9/hr[8] keeping all other variables constant. The cost of cartons (box) is largest contribution to the variable costs (33%).

The table below shows that for each hectare of banana, 137 MD (man days) are required per year, which is equivalent to 0.6 full time jobs.

Table 32 – Labour requirement for banana production

hrs/ha/yr	MD*/ha/yr	Jobs**/ha/yr
1,093	137	0.6

*MD = man days; 8hrs = 1MD

** Jobs were derived by assuming that 218 MDs are equivalent to a full time job.

3.2.2 Macadamia nuts production

Overview of the market conditions for macadamia nuts production in South Africa

The South African Macadamia industry is the third largest producer in the world. It is probably the fastest growing tree crop industry in South Africa. Production grew from 500 kernel tons in 1995 to 3,000 kernel tons in 2002. Over 90% of the production (12% of world production) is exported annually. It is estimated that macadamia trees are planted over 9,000 ha.

The industry is export based and has tremendous growth and development potential as the supply at present is still low in relation to demand. The industry currently employs 2,845 people directly; although the first part of the processing industry is mechanised, the subsequent stages of sorting/grading/quality control/shop floor management remain very labour intensive (SAMAC 2003).

The price paid in 2002 for Nut-In-Shell (NIS) to farmers delivering the NIS to any of the cracking plants in South Africa was R12.5/kg (three of these plants are located in the Levubu). This price is paid irrespectively of whether the plant is then selling the kernel on the local market or export. In 2003 the price dropped a little because of the strengthening if the Rand to around R10.5 but in 2004 it is expected to bounce back to the R12.5/kg level because of shortage of supply in world markets at the present time (SAMAC 2003).

Production of macadamia nuts in the Luvubu catchment (data from farmers' survey)

Macadamia nuts are the second biggest commodity in the Luvubu District. Macadamias nuts have replaced pecan nuts. The reason for this is that the income per hectare for pecan nuts is much lower than that for macadamias, turnover is much more unstable and marketing channels for pecan nuts are not formalised. 90% of macadamias produced in the district are exported; while the remaining 10% mainly consist of damaged nuts, which are sold to the cosmetic industry for their oils. Other producers in South Africa are mainly situated in Kwazulu-Natal.

Warehouses, which also serve as packing facilities for macadamias in the area, belong to various shareholders, mainly producers. Three warehouses are situated in the Levubu district: 1) Green farms; 2) Royal Macadamia; and 3) Zetmac.

[8] The new minimum hourly wage in the agricultural sector (monthly wage is R650).

The Greenfarms Nut Company owns 30% of the Greenfarms warehouse while producers in the area own the other 70%. Royal Macadamia is owned by 7 shareholders, all producers from the area. The third warehouse, Zetmac, has 4 groups of shareholders namely Sapekoe Estates (owns 26%), ARDC (owns 26%), Levubu Macadamia (32%) and Levmak, consisting of nine producers (owns 16%).

The amount of macadamia nuts received and processed by each of these warehouses per year (nut-in-shell values) is:

- Green farms: 2,500 ton per annum
- Royal Macadamia: 1,500 ton per annum
- Zetmac: 2,500 ton per annum

All together they are processing each year on average 6,500 ton.

There is at present a major initiative by one of the macadamia processing companies in Levubu, namely Green Farms Nut Co., to actively encourage and assist small farmers in the Venda areas to plant and produce macadamia nuts. They have started training sessions at which more than 100 of farmers have been participating; and a large nursery has been set up to provide these farmers with macadamia trees to plant.

The main biophysical characteristics of this crop as reported in the farmers' survey are the following:

- Macadamias do not use as much water per week as bananas; the estimated water usage is 10,000 – 15,000 litres per week in contrast with the 40,000 litres per week for bananas.
- Tree density per hectare is 200 trees / ha

Gross margins and labour requirements for macadamia nuts production

The gross margins have been calculated using COMBUD data for the Levubu farming area of year 2002. The COMBUD data assumed a tree density of 312 trees/ha and the rotation time of 30 years. In COMBUD the selling price of macadamia has been set at R2.11 per kg, which is a much lower price than the price set at national level. The General Manager of SAMAC (that has been involved in drawing up the production costs data for the COMBUD) has explained this price (R2.11/kg) as possibly being the price at which small/emerging farmers sell their NIS; however the price of R12.5/kg should be the value to be used in any economic analysis representing the macadamia nut sector. So the COMBUD data were used to generate two gross margins: one setting the price of NIS at R2.11 and the other using R12.5 for NIS.

The estimations below are per hectare and are based on an hourly wage set at R2.2/hr.

Table 33 – Gross margins of macadamia production with NIS price at R2.11/kg and R12.5/kg respectively

NIS price at R2.11/kg		NIS price at R12.5/kg	
Annualised gross margins (R/ha/yr)	**Discounted gross margins (R/ha/yr)**	**Annualised gross margins (R/ha/yr)**	**Discounted gross margins (R/ha/yr)**
1,917	552	49,482	23,918

*MD = man days; 8hrs = 1MD

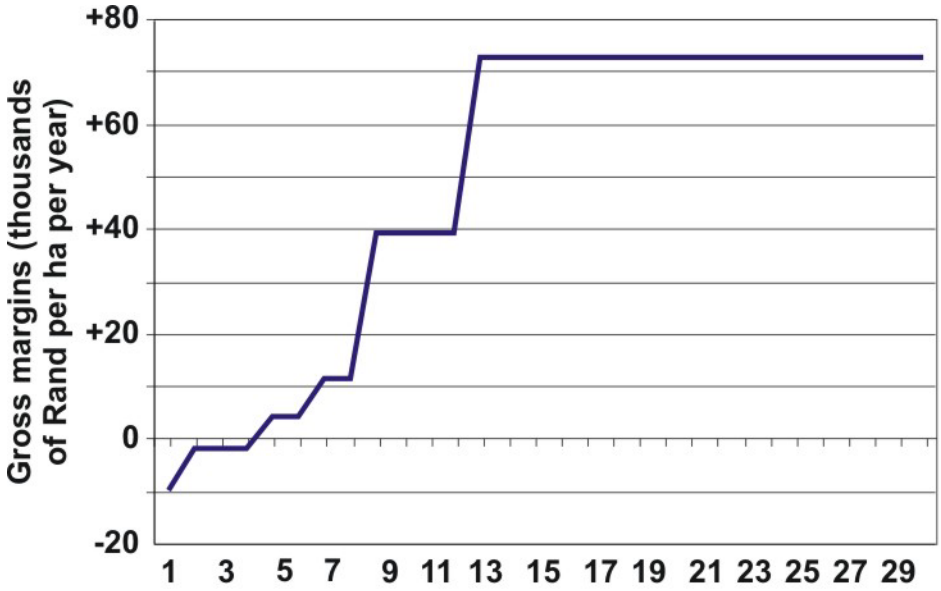
** Jobs were derived by assuming that 218 MDs are equivalent to a full time job.

The annualised gross margins of a small/emerging farmer is approximately R2,000/ha, while the average gross margins per hectare using R12.5/kg for NIS have been estimated to be around R50,000. However the annualised gross margins to be used for future comparative analysis are the latter value.

In contrast with banana production the difference between the annualised gross margins and the discounted gross margins for the macadamia nuts is quite large. This is because both the rotation is longer than for banana, and the time it takes for a macadamia tree to mature and give the first trees is greater. It possible to see in the figure below that macadamia trees start

to produce fruits only after 4 years from when are planted and that it takes approximately 13 years for a macadamia tree to become mature.

Figure 31 – Macadamia annual gross margins (R/ha/yr)



The establishment costs are R10,000/ha much smaller than establishment costs for the banana production (between R23,000 and 33,000).

A hectare with 312 trees of macadamia managed in optimal rotations can generate 4.6 ton each year. If all trees were mature they would generate annually 6.6 ton based on COMBUD data.

Table 34 – Annualised yield of macadamia production

Ton/ha/yr
4.6

Labour costs represent 28% of total variable costs when the hourly wage is R2.2/hr and this proportion grows to 49% when the hourly wage is set at R3.9/hr[9] keeping all other variables constant.

The table below shows that for each hectare of macadamia trees 123 MD (man days) are required per year, which is equivalent to 0.6 full time jobs.

Table 35 – Labour requirement for macadamia production

Hrs/ha/yr	MD*/ha/yr	Jobs**/ha/yr
984	123	0.6

The largest proportion of hours required during macadamia nut production is for harvesting; therefore the jobs created from these cultivars are more seasonal than permanent positions.

3.2.3 Avocado production

Overview of the market conditions for avocado production in South Africa

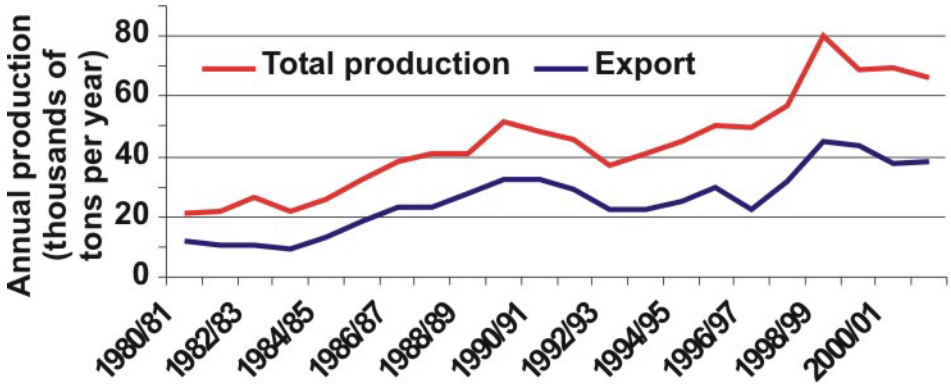
Avocados are grown in the subtropical Northern, North Eastern and Eastern Transvaal, lowveld and parts of Natal. Smaller orchards are found also around Rustenburg.

As the national markets are saturated, exports are the only way forward. South Africa is the biggest supplier of avocados to Britain. The European continent has been identified as South

[9] With monthly wage at R650; the new minimum wage in the agricultural sector.

Africa's biggest market for exporting avocados followed by the U.S.A. The total production of avocado has constantly increased over the last two decades. The exports represent around the 60% of the total production.

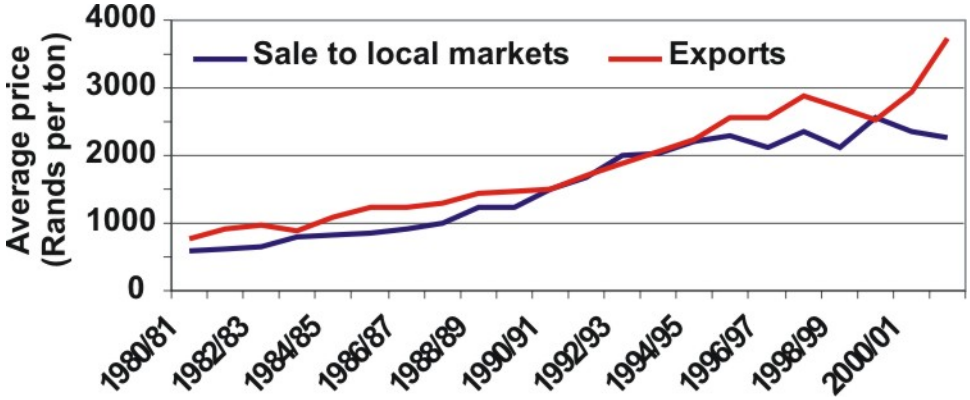
Figure 32 – Avocado annual total production



Source: Abstract of Agriculture statistics (2002)

The average annual price of avocado has been constantly increasing in the last two decades moving from R623/ton in 1981/82 to R2272/ton in 2001/02. The price at which avocado is sold for export has always been slightly higher than the average price sold on national markets. The difference between the two has increased even more in the last few years.

Figure 33 - Average price of avocados for the last two decades



Source: Abstract of Agriculture statistics (2002)

Production of Avocado in the Luvubu catchment (data from farmers' survey)

Avocados have been estimated as the third highest earner in the region. In this area 75% of avocados from the area are exported and the remaining 25%, consisting of either damaged fruit or fruit too small for exporting, is sold nationally. For example, in 2002, 1 million cartons (of 4kg each) were exported. The estimate for 2003 is that 700,000 cartons will be exported (78%), 200,000 will be sold locally (22%) and 1,500 ton will be processed for oil (0.2%).

The main biophysical characteristics of avocado as described in the farmers' survey are the following:

- The yield is approximately 30 ton/ha per annum.
- The tree density is 200 trees per hectare, the same as for macadamias
- The water use is 10,000 to 15,000 litres per ha per week

Gross margins and labour requirements for avocado production

The gross margins have been calculated using COMBUD data for the Levubu farming area for the year 2002. The COMBUD provides data for two types of avocado species: Fuerte and Hass. For the variety *fuerte* it is assumed a tree density of 200 trees/ha and the rotation time

of 25 years; while for the *hass* variety the tree density is 400 tree/ha and the rotation of 12 years. For both the two types of avocado three different selling prices are used: a) fruit sold locally R12.32/box; b) fruits sold for export R12.54/box; and c) fruits sold to hawkers at R1/box. 70% of avocado *fuerte* is exported, against the 60% of avocado *hass*. The estimations below are per hectare and assume the cost of labour to be R2.2/hr.

Table 36 – Avocado (Fuerte) productions outcomes

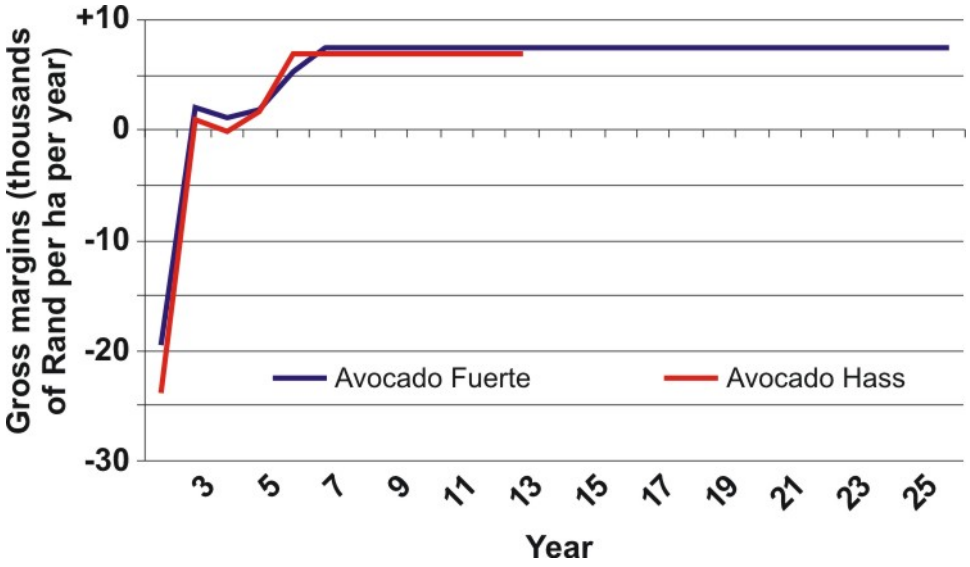
Annualised gross margins (R/ha/yr)	Discounted gross margins (R/ha/yr)
5,632	3,075

Table 37 – Avocado (Hass) productions outcomes

Annualised gross margins (R/ha/yr)	Discounted gross margins (R/ha/yr)
2,866	1,678

The avocado fuerte generates higher annualised gross margins than the avocado hass, because of its longer productive life (rotation) and slightly lower establishment costs. On average 40% of these establishment costs are due to the installation of an irrigation system (R8,000/ha). The total cost of tree planted is 22% of establishment costs for avocado (fuerte) and 36% for avocado (hass).

Figure 34 – Avocado (fuerte) annual gross margins (R/ha/yr)



Labour costs represent a small proportion of the total variable costs both when the hourly wage is R2.2/hr (6%) and when it is R3.9/hr[10] (10%). On the contrary, packaging costs are the costs contributing most to the total variable costs (around 70%).

It takes one year for avocado trees to start to produce fruits and 5 to 6 years to become completely mature (the yield in COMBUD was expressed in unit boxes). The annualised yield for avocado fuerte is higher than the yield for the avocado hass; however the yield at maturity is the same for the avocado fuerte and avocado hass (3750 boxes/ha).

Table 38 – Annualised yield of Avocado (Fuerte) production

Box/ha
3,292

Table 39 – Annualised yield of Avocado (Hass) production

Box/ha
2,833

[10] With monthly wage at R650; the new minimum wage in the agricultural sector.

The table below shows for each hectare planted with avocados are required 65 MD (man days) per year for the variety of avocado fuerte and 49MDs for the variety hass, which is equivalent to 0.26 and 0.23 full time jobs, respectively.

Table 40 – Labour requirement for Avocado (Fuerte) production

hrs/ha/yr	MD*/ha/yr	Jobs**/ha/yr
523	65	0.26

*MD = man days; 8hrs = 1MD
** Jobs were derived by assuming that 218 MDs are equivalent to a full time job.

Table 41 – Labour requirement for Avocado (Hass) production

hrs/ha/yr	MD*/ha/yr	Jobs**/ha/yr
395	49	0.23

*MD = man days; 8hrs = 1MD
** Jobs were derived by assuming that 218 MDs are equivalent to a full time job.

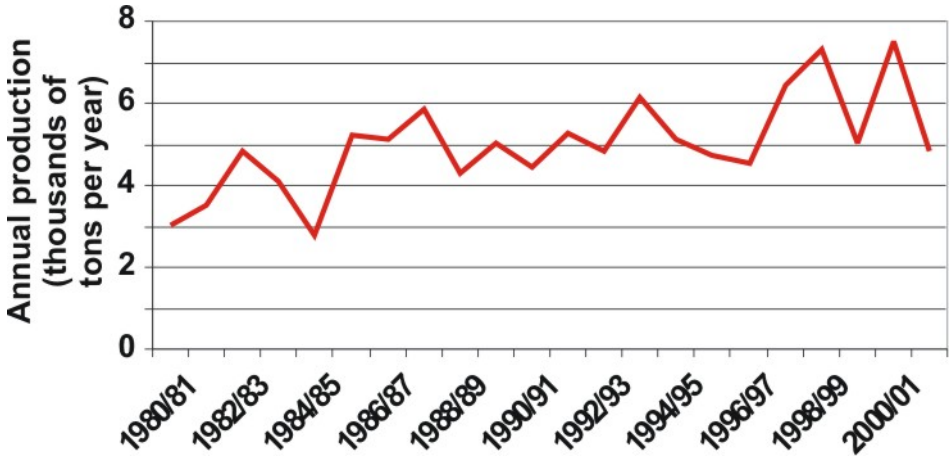
Approximately 35% of labour requirement is for harvesting, so this part of the jobs created is more seasonal than permanent jobs.

3.2.4 Litchi production

Overview of the market for litchi production in South Africa

In South Africa there are 1000 hectares planted with litchis. More than 6500 tons of fruit are produced annually. The most important production areas are Malelane, Nelspruit, Trichardsdal, Tzaneen, Louis Trichard, Levubu and the South Coast of Natal. The total litchi production has slightly increased in the last two decades but not with a constant trend; litchi production is, in fact, characterised by large fluctuation from year to year. This makes unstable any prediction of annual gross returns from this sector.

Figure 35 – Litchi annual total production

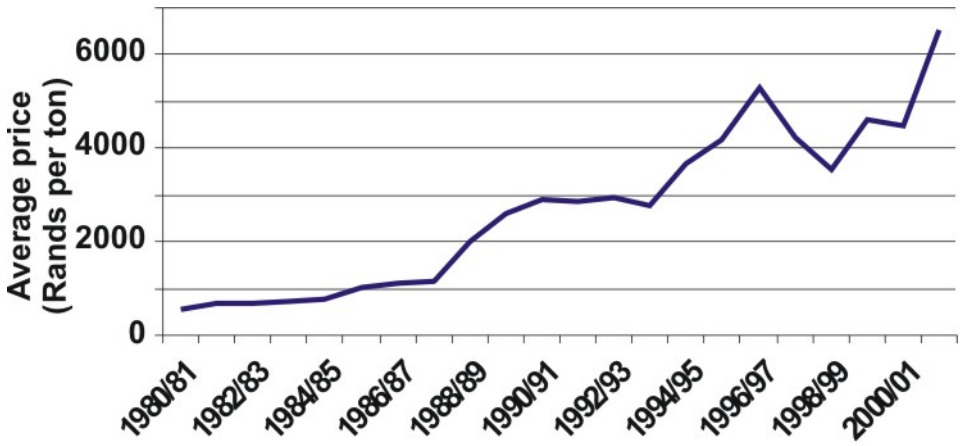


Source: Abstract of Agriculture statistics (2002)

Despite the fluctuation in the litchi production, its price has not been fluctuating so much, showing a positive increase over the last two decades (see figure below). Such increase was higher than the inflation rate. In 2001/202 the average price of litchi was R6537/ton.

The constraint on litchi production it is that the fruit has to be harvested and marketed within two weeks, and therefore there is a need for a large labour force for a very short time. The European Union is the most important market, with the United Kingdom and France accounting for most of the sales.

Figure 36 – Average price of litchi sold on national fresh produce markets



Source: Abstract of Agriculture statistics (2002)

Production of Litchi in the Luvubu catchment (data from farmers' survey)

Farmers expressed as a concern with the litchi production the fact that its production fluctuates a lot from year to year. All litchis produced in the district are exported out of the district. All farmers surveyed had some litchis. On average they had 2/3 ha planted with litchis and overall 65 ha were planted in the survey area. The production has been estimated to be approximately 10 ton / ha. 70% of litchis yield are sold fresh at R5,000/ton and the remaining 30% is sold for juice at R2,000 / ton.

Gross margins and labour requirements for litchi production

The gross margins have been calculated using COMBUD data for the Levubu farming area of year 2002. The following biophysical and financial data were assumed in COMBUD for the litchis production:

- a tree density of 140 trees/ha;
- the rotation time of 25 years
- Hourly wage at R2.2/hr
- Litchi price for export at R3/kg
- Litchi price for local market at R3.77/kg
- Litchi price for processing at R0.98/kg
- 53% of litchi production is processed; 20% exported and 27% sold nationally

The data found in COMBUD differs from the data provided by the farmer surveyed, in terms of the proportion of litchi that is processed and the price at which is sold. Therefore the annualised gross margins shown in table below (based on COMBUD data) would be higher if the amount of yield processed (30%) and the prices (R2/kg) suggested by farmers were used instead.

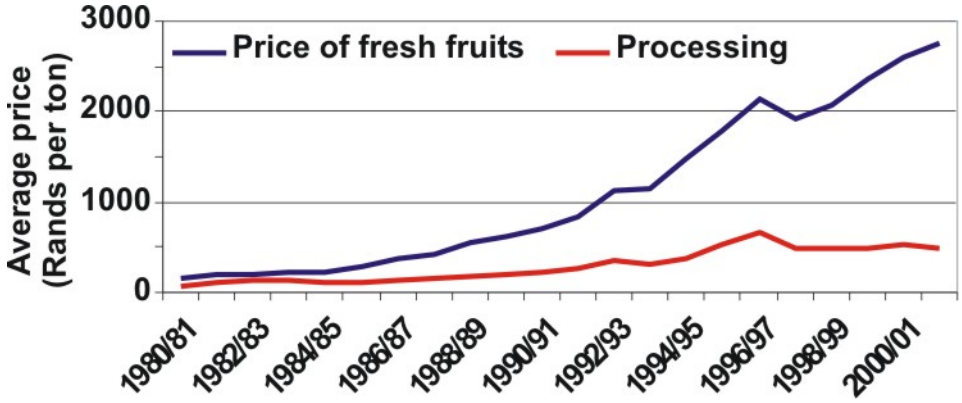
Table 42 – Litchi production's outcomes

Annualised gross margins (R/ha/yr)	Discounted gross margins (R/ha/yr)
2,222	601

The annualised gross margins would increase by 76% if the price of litchi sold for processing increased from R0.98/kg to R2/kg, while keeping all other variables constant. On the other hand if the proportion of litchi that is processed changed from 53% to 30%, the annualised gross margins would increase by 74%, as then more yield would be sold on the local and export markets, at higher selling prices (R3.77/kg and R3/kg). If both these two changes were carried out at the same time, the annualised gross margins would increase to R4,783/ha/yr (117%).

The figure below shows the annual gross margins that a hectare grown with litchi can generate over the 25 year rotation. The average across these annual gross margins is the annualised gross margin shown in table above.

Figure 37 – Litchi annual gross margins (R/ha/yr)



It is clear that it takes approximately 3 years for a litchi tree to produce any fruits after it is planted, and another 16 years before becoming completely mature. This explains why there is a big difference between the annualised and discounted gross margins (see table 42 above). Based on the COMBUD data the litchi annualised yield is approximately 3 tons per hectare. The litchi yield can reach 6 tons per hectare when it matures (this is a bit lower than the data provided during the farmers' survey).

Table 43 – Annualised yield of Litchi production

Kgs/ha
3,061

It appears that litchi production has one of the lowest labour requirements compared with other crops. In facts, for each hectare planted with litchi, 38 MD are required compared to the 137MD required for banana. More than 50% of the labour requirement is for harvesting, so this type of crop would generate particularly seasonal work more than permanent positions.

Table 44 – Labour requirement for Litchi production

hrs/ha/yr	MD*/ha/yr	Jobs**/ha/yr
304	38	0.17

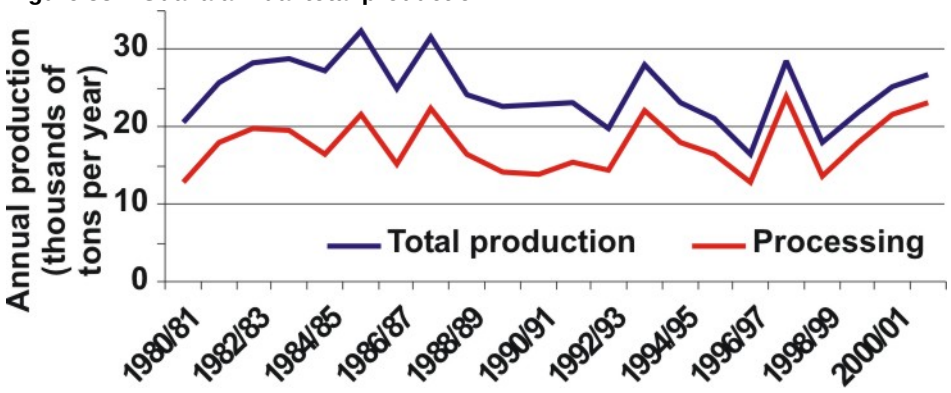
*MD = man days; 8hrs = 1MD
** Jobs were derived by assuming that 218 MDs are equivalent to a full time job.

3.2.5 Guava production

Overview of the market conditions for Guava production in South Africa

Gross income from guavas is R6,5 million a year. Production of guavas was 26,742 tons for the year of 2001/2002. In contract to other subtropical fruits its production does not show a clear trend. As with the litchi production, it fluctuated a lot over the last two decades. However, it is possible to observe that the proportion of guavas that is processed has increased with respect the total production.

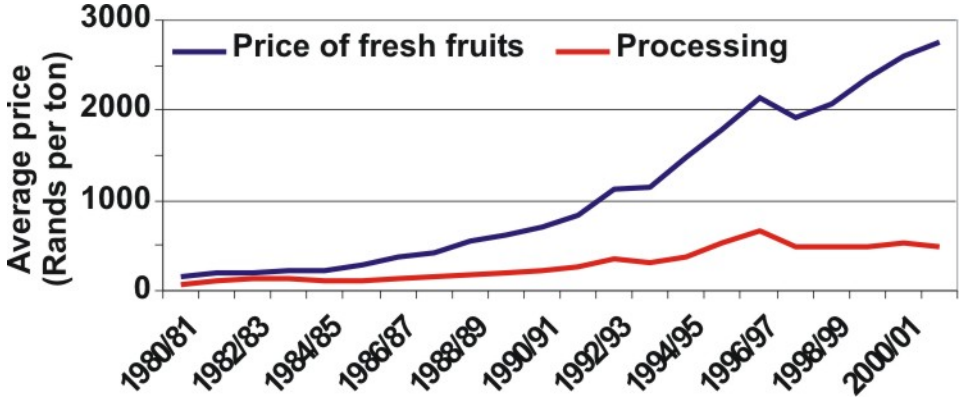
Figure 38 – Guava annual total production



Source: Abstract of Agriculture statistics (2002)

Although total production has not changed, the price for fresh fruit has exponentially increased; while the price for guavas sold for processing has also increased.

Figure 39 – Average price of guavas sold on national fresh produce markets



Source: Abstract of Agriculture statistics (2002)

In 2001/02 the average market value of guavas was R2,756/ton and the average price for processing was R478,92/ton.

Production of Guavas in the Luvubu catchment (data from farmers' survey)

Approximately 350 ha of the survey area was utilised for growing guavas. It has been estimated that on average between 30 to 40 tons of guavas can be produced per hectare each year in the district. Tree density for guavas is higher than that for avocados and macadamias, with 400 trees / ha. The guavas produced in the district are sold either for juice to Qualijuice, a local company, earning R420 / ton, or sold fresh, earning R1,200 / ton. Of the guavas produced in the survey area, 50% are sold for juice and 50% fresh. However, in 2003, it is estimated that less guava will be sold through the fresh produce market (approximately 1,500 ton) while 4,500 ton will be sold for juice (75%).

Gross margins and labour requirements for guavas production

The gross margins have been calculated using COMBUD data for the Levubu farming area of year 2002. The following biophysical and financial data were assumed in COMBUD for the guavas production:

- Tree density assumed 333 trees/ha
- Expected production time 15 years
- Average price of guavas sold on the local market is R1.63/kg
- Labour costs R2.2/hr
- 100 % of yield is sold on local markets

The data found in COMBUD differs from the data provided by the farmer survey in terms of both the proportion of guavas processed, and consequently the price at which is sold. Therefore the annualised gross margins shown in the table below, which are based on COMBUD data, would be lower if amount of yield processed (75%) and prices (R0.42/kg) suggested by farmers were used instead .

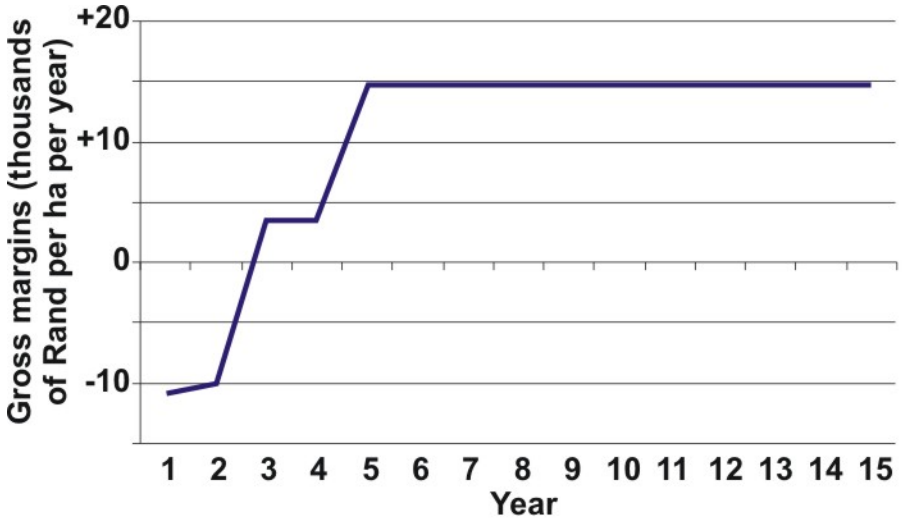
Table 45 – Guavas production's outcomes

Annualised gross margins (R/ha/yr)	Discounted gross margins (R/ha/yr)
9,805	6,648

The annualised gross margins would reduce by 90% (R 950/ha/yr) if the proportion of yield utilised for processing increased to 75% and the price reduced to R0.42/kg.

The establishment costs are around R11,000/ha. The major contribution to the establishment costs is from the cost of trees in the first year and from the installation of the irrigation system in the second year.

Figure 40 – Guavas annual gross margins (R/ha/yr)



Based on the COMBUD data it appears that guava production is heavily labour intensive. In fact the labour costs represent 50% of the variable costs when the hourly wage is set at R2.2, but it becomes 90% when the hourly wage is equal to R3.9. An increase in the hourly wage from R2.2 to R3.9 would cause a 27% decrease in the gross margins.

It takes two years for a guava tree to produce any fruit and 5 years to reach its maximum production. Based on the COMBUD data the guavas annualised yield is approximately 12 tons per hectare. This yield can reach 16 tons per hectare when they mature, which is a bit lower than the data provided during the farmers' survey (30 – 40 ton/ha). So if the farmers data were to be used, the annualised gross margins would increase with respect the one shown in the table 46.

Table 46 – Annualised yield of Guavas production

kg/ha
11,733

Guava production has the highest labour requirement of all the other sub-tropical plants. In fact, for each hectare planted with guavas 224 MD are required compared with the 137MD required for banana. More than 60% of total hours required during guava production is for harvesting, so the nature of the jobs created are more seasonal than permanent position.

Table 47 – Labour requirement for Guavas production

hrs/ha/yr	MD*/ha/yr	Jobs**/ha/yr
1,794	224	1.03

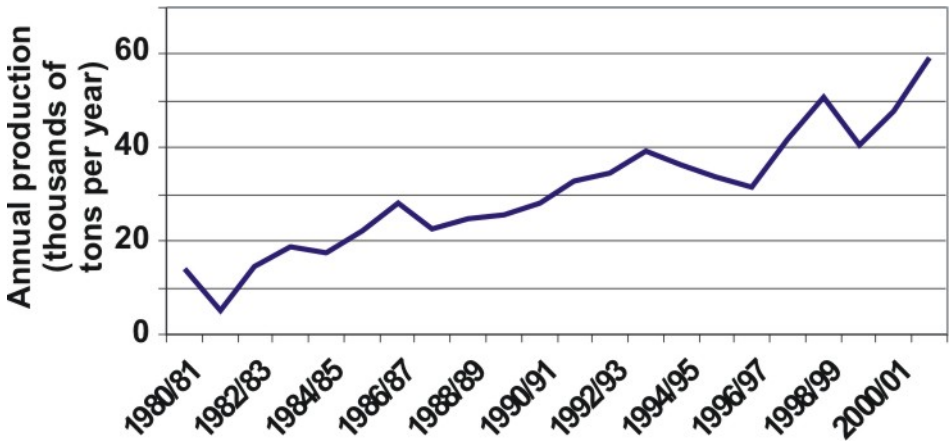
*MD = man days; 8hrs = 1MD
** Jobs were derived by assuming that 218 MDs are equivalent to a full time job.

3.2.6 Mango production

Overview of the market conditions for mangos production in South Africa

In South Africa a steady increase in mango production has been observed over the last 30 years from 6,170 in 1970 to 59,239 tons in 2001/2002.

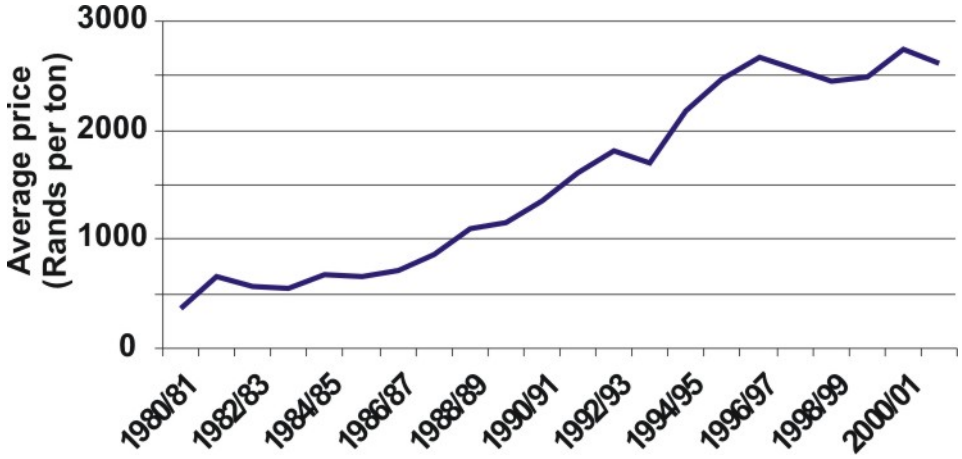
Figure 41 – Mango annual total production



Source: Abstract of Agriculture statistics (2002)

Also the average price of the mango has significantly increased in the same period, at a rate much higher than the inflation rate. In 2001/2002 the average price of mango was R2,624/ton.

Figure 42 – Average price of mangos sold on national fresh produce markets



Source: Abstract of Agriculture statistics (2002)

Production of Mangos in the Luvubu catchment (data from farmers' survey)

In the surveyed area there are 246 ha under mangos. It was estimated that a hectare of mango can produce on average 40 ton per annum. The mango are planted with a tree density per ha equal to 200 trees / hectare. Mango plantations use on average between 10,000 and 15 000 litres per hectare per week.

Of the mangos grown in the district 80% is sold for processing at R500 / ton, while the remaining 20% is sold fresh at R2000 / ton.

Gross margins and labour requirements for Mangos production

The gross margins have been calculated using COMBUD data for year 2002. The following biophysical and financial data were assumed in COMBUD for the mangos production:

- Tree density assumed 667 trees/ha
- Expected production time 15 years
- Labour costs R2.2/hr
- Price of mangos sold on local market is R14.5/carton
- Price of mangos sold for processing is R4.5/carton
- Price of mangos sold for export is R20/carton
- 56% of mangos produced is sold for export; 27% is sold on the local market and the remaining 17% for processing.

The data found in COMBUD differs from the data provided by the farmer surveyed in terms of proportion of mangos that are processed. Therefore the annualised gross margins shown in table below, which are based on COMBUD data, would be lower if the proportion of yield processed (80%) suggested by farmers were instead used. If the proportion of cartons that are sold for processing is increased to 80% the annualised gross margins would reduce by 62% (R20,525/ha/yr).

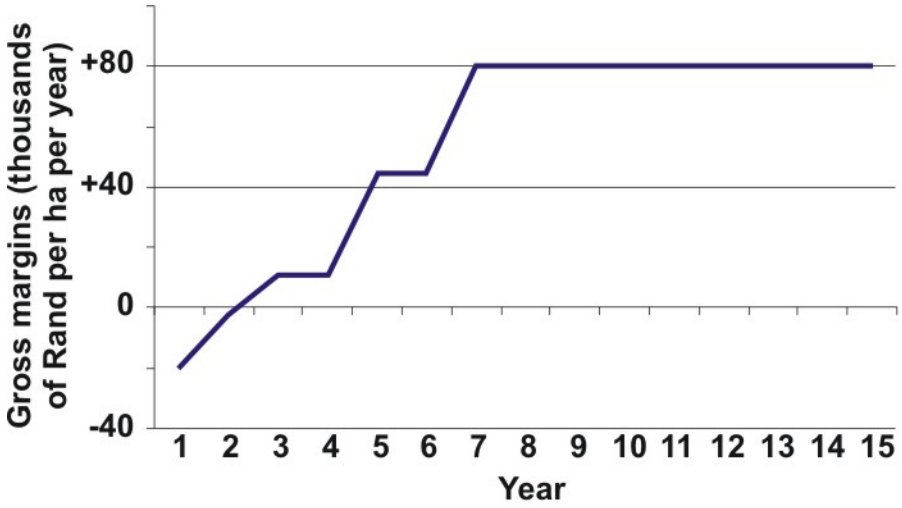
Table 48 – Mango productions outcomes

Annualised gross margins (R/ha/yr)	Discounted gross margins (R/ha/yr)
54,186	37,592

It is not possible to comment whether there is a price difference between the farmers' survey data and the COMBUD data as the prices are expressed in different units and there is no information on the weight content of the cartons. In addition, the tree density assumed in COMBUD (667 trees/ha) differs from the density reported in the farmers' survey. If such a lower tree density were to be used, the yield would similarly be lower as would the gross margins.

The establishment costs are around R20,000/ha. The major contribution to the establishment costs are from the cost of mango trees and the installation of the irrigation system in the second year.

Figure 43 – Mango annual gross margins (R/ha/yr)



It takes two years for a mango tree to produce any fruit and 7 years to reach its maximum production. Its annualised yield is around 4,000 carton/ha plus 2 ton of mangos that are sold to hawkers.

Table 49 – Annualised yield of Mangos production

carton/ha
3,923

The table below shows that for each hectare planted with mangos 43 MD (man days) are required per year, which is equivalent to 0.20 full time jobs.

Table 50 – Labour requirement for Mangos production

hrs/ha/yr	MD*/ha/yr	Jobs**/ha/yr
347	43	0.20

*MD = man days; 8hrs = 1MD
** Jobs were derived by assuming that 218 MDs are equivalent to a full time job.

However, the majority of labour requirement (more than 50%) is for harvesting; therefore the jobs created are more seasonal jobs than permanent jobs.

3.2.7 Citrus production

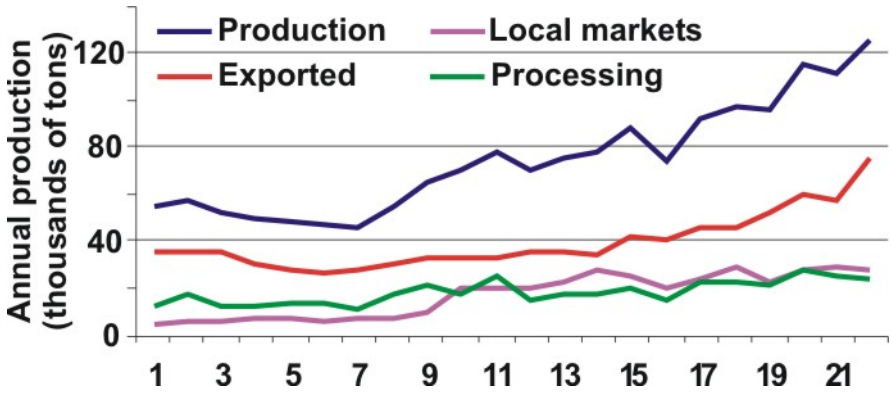
Overview of the market conditions for citrus production in South Africa

Citrus trees are planted across all South Africa, with 56,203 ha in 2002. Limpopo is the second most popular province after Eastern Cape. The variety most often grown in South Africa is the Valencia. With regard to this particular variety, Limpopo is the province with the greatest area planted with Valencia (36% of all Valencia grown in South Africa come from Limpopo).

The total production of oranges (including valencias and navels) in 2002 was 1,265,713 ton. 60% was exported, 22% was processed and the rest (18%) was sold nationally. The major export destinations were Northern Europe (28%), and the Middle East (22%).

In the last 30 years the production of valencias has more than doubled. The amount sold for processing has not changed much in the last few years, whereas exports have more than doubled in the same period.

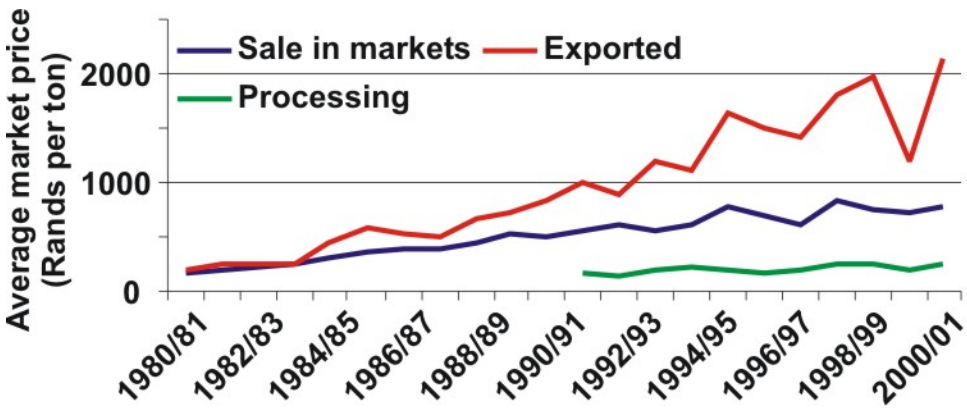
Figure 44 – Orange annual total production



Source: Abstract of Agriculture statistics (2002)

The average price of Valencia sold on local markets in 2002 was R924/ton; the processed net realisation was R248/ton and export net realisation was R2,059/ton. Over time, the export price has diverged both from the average price at which Valencia is sold on the national markets, and from the price at which they are sold for processing. At the same time, the price of those sold for processing has hardly changed.

Figure 45 – Average price of oranges sold on national fresh produce markets



Source: Abstract of Agriculture statistics (2002)

Production of Citrus in the Luvubu catchment (data from farmers' survey)
In the surveyed area the hectares planted with citrus are 350, of which 60 ha under naartjies, 100 ha under "nawels" and 190 ha under valencias. Two citrus packing warehouses are situated in the study area.

Gross margins and labour requirements for citrus production
The gross margins have been calculated using COMBUD data for year 2002. The following biophysical and financial data were assumed in COMBUD for the valencia production:

- Tree density assumed 450 trees/ha
- Expected production time 20 years
- Labour costs R2.2/hr
- Price of valencias sold on local market is R0.85/kg
- Price of valencias sold for processing is R0.33/kg
- Price of valencias sold for export is R0.82/kg
- 50% of valencias produced are sold for export; 41% are sold on the local market and the remaining 9% for processing.

The main difference between the COMBUD data and the data from the citrus producer association is the value of export prices. In COMBUD it is assumed to be R0.82/kg against the R2/kg from the citrus producer association. The annualised gross margins in table below would increase to 27,137 if the export price of R2/kg was used.

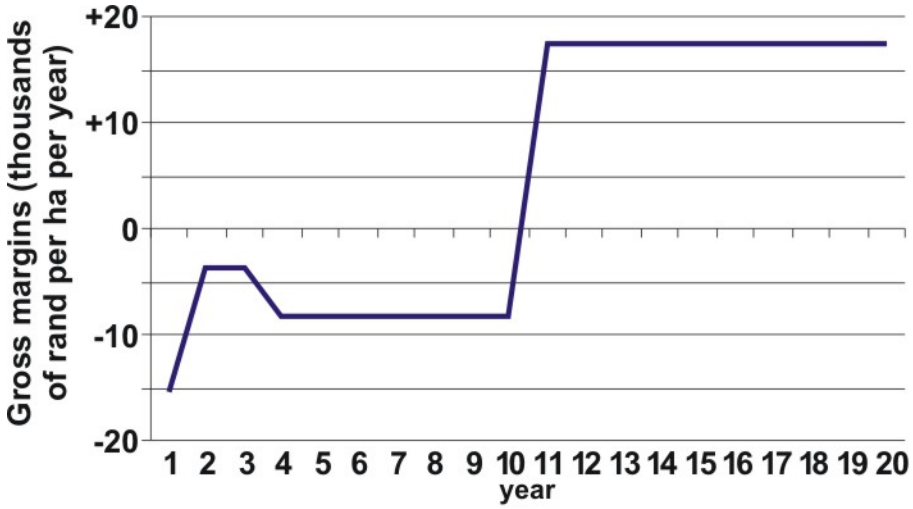
Table 51 – Valencias production's outcomes

Annualised gross margins (R/ha/yr)	Discounted gross margins (R/ha/yr)
4,619	1,512

The establishment costs are around R15,000/ha. The major contribution to the establishment costs are from the cost of valencias trees.

The figure below shows that the gross margins are positive only when the oranges achieve maximum yield. This would be different if the export price is changed from R0.98/kg to R2/kg.

Figure 46 – Valencias annual gross margins (R/ha/yr)



It takes three years for an orange tree to produce any fruit and 11 years to reach its maximum production. Its annualised yield is around 38 ton/ha, while the yield at maturity can reach 56 ton/ha.

Table 52 – Annualised yield of Orange production

Kg/ha
38,087

Labour costs represent 11% of total variable costs when hourly wage is R2.2/hr and this proportion grows to 20% when the hourly wage is set at R3.9/hr[11] keeping all other variable constant.

The table below shows for each hectare of oranges trees 157 MD (man days) are required per year, which is equivalent to 0.72 full time jobs.

Table 53 – Labour requirement for Orange production

hrs/ha/yr	MD*/ha/yr	Jobs**/ha/yr
1,253	157	0.72

*MD = man days; 8hrs = 1MD
** Jobs were derived by assuming that 218 MDs are equivalent to a full time job.

However, 80% of hours required during the orange production are used for harvesting; therefore the jobs created from these cultivars are more seasonal than permanent positions.

3.3 Labour in Luvubu from formal agriculture

At present, approximately 1,800 workers are employed by the farmers of the Levubu Farmers Society. 400 of them are employed at the 8 warehouses in the district; additionally 200 workers are also employed on a seasonal basis. These workers are paid the new minimum wage specified by the Department of Labour (R650 / month). The new minimum wage is challenging farmers in the area, with a series of implications for the relationship between farmers and the farm worker.

As a consequence of this increase in the minimum wage, farmers are not willing to pay any more for construction and maintenance of workers' houses, electricity, water, travel, medical bills; in addition they are also not willing to hand out free produce from the farm as they did in the past. Aging workers will not be able to stay on at the farm and do small tasks as in the past. Farmers will employ labourers who are fit and able to do the work.

From the analysis of the production of the main fruit tree species grown in the area it appears that the largest proportion of the labour requirement (with exception of the first few years) is for harvesting. This proportion can range between 45 to 85% of the total labour requirement. This implies that a good proportion of the jobs created by the horticultural sector are seasonal and not permanent.

Water for agriculture

Water for the commercial farms in the Levubu district either comes from the state water scheme (linked to the Albasini dam, Luvuhvu River and the Latanyanda River) or from private boreholes on farms.

Three main irrigation channels service the area; one from the Albasini Dam, one from the Levubu River, and one from the Latanyanda River. However, due to drought in the area, the irrigation channels are not up to standard and need upgrading. DWAF considers this upgrading as being responsibility of commercial farmers and there have no intention of investing more money to maintain these channels (Havenga 2003). Many farmers are therefore relying more and more on private boreholes on their farms, despite the fact that it is quite expensive to sink a borehole.

At present, only 22 of 73 sluices (30%) on the Albasini furrow are in use, due to degraded infrastructure. 90 % of sluices on the Luvuvhu and Latanyanda are in use. 1,548 ha of the area studied fall under this water scheme.

The farmers' survey provided useful information on the water usage for some of the crops cultivated in the region. Such data are summarised in the table below.

[11] With monthly wage at R650; the new minimum wage in the agricultural sector.

Table 54 – Crop water usage

Crop type	Water usage (litre/ha/week)
Banana	40,000
Macadamia nuts	10,000 – 15,000
Avocado	10,000 – 15,000
Mango	10,000 – 15,000

Given the context of irrigated agriculture in which this study is placed, the term used by farmers indicating crop water usage almost certainly refers to the amount of water required to irrigate a crop sufficiently. As such, it should not be taken to mean actual evapotranspiration (implicitly combining crop transpiration and soil evaporation from cropped soil). For this reason, direct comparisons are difficult to make between 'crop water usage' and the proxy values of 'water use' from plantation forestry (*i.e.* the actual evapotranspiration that was simulated by the ACRU model). However, it is a fair assumption that in a drought-prone area, and where the process of irrigation carries both establishment and operational costs, farmers are unlikely to significantly 'over-irrigate'. If this assumption is made, then tentative comparisons between relative water use of irrigated agriculture and that from rain-fed plantation forestry could be made if necessary.

Comparison of the different agricultural products

The table below compares the annualised gross margins and labour requirements across the different types of sub-tropical fruits that are cultivated in the Luvuhvu catchment. The gross margins used were based on COMBUD data. However, some of the COMBUD data were changed to reflect the more specific characteristics of Luvuhvu district when the data provided directly by farmers were particularly different from the corresponding COMBUD data. These changed gross margins were used for the comparison (data shown in column 3 in the table).

Macadamia nuts are the most profitable compared to the other fruit trees, followed by mango, banana and avocado. In terms of labour requirement mango and guavas provided the highest values.

The majority of the labour requirement for all the fruit trees is for harvest, so they do create jobs but a proportion of these are seasonal and not permanent.

Table 55 – Gross margins and labour requirement compared across the fruit trees production

Crop type	Annualised gross margins (R/ha/yr)	Changes to annualised gross margins	MD/ha/yr	% of labour for harvest
Banana	16,111	16,111	137	-*
Macadamia nuts	49,482	49,482	123	63%
Avocado	5,621	5,621	65	38%
Litchi	2,144	4,783	38	52%
Guavas	9,805	9,50	224	66%
Mangos	54,187	20,525	347	50%
Oranges	4,619	4,619	157	85%

* COMBUD did not specify the labour requirement for harvest in the banana production.

Using the information on the crop water use provided by the farmers' survey (see table 56) it the gross margins and labour requirement per unit of water used by fruit trees were derived. Data on water use were only available for some fruit tree species. However, these were for the most commonly grown fruit trees in the catchment (banana, macadamia nuts, and avocado).

Table 56 – Rand and MDs per m^3 of water usage per each fruit tree production

Crop type	R/m^3/ha	MD/m^3
Banana	8	0.07
Macadamia	76	0.19
Avocado	9	0.10
Litchi	-	-
Guavas	-	-
Mango*	32	0.53
Oranges	-	-

* Changed gross margins have been used in the calculation (see table 42)

Macadamia nut production generated the greatest number of Rand per unit of water used, followed by mango, avocado and banana. It is interesting to note that banana production is now apparently less profitable than avocado production when water use is considered as part of the equation. Avocado is able to generate both more Rand and MDs per unit of water than banana.

Mango production generates more labour per unit of water used than macadamia nut production. However, the labour requirement specified here refers only to the labour required during the rotation period. These values do not include the labour employed in the warehouses where the subsequent stages of sorting/grading/quality control are carried out. For the case of macadamia nut production, this is the major labour requirement as it is relatively labour intensive. If these data were included, the difference between mango and macadamia nuts would reduce.

The sub-tropical fruit crops have the shortest of the value chains. In most cases the fruit itself is generally produce sold direct to final consumers. Most of the fruits grown in Luvuhvu are sold for export (with the exception of banana), particularly macadamia nuts.

Table 57 – Proportion of yield sold on national market, exported or processed

Crop type Data sources	**National markets (%)**	**Export (%)**	**Processing (%)**
Banana	100	-	-
Macadamia nuts			
Farmers' survey	-	90	10
COMBUD	-	100	-
Avocado			
Farmers' survey	22	77.8	0.2
COMBUD	15	70	15
Litchi			
Farmers' survey	70*		30
COMBUD	27	20	53
Guavas			
Abstract statistics	28*		72
Farmers' survey	25*		75
COMBUD	100*		-
Mangos			
Farmers' survey	20*		80
COMBUD	27	56	17
Oranges			
Abstract statistics	18	60	22
COMBUD	41	50	9

* The proportion for fresh fruits was provided, but not the break down between national markets or export was specified.

Mango, guavas and litchi appeared to have the largest proportion of their production sold for processing, in particular for juice production.

Secondary processing activities, which include manufacturing of fruit juice (Qualijuice, a fruit juice local company particularly for Guavas) and packing/sorting warehouses (2 for citrus and 3 macadamia nuts) were identified in the Luvuhvu catchment (see table below).

Table 58 - Number of processing plants in the surveyed region:

Crop type	**Warehouse**	**Processing plant**
Bananas	n/a	n/a
Macadamia nuts	**3**	n/a
Avocados	n/a	n/a
Litchis	n/a	n/a
Guavas	n/a	**1**
Mangos	n/a	n/a
Citrus	**2**	n/a
Other*	**3**	n/a

* The type of fruit kept in the warehouse was not specified in the data.

The proportion of macadamia nuts, avocado, mango, litchi, and oranges that are sold for processing leaves the Luvuhvu catchment, and consequently so does the added value and jobs creation associated with secondary processing.

Even part of the export could be seen as a loss of added value leaving South Africa, as a fair proportion of tree fruits exported are then processed abroad. This is particularly true for the macadamia nuts that are often not consumed as a fruit itself.

As in the case of commercial forestry, a proportion of the added value that now leaves the catchment could be kept within by investing in processing plants and warehouses that are labour intensive and provide intermediate products that could subsequently be exported (*e.g.* Macadamia nut oil).

Currently, in the Luvuhvu farming area, banana is the biggest commodity. However, it is also the fruit tree with the highest water usage and the lowest potential of added value (as it is consumed mainly as a fruit itself). So this fruit type is not generating added value, and is consuming water that could be used more profitably used to irrigate fruit trees such as avocado and mango, which can generate more Rand and jobs per unit of water used and have more potential for processing.

Macadamia nuts production appears to be the most profitable option, both in terms of total gross margins (R/ha) and per unit of water used (R/m^3/ha). Macadamia nut production is in fact expanding across the Luvuhvu catchment much more rapidly that any other type of fruit tree production.

However, the fact that it takes at least seven years for the cumulative gross margins for macadamia nut production to become positive could be a barrier for small farmers investing in such production. On the contrary banana production is able to generate cumulative positive gross margins within three years. Both mango and avocado similarly require between 6 and 7 years to generate returns sufficient to compensate for the establishment and annual variable costs.

A large scheme has been established in Luvuhvu to stimulate more farmers to invest in macadamia nut production, by providing training and fruit tree plants. The option to invest in the most profitable crop is the most rational choice. However, the risk that a crash in the market price of macadamia nuts must be considered in the profit maximisation. Emphasis should be put on the risk of loss of diversification. Luvuhvu could become the leading South African producer of macadamia nuts, but become also less resilient to marginal changes in the macadamia nut price. So investment in alternative fruit tree production and processing plants should also be encouraged.

4 Comparisons between the forestry and Agriculture Sectors

4.1 Comparison between the timber plantations

Before timber production can be compared with the irrigated agriculture, the different types of timber plantation should be compared. If timber plantations are compared only on the grounds of gross margins and labour requirements generated at the plantation level, and without considering the additional gross margins and labour created during secondary processing, pine plantations generate more Rand per unit of water used, than Eucalyptus at 22 years and 10 years rotation. Eucalyptus at a 10 year rotation generates more MD per unit of water used.

Table 59 – Rand and MDs per m^3 of water usage per each type of timber tree plantation

Crop type	R/m^3/ha/yr	MD/m^3/ha/yr
Pine	0.24	0.0012
Eucalyptus (22 year)	0.15	0.0013
Eucalyptus (10 year)	0.07	0.0020

Roundwood pine is mainly sold for saw logs. As there are 20 sawmills in Limpopo, a good proportion of the added value generated by sawmill processing is kept within the province. So compared to the other type of plantations, which have a lower proportion of roundwood sold for saw logs, pine plantations are able to generate a larger proportion of added value within the province. However, this added value refers only to the added value associated with sawmills, as all the added value which is generated by furniture plants is not retained within the province.

On the other hand, roundwood eucalyptus, managed in 10 years rotation, generates more employment per unit of water used. In addition to the jobs created for roundwood production, eucalyptus (10 years rotation) also generates indirect jobs for the debarking phase, which is carried out inside the province, before this roundwood is sent to pulp mills. However, the majority of the added value potentially generated by eucalyptus is lost, as most of the roundwood is used for pulpwood and consequently exported out of the province. Roundwood from pine and eucalyptus managed on a 22 years rotation have the longest product chain and consequently added value. So if investment could be made into furniture production and wood by-product plants located within Limpopo, the largest proportion of added value and additional jobs that could generated by plantation forestry would be kept within the province.

4.2 Comparison of forestry with agriculture

Comparative analysis of rain-fed forestry with irrigated agriculture must be made carefully, as the terminology used in forestry and irrigation planning and the way water use have been derived are different. The following tables present the returns in terms of gross margins and MDs creation per unit of water used by each tree crop or forestry plantation type. However, it is important to point out that these gross margins refer to only the production phase and not to the added value generated by the output of these productions.

Table 60 – Rand and MDs per m^3 of water usage per each type of timber and fruit tree plantation

Timber tree type	R/m^3/ha/yr	MD/m^3/ha/yr
Pine	0.24	0.0012
Eucalyptus (22 year)	0.15	0.0013
Eucalyptus (10 year)	0.07	0.0020

Fruit tree type	R/m^3/ha/yr	MD/m^3/ha/yr
Banana	8	0.07
Macadamia	76	0.19
Avocado	9	0.10
Litchi	-	-
Guavas	-	-
Mango*	32	0.53
Oranges	-	-

* Changed gross margins have been used in the calculation (see table 42)

So although the returns from roundwood forestry production are lower than those from fruit tree production (per unit of water used), the added value generated by timber trees plantation is higher as their product chain is longer. However, these added values are currently lost as they are exported out of the province.

The Luvuhvu catchment is an area considered too dry to support further development of commercial plantation forestry, and plantation forestry as a sector is not profitable enough (per unit of water used) to warrant using irrigation. Therefore it is important not only to diversify plantations (such as pine) into those which provide the highest total added value that can be kept within the province, but also to invest in 'low tech' processing plants that would be able to retain part of the added value and generate jobs within the province.

Agriculture appears to be both creating more jobs and generating more gross margins per unit of water used. However, this sector has a much shorter product chain than forestry. In a similar manner to forestry, a large proportion of the added value generated by processing fruit products is exported out of the province. Diversification in the agriculture sector across the Luvuhvu catchment must be ensured in order to reduce any risk of loss of revenue for farmers in the long run.

It can be concluded that rather than changes in land use, changes in infrastructure and manufacturing would be a way to ensure economic growth and social development in the catchment, and in the province as a whole.

5 Conclusions

At the macro level it was found that the economy in the Luvuhvu catchment was based mainly on the service sector, followed a long way back by trade, agriculture and mining. In this sense, the Luvuhvu catchment economy is in a vulnerable situation (depending mainly for its growth from only one sector), but also in an artificial one (as the service sector is driven more from political consideration than from economic drivers).

The formal economy in the Limpopo province is clearly a very open economy, as only a small proportion (2.8%) of total agricultural production is consumed within the province and catchment, with the rest exported. On the other hand, Limpopo is importing a large proportion of good and services. For example, 90% of all agricultural goods consumed or used as intermediary inputs in the Province are imported. This situation is even more of a problem in the Luvuhvu catchment where manufacturing sector is not very developed.

The implication of this outflow of raw primary goods and the importation of intermediary and final goods is a loss of added value that could be generated by processing primary products locally. It is a loss both in terms of potential employment and in income. Such a change in trend could be achieved by concentrating investment in the manufacturing sector within the Limpopo province in general and Luvuhvu catchment in particular.

The lack of infrastructure could be a reason why in the Luvuhvu catchment manufacturing and transport sector have not developed, despite the comparative advantage of labour costs being quite low.

In the last few years, the commercial agricultural sector in the Luvuhvu has shown a significant expansion. Agricultural producers have invested in horticulture products such as macadamia nuts that have favourable market conditions for export, making this sector economically dynamic.

Forestry and agriculture correspond respectively to 11 and 20% of the total land use activity in the catchment. However, based on a recent evaluation carried out by FES (2003) the Luvuhvu catchment is an area that is too dry to support further commercial plantation forestry development.

The major timber species in the region are softwoods, *Eucalyptus grandis*, and other eucalyptus species. With regard forestry it was found, from the analysis, that:

1. Forestry plantations in Limpopo are able to generate between 2400 and 3000 direct jobs, which will be able to support around 10,000 people;

2. Forestry is able to indirectly generate between 15,000 and 18,000 jobs in secondary processing such as pulp/paper mills, sawmills and furniture plants. These jobs will be able to support around 50,000 dependents.

3. The most profitable plantation forestry species is pine, which has the potential to generate R1119/ha/yr (including road maintenance costs). The total hectareage planted under pine in Limpopo employs on average between 700 and 800 people.

4. Eucalyptus species generate lower gross margins (between R777 and R364/ha) but employs more people per hectare. Total eucalyptus plantations in Limpopo employ on average between 1,800 and 2,000 people.

5. Only a small proportion of total indirect jobs created are located within the Limpopo province, as no pulp and paper mills and furniture plants are located within this province.

6. A large proportion of softwood (pine) is processed within the province (70%), mainly for production of saw logs. Therefore, despite pine plantations creating less than half of jobs created by eucalyptus, a greater proportion of these jobs are retained within the province.

7. The secondary process generating the highest added values among pulp/paper mills, sawmills and mining mills are the pulp/paper mills (with a revenue addition ratio of 5.2), followed by sawmills (with a revenue addition ratio of 2.5) and mining mills (with a revenue addition ratio of 1.7).

8. All the added value generated by pulp/paper milling is exported out of the province, while 55% of the added value generated by sawmills is retained within the province.

9. As roundwood pine is mainly sold for saw logs, compared with the other types of plantations (where a lower proportion of roundwood is sold for saw logs), pine plantations are able to generate a larger proportion of added value within the province. However, this added value refers only to the added value associated with sawmills, as all the added value which is generated by furniture plants is not retained within the province.

10. Roundwood eucalyptus managed on a 10 years rotation generates more employment per unit of water used. In addition to the jobs created for roundwood production, eucalyptus (10 years) also generates indirect jobs for the debarking phase which is carried out within the province, before the roundwood is sent to pulp mills. However, the majority of the added value potentially generated by eucalyptus is lost as the majority of this wood is used for pulp and consequently exported out of the province.

11. Roundwood pine and eucalyptus managed on a 22 years rotation have the longest product chain and consequently added value. So if investment could be put in furniture production and wood by-products plants (within Limpopo), the largest proportion of added value and indirect jobs that could generated by forestry plantation would be kept within the province.

12. Luvuhvu catchment is an area that is too dry to support further commercial plantation forestry, and the forestry sector is not profitable enough (per unit of water used) to make using irrigation scheme profitable. Therefore it is important not only to diversify the plantations to those which provide the highest total added value that can be kept within the province (such as pine), but also to invest in ‘low tech’ processing plants (such as pole production) that would be able to retain part of the added value and generate jobs within the province.

The other large water user is the commercial agriculture. In the Luvuhvu catchment are grown mainly banana, macadamia nuts, avocados, litchi, guavas, mangos and citrus. From the analysis that was carried out, it resulted that:

13. Macadamia nuts production is the most profitable compared to the other fruit trees production both in terms of gross margins per hectare (R49,482/ha) and per unit of water used (R76/m^3)

14. In terms of gross margins per hectare, after macadamia nut production comes mango, banana and avocado. In terms of gross margins per unit of water used Macadamia was followed by mango, avocado and banana. Therefore, banana production appears to be less profitable than avocado when water usage is considered as part of the equation. Avocado production generates both more Rand and more jobs per unit of water than banana.

15. In terms of labour requirement mango and guavas provided the highest values. In the case of mango both in terms of MDs per hectare than MDs per m^3.

16. From the analysis of the production of the main fruit trees grown in the area it resulted that the largest proportion of the labour requirement (with exception the first few years) is for harvesting. This proportion can range between 45 to 85% of the total labour requirement. This implies that a good proportion of the jobs created by the horticultural sector are seasonal and not permanent.

17. At present, approximately 1,800 workers are employed by the farmers of the Levubu Farmers Society. 400 of them are employed at the 8 warehouses in the district; additionally 200 workers are also employed on a seasonal basis. It is important to point out that the number of employees here refers to the Luvuhvu catchment area, while the employment figures mentioned in the forestry part refer to the Limpopo province as a whole.

18. The sub-tropical fruit crops have the shortest of the value chains. In most cases the fruit itself are main products sold to final consumers. In the case of the Luvuhvu catchment area most of the fruits grown are sold for export;

19. Mango, guavas and litchi appeared to have the largest proportion of their production sold for processing in particular for juice. Secondary processing activities, which include manufacturing of fruit juice (Qualijuice, a fruit juice local company particularly for Guavas) and packing/sorting warehouses (2 for citrus and 3 macadamia nuts) were identified in the Luvuhvu catchment (see table below).

20. The proportion of macadamia, avocado, mango, litchi, and oranges that are sold for processing leaves the Luvuhvu catchment, and consequently the added value and jobs creation associated with the secondary processing. Part of the export could even be seen as a loss of value added leaving South Africa, as a proportion of fruit exported are then processed abroad; in particular this is true for the macadamia nuts that are often not consumed as a fruit itself.

21. As in the case of commercial forestry a proportion of the added value that now leaves the catchment could be kept within by investing in processing plants and warehouse that are most labour intensive and provide intermediate products that successively could be exported (ex. Macadamia nut oil).

22. In the Luvuhvu farming area banana is the currently the biggest commodity, and is also the fruit tree with the highest water usage and the lowest potential of added value (as it is consumed mainly as a fruit itself). Therefore, this fruit type is not generating added value, and is consuming water that could be used more profitably if used to irrigate fruit trees such as avocado and mango, which can generate more Rand and jobs per unit of water used, and have more potential for processing.

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23. Emphasis should be put on the risk of loss of diversification. Luvuhvu could become the leading South Africa producer of macadamia nuts, but thereby become also less resilient to marginal changes in the macadamia nut price. So alternative fruit trees production and processing plants should be encouraged as investments.

In conclusion, it can be seen that agriculture appears to create more jobs and generates more gross margins per unit of water used than forestry. However, the agriculture sector has got a much shorter product chain than the forestry one, with consequently lower added values potential.

Most of the forestry added value and a large proportion of the added value generated by processing the fruit products are exported out of the province. So both fiscal incentives and government investment for the purpose of job creation should be targeted to 'low-tech' activities both for the forestry (furniture manufacturing) and agricultural sector (fruit processing).

Managing water solely for the export of products with high water use requirements and low indirect value addition therefore amounts to exporting water at likely low values or economic returns, and subsidising the purchaser of those products with virtual water.

It is important to achieve an optimal allocation of resources within the thresholds of the whole catchment, in order to ensure maximum societal returns. Therefore, regulation should encourage water users to focus internally on their production processes to minimise their water use though market forces, or the introduction of higher water use charges.

It can be concluded that more than changes in land use changes in both infrastructure and manufacturing should provide means to ensure an economic growth and social development in the catchment and in the province as overall.

The gross margins and the employment requirement for the forestry and commercial agriculture sector that have been calculated in this report will be incorporated into an integrated land use model for the Luvuhvu catchment.

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