

BIOTECHNOLOGY FIRST PAPER

The Scope of the Biotechnology Industry in the Western Cape

**ACCESS MARKET INTERNATIONAL (PTY) LTD
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1. INTRODUCTION

The Western Cape's agriculture is distinguished in several ways from that in the rest of South Africa, largely because of the physical resource differences. The winter rainfall region of the Boland and the year-round rainfall of the Southern Cape provide agricultural conditions that make the crop mix and productive potential unique. A main feature of the region's agriculture is production stability, based on stable and relatively adequate winter rainfall and supported by well-developed infrastructure for both input supply and output processing.

Agriculture is one of the primary pillars of the Western Cape economy. Although the province contributes some 14% to the country's Gross Domestic Product, it generates about 23% of the total value added of the agricultural sector in South Africa, which was R25bn in 2001. Agriculture accounted for 5.2% of the Western Cape's Gross Regional Product in 2001. As many as 11 commodities contribute significantly to agricultural production, with fruit, poultry/eggs, winter grains, viticulture and vegetables together comprising more than 75% of total output. Consequently, diversity of agricultural enterprises also contributes to agriculture's general stability.

Various topographic features divide the province into a number of subregions, each with its own distinct climate. High mountain ranges interact with on-shore movements of moisture laden ocean air to serve as water harvesting systems. The resulting runoff provides substantial irrigation potential in the coastal region and parts of the Karoo semi-desert area beyond the mountains. The province can be divided into seven main climate-zones.

While there is agricultural activity in the Cape Metropolitan area, including some high value enterprises, the economic and social character of this subregion is definitely urban or metropolitan. This area is comprised of the Bellville, Goodwood, Cape Town, Simonstown and Wynberg districts and is usually referred to as the Cape Peninsula. However, intensive poultry, pork, vegetable and milk production based on zero grazing technology can be found within a radius of about 75 km from Cape Town.

The South coast subregion, with an area of approximately 960 000 ha, produces mainly wheat and malting barley in rotation with planted pastures under rainfed conditions. The production of wool, milk and meat, which is already significant, should increase and cultivated pastures and fodder grains can be expected to replace some wheat in the future. Intensive production under irrigation of vegetables and hops, mainly in the George area, and irrigated pastures for milk production can be found towards the escarpment.

The Little Karoo, stretching from Barrydale to the upper reaches of the Langkloof, is renowned for its ostrich industry around Oudtshoorn, the production of deciduous fruit for canning, drying and increasingly for export, and for lucerne hay. The land under irrigation is less than 4% of the total area of about 2 million ha but produces more than 80% of the total value of production.

The 80 000 ha intensively cultivated and irrigated areas of the Boland produces mainly deciduous fruit and wine grapes, with Elgin and Ceres being the main centres for apple and pear production and the Hex River Valley and Paarl for table grapes.

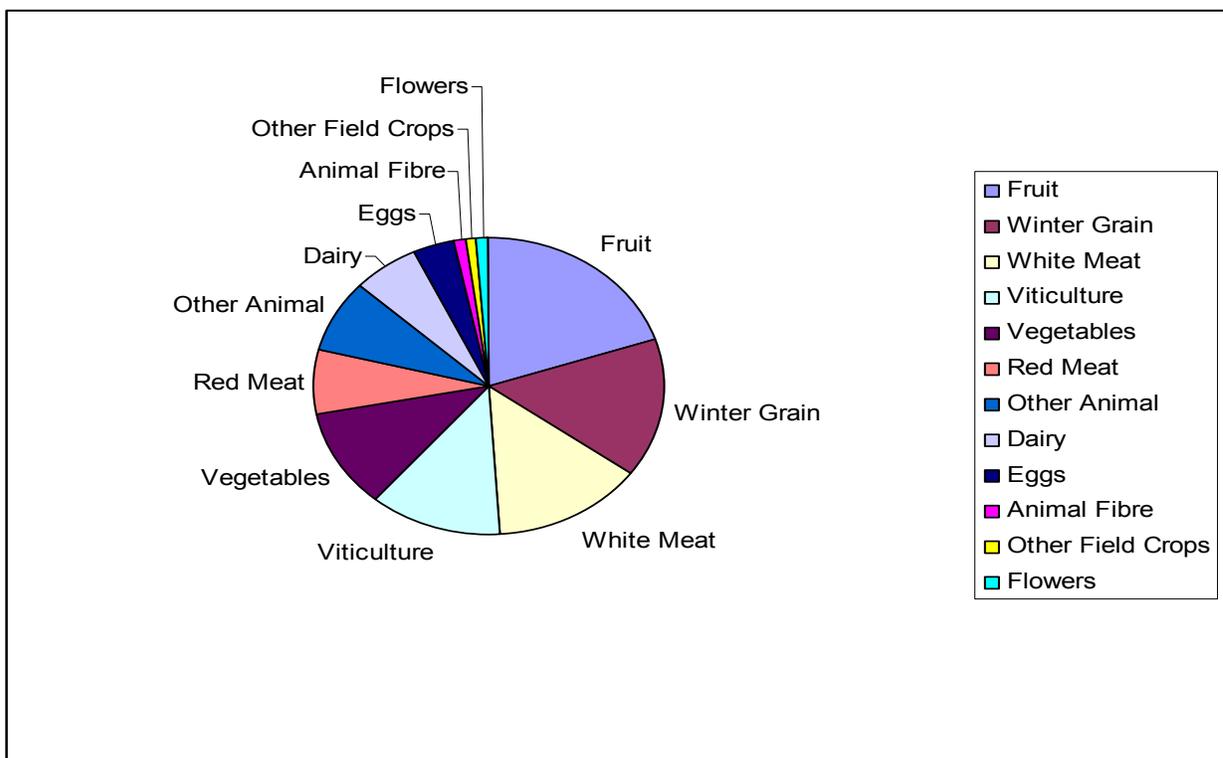
The Swartland consists of approximately 270 000 ha of land that is confined primarily to rain-fed wheat and pastures. Sheep and dairy farming are also found in rotation with wheat. A move away from monoculture wheat toward mixed crop-livestock systems is occurring at present and should continue in the near future.

The northwest subregion produces mainly wine grapes and citrus under irrigation along the Olifants River. A small but flourishing rooibos tea industry has been established around Clanwilliam. The grazing areas, such as those in the Great Karoo, are used for the production of meat, wool and mohair.

2. MICROECONOMIC OVERVIEW¹

2.1. Commodity mix²

Figure 1 show the most important agricultural commodities grown in the Western Cape. These are discussed in more detail below.



¹ Data used here were mostly obtained from the Wesgro website (Wesgro, 2003) unless otherwise specified.

² Appendix 1 provides a list of data sources for Western Cape Agricultural Statistics.

Source : Wesgro 2001

1.1

Figure 1: Agricultural production in the Western Cape

Viticulture

South Africa is the world's sixth largest wine producer, accounting for 2.8% of global production. The Western Cape's favourable climatic and soil conditions make it home to most of South Africa's wineries, accounting for 90.5% of production. Viticulture contributes some 30% to the region's horticultural income and about 3% to its Gross Regional Product. The gross output value of wine-industry-related firms is R14.6 billion. In 2001, there were 4 390 primary wine producers and 388 cellars – an increase of 15% over 1999. This included 67 cooperatives, 91 estates, 219 private wine cellars and 11 producing wholesalers. The area under vines is some 106 000 hectares. About 746 million litres of wine are produced annually from 314 million vines. On average, 71% of production finds its way into good wine (for drinking) - up from 65% in 1999. Another 1% finds its way into rebate wine (for distillation of pot still brandy), 15% into distilling wine, and 13% into non-alcoholic uses such as grape juice and grape concentrate.

The late 1990s saw considerable foreign investment in Western Cape vineyards, large-scale replanting and quality improvements, leading to a boom in exports. There was an explosion in the number of wineries and wines produced – over 100 new wineries between 1999 and 2001. There was also substantial investment in information technology, export infrastructure, and distribution facilities. Given the low production costs in the Cape (despite the high cost of imported equipment and cost escalation caused by devaluation of the Rand), Cape wineries have proven competitive – particularly those wineries producing fine a quality at a premium price. The South African wine industry is encouraging people from previously disadvantaged communities to emerge as wine farmers/makers. To this end, the Wine Industry Trust was established in 1999, with funding of R370 million over ten years. One of its responsibilities is investment in 'wine education' to facilitate entry into the industry. A number of Cape wine farmers have established joint ventures with their workers, e.g. Spice Route, New Beginnings, Thandi Wines and Tukulu. The New Farmers' Development Corporation

helps workers from disadvantaged communities to secure capital for the establishment of commercially viable farms.

South African wine exports grew to 210 million litres in 2002 – up from 50.7 million litres in 1994. Exports accounted for 33.5% of good wine production, compared to just 14.6% in 1995. In addition, 61.5 million litres of bulk wine were exported. Total export value for wines in 2001 was about R4.5 billion. In 2001 South Africa imported 2.4 million litres of natural wine, 20 787 litres of fortified wine and 151 03 litres of sparkling wine. Approximately 50% of bottled wine exports are to the UK, 21% to The Netherlands, 9% to Scandinavia and 6.5% to Germany – together accounting for more than 85% of South Africa’s wine exports. Other markets currently representing less than 3% of exports, but identified as growth opportunities, include the US, India, China and Japan.

Wine tourism has potential – 43% of tourists to South Africa visit the winelands. The wine industry indirectly contributes more than R3.5 billion annually to the tourism industry.

Fruit

Fruit farming forms the backbone of agriculture in the Western Cape. Growing conditions are ideal for both soft citrus and deciduous fruit, exports of which are expected to rise from R6.5 billion in value in 2001 to R8 billion in 2003. Since 1990, the total value of citrus production has increased by 9.9% a year – twice the rate of the agricultural sector as a whole. This trend is expected to continue, mainly as a result of production expansion supported by strong export market growth. The citrus industry is currently valued at R1.8 billion annually.

With some 2 500 deciduous fruit growers, the Western Cape is the country’s largest producer of deciduous fruit (see Table 1), accounting for about 85% of total exports. In 2001, gross export earnings were about R5.1 billion. The Western Cape’s share of world apple production is just under 2%, yet it exports 35-45% of its total crop. The EU absorbs 75% of South African apple exports, while exports to the Middle East, Far East and the United States are growing. The Western Cape accounts for only 1% of world pear production but is the largest southern hemisphere exporter of Comice and Forelle varieties. About 40% of production is exported, with some 75% going to the EU (about 35% to the UK and 65% to mainland Europe). Together with Chile, the Western Cape is the southern hemisphere’s main exporter of table grapes. Exports have grown in recent years, especially of both white and red seedless varieties. More than 90% of the crop is exported, with the EU accounting for 75% of table grape exports. Similarly, the Western Cape and Chile are the main southern hemisphere players in the stone fruits market, although Chile exports nearly three times the volume. It is plums, however, which represent the largest volume of exports, with over 80% bound for the EU. About half of all production is sold fresh, while some 20% is processed into juice. The remainder is used for canning and dried fruit. Although the apple market is currently static, and nectarines and peaches are growing at just 0.5% per annum, growth in the pear and apricot markets is approximately 2% per annum, with more substantial growth of 5% for plums and 7.5% for table grapes.

1.1.1.1.1 Table 1: Western Cape deciduous fruit production areas in comparison with South Africa

	Western Cape (ha)	South African Total (ha)
Apples	18 176	22 379
Pears	11 501	12 777

Table Grapes	8 809	12 247
Apricots	4 234	4 738
Plums	4 094	4 493
Prunes	555	567
Nectarines	1 075	1 379
Dessert Peaches	738	1 379
Cling Peaches	7 948	8 229

Source: Compiled from OABS 2004

There are some 1 200 citrus growers in South Africa, producing 1.5 million tons of fruit in 2001. The Western Cape produces 17 % of the total citrus crop (see Table 2). While South African citrus makes up only 2% of total world production, it accounts for more than 8.5% of total world exports. It competes directly with other southern hemisphere producers like Australia, Argentina and Chile, all of which go to market during the same season. Some 60% of the annual crop is exported, accounting for 80% of income, while 20% is consumed locally and 20% is processed into juice.

1.1.1.1.2 Table 2: South African Citrus Production Regions

District	Area (ha)	Contribution (%)
Eastern Cape	14,212	26
Limpopo	13,409	24
Mpumalanga	12,031	21
Western Cape	9,656	17
KZN	3,937	7
Swaziland	2,086	4
Other	503	1
TOTAL	55,834	100

Source: Citrus Growers Association

The Western Cape has long been known as a quality producer of canned fruit, much of it exported. Although European subsidies have put South African canners under pressure, there are still opportunities for high value added products for markets in the Far East, Europe and the Americas.

The fruit juice industry is also a strong growth sector. The biggest producer in the Western Cape is Ceres Fruit Processors, which produces large quantities of apple and pear concentrate. Other major players include Associated Fruit Processors, Elgin Fruit Juices and Granor Passi, as well as KWV, which produces

grape juice concentrate. For the export market, aseptically packed concentrates and juices – without preservatives, artificial sweeteners or colorants – have proved popular. Major export markets include Europe and the Far East, where the Western Cape is known for its quality products and wide variety of flavours and flavour combinations.

In 2001, total production of dried fruit was 3 740 tons of dried tree fruit, and 31 000 tons of vine fruit. The gross value at producer level was R34.9 million for tree fruit and R121.6 million for vine fruit. Some 65-70% of annual production is exported. There are approximately 1 450 growers supplying this industry, mostly in the Citrusdal, Boland and Langkloof areas, although vine fruit for drying into raisins comes largely from the Orange River area in the Northern Cape. SA Dried Fruit is the largest player and the only one processing and marketing both tree and vine fruit.

Vegetables

Given the suitability of the regional climate, vegetable production is an important component of Western Cape agriculture, representing some 12% of total production. In 1999, some 61260m of fresh vegetables were exported from Cape Town's port. Most trade in fresh produce is either through the major urban fresh produce markets or through farmer organisations like Potato South Africa and the Onion Forum, which also make efforts to establish business partners abroad. Trade in vegetables through the Epping Fresh Produce Market in Cape Town is some 150 million tons annually, although this figure does not take into account an estimated 50% of production that is traded via the informal sector, produced under contract for major supermarket chains or exported, largely to the EU. In 1999, some 9800 hectares of land in the Western Cape was planted with potatoes, producing over 323 000 tons. More than 80% of the national crop is sold fresh or as seed, most of the balance being processed into French fries and crisps, although a small percentage is also used for baby food, mixed vegetables and canning. The yield from the province's 3 200 hectares of onion fields in 1999 was 152 000 tons. Nearly 23 000 tons of fresh tomatoes were also produced, excluding those destined for processing. In addition, the Western Cape accounts for 80-90% of national vegetable seed production.

Animal products

With 493 380 head of cattle in February 2004, the Western Cape accounts for just 3.6% of the national herd, although its 2 979 410 sheep make up a more substantial 10.6%. The region also has 239 757 pigs (15.3 %) and 244 915 goats (3.7%) (see Table 3). The industry is either extensive and field-based (cattle and sheep), or intensive and based on grain feeds (poultry and pigs). While demand for red meat has declined, demand for pork and poultry has risen strongly. The ostrich industry, historically based in the Western Cape, has faced hard times since the mid 1990s, which were characterised by plummeting prices due to over-production, as well as problems with disease and quality control.

Table 3: Estimated livestock numbers per province February 2004

Provinces	Cattle	Sheep	Pig	Goat
Western Cape	493 380	2 979 410	239 757	244 915
Northern Cape	477 005	7 392 223	16 553	471 097
Free State	2 308 416	5 929 711	104 736	74 095
Eastern Cape	3 150 292	8 376 167	273 553	3 015 918
KwaZulu-Natal	2 796 023	826 922	187 972	923 004

Mpumalanga	1 363 183	1 619 400	234 769	102 252
Limpopo	1 173 898	205 044	173 158	1 044 219
Gauteng	273 143	85 171	174 527	8 484
North West	1 785 612	719 180	158 324	766 857
RSA Total	13 820 952	28 133 229	1 563 350	6 650 841

Source: Compiled from the NDA statistical database

The Western Cape broiler industry produces some 135 000 tons annually, accounting for over 17% of national production, which is worth almost R6bn at producer level. The region is home to the country's third largest broiler player, County Fair, as well as its largest egg producer, Nulaid. The Western Cape produces about 20% of the country's annual total of 4,6 billion eggs.

Dairy

The dairy industry is the fourth largest agricultural industry in South Africa, representing 5.6% of the gross value of all agricultural production. The coastal regions of the Western, Southern and Eastern Cape and KwaZulu-Natal contribute more than 42% of national milk production, with the largest number of dairy producers found in the Free State (24.9%) and the Western Cape (21.5%). The 1 267 milk producers in the Western Cape produced 500 million litres of milk in 1999, with a total value at producer level of R545 million.

Milk is bought and processed by over 300 processors and manufacturers, while some 500 producer-distributors also market liquid milk and fresh dairy products.

Large dairy companies represent a very small percentage of all processors but process over 80% of the total milk delivered to dairies, producing a large range of mainly commodity dairy products. There are also numerous small operations processing less than 2000 litres of milk a day, often supplying on a regional basis. Following agricultural deregulation in the mid 1980s, there has been substantial restructuring of both the dairy production and processing sectors in an effort to improve global competitiveness. A significant confidence indicator in the restructuring of the processing sector, in particular, has been the recent heavy investment of multi-nationals like Parmalat and Danone in large South African dairy companies, and the continuing presence of Nestlé and Unilever.

Grain, cereals and oilseeds

The Western Cape is traditionally the country's second largest wheat producer, with 43% of its wheat fields. The province is also the country's sole grower of hops – primarily in the area around George – as well as its major barley grower, producing nearly 95% of South Africa's 90 000 tons of barley in 1999.

Flowers

The floricultural export market has reflected growth in value of more than 54% in the last four years, although the devaluing Rand has played a part in this dramatic appreciation. Roses, chrysanthemums, carnations and gladioli, mostly from Gauteng, make up the bulk of sales, but indigenous flora from the Western Cape also make a significant contribution to national sales. Total annual production of indigenous "fynbos" flowers is in

the region of 5 million kilograms, of which 95% is grown in the Western Cape. The export value at producer level is some R60 million for fresh flowers and R30 million for dried flowers, while the local fresh flower market accounts for a further R15 million. Over the past decade, growth in the market for indigenous, fresh, cut flowers has been some 3-5% annually.

Natural products

Growth in global demand for organic foods is beginning to make an impact on South African markets, leading a number of farmers to turn to organic production methods that preserve the soil by crop rotation and natural composting, without the use of synthetic fertilisers or chemical pesticides.

2.2. Western Cape production in a national perspective³

The Western Cape comprises some 12.4% of the agricultural land in South Africa. Table 4 shows the extent of the linkages between agriculture and the rest of the provincial economy in a comparative perspective. The first part of the Table shows the situation in 1996. From these data it is evident that farms were on average smaller than in the rest of the country, the production processes are relatively more labour intensive (farmers in the province employed 17.8% of all farm workers in the country on 12.4% of the land), worker remuneration was considerably higher (farm workers in the province earn 23.9% of all farm wages in the country on 12.4% of the farming area), and farmers' gross income is higher than the average for the rest of the country. Higher wages and higher profits mean that the purchasing power in the rural areas of the province is higher than in other parts of the country.

In addition, farmers buy relatively more intermediate inputs, and the level of capital investment is also relatively higher. To the extent that capital and intermediate goods are purchased within the province, this also reflects on stronger linkages with the rest of the economy. Finally, a comparison between the relative level of capital investment and the relative level of indebtedness shows that a greater proportion of capital investment is funded by means of equity rather than debt, which reflects a greater degree of confidence in the economy, and brings all the usual benefits of direct investment, both foreign and local.

The second part of the Table shows the situation in 2002. From these data it is evident that the province has maintained its pre-eminent position in South African agriculture.

³The data presented here was taken from the 1996 Agricultural Survey. In 2000 Statistics South Africa undertook a survey for the National Department of Agriculture "Report on the Survey of Large and Small Scale Agriculture" (2002) which gathered information on, amongst others, i) number of farms ii) farming debt iii) net farm income etc. While this survey is much more recent, the results have not been included here due to the fact that many of the data appear spurious. For example it estimates that there are 23,000 farming units in the Western Cape furthermore, the Survey estimated that South Africa produced more than 1,2 million tons of apples in 2002 while the Abstract gives this figure as being 567,005.

What is also interesting is the changes that have taken place since 1996. The data show that agriculture in the province is even more employment-intensive than 6 years ago (it now employs 22.5% of the country's farm labour force as opposed to 17.8% in 1996), and that employment on Western Cape farms has actually increased from 202949 in 1996 to 211 808 in 2002. Further, farm wages have risen faster than in the rest of the country (gross remuneration is 27.1% of the country's total remuneration to farm workers, compared to 23.9% in 1996).

The province has maintained its position with respect to gross farm income (20.1% of the country's total compared to 22.4% in 1996) even though the value of field crop production was higher than average in 2002 as a result of the collapse of the Rand. Furthermore, spending on intermediate inputs increased to 20.5% of the country's total, compared to 18.7% in 1996. Thus, the linkages between agriculture and the rest of the economy (largely the result of remuneration to workers and the purchase of intermediate inputs) remain stronger in the Western Cape. Another significant change is that capital expenditure has hardly increased, and a larger share of the expenditure is being financed by debt. Yet these trends are less marked in the Western Cape than elsewhere in South Africa.

2.3. Land use and yield levels

The data in Table 5 show that 19% of the agricultural land in the Western Cape is suitable for planting crops (arable), which is not much higher than the national average of 13.7%. However, while only 26% of the arable land in the Western Cape (and 2.5% of all agricultural land in the province) is irrigated, this is almost double the national average of 1.4% of all agricultural land.

The Table also shows the significant expansion in the area under horticultural products over the past decade. Growth in output has, therefore, come from both technology-induced yield effects and from area expansion. As the latter becomes less of an option in future, the sector will become even more dependent on the technology development and transfer system.

Table 4: Western Cape agriculture in perspective

	1996			2002		
	RSA (total)	Western Cape	Western Cape/RSA (%)	RSA (total)	Western Cape	Western Cape/RSA (%)
Farming area (ha)	82 748 886	10 249 642	12.4	82 748 886	10 249 642	12,4
Number of farms (1993)	57 980	8 352	14.4	45818	7185	15.7
Average farm size (ha)	1427	1227	86.0	1806	1427	79.0
Number of farm workers	1 139 427	202 949	17.8	940815	211808	22.5
Gross remuneration (R'000)	2 779 816	664 555	23.9	6215583	1682857	27.1
Gross farming income (R'000)	19 631 654	4 394 427	22.4	52971232	10653332	20.1
Spending on intermediate inputs (R'000)	14 396 443	2 692 249	18.7	42092135	8642186	20.5
Capital expenditure (R'000)	2 078 368	651 962	31.4	2946773	682574	23.2

Total debt (R'000)	15 283 265	2 522 127	16.5	30857891	7304531	23.7
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Source: Agricultural Survey, 1996

Table 5: Land utilisation in the Western Cape

Land use	Ha (1990)	Ha (2000)	%
Total area		12938600	-
Farm land		11560609	89,3
Irrigated land		286004	
Potential arable land		2454788	19,0
Wine grape vines	88407	106300	
Fruit trees	57860	75300	
Vegetables	30475	61300	
Field crops		1286510	
Other		925378	
Grazing land		9105821	70,4
Nature conservation		730731	5,6
Forestry		198938	1,5
Other		448322	3,5

Source: Abstract, 2003, Wesgro, 2001 and Department of Agric. Western Cape - GIS

2.4. Farm numbers and sizes

Table 6 gives the number of farms as well as the average farm size per statistical region in the Western Cape in 1991 (no more recent data are available). Average farm sizes are strongly influenced by the climate and production potential of the region. For example, the average farm size in region 2 (Stellenbosch, Kuilsriver, Somerset West) was 141 hectares whereas the average farm size in the Karoo (region 12) was 5135 hectares. Within regions there are also significant variances. Region 9, for example, consists of the districts Clanwilliam, Vredendal and Vanrhynsdorp. Relatively small, intensively irrigated farms are found along the Olifants River (Clanwilliam and Vredendal), while Vanrhynsdorp is a drier, extensively farmed area with larger farms.

Table 6: Farm numbers and sizes by statistical region for rural Western Cape

Region	Number of farming units	Total size	Average size	Number of farmers
Kuilsriver, Paarl, Somerset West, Stellenbosch, Strand, Wellington	1101	155473	141	776
Bredasdorp, Caledon, Heidelberg, Hermanus, Swellendam	1339	1114705	832	999

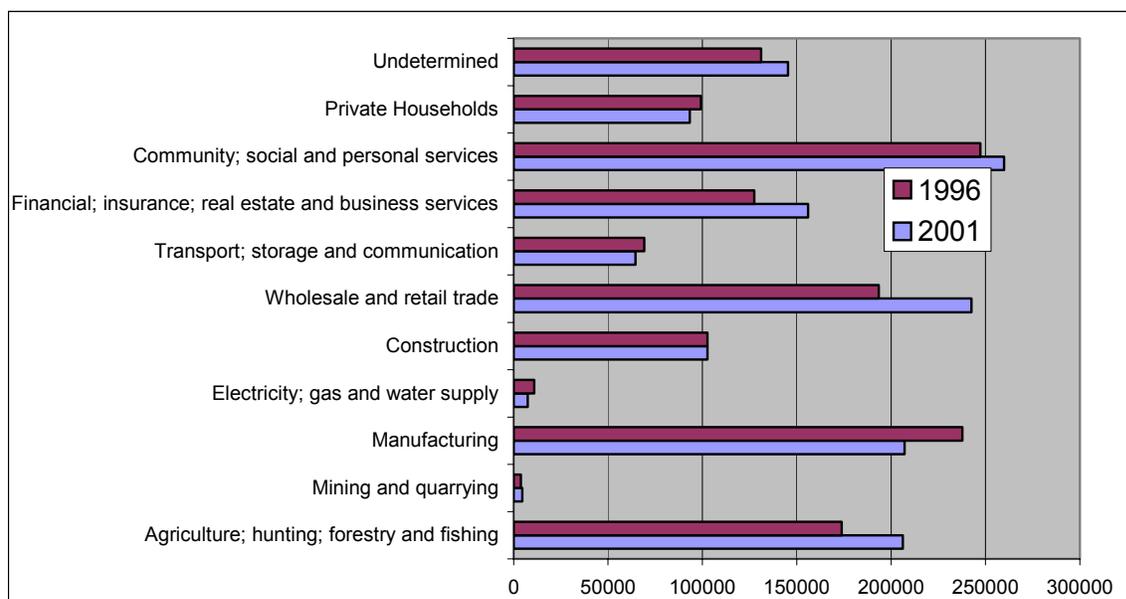
George, Knysna, Mossel Bay, Riversdale	1112	778329	700	1207
Uniondale	125	201971	1616	70
Calitzdorp, Ladismith, Oudtshoorn	533	559870	1050	626
Ceres, Montagu, Robertson, Tulbach, Worcester	1339	122659	913	1947
Hopefield, Malmesbury, Moorreesburg, Piketberg, Vredendal	1158	870682	752	954
Clanwilliam, Vanrynsdorp, Vredendal	1146	1637862	1429	948
Beaufort West, Laingsburg, Prince Albert, Murraysburg	1146	5884252	5135	781
	8999	12425803	1381	8308

Source: Eckert, 1997

2.5. Employment and wage income

Figure 2 below illustrates the importance of the agricultural sector as an employer in the Western Cape. More than 13.8% of Western Cape residents between the ages of 15-65 and who are employed, work in the agriculture hunting, forestry and fishing sectors. Furthermore Figure 2 shows that while the manufacturing sector has shed an estimated 30,000 jobs from 1996-2001, the primary sector has gained 32,000. Whether these jobs all accrued to the agricultural sector, their full or part-time nature, their location as well as the income they generate all determine the impact of this increase on provincial rural poverty levels. This level of detailed information is not yet available from Census 2001, however the results of two micro level surveys⁴ are presented below shed some light on the changes occurring in Western Cape agricultural employment patterns

⁴ The first of these studies was carried out by Sunde and Kleinbooi in 1999. Sunde and Kleinbooi (1999) interviewed 112 farmers/managers and 345 woman farm workers to not only gauge the development status of these women but also describe their location within the agricultural labour market and their access to socio-economic rights. Du Toit and Ally (2002) surveyed 77 horticultural farms in a number of Western Cape districts to assess changes taking place in the labour absorptivity of the Western Cape horticulture sector as well as to explore the implications of this on the livelihoods of farm workers.



Source: Census 2001

Figure 2: Western Cape: Employment by Sector 2001

These changes include:

- Substitution of permanent labour with temporary/part-time/seasonal labour:** Both Du Toit and Ally (2002) and Sunde and Kleinbooi (1999) found a marked shift away from the employment of permanent workers towards the employment of temporary workers. Reasons cited by farmers as factors inducing this shift include the Extension of Security of Tenure (ESTA) legislation, rising labour costs and minimum wages.
- Increased use of labour contracting:** Du Toit and Ally (2002) found that more than 53% of the farmers they interviewed indicated that they make use of an agricultural labour contractor/broker. In such an instance the employment relationship is no longer directly between the farmer and worker. Rather, a farmer concludes an arrangement with a broker who then supplies the farmer with a team of workers. While this externalisation of labour offers agricultural producers with certain advantages such as the ability to control costs and risks, for farm workers this holds serious implications in terms of livelihoods and income. Rather than being “part of the farm” the relationship between workers and farmers is increasingly an indirect one- limited to cash payment for particular tasks completed (Du Toit and Ally 2002).
- Relative increase in the number of women farm workers employed:** Sunde and Kleinbooi (1999) found a significant increase in the number of women farm workers being employed on farms in the Western Cape. The main reasons cited for this are employers’ attempts to maximise the utilization of the existing on-farm labour pool (and thereby control housing costs). The shift towards mixed farming systems has helped flatten the sharp seasonal labour demand peak thus enabling farmers to employ women throughout the year.

With respect to labour remuneration, the best available data comes from the 1996 Agricultural Survey (Table 7 below). These data confirms that agriculture in the Western Cape is relatively more labour using than elsewhere in the country (the data differ from those in Table 2 because these refer to permanent workers only). With 12.4% of the farming area, Western Cape farmers employed 16.2% of the farm workers in 1993, 21.0% in 1996. Total remuneration also increased more rapidly than elsewhere, increasing from 21.8% of the total in the country to 26.1%. Western Cape farmers are also less likely to pay workers in kind (and more likely to pay in cash). Finally,

farm worker wages in the rest of the country had started to catch up with those in the Western Cape by 1996, but wages here were still at least a quarter higher than in the rest of the country.

Table 7: Labour remuneration in agriculture

	Unit	1993			1996		
		Western Cape	RSA	Western Cape as a % of RSA	Western Cape	RSA	Western Cape as a % of RSA
Regular Employees (Total)	Number	104,646	647,905	16.2	127,918	610,476	21.0
Total Remuneration	(R'000)	716,540	3,281,317	21.8	1,327,764	5,092,550	26.1
Cash Remuneration	(R'000)	584,016	2,476,688	23.6	1,094,226	4,012,237	27.3
Per worker: Annual							
Total Remuneration	(R'000)	6.85	5.06	135.4	10.38	8.34	124.5
Cash Remuneration	(R'000)	5.58	3.82	146.1	8.55	6.57	130.1
Cash % of total		82%	75%		82%	79%	

Source: Agricultural Census 1993 and Agricultural Survey, 1996

Despite the increase in employment and income opportunities for Western Cape farm workers, their overall development status and access to socio-economic rights has been found to be extremely tenuous (Sunde and Kleinbooi, 1999). In order to gauge the absolute and relative development status of Western Cape farm workers, their position can be compared with a range of Western Cape labour reference groups using the 1996 and 2001 Census data. These groups include the following

- **Workers in other sectors (metro):** This consists of all Western Cape employees working in other sectors of the economy and who reside in the Cape Town Metropolitan Area.
- **Workers in other sectors (non-metro):** This consists of all Western Cape employees working in other sectors of the economy and who reside outside of the Cape Town Metropolitan Area.
- **Unemployed (metro):** This consists of all Western Cape residents who were classified in the Census 96 and Census 2001 as being unemployed and who reside in the Cape Town Metropolitan area. By unemployed is meant that these people a) did not work seven days prior to the interview and b) want to work and are available to start work within four weeks after the Census 96/Census 2001 was conducted.
- **Unemployed (non-metro):** This consists of all people who were classified in the Census 96/Census 2001 as being unemployed and who reside outside of the Cape Town Metropolitan area. By unemployed is meant that these people a) did not work seven days prior to the interview and b) want to work and were available to start within four weeks after the interview

Table 8 shows the comparative living standards of farm workers in the Western Cape. While these data paint a bleak picture, they need to be seen in the perspective of farm worker conditions in the rest of the country, as was shown in Table 4 above. Furthermore Table 8 also indicates the extent to which the absolute and relative development status of farm workers has improved, with improvements in education levels being most significant.

The data in Table 8 show that farm workers are employed in considerably less skilled occupations than employed and unemployed workers in other parts of the Western Cape economy, and hence also have lower levels of education. They also compare poorly with other workers in terms of access to basic amenities such as home ownership, sanitation, piped water and electricity. Unsurprisingly they also earn less than other employed workers in the urban and rural areas.

2.6. Status of land reform

Briefly, the South African land reform programme consists of three components namely restitution, tenure reform and redistribution. *Restitution* deals with historical land rights and the return thereof, *tenure reform* examines forms of land holding while *redistribution* is focussed on the transformation existing, racial biased land ownership patterns.

With respect to *redistribution*, from 1995 to 1999 this was implemented by means of a *Settlement/Land Access Grant* (SLAG). SLAG was a small grant (R16,000) made available to poor households, usually organised in groups, to buy land on the open market. In 2001, the Department of Land Affairs (DLA) revised this programme and launched, *Land Redistribution for Agricultural Development* (LRAD). The aim of LRAD is to provide financial assistance to black South Africans who wish to farm and it is implemented via a sliding scale grant system ranging from R20 000 to R100 000 depending on own contribution.

Table 9 shows the status of the land reform programme (*redistribution*) in the Western Cape up to the end of 2002. These data show that only some 80 000 ha of land (or about 8/10ths of a percent) had been transferred in the five years since 1997. While an estimated 6,170 households have benefited from the redistribution programme, Table 10 goes further to show that a large percentage of these households took up land for settlement and not farming purposes.

Budget constraints are currently hampering the activities of the Western Cape office of the Department of Land Affairs (DLA). By December 2002, this office had accumulated LRAD commitments worth over R100 million, of which only R48 million was available from current budgets. Over-commitment of funds in 2002/2003 forced the Western Cape land reform office to cease processing new LRAD applications (Jacobs et al, 2003). The number of applicants awaiting land for farming in the Western Cape is estimated to 10,000. It is thus clear that the demand for land in the Western Cape via LRAD, outstrips the supply capacity of the Department of Land Affairs.

Table 8: Living standards of farm workers in the Western Cape in comparative perspective

	Farm Workers		Other Workers (Metro)		Other Workers (Non-metro)		Unemployed (Metro)		Unemployed (non-metro)	
	1996	2001	1996	2001	1996	2001	1996	2001	1996	2001
Occupation structure: % employed in elementary occupations	82	78.10	22	23.03	33	50.9	n.a	n.a	n.a	n.a
% of jobs part time	12.1	-	10.1	-	10.45	-	n.a	-	n.a	-
Education: % whose highest school class completed is grade 7 or less	71.9	61.7	18	16.4	31.4	39.7	22	45.1	33	37.3
Housing: % living in informal/traditional dwelling	7	8.8	14.3	15.0	13.48	11.0	39.5	37.4	24.83	28.8
Housing Ownership: % who own home	17.1	18.24	75.8	57.7	66.9	44.65	79.8	50.16	77.6	52.00
Sanitation: % access to flush/chemical toilet	56.5	71.2	93	91.7	86	83.5	79.1	79.5	79.6	82.3

Water: % with access to piped water in dwelling	53.02	56.5	85.6	75.9	74.4	65.2	61.02	49.3	58.94	46.8
Electricity:% household who use fuel for cooking	54.6	69.2	86.4	86.9	76.8	69.15	60.1	62.9	60.1	63
Income: % who earned less than R 500 per month 1996	58		9.5		18.7		n.a		n.a	
% who earned less than R800 per month 2001 (R 543 in 1996 prices)		72.24		15.87		44.9		n.a		n.a
Household income:% whose average household income per member <= R250	44.7		11.8		20.9		60.1		63.5	

Source: Census 96, Census 2001 Unpublished information Statistics South Africa

Table 9: Land redistribution in the Western Cape

	Number of projects	Number of households	Number of female-headed households	Size of land (Ha)
1997	6	383	90	678.00
1998	17	1,478	249	10,415.00
1999	20	944	279	44,493.00
2000	24	2,211	314	4,445.79
2001	27	916		11,798.00
2002	18	238		8,498.00
TOTAL	112	6,170.00	932.00	80,327.79

Source: Monitoring and Evaluation Directorate: Department of Land Affairs

Table 10: Types of Land redistribution in the Western Cape

	Number of projects	Number of households	Number of female-headed households	Size of land (Ha)
ESTA	13	1221	183	213.42
LRAD	29	348		11,857.99
Commonages	2	26		5,843.00
Share equity	20	827	109	6,882.52
SLAG Production	24	1169	162	14,704.00
SLAG Settlement	20	2102	383	6,798.03
SLAG Prod & settlement	4	477	95	34,028.00
Total	112	6170	932	80,326.96

Source: Monitoring and Evaluation Directorate: Department of Land Affairs

The pace of land reform in the Western Cape is not only constrained by the budget of the DLA but also by the supply of land. Current policy primarily rests on the open market acquisition of land by beneficiaries and is thus dependent on private owners willingness to sell. Anecdotal evidence points to a lack willingness on the part of these owners to sell their properties, often deterred by the lengthy and bureaucratic process involved in a land reform transaction. In 2000 the Minister of Land Affairs indicated that 669,000 ha of State land would be targeted for disposal to LRAD beneficiaries (at market related prices) to help speed up the land reform process. As can be seen in Table 11 below, very little of this land is located in the Western Cape (Jacobs et al, 2003).

Table 11: State Land Targeted and Disposed (Hectares)

Province	Land Targeted	Disposal until March 2002
Limpopo	270,777	128,180
North West	36,459	43,778
Western Cape	17,380	3,860
KwaZulu-Natal	48,472	36,610
Northern Cape	49,931	50,824
Eastern Cape	161,363	50,283
Mpumalanga	27,853	15,060
Free State	36,364	67,498
Gauteng	20,401	N/A
Total	669,000	396093

Source: Jacobs et al (2003)

Relatively high land prices are also an important barrier to entry for many new land reform participants especially in the Western Cape. From 1995-1999 Western Cape land prices increased by 41.3% while the national average was only 3.8% (Abstract, 2003).

Finally, the success of the South African land reform programme cannot only be evaluated in terms of improved access to land but also to the extent that land reform beneficiaries are able to access the necessary support they require to be able to farm successfully. No specific institution was given the responsibility for co-ordinating and implementing post-settlement support and it is only in the last 2-3 years that the provincial departments of agriculture have assumed this role. The Western Cape Department of Agriculture has been restructured to incorporate a Farmer Settlement Directorate to ensure land reform beneficiaries have access to agricultural extension, infrastructure support and training. This Directorate receives its budgets from the Province governments, while funding from the NDA is usually earmarked for specific activities such as training and or infrastructure projects.

3. MACROECONOMIC CHARACTERISTICS⁵

3.1. GDP growth

Table 12 shows the rate of GDP growth for the first half of each decade for different sectors in the Western Cape economy over the past 25 years. The two most evident conclusions from these data are that agriculture in the Western Cape has grown faster than a) the rest of the Western Cape economy since at least the mid-1970s, and b) has grown faster than the economy of South Africa since at least the mid-1980s.

⁵ This discussion draws heavily on Eckert *et al*, 1997

Table 12: Real GDP growth by sector in the Western Cape economy, 1975-2001

Sector	1975-1980	1985-1990	1996-2001
Agriculture	1.9	5.1	2.3
Mining	-2.8	-9.4	-12.2
Manufacturing	4.1	1.1	0.6
Energy	-2.1	1.2	2.7
Construction	-5.5	-2.0	4.0
Trade	-0.1	1.1	1.4
Transport	3.0	1.7	6.6
Finance	1.8	3.2	4.9
Other services	1.5	1.1	-1.8
Western Cape	1.5	1.6	2.3
South Africa	3.1	1.6	2.0
SA agriculture	4.1	3.7	0.7

Source: Viljoen and Eckert, 1997 and Statssa, 2002

3.2. Agricultural budget expenditure trends

Table 13 shows a healthy growth over the entire period 1999/2000 to 2005/05 in the budget for Agriculture. Starting off at about 0.6% of the provincial budget in 1999/00, it grows to almost 0.9% in 2004/05.

Table 13: Expenditure 1999/2000 to 2004/05

PROGRAMME	Actual			Voted	Medium-term estimate	
	1999/00	2000/01	2001/02	2002/03	2003/04	2004/05
	R'000	R'000	R'000	R'000	R'000	R'000
1. Administration	16 661	15 144	17 808	25 945	21 636	24 245
2. Technology Development & Transfer						
3. Agricultural Engineering	23 710	26 954	35 560	34 000	39 106	40 915
4. Veterinary Services						
5. Agricultural Training	19 001	19 726	28 186	32 258	34 202	39 946
6. Farmer Settlement						
	10 604	11 769	13 473	14 077	15 141	17 998

	9 088	9 782	12 024	20 945	25 412	16 468	
	1 289	3 592	-	7 042	8 041	18 838	
TOTAL	63 692	86 967	107 051	134 267	143 538	158 410	
Percentage Change		From 1999/00 to 2000/01	From 2000/01 to 2001/02	From 2001/02 To 2002/03	From 2002/03 to 2003/04	From 2003/04 to 2004/05	
1. Administration			17,59	45,65	-16,61	12,06	
2. Technology Development & Transfer		13,68	31,92	17,04	15,02	4,63	
3. Agricultural Engineering		3,82	42,89	-0,97	6,03	16,79	
4. Veterinary Services		10,99	14,48	11,34	7,56	18,87	
5. Agricultural Training		7,64	22,92	50,48	21,33	-35,20	
6. Farmer Settlement		178,67	-100	100	14,19	134,27	
Total for Department		36,54	23,09	25,42	6,90	10,36	
Proportion of Programme to Budget		Actual			Voted	Medium-term estimate	
PROGRAMME		1999/00	2000/01	2001/02	2002/03	2003/04	2004/05
		%	%	%	%	%	%
1. Administration			17,41	16,63	19,32	15,07	15,31
2. Technology Development & Transfer							
3. Agricultural Engineering	37,23	30,99	33,22	25,32	27,24	25,83	
4. Veterinary Services	29,83	22,68	26,33	24,03	23,83	25,22	
5. Agricultural Training		16,65	13,53	12,59	10,48	10,55	11,36
6. Farmer Settlement		14,27	11,25	11,23	15,60	17,70	10,40
		2,02	4,13		5,24	5,60	11,89
TOTAL		100	100	100	100	100	100

Source: Western Cape Expenditure Review 2003

3.3. Relative economic contributions from different sectors

Table 14 presents aggregated structural relations between different sectors of the Western Cape economy. These data show that the sector is employment intensive, contributing nearly 13% of total formal sector jobs, but low paying, with only 2.56% of total provincial salary and wage payments being derived from farm employment. Horticultural enterprises dominate agriculture's contributions to provincial value added, employment and employee remuneration. Economic contributions from the livestock subsector are also relatively high, both in terms of value added and employment. As a generator of jobs, broiler production

outclasses all but some of the horticultural enterprises. Salary and wage payments to farm workers, however, are particularly low in livestock enterprises relative to other subsectors.

Table 14: Structural relations in the Western Cape economy, 1993

	Value Added	Salary and Wage Payments	Employment ^a
All Agriculture	4.16	2.56	12.79
Cereals	0.27	0.15	0.17
Horticulture	2.22	1.46	6.99
Livestock	1.14	0.56	4.61
Agribusiness	4.20	4.10	2.40
Non-Agriculture	72.02	69.09	62.49
Government	18.58	22.48	22.32
Households	1.04	1.77	

Source: Eckert, *et al*, 1997

3.4. International trade

One of the main reasons for the greater contribution of agriculture to the Western Cape economy is the boom in exports. Agriculture's contribution to South Africa's exports has expanded rapidly in the past decade, but exports have nevertheless declined as a proportion of total exports, from more than 10% in 1980 to as low as 7% in 2000. A rapid increase in agricultural exports, mostly from the Western Cape, has however seen this share increase to 8.3% in 2002. At the same time, agricultural imports have also increased rapidly, and more rapidly than in the case of the rest of the economy, with the result that the import share has increased from 2.6% of total imports in 1980 to 5.5% in 2002. The data are shown in Table 15.

Table 15: South Africa's trade portfolio

	1980	1990	2000	2001	2002
Exports					
Total SA exports (Rm)					
Total agricultural exports (Rm)	19 915.4	60 770.0	208 473.9	245 447.9	308 054.1
Agricultural exports as % of total exports	2 052.5	5 289.8	14 572.9	20 074.5	25 460.2
	10.3	8.7	7.0	8.2	8.3
Imports					
Total SA imports (Rm)	14 381.3	44 141.5	186 380.8	217 115.8	273 646.6
Agricultural imports (Rm)	369.2	2 203.3	9 398.4	10 704.2	14 939.1
Agricultural imports/total imports (%)	2.6	5.0	5.0	4.9	5.5

Source: Adapted from Abstract, 2004

Table 16 shows the top 10 exports from the Western Cape. These categories make up 70,8 percent of total Western Cape exports, with eight of the categories increasing faster than the average of all exports. Three of the categories (including the two largest – fresh, dried and processed fruit, and wine, making up a third of all Western Cape exports) are agricultural products. Further, while the growth in fruit exports has been relatively slow since the mid-1990s, these are expected to increase more rapidly in future. Wine exports, on the other hand, represent an unqualified success story, as the volume of exports has increased from 23m litres in 1991 to 217m litres in 2002, while the value of exports has increased even more rapidly.

Product categories with only a relatively small share in total exports (R25m – R500m, or less than 2% of exports) have also shown significant increases from 1996 to 2002. Table 17 shows 16 of these categories, which together increased their share of total exports from 9,2% in 1996 to 15,2% in 2001 and 16,8% in 2002. Seven of these (tobacco products; meat; cosmetics & essential oils; seeds, fruit & medicinal plants; dairy products; plants, flowers, bulbs; and animal feed) are related to agriculture. Other, smaller categories where there has been a rapid growth in exports include processed cereals, and tea (rooibos and honeybush) and spices.

Table 16: Top 10 Western Cape export products

Product Categories	Exports 2002 (Rm)	% of WC Total 2002 ³⁾	% increase 2002/1996-8	Col. (3) less exchange depreciation ²⁾ (4)
	(1)	(2)	(3)	
1. Fruit, fresh, canned and juices	6337,7	22,3	135,6	49,0
2. Wine, beer & spirits				
3. Fish	3187,4	11,2	323,8	237,2
4. Iron & Steel and ores/slag/ash				
5. Machinery & appliances	2418,4	8,5	246,6	160,0
6. Textile products				
7. Precious & semi-precious stones				

& jewellery				
8. Clothing	2381,4	8,4	335,6	249,0
9. Plastic products	1311,0	4,6	222,5	135,9
10. Hides, skins & leather	1216,1	4,3	307,4	220,8
	1169,3	4,1	411,5	324,9
	755,8	2,7	217,0	130,4
	682,7	2,4	300,6	214,0
	640,5	2,3	88,9	2,3
	20100.3	70.8	-	-
Total exports ¹⁾	28 418,0	100,0	194,6	108,0 ⁴⁾

Source: Wesgro, 2003

Notes:

- 1) Excluding Mineral fuels, oils & oil products of R4 051,4 million which include “non-W/Cape exports”.
- 2) Based on the depreciation of the Rand relative to the Euro (2002/Av. 1996-98 in %) – the depreciation is 86,6% for the 6-year period. Thus, at constant EU: R exchange rates total Western Cape exports between 1996 and 2002 more or less doubled.
- 3) The top 10 exports cover 70,8% of total W/Cape exports excl. fuel/oil).
- 4) Compared to the average overall “real” increase of exports 1996-2002 of 108,0% eight of the Top 10 export products increased at an above-average rate ((1) – (8)), whereas fruit (the W/Cape top export product) and leather/hides increased below average.

In addition, it is known that there has been significant growth in exports of niche products. The wild flower industry, for example, is valued at some R150m per year, 80% of which is exported. The deciduous fruit industry is dependant on bees for pollination, and the bees are almost totally reliant on fynbos in winter. Fynbos, in turn, is an important component of tourism, which attracts about 13% of the Western Cape regional product (Business Day, 27 June 2003). Another example of a rapidly growing niche product is provided by the aquaculture sector.

3.5. Macroeconomic implications of sectoral change

Table 18 presents selected fixed price multipliers for the Western Cape economy. Numbers in the individual columns reflect two different definitions. Employment figures indicate the number of person years of employment created when sales of farm products increase by R1 million. In the other two columns, figures indicate the ratio of the expected change in the particular measure for a given change in the value of final demand. Thus, R1.00 of additional demand for the agricultural sector’s output in general will require R0.21 of additional imports and contribute R0.26 to government revenue. Thus, in terms of this model, agriculture’s potential to contribute to employment in the provincial economy exceeds those of the non-agricultural sectors. Within the latter category, agribusiness has substantially higher employment multipliers than other non-agricultural sectors. Within agriculture itself, the high fliers are the horticultural sub-sector, livestock and field scale vegetables, while cereal production does not compete well. Horticulture and livestock production are also less import-intensive, while cereals and livestock contribute more to government revenue.

The model used for the analysis is a comparative static Computable General Equilibrium (CGE) model. This class of model captures the functioning of an economy at a point in time and through the specification of behavioural relationships can be used for comparative static analysis of the effects of shocks on the economy. The CGE model developed for South Africa (Chant, 2001) is calibrated with data from a social accounting matrix (SAM) for South Africa (McDonald and Robinson, 1998). The SAM is for the Western Cape for 1993. An aggregated version (207 accounts) of the original 291 account Western Cape SAM was used for the calculation of the multipliers. The agricultural commodity and activity accounts, household and factor accounts were aggregated. The activity accounts for the Western Cape correspond to the 94 accounts used in the 1993 supply and use tables for SA.

The SAM records transactions, whereas the CGE model must specify behavioural relationships in terms of both price and quantity (Chant *et al*, 2001). Domestic consumer prices are determined by the domestic prices of domestically supplied commodities and imports. Import prices are determined by the world price of imports, the exchange rate and the import tariff rates. The import tax forms a wedge between domestic and world prices of imports. Domestic consumer prices are subject to the sales tax and this elevates domestic consumer prices above the price of domestic and foreign commodities. Activity prices are determined by the combination of domestic activity prices and export prices. The price of exports is determined by the world price of exports, the exchange rate and the export subsidy. Finally, the value-added prices are determined by the activity prices, the production tax rate, the input-output coefficients and the commodity prices.

Domestic demand comprises of intermediate demand, household consumption, government consumption and investment consumption, which includes destocking. This is satisfied by domestic demand and imports. Similarly domestic production comprises of domestic supply and exports. The level of domestic production determines the level of factor demands which in turn are met by factor supplies.

For the calculation of the SAM-Leontief multipliers the government, capital and rest of the world accounts were assumed exogenous. Note that these multipliers are expected to be slightly larger than input-output multipliers and can be regarded as the upper bound for multipliers.

Table 17: Secondary exports with significant growth 1996-2002

Product Category	Exports in Rm		
	1996	2001	2002
1. Electrical, telecommunications machinery, equipment	226,7	400,8	594,7
2. Ships & boats	37,4	217,1	569,2
3. Furniture, lamps, soft furnishings	86,5	293,6	472,3
4. (Other) chemical products	87,3	110,8	412,9
5. Wood (products)	34,6	244,9	410,4
6. Vehicle parts/accessories	37,6	281,6	378,9
7. Tobacco (products)	47,8	205,6	352,1
8. Meat	32,5	260,1	309,8

9. Cosmetics & essential oils	12,4	103,4	204,4
10. Organic chemicals	55,1	153,2	183,9
11. Paper & paperboard	58,6	140,2	174,7
12. Stones, lime, cement	52,5	216,5	173,7
13. Seeds, fruit & medicinal plants	17,1	129,1	154,8
14. Dairy products	11,8	28,8	130,4
15. Plants, flowers, bulbs	45,6	84,8	127,0
16. Animal feed	4,9	31,1	119,9
Sub-total	848,4	2 901,6	4 769,1

Source: Wesgro, 2003

The first column in Table 19 shows the addition in total output of the Western Cape economy that results when the demand for agricultural products of the province increases. Thus, R1.00 of additional demand for the agricultural sector's output will increase total output of the provincial economy by R2.50. Some of the sub-components of agriculture generate even larger increments in output, the highest being meat, while the output multipliers for the food processing subsectors are also relatively large. Among the highest output multipliers is found in the animal feed sector (2.76). However, total output gives a skew picture of the economic impact of a sector, therefore the Gross Geographic Product (GGP) multiplier is also provided in the second column of Table 19.

Table 18: Fixed price multipliers for commodity and sector groupings

	Employment	Imports	Government Revenue
All agriculture	82.8	0.21	0.26
Cereals	26.1	0.27	0.27
Horticulture	92.8	0.20	0.24
Livestock	88.4	0.20	0.27
Agribusiness	39.7	0.26	0.20
Non-Agriculture	29.4	0.25	0.22

Source: Eckert, et al, 1997

1.2

Table 19: SAM-Leontief multipliers from the 1993 Western Cape Social Accounting Matrix

	Output	GGP	Labour	Capital	Income
Agriculture	2.50	1.05	0.51	0.54	0.79
Meat	2.75	1.05	0.54	0.51	0.81
Fruit	2.67	1.09	0.51	0.58	0.81
Oils	2.67	1.06	0.49	0.57	0.78
Dairy	2.79	1.10	0.53	0.58	0.82
Grain mills	2.66	1.07	0.48	0.59	0.78
Animal feeds	2.76	0.98	0.46	0.52	0.73
Fish	2.75	1.14	0.57	0.57	0.86
Bakeries	2.78	1.12	0.55	0.57	0.85
Confectionery	2.58	1.05	0.55	0.50	0.80
Other food	2.41	1.13	0.46	0.67	0.80
Beverages & tobacco	2.64	1.07	0.50	0.57	0.79
Textiles	2.53	1.11	0.57	0.54	0.85
Wood	2.56	1.13	0.59	0.54	0.87
Basic chemicals	2.97	1.16	0.56	0.60	0.87
Fertilisers	2.31	1.06	0.44	0.62	0.75
Tyres	2.53	1.09	0.56	0.53	0.83
Iron and steel	2.17	1.04	0.51	0.53	0.78
Agricultural machinery	2.62	1.05	0.57	0.48	0.82
Machine-tools	2.63	1.13	0.62	0.50	0.88
Food machinery	2.72	1.10	0.59	0.50	0.85
Trade	2.31	1.22	0.64	0.58	0.94
Accommodation	2.14	1.12	0.45	0.67	0.79
Transport services	2.07	1.09	0.54	0.55	0.83
Communications	2.22	1.25	0.76	0.49	1.02
Insurance	2.15	1.25	0.60	0.66	0.93
Real estate	1.87	1.08	0.27	0.81	0.68

General Government	2.30	1.29	0.93	0.36	1.12
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Reference: Punt, C (2002) *SAM-Leontief multipliers for the Western Cape*. Personal Communications. Department of Agriculture: Elsenburg

The GGP multiplier shows the ratio of the expected change in provincial value added (i.e. provincial GGP) for a given change in the value of final demand. Within agriculture, an increase in the demand for fruit by R1 million will lead to an increase of R1.1 million in provincial GGP. An increase in demand for the produce of the agribusiness sector will result in even larger increases in provincial GGP, with the multipliers ranging from 1.05 in the case of confectionaries to 1.12 in the case of bakeries and 1.13 in the case of other foods. These multipliers are, nevertheless, lower than those found in some service sectors.

The Table also shows the payments to capital and labour as a result of the added output. In the case of agriculture as a whole, labour remuneration makes up 49% (0.51 of 1.05) and payments to capital 51%, as compared to fertiliser, for example, where payments to labour contributes less than 42%, and hence the production process is more capital intensive.

Finally, the data in the last column of Table 19 show how household income is affected as a result of an increase in demand for agricultural products. These data show that the incomes of farmers and farm workers increase by R0.79 for every R1.00 increase in demand (the difference constitutes 'leakages' such as taxes, etc.). This is also lower than in the case of other industries, especially in the service sector. However, growth in demand for agricultural products tends to lead to a more equal distribution of income, as is evident from Table 19.

3.6. Effects of sectoral growth on household incomes

Each sector of the economy will generate incomes received by households in a unique multiplier pattern. Sectoral differences appear in the amount of such incomes generated and in the equity or inequity of their distribution. Table 20 illustrates some of these differentials for the agricultural sector. The "income multiplier" column provides coefficients that reflect the amount of additional household incomes resulting from R1.00 of additional sales in agriculture. The data show clearly that rural household incomes rise by more than those of urban households when the agricultural sector grows, leading to a more equitable distribution of income.

This analysis demonstrates the importance of the Western Cape's commercial agriculture to meeting efficiency and equity objectives. Commercial agriculture, taken in the aggregate, is the strongest provider of jobs and has a significant impact on value added (GGP) in the province. The sector excels in generating incomes for households and is particularly notable for the high share of those incomes that accrue to the province's poor. Because of their backward linkages to production agriculture, the agribusinesses compares well with other non-agricultural sectors in terms of these goals as well.

Table 20: Income multipliers for selected households

	GGP	Labour	Capital	Output	Income
African urban households	0.69	0.35	0.34	1.48	1.54

African rural households	0.66	0.32	0.34	1.44	1.81
Coloured urban households	0.61	0.30	0.31	1.30	1.46
Coloured rural households	0.70	0.32	0.38	1.53	1.63
White urban households	0.51	0.26	0.25	1.03	1.39
White rural households	0.46	0.24	0.22	0.90	1.40
Enterprises	0.28	0.14	0.14	0.58	0.76

Reference: Punt, 2002

4. CONSTRAINTS TO EXPANSION

The data presented here show that the agricultural sector of the Western Cape has grown relatively rapidly over the past decades, and that there have been a number of success stories, such as the rapid growth in wine, citrus and table grape exports, and the exploitation of foreign and domestic markets with smaller niche products. Further, the sector has contributed to, and benefited from, the boom in the tourism industry. The contribution of agriculture has been both directly through increased output, and indirectly through the multiplier effect. Whether the sector can continue with this growth depends on a number of factors, the most important being:

- **The level of market demand.** South Africa is a relatively small player in most of the foreign markets to which Western Cape farmers sell their products. For this reason, exporters should be able to continue exploiting growing markets, and to shift exports to markets with higher growth over time. However, continued expansion in exports is dependent on a) farmers' ability to maintain their competitive position; b) the exchange rate; c) growth in world markets.

With respect to maintaining their competitive position, farmers' profit margins have come under increasing pressure since 1995. From 1995 to 2002, producer prices for fruit, vegetables and viticulture products increased by 41.6%, 44,2% and 54.2% respectively. Over the same period, the cost of farming implements and intermediate inputs increased by 61.2% ad 84.8% respectively (Abstract, 2003).

The steady depreciation of the Rand over the past decade helped boost export earnings however, the strong appreciation of the Rand during the past year does not bode well for Western Cape exporters.

Farmers have shown their ability to adapt to the rapidly changing policy environment thus far, although misguided policies in the form of unstructured land reform and labour market interventions, etc. could threaten this ability in the longer run.

- **Farmers' competitive position.** This will depend on the extent to which supply chains can be kept competitive and on farmers' ability to find and adapt new technologies. The two most important variables in this regard are the logistical costs of getting perishable products to the market (i.e. the availability of high quality transport infrastructure, port facilities, etc.) and the funding of agricultural research and development initiatives. In terms of agro-logistics, a 1997 study showed how the expansion of the local fynbos industry was hampered

by a lack of affordable airline freight space into the European Union (Allerts et al 1998). Similarly, a study on the cold fruit supply chain between South Africa and the Netherlands identified various infrastructure capacity problems such as insufficient cold storage facilities in certain regions, not enough refrigerated trucks suitable for fruit transport and bottlenecks in the fruit terminals as barriers to industry development (Broens et al 2000)

- **Resource availability.** Many of the agricultural products in the Western Cape require specific kinds of soils, characterised by slope, rainfall, soil composition, etc., and soils are a scarce resource. The availability of soils is also dependent on farmers' willingness to invest in fixed improvements to soil, hence on a stable investment climate. Much of agricultural production is also dependent on irrigation, hence the availability of water, where competition from urban areas for scarce water resources is strong, will play an important role in determining the future growth potential of agriculture.

This point is illustrated by the fact that although the most important source of water in the Western Cape, the Berg-Breede Basin, yielded a surplus of 617 million cubic metres in 1996, a deficit of 834 million m³/year is projected for this system by 2030. This deficit is due to a trebling in urban and domestic demand as well as an increase in industrial use. The Berg/Breede system has the scarcest water in the country and Leiman et al (2000) indicate that it is the only South African case where agriculture, as low value user, will have to transfer some of its water resource allocation to urban and industrial users. This expected shift will have serious consequences for the development of intensive agriculture in the Western Cape and require significant investment in new irrigation systems along the alternative Olifants/Doring River system. Such investment is dependent on investor confidence, which in turn depends largely on political and social stability, i.e. on judicious policies that encourage employment-creating growth and equity in the country at large.

- **The regulatory environment.** Most farms are operated as small and medium scale enterprises. As such, these businesses are as subject to the disincentive effects of bureaucratic red tape as their urban counterparts. These include the provisions of tax, environmental and labour laws that were designed to suit the needs of big business, and often hamper the growth of SMMEs.

South African (and Western Cape) fruit exporters are in a far less vulnerable position now than in the era of monopoly exporting, as they sell a wider variety of produce to a greater number of markets, i.e. they are less vulnerable to sudden shifts in demand in single markets. There is, therefore, sufficient reason to believe that the current export success from the Western Cape is more than a temporary phenomenon. When coupled with the multiplier effects of this growth on the agro-processing industry and on tourism, and with their positive redistributive effects, there is every reason to believe that the sector can continue to lead both growth and equity in the provincial economy.

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2 APPENDIX 1:

Western Cape Deciduous Fruit

Western Cape apple producing regions

District	Area (ha)	% of Total
Groenland	7 595	33.94%
Ceres	5 020	22.43%
Villiersdorp / Vyeboom	3 495	15.62%
Langkloof West	515	2.30%
Little Karoo	490	2.19%
Piketberg	384	1.72%
Southern Cape	204	0.91%
Hex Valley	148	0.66%
Somerset West	143	0.64%
Wolseley / Tulbagh	69	0.31%
Berg River	55	0.25%
Stellenbosch	34	0.15%
Franschhoek	16	0.07%
Cape Town	8	0.04%
Rest of South Africa	4 203	18.77%
TOTAL	22 379	100%

Western Cape pear producing regions

District	Area in hectares	% of Total
Ceres	5 367	42.00%
Groenland	1 755	13.74%
Wolseley / Tulbagh	1 182	9.25%
Villiersdorp / Vyeboom	928	7.26%
Little Karoo	850	6.65%

Berg River	307	2.40%
Somerset West	255	1.99%
Piketberg	244	1.91%
Stellenbosch	223	1.75%
Langkloof West	131	1.02%
Hex Valley	105	0.82%
Southern Cape	96	0.75%
Franschhoek	51	0.40%
Cape Town	7	0.06%
Rest of South Africa	1 276	10%
TOTAL	12 777	100%

Western Cape Table Grape production regions

District	Table Grapes		Dry & Table Grapes		Dry Grapes	
	Area (ha)	% of Total	Area (ha)	% of Total	Area (ha)	% of Total
Hex Valley	4 580	37.40%	445	5.17%		
Berg River	2 616	21.36%	474	5.50%		
Piketberg	919	7.50%	239	2.78%		
Little Karoo	313	2.55%	107	1.24%	1	0.14%
Namaqualand	278	2.27%	335	3.89%	405	43%
Wolseley / Tulbagh	60	0.49%	2	0.02%		
Stellenbosch	30	0.25%	15	0.18%	26	3%
Ceres	6	0.05%	1	0.02%		
Groenland	4	0.03%	2	0.02%		
Cape Town	3	0.02%		0.00%		
Rest of SA	3 438	28.08%	6999	81.18%	506	53.86%
TOTAL	12 247	100%	8 619	100%	938	100%

Western Cape apricot production regions

District	Area planted (ha)	% of Total
Little Karoo	3255.2	68.70%
Piketberg	208.0	4.39%
Wolseley / Tulbagh	158.5	3.35%
Ceres	144.4	3.05%
Langkloof West	135.1	2.85%
Hex Valley	103.0	2.17%
Berg River	66.2	1.40%
Villiersdorp / Vyeboom	60.1	1.27%
Southern Cape	47.1	0.99%
Somerset West	18.5	0.39%
Cape Town	17.7	0.37%
Groenland	12.0	0.25%
Namaqualand	5.4	0.11%
Franschhoek	2.0	0.04%
Stellenbosch	0.3	0.01%
Rest of SA	504.5	10.66%
TOTAL	4 738	100%

Western Cape plum & prune production regions

District	PLUMS		PRUNES	
	Area (ha)	% of Total	Area (ha)	% of Total
Berg River	904.01	20.12%	3.86	0.68%
Little Karoo	951.19	21.17%	19.36	3.41%
Stellenbosch	545.13	12.13%		
Groenland	475.65	10.59%		
Franschhoek	286.25	6.37%	0.07	0.01%
Wolseley / Tulbagh	191.26	4.26%	431.94	76.11%
Ceres	150.38	3.35%	79.25	13.97%

Somerset West	156.33	3.48%		
Villiersdorp / Vyeboom	141.92	3.16%	1.91	0.34%
Southern Cape	125.02	2.78%		
Hex Valley	78.50	1.75%	13.06	2.30%
Piketberg	66.58	1.48%	5.43	0.96%
Cape Town	12.28	0.27%		
Langkloof West	9.58	0.21%		
Rest of SA	398.92	8.88%	12.12	2.22%
TOTAL	4 493	100%	567	100%

Western Cape nectarine production regions

District	Area planted (ha)	% of Total
Ceres	390.78	28.34%
Berg River	156.60	11.36%
Wolseley / Tulbagh	145.84	10.58%
Little Karoo	142.81	10.36%
Piketberg	105.09	7.62%
Villiersdorp / Vyeboom	38.27	2.78%
Stellenbosch	29.66	2.15%
Hex Valley	25.38	1.84%
Groenland	21.95	1.59%
Franschhoek	13.24	0.96%
Southern Cape	3.61	0.26%
Somerset West	1.27	0.09%
Cape Town	1.09	0.08%
Namaqualand	0.35	0.03%
Langkloof West	0.24	0.02%
Rest of SA	302.9	21.94%
TOTAL	1379.08	100%

Western Cape peach producing areas in hectares

District	Dessert peaches		Cling peaches	
	Area (ha)	% of Total	Area (ha)	% of Total
Little Karoo	80	6.04%	3 599	43.74%
Wolseley / Tulbagh	168	12.74%	1 442	17.52%
Ceres	158	11.99%	1 200	14.58%
Southern Cape	0	0.02%	501	6.09%
Hex Valley	15	1.16%	482	5.86%
Villiersdorp / Vyeboom	10	0.78%	287	3.49%
Piketberg	191	14.46%	216	2.63%
Berg River	65	4.96%	66	0.81%
Franschhoek	25	1.89%	47	0.57%
Stellenbosch	10	0.77%	32	0.39%
Langkloof West	3	0.19%	32	0.38%
Groenland	6	0.45%	30	0.37%
Somerset West			8	0.10%
Cape Town	6	0.43%	6	0.07%
Namaqualand	1	0.08%	0	
Rest of SA	641	44.04%	281	3.4%
TOTAL	1 379	100%	8 229	100%

APPENDIX 2

Citrus Fruit Production per Province

South African citrus production regions

District	Area (ha)	Contribution
Eastern Cape	14,212	26%
Limpopo	13,409	24%
Mpumalanga	12,031	21%
Western Cape	9,656	17%
KZN	3,937	7%
Swaziland	2,086	4%
Other	503	1%
TOTAL	55,834	100%

South African Valencia's production regions

District	Area (ha)	Contribution
Limpopo	9,223	40%
Mpumalanga	5,276	23%
Eastern Cape	4,089	18%
Western Cape	2,187	10%
KZN	1,134	5%
Other	925	4%
TOTAL	22,834	100%

South African navel production regions

District	Area (ha)	Contribution
Eastern Cape	5,461	40%
Western Cape	3,696	27%
Mpumalanga	2,419	18%
Limpopo	1,064	8%

KZN	637	5%
Other	372	2%
TOTAL	13,650	100%

South African mandarin production regions

District	Area (ha)	Contribution
Western Cape	2,639	49%
Eastern Cape	1,913	36%
Mpumalanga	429	8%
Limpopo	207	4%
Other	177	3%
TOTAL	5,366	100%

South African lemon & lime production regions

Region	Area (ha)	Contribution
Eastern Cape	2,455	50%
Western Cape	946	19%
Limpopo	622	13%
Mpumalanga	469	9%
KZN	377	8%
Other	68	1%
Total	4,936	100%

APPENDIX 3

(www.nda.agric.za)

Estimated cattle numbers per commercial areas in the Western Cape

MAGISTERIAL DISTRICT / LANDDROSDISTRIK	QUARTERS / KWARTALE						
	Aug-02	Nov-02	Feb-03	May-03	Aug-03	Nov-03	Feb-04
Western Cape / Wes-Kaap							
Commercial areas / Kommersiële gebiede							
Beaufort West	3,425	3,428	3,260	3,438	3,445	3,416	3,392
Bellville	8,864	8,870	8,437	8,897	8,914	8,840	8,779
Bredasdorp	21,865	21,879	20,810	21,945	21,988	21,806	21,655
Caledon	32,720	32,741	31,141	32,839	32,903	32,632	32,406
Calitzdorp	3,163	3,165	3,010	3,175	3,181	3,155	3,133
Ceres	1,939	1,941	1,846	1,947	1,950	1,934	1,921
Clanwilliam	10,126	10,133	9,638	10,163	10,183	10,099	10,029
George	9,997	10,003	9,515	10,033	10,053	9,970	9,901
Heidelberg	39,535	39,560	37,628	39,679	39,757	39,429	39,155
Hermanus	25,664	25,680	24,426	25,758	25,808	25,595	25,418
Hopefield	5,155	5,158	4,906	5,174	5,184	5,141	5,106
Kaap	2,260	2,262	2,151	2,269	2,273	2,254	2,239
Knysna	13,376	13,384	12,731	13,425	13,451	13,340	13,247
Kuilsrivier	1,566	1,567	1,491	1,572	1,575	1,562	1,551
Ladismith	8,397	8,402	7,992	8,427	8,444	8,374	8,316
Laingsburg	856	857	815	859	861	854	848
Malmesbury	66,542	66,584	63,331	66,784	66,914	66,362	65,902
Montagu	3,595	3,597	3,422	3,608	3,615	3,585	3,561
Mosselbaai	28,884	28,902	27,491	28,989	29,046	28,806	28,607
Murraysburg	2,183	2,185	2,078	2,191	2,196	2,177	2,162
Oudtshoorn	8,764	8,770	8,341	8,796	8,813	8,740	8,680
Paarl	13,126	13,134	12,493	13,174	13,199	13,091	13,000
Piketberg	34,513	34,535	32,848	34,639	34,706	34,420	34,181
Prins Albert	1,014	1,014	965	1,017	1,019	1,011	1,004
Riversdal	47,560	47,590	45,266	47,733	47,826	47,432	47,103
Robertson	6,608	6,613	6,290	6,633	6,645	6,591	6,545
Simonstad	117	117	112	118	118	117	116
Somerset-West	247	247	235	248	248	246	245
Stellenbosch	2,800	2,802	2,665	2,811	2,816	2,793	2,774
<i>Biotechnology Sector Study</i>							
Strand	*	*	*	*	*	*	*
Swellendam	31,705	31,725	30,175	31,820	31,882	31,610	31,400

Estimated sheep numbers per commercial areas in the Western Cape

MAGISTERIAL DISTRICT / LANDDROSDISTRIK	QUARTERS / KWARTALE						
	Aug-02	Nov-02	Feb-03	May-03	Aug-03	Nov-03	Feb-04
Western Cape / Wes-Kaap							
Commercial areas / Kommersiële gebiede							
Beaufort West	258,661	234,307	230,519	255,653	258,391	246,923	241,445
Bellville	9,463	8,572	8,433	9,353	9,453	9,033	8,833
Bredasdorp	218,826	198,223	195,018	216,281	218,598	208,896	204,262
Caledon	373,688	338,504	333,032	369,343	373,299	356,731	348,817
Calitzdorp	5,658	5,125	5,042	5,592	5,652	5,401	5,281
Ceres	110,180	99,806	98,193	108,899	110,065	105,180	102,847
Clanwilliam	102,689	93,021	91,517	101,495	102,582	98,030	95,855
George	46,417	42,047	41,367	45,877	46,369	44,311	43,328
Heidelberg	208,179	188,578	185,529	205,758	207,962	198,732	194,323
Hermanus	12,645	11,454	11,269	12,498	12,631	12,071	11,803
Hopefield	6,687	6,057	5,959	6,609	6,680	6,383	6,242
Kaap	573	519	511	567	573	547	535
Knysna	5,614	5,085	5,003	5,549	5,608	5,359	5,240
Kuilsrivier	1,216	1,102	1,084	1,202	1,215	1,161	1,135
Ladismith	21,019	19,040	18,733	20,775	20,998	20,066	19,620
Laingsburg	122,027	110,537	108,750	120,608	121,900	116,489	113,905
Malmesbury	301,033	272,690	268,281	297,532	300,719	287,373	280,997
Montagu	24,529	22,219	21,860	24,243	24,503	23,416	22,896
Mosselbaai	148,760	134,753	132,575	147,030	148,605	142,009	138,859
Murraysburg	87,687	79,431	78,147	86,667	87,595	83,708	81,851
Oudtshoorn	21,575	19,543	19,227	21,324	21,552	20,596	20,139
Paarl	23,900	21,649	21,299	23,622	23,875	22,815	22,309
Piketberg	126,500	114,589	112,737	125,029	126,368	120,760	118,081
Prins Albert	80,822	73,212	72,029	79,882	80,738	77,155	75,443
Riversdal	209,873	190,113	187,039	207,433	209,655	200,350	195,905
Robertson	24,075	21,808	21,455	23,795	24,050	22,982	22,472
Simonstad	302	273	269	298	301	288	282
Somerset-West	211	191	188	209	211	202	197
Stellenbosch	36,879	33,407	32,867	36,450	36,841	35,206	34,425
Strand	*	*	*	*	*	*	*
Swellendam	177,146	160,467	157,873	175,086	176,962	169,108	165,356
<i>Biotechnology Sector Study</i>							
Tulbagh	26,549	24,049	23,660	26,240	26,521	25,344	24,782
Uniondale	66,980	60,673	59,692	66,201	66,910	63,940	62,522

Estimated goats numbers per commercial areas in the Western Cape

MAGISTERIAL DISTRICT / LANDDROSDISTRIK	QUARTERS / KWARTALE						
	Aug-02	Nov-02	Feb-03	May-03	Aug-03	Nov-03	Feb-04
Western Cape / Wes-Kaap							
Commercial areas / Kommersiële gebiede							
Beaufort West	71,269	73,540	70,545	70,469	69,748	70,014	70,454
Bellville	36	37	36	36	35	35	36
Bredasdorp	941	971	932	931	921	925	931
Caledon	1,320	1,362	1,307	1,305	1,292	1,297	1,305
Calitzdorp	272	281	270	269	267	268	269
Ceres	*	*	*	*	*	*	*
Clanwilliam	6,372	6,575	6,308	6,301	6,236	6,260	6,299
George	14,480	14,941	14,333	14,317	14,171	14,225	14,314
Heidelberg	4,489	4,632	4,443	4,438	4,393	4,410	4,437
Hermanus	567	585	561	561	555	557	561
Hopefield	191	197	189	189	187	187	189
Kaap	*	*	*	*	*	*	*
Knysna	259	267	256	256	253	254	256
Kuilsrivier	28	29	28	28	28	28	28
Ladismith	11,761	12,136	11,642	11,629	11,510	11,554	11,627
Laingsburg	1,620	1,672	1,604	1,602	1,585	1,592	1,602
Malmesbury	1,661	1,714	1,644	1,642	1,625	1,632	1,642
Montagu	1,253	1,293	1,241	1,239	1,227	1,231	1,239
Mosselbaai	1,424	1,470	1,410	1,408	1,394	1,399	1,408
Murraysburg	22,888	23,618	22,656	22,632	22,400	22,486	22,627
Oudtshoorn	8,051	8,307	7,969	7,960	7,879	7,909	7,959
Paarl	3,319	3,425	3,286	3,282	3,248	3,261	3,281
Piketberg	1,684	1,738	1,667	1,666	1,648	1,655	1,665
Prins Albert	13,490	13,920	13,353	13,339	13,202	13,253	13,336
Riversdal	4,792	4,945	4,743	4,738	4,690	4,708	4,737
Robertson	967	998	957	956	947	950	956
Simonstad	17	18	17	17	17	17	17
Somerset-West	0	0	0	0	0	0	0
Stellenbosch	50	51	49	49	48	49	49
Strand	*	*	*	*	*	*	*
Swellendam	925	955	916	915	905	909	915
<i>Biotechnology Sector Study</i>							
Tulbagh	43	45	43	43	42	43	43
Uniondale	58,851	60,727	58,253	58,191	57,595	57,815	58,178

APPENDIX 4

Key Sources of Information for Western Cape Agricultural Sub-sectors

Sector	Source
Viticulture	South Africa Wine Industry Statistics 2001/02 www.wosa.co.za/statistics-sawis.asp (Open)
Fruit Deciduous	Key Fruit Industry Statistics (Deciduous Fruit Industry) www.deciduous.co.za/oabs/index (open) & www.fip.co.za
Citrus	www.citrusa.co.za link to www.fruitinfo.co.za (must be subscriber) www.fip.co.za
Vegetables (General)	Crops and Markets, 2003 www.nda.agric.za
Potatoes	http://asa.pc.co.za (South African Potato Producers Association)
Animal Products	Abstract of Agricultural Statistics, 2003 www.nda.agric.za
Dairy	Milk Producers Association www.mposa.co.za
Winter grains	Abstract of Agricultural Statistics www.nda.agric.za
Fynbos	South African Flower Exporters Association www.safex.co.za

EXECUTIVE SUMMARY

Since the inception of the Cape Biotech Initiative in December 2001, the biotechnology sector of the Western Cape has grown through amongst other initiatives, the creation of the Cape Biotech Trust (CBT) and currently represents a small but promising building block towards regional competitiveness. Although the CBT focus area is more towards human health biotechnology solutions, as a result of its mandate from the Department of Science and Technology (DST), the Western Cape has specific requirements in the area of plant biotechnology to support its agricultural and natural environment. Through a good working relationship with PlantBio, based in the KwaZulu-Natal with representation in the Western Cape, local institutions and companies benefit from the support and funding of government.

The sector has a well-developed university education and research system producing highly skilled labour and suppliers of equipment and consumables are well supported. Supporting industries, including commercialisation support from incubators, manufacturing support and financial services including venture capital, are also well represented in the sector. Government has created several

national instruments that support the development of the biotechnology industry and the regional infrastructure in the Western Cape is regarded as being adequate to support an innovation centre. The biotechnology sector however is slow to commercialise numerous ideas developed within the university and science council environment.

Despite some 400 research groups operating in the Western Cape, the sector comprises of only 15 core biotechnology companies according to the EgoliBio National Biotechnology Survey conducted in 2003. The majority of the Western Cape biotechnology companies are therefore heavily reliant on donor funding. The reasons for this are numerous, the most apparent are that this nascent industry is capital intensive, requires highly skilled and specialised staff, has long lead times for ideas to mature into revenue generating products or services and is highly risky. Setup costs can run into several millions of rands and ongoing operational costs can easily match this. Even assuming the start-up company is able to raise finance, the cost of regulatory, tax and administrative compliance is substantial for the small companies entering the market. Given the substantial investment in education and training required by most employees, the remuneration offered is low compared to other industries and many potential contributors to the sector find it preferable to move into other less risky and more remunerative areas of business. Many biotechnology innovations require considerable lead time due to proof of concept research, field/clinical trials and registration processes and thus consume start-up capital for several years before any return is possible. Given the basic level of South Africa's social safety net, the cost of failure to entrepreneurs is high which actively discourages entrepreneurs from leaving the refuge of the university environment. A lack of business to science crossover skills has also been raised as a barrier to the commercialisation of biotechnology innovation.

These challenges are not insurmountable. Biotechnology is a high-risk, high-return sector which, with appropriate funding, government support and strong industry body participation, can grow. Significantly more funds need to be made available to registered companies who are able to prove they have a viable business model supported by independently audited science. Government needs to raise the profile of the industry through facilitation of the efforts of the commercial entities in the industry rather than acting as the face of the industry. The Cape Biotech Trust and Plant Bio related initiatives in the Western Cape need to be supported by business, government and academia if a coherent sector growth plan is to be realised.

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INTRODUCTION

3 BIOTECHNOLOGY SECTOR SCOPE

The biotechnology sector can be defined in a variety of ways. For the purposes of this report we have chosen to follow the definition of biotechnology adopted by the United Nations (UNEP, 1992. Convention on Biological Diversity, Article 2. United Nations Environment Programme) and endorsed in the South African National Biotechnology Strategyⁱ of 2001.

“Biotechnology is a body of techniques that use biological systems, living organisms, or derivatives thereof to make or modify products or processes for specific use.”

Within this broad definition, biotech can be further characterised into:

- 1st generation, where biological organisms are used to produce a product, for example yeast is used to make beer,
- 2nd generation, where pure cell or tissue cultures are used to produce something, for example yeast is stressed and used to make antibiotics, and
- 3rd generation, where the genetic information within cells is altered to produce a product not normally made, e.g. the DNA of yeast is changed to produce a protein, which it would not normally make, for the manufacture of a drug.

In order to limit overlap with other sectors and ensure adequate depth of insight we will limit our survey to entities involved in 2nd and 3rd generation biotechnology only. This scope is aligned with the position expressed in the National Biotechnology Strategy of South Africa that third generation biotechnology offers the greatest potential, in terms of providing a source of innovation and competitive advantage for the country’s Biotechnology industry as a whole.

Furthermore, as was pointed out in the 2003 National Biotechnology Surveyⁱⁱ, it is important to realise that:

- “Biotechnology refers to a set of processes or technologies and is not an industry or output, therefore one cannot use a statistical industry-based framework for analysis”
- “Biotechnology spans a wide range of different sectors and activities and the boundaries are difficult to define”
- “The industry in South Africa is fragmented and uncoordinated, which makes the identification of stakeholders and their respective activities challenging”

- “Due to the cross-cutting nature of biotechnology and the fact that it does not fall into any specific industry classifications, trade data is difficult to come by”

These factors need to be taken into consideration when profiling the sector

4 PROFILE OF THE BIOTECHNOLOGY SECTOR

Before we examine the biotechnology sector of the Western Cape it is important to stop and ask “Why does the Western Cape need a biotechnology sector?” The brief answer is that biotechnology has become an essential component of a balanced economic development portfolio and if the Western Cape wishes to promote sustainable growth and development, biotechnology cannot be neglected. Biotechnology is also one of the three technology focus areas the national Government has chosen to invest in over a period of 10 to 20 years. These technology missions were established through a rigorous selection process, documented in the National Research and Technology Foresight programme and in particular, the report on Biodiversityⁱⁱⁱ, published in 1999. A recent publication^{iv} from The Organisation for Economic Co-operation and Development (OCED) expresses this intent at greater length:

“The recent and continuing advances in the life sciences are making a reality of the prediction that this will be the century of biotechnology. Capturing the economic, environmental, health and social benefits of biotechnology will challenge government policy, public information, law, education and the scientific and technological infrastructure, and will affect our societies and many aspects of our life as profoundly as information technologies have already done. Such scientific advance has the potential to enable better outcomes for health, the environment, and for industrial, agricultural and energy production. Successful capture of these will provide significant opportunities for sustainable growth in the OECD area and beyond, partly through transformation of industries. By increasingly interacting with information and communication technologies, bioinformatics and nanotechnologies, the potential is even greater. Innovative products and services with improved economic and environmental performance will draw on renewable resources and biological processes to meet the needs of society. If delivered successfully, they have the potential to help decouple industrial growth from environmental degradation and deliver a more resilient, more bio-based economy, less susceptible to uncontrollable global events and less dependent on large-scale distribution systems. Life science research and biotechnology also promise more effective and efficient products to help deliver better health, whether in developed or developing countries, that are based on a fuller understanding of the human body and its ailments and diseases and of the interventions required to deal with them. These products can deliver on two vital and inextricably linked goals - improved health and more sustainable growth and development.”

Locally, the Department of Arts, Culture, Science and Technology (DACST), which was split to become the Department of Science and Technology (DST), White Paper on Science and

Technology^v has clearly identified technology as important in enhancing the quality of life of all South Africans. Biotechnology has also been identified as one of the cornerstones of a knowledge-based economy and growth focus area in the Foresight Synthesis Report^{vi}. The report stated that it identified:

“Biotechnology for a more rapid and efficient means to diversify and improve the food and other industrial product base. Biotechnology may be applied in combination with traditional breeding techniques for the elucidation of novel genes, for ease of processing, for improvements of crops and animals, and for legal use.”

Biotechnology, although not mentioned specifically, will assist in achieving the aims laid out in the Department of Economic Affairs, Agriculture and Tourism’s White Paper on “Preparing the Western Cape for the Knowledge Economy of the 21st Century”^{vii}.

Success in the biotechnology industry can be measured at a number of different levels as is beginning to emerge from a current project being undertaken by the Department of Science and Technology (DST). Current success is measured at the Biotechnology Regional Innovation Centre [BRIC] level, the CBT being the organisation primarily responsible for the development of biotechnology in the Western Cape. The performance measurement of the regional strategies and initiatives are currently measured in terms of:

- Ability to promote economic growth and employment creation through the enhancement of technological innovation in the biotechnology sector in terms of the number of jobs created.
- Establishment of companies and / or improved business performance, with an emphasis on local relevance / community development, with the aim of generating new products and services in the biotechnology sector.
- Ability to promote technology transfer / diffusion within the biotechnology sector of the local economy.
- The development, management and access and utilisation of the biotechnology platforms established by the DST^{viii}.
- Development and management of intellectual property either for commercialisation or transfer.
- Establishment of internship programmes to build capacity to enable the biotechnology industry to grow.

The various objectives that would establish the success of the industry are formulated at three levels. At the highest level these need to meet the national imperatives, or from a regional point of

view contribute to the same. At the second level the objectives would serve the regional economy and at the third level opportunistic objectives that are shorter term in nature would satisfy funding requirements though the transfer of intellectual property.

Funding for biotechnology in the Western Cape, which was predominantly Cape Biotechnology Trust (CBT) funding for the first three years (2003-2005) amounted to some R120 million. Future funding contributions from the other biotechnology instruments such as Plantbio and the National Biotechnology Network (NBN), would also make contribution to technology initiatives in the Western Cape and it is conservatively estimated that these would also make a contribution of some R10-12 million per annum.

CBT's funding requirements, which are dependant on the number and combination of projects and interventions undertaken, are planned to fluctuate between R100 million and R150 million and would stabilise around R50 to 60 million in 2010.

Of the 15 commercial core biotechnology organisations mentioned in the National Biotechnology Audit, it is our perception that only approximately 33% of these companies are producing profitable returns; this means that the industry is likely to run at a negative return on investment for a number of years. It is expected that between years 5 and 10, positive returns on investment should start to materialise.

4.1 SPATIAL LOCATION OF THE SECTOR IN THE PROVINCE

Globally there are in excess of 4 400 biotechnology companies of which 85% are located in Europe and North Americaⁱⁱ. More than 100 cities and regions are attempting to establish biotechnology clusters and there are currently estimated to be between 150 and 200 bio-clusters worldwideⁱⁱ.

Table 1: Number of Biotechnology companies per capita for nations in Europe - December 2000

Country	Number of dedicated biotechnology companies	Companies per million inhabitants
Sweden	235	26.0
Switzerland	93	12.6
Ireland	39	11.2
Finland	53	10.4

Country	Number of dedicated biotechnology companies	Companies per million inhabitants
Denmark	51	9.6
Norway	37	8.3
United Kingdom	448	7.6
Germany	504	5.9
France	342	5.8
Belgium	55	5.4
Netherlands	79	5.0
Austria	11	1.4
Italy	64	1.1
Spain	32	0.8
<i>Western Cape</i>	<i>15</i>	<i>3.33</i>

Based upon the above analysis the Western Cape does actually compare favourably to the European countries in terms of biotechnology companies per million inhabitants.



Figure 1: International location of Peer group and Best Practice Biotechnology clusters^x

The most successful biotechnology clusters can be found in the Britain at Cambridge and in the United States at the Bay Area and in Boston. Further, more comparative biotechnology clusters can be found in:

- Australia
- Cuba
- Ireland
- Israel
- New Zealand
- Singapore
- South Korea

The reasons that these clusters are considered to be comparative to South Africa and the Western Cape are due to the fact that they also represent smaller and developing economies similar in size with limited resources, are located far from large markets and have a pro-active biotechnology strategy.

The Western Cape, through the CBT is currently in the process of developing such a cluster.

In 2003 a survey on biotechnology in South Africa^x identified 36 biotechnology related companies in the Western Cape. Of these 15 companies are core-biotechnology companies and 21 are non-core

companies. There are some 400 research groups in the Western Cape. The majority of these companies and research groups are located in the greater Cape Peninsula area. A smaller grouping was also identified in the George area. Currently new initiatives are being launched and several new ventures are being funded. In terms of spatial distribution, the Cape Peninsula, George clustering seems unchanged (see Figure 2). It should however be noted that accurate quantitative statistics on the sector are largely unavailable.

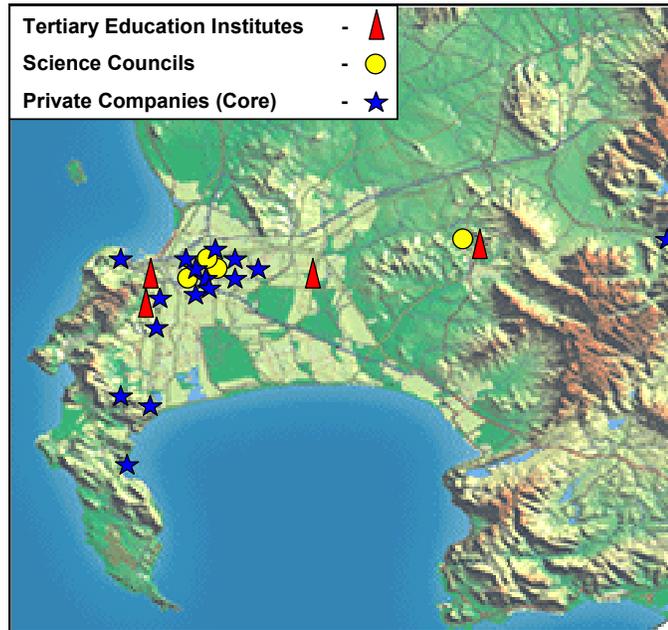


Figure 2 Distribution of Tertiary education institutes, science councils and core biotechnology companies

The National Biotechnology Survey⁹ indicated that most of the companies in the Western Cape tend to prefer to concentrate on natural product related biotechnology initiatives.

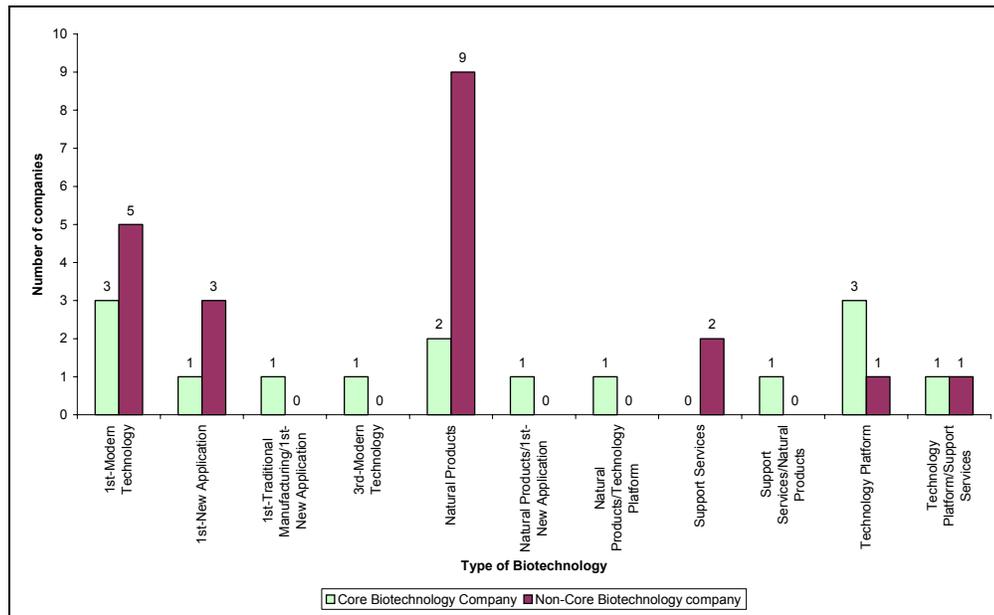


Figure 3: Type of Biotechnology Initiatives of Western Cape Companies

From a review of available literature and discussions with industry players we were able to identify the following active entities within the sector. Although the study is limited to 2nd and 3rd generation biotechnology entities, this list includes some 1st generation biotechnology entities, as these have been deemed to be core to the industry in previous reports or through Cape Biotech Trust funding.

- Educational Institutions – Universities and Universities of Technology (previously Technikon)
 - University of Cape Town (UCT)
 - University of the Western Cape (UWC)
 - University of Stellenbosch (US)
 - Cape Technikon
 - Peninsula Technikon
 - Port Elizabeth Technikon – George Campus
- Research Institutions and Organisations

- Institute for infectious diseases and molecular medicine at UCT
- South African National Bioinformatics Institute at UWC
- Institute for Wine Biotechnology at US
- Institute for Plant Biotechnology at US produces yeasts to improve wine fermentation
- Medical Research Council (MRC)
- SAAVI: The SAAVI public-private partnership was established to co-ordinate the research, development and testing of HIV/AIDS vaccines in South Africa. SAAVI is based at the MRC and is working with key national and international partners to produce an affordable, effective and locally relevant HIV/AIDS vaccine in as short a time as possible.
- ARC Infruitec-Nietvoorbij
- Council for Industrial and Scientific Research (CSIR)
- National Botanical Institute
- South African Bureau of Standards
- iThemba Laboratories
- WineTech produces environmentally adaptable grape vine varieties
- Industry development or lobby bodies and Venture Capital companies
 - Cape Biotech Trust (CBT)
 - Acorn Technologies – a biotechnology incubator)
 - BioAfrica
 - BioWatch
 - Catalyst Innovation Incubator
 - Bioventures
 - Phakamisani Ventures

- National Bioinformatics Network [NBN]
- The National Botanical Institute
- Core commercial biotechnology companies
 - Afriplex, producing extracts, essential oils, natural flavours and isolates, tinctures and plant ,materials
 - Anchor Biotechnologies, producing phyto-pharmaceuticals
 - AzarGen, producing plant based compounds of diagnostic, therapeutic and industrial value
 - Bay Labs
 - BioDelta, producing pure Spirulina and other organic products
 - Biovac Institute responsible for developing and maintaining a local presence in vaccine production
 - Disa Vascular specializing in the design and development of coronary & peripheral stents and related technologies
 - Electric Genetics producing bioinformatics data
 - Faizyme Laboratories specialising in the isolation and purification of horseradish peroxidase and a select range of enzymes
 - Genecare Molecular Genetics producing diagnostics
 - Integrow Health is a supplier of raw materials to the international medicinal plant industry. The products include Aloe ferox gel, devils claw, dog rose oil and pumpkin seed oil
 - KARI producers research into drought resistant crops
 - Kelp Products producing value added seaweed products, from plant growth regulators, fertilizers and soil conditioners to food supplements and cosmetic preparations
 - Meyer Zall Pharmaceuticals researching drug and vaccine delivery
 - Ribotech involved in drug development and drug delivery

- Sannitree International producing a wide range of freeze-dried enzymes and aggressive bacteria
- Seravac Biotech producing of enzymes and related products to the diagnostic, pharmaceutical, biotechnological and research industries.
- Shimoda Biotech producing research on cancer and drug delivery systems
- Synexa Life Sciences involved in drug discovery
- Vision Biotech producing HIV tests and ACG pregnancy tests
- Other
 - Frontier micro-propagation labs
 - Ideas to Industry initiated by the MRC
 - Mushroom Biomedical Ventures
 - Swift Micro Laboratories
 - SUNBio

4.2 SECTOR TRADE OUTPUT DATA TRENDS

The output of the biotechnology sector, both nationally and regionally is extremely difficult to quantify as the sector produces a wide variety of products and services. In Rand terms the sector was estimated to have a national sales turnover of R368m in 2003^x. No conclusive sales turnover figure could be established for the Western Cape contribution, although it is believed to be less than 50% if the number of companies is taken as an indication of the turnover.

To quantify the combined value of product sales would not be conclusive due to the varying nature of biotechnology activities undertaken in the Western Cape. A company such as Anchor Yeast is probably one of the most active Western Cape based manufacturers of biotechnology related products, although it would be very difficult to classify the company as either a core or non-core biotechnology company. Several other biotechnology companies have also survived several years of operation and are proving to be profitable and not relying on external funding for operations, these include amongst others Synexa, Seravac, Shimoda and Frontier Micro-propagation Labs.

Probably the best measures of output in this sector are:

- Patents granted

- Publications in scientific journals
- Sales of biotechnology services and products
- Sales of biotechnology companies
- Sales of biotechnology intellectual property

In 2003 a search of the United States Patents and Trademarks Office revealed 65 patents filed by South African inventors and classified under code 435 (molecular biology and microbiology)^x. A repeat of this search produced only 58 matches, of which 5 listed inventors as being located in Cape Town. A vibrant, innovative and growing biotechnology industry would be expected to be filing more patents with the United States Patents and Trademarks Office, as the United States is in the forefront of the commercialisation of biotechnology. Searching of South African and European patent offices has, as was found by past surveys^x, been inconclusive as classification of inventors and patents does not allow for accurate segmentation of biotechnology patents from South Africa or the Western Cape. It is also possible that, given the wide scope of the sector, patents may have been filed under different classifications. Certain entities may also not file patents so as to protect their intellectual property beyond the patent expiration date.

Publications, while not necessarily an indicator of commercial success, job creation or economic progress, do indicate innovation. At a national level South Africa has seen a 13% fall in life sciences publications between the period 1990-1994 and the period 1996-2000^{xi}. South Africa's publication output as a percentage of global output has also declined in recent years^{xi}. Within these figures are however some success stories. Immunology has seen a growth of 80% in publications, pharmacology 13% and microbiology 12%. A search of the PubMed^{xii} database for publications of a biomedical nature revealed that publication from authors affiliated to Cape Town grew by an average of 4% per year between 2000 and 2004.

Most of the core biotechnology companies appear to be growing the value of their intellectual property through investment in Research and Development, with the aim of either licensing the intellectual property or selling the company together with the intellectual property it contains.

No significant sales of companies or intellectual property were reported by the interviewees however, it cannot be excluded that such sales have taken place and gone unreported or unnoticed.

These are important indicators that need to be monitored and tracked to establish the progress over the planning periods for regional development and the CBT could in future play an important role in facilitating the measurement of the rate of development and the realisation of the expected investment returns.

4.3 FINANCIAL STRUCTURE AND INVESTMENT RETURNS OF THE BIOTECHNOLOGY SECTOR

The sector is characterised by several large tertiary education and parastatal bodies, a few core companies and a number of support organisations and suppliers.

The institution that possibly attracts the largest pool funding is the South African AIDS Vaccine Initiative (SAAVI) which was formed in 1999 as a lead programme of the Medical Research Council of South Africa. Primary funding was received from the Department of Health, the Department of Science and Technology and Eskom. Transnet and Impala Platinum have also come on board as additional funders in 2004^{xiii}. Today SAAVI brings together researchers from the universities of Cape Town and Stellenbosch, the National Institute of Communicable Diseases, the Medical Research Council, AlphaVax, the University of North Carolina, the division of AIDS at the National Institute of Allergy and Infectious Diseases, the HIV Vaccine Trial Network and the International AIDS Vaccine Initiative^{xiv}.

Another significant player is the Biovac Institute. The Biovac Institute is composed of Biovac (Pty) Ltd, an existing South African vaccine distributor, Vaxintel and Heber Biotech. This consortium has formed a Public Private Partnership (PPP) with the Department of Health and the State Vaccine Institute.

Bioventures^{xv} has investments in:

- Shimoda Biotech (Pty) Ltd
- Disa Vascular (Pty) Ltd.
- Synexa Life Sciences (Pty) Ltd.
- Electric Genetics (Pty) Ltd.
- PlatCo Technologies (Pty) Ltd. (an offshoot of Shimoda Biotech)

Cape Biotech is currently funding the following ventures:

- Synexa Life Sciences (Pty) Ltd
- Department of Molecular and Cellular Biology, UCT
- Shimoda Biotech (Pty) Ltd
- Genecare Molecular Genetics (Pty) Ltd
- Stellenbosch University, Institute for Wine Biotechnology

- Biovac Institute
- Natural Carotenoids South Africa (NCSA)
- DISA Vascular

Acorn Technologies, the biotechnology incubator based in the Western Cape, will be supporting 19 projects during 2005 and is aiming to grow the amount of projects to an expected 65 by 2008. The projects for 2005 include ten early and middle stage projects and nine late or commercialisation stage of trading SMMEs. Acorn has made R1.2m of risk finance available to the late stage projects, while they are hoping to raise R35m from governmental sources such as the Department of Trade and Industry (*The dti*) and Department of Science and Technology (DST) for the early stage projects. Acorn Technologies' funding is normally supplied as a low interest loan pegged to the R150 bond over a two year period.

Catalyst Innovation, although based in Cape Town and potentially a biotech investor, holds no current investments in biotech companies and has limited past investments to medical devices^{xvi}. Further sector ownership details are sketchy at best with private sector companies not wishing to divulge information about their ownership or financial dealings.

Some interviewees indicated that the biotechnology sector is currently a negative return industry with profits only made when investors are able to sell off the company or its intellectual property. The bulk of the sector resides with tertiary education institutions and parastatals where private ownership is either structurally prohibited or limited to PPP's. The few biotech companies that have survived without start-up, NGO or government funding are unlisted and no public information on returns is available.

Analysis of biotechnology funding in South Africa as a whole can only currently be estimated as the details of biotech funding from external sources are generally not available, although most of the sources are known. In 2005/6 the public biotechnology funding amounted to approximately R170 million. To this can be added other sources of public funding through non biotech specific funding from the Innovation Fund and programmes like THRIP. The contribution from the two sources is estimated to be a further R25 million. External funding from the European Union's 6th Framework Programme, Bioventures and Catalyst Technologies could amount to a further R110 to R150 million according to CBT analysis. Thus, the total funding from all sources in the 2005/6 year in South Africa is estimated to be in the range of R300 to R350 million. CBT plans to spend R52 million in the 2005/6 financial year from public funding, with a further R82 million funding being secured through co-investment with additional funding over and above this being negotiated. This increased level of funding will allow more funds to be allocated to projects within the focus areas that the CBT has identified.

4.4 BIOTECHNOLOGY SECTOR FOCUS AREAS

A wide range of technologies is in use in the Western Cape Biotechnology sector and many of these are deployed across several focus areas. In order to better understand the technological bias of the region we will investigate the technology focus areas identified by industry experts in a surveyii conducted by the Cape Biotech Trust.

4.4.1 Current focus areas

The Cape Biotech Trust surveyed biotechnology entities in the Western Cape and identified the following activity distribution:

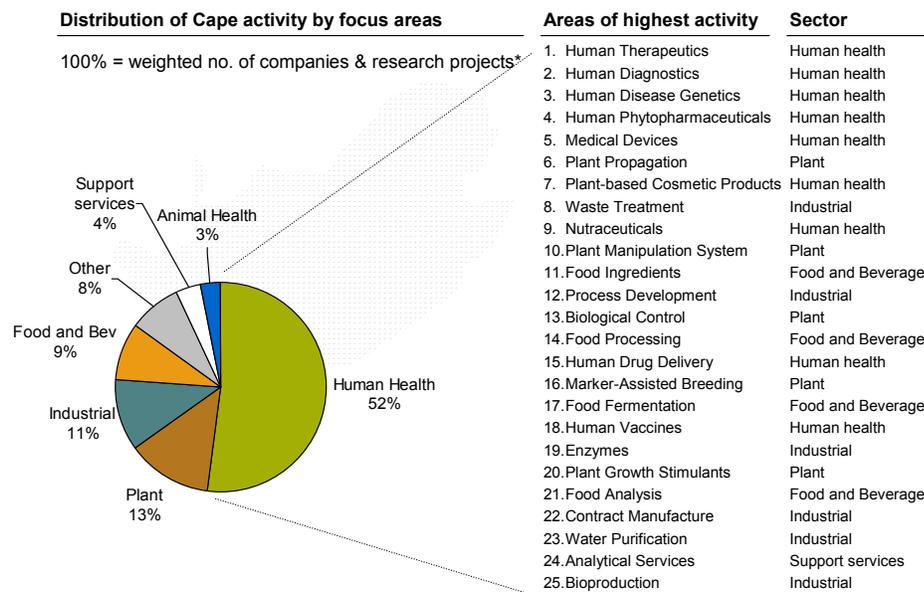


Figure 4 Distribution of Cape activity by focus areaⁱⁱ

These have been refined into the following focus areas:

- Vaccines
 - Vaccines for developing world health issues
 - Contract R&D services to big pharmaceutical companies
 - Clinical trialling
 - Animal models

- Bio-pharmaceutical contract manufacturing
- Diagnostics
 - Diagnostics for developing world health issues
 - Assay development
 - Cell models
 - Animal models
 - Clinical trialling
- Natural New Chemical Entities (NCE's)
 - Biodiversity bio-mining
 - Therapeutics for developing world health issues from natural origin
 - Nutra-ceuticals from biotech processes
 - Clinical trialling
- Drug delivery
 - Drug delivery alternatives with generic actives
 - Clinical trialling
 - Biopharma contract manufacturing
- Bioinformatics (National Bio-informatics Network)
 - Clinical genomics and pharmacogenomics
- Plant biotechnology (PlantBio Innovation Centre)

Plant biotechnology applications for healthcare and for industrial processes are considered non-core to PlantBio, but will be supported in collaboration with other BRICs. Plant biotechnology applications cut across different disciplines and objectives:

- Plant Transformation

- Involves the insertion of specific foreign genes into a plant's genome with the aim of introducing a specific trait like resistance to a disease or tolerance to herbicide. Trends in research are aimed at developing drought and disease resistance, improving nutritional composition of essential crops and bio-farming
- The Western Cape institutions involved in Transgenic Research are the University of Cape Town, University of Stellenbosch and the University of the Western Cape
- In the Western Cape, there has been work done on table and vine grapes at the University of Stellenbosch, strawberries at Infruitec and maize at the University of Cape Town
- Seed-Breeding: traditional and non-traditional:
 - Is defined as the enrichment of plant germplasm with traits through natural methods of crossing as opposed to genetic modification.
 - The largest opportunity for seed-breeding lies in corn/ maize. Corn generates a high yield form of crop, however, it is not self perpetuating, and therefore needs to be bought from a production source annually.

Table 2: Examples of breeding projects affecting products in the Western Cape

Project	Purpose
Apple	Dry stock disease, fruit quality traits, local growing conditions
Apricots	New cultivar
Japanese plums	New cultivar
Pears	Red to green fruit colour conversion
Surinam cherries	Seedless

- Biological control
 - Involves the selection of suitable candidate (bacterium, fungus or insect)
 - Formulation and application for disease and pest control as an alternative to chemical pesticides
 - Within the Western Cape, iThemba Laboratories is working in conjunction with a Deciduous Fruit Producer to release sterile male Coddling moths into orchards

- Bio-fertilisation
 - Selection of suitable candidate (bacterium, fungus)
 - Formation and application for rhizosphere colonisation
- Plant Propagation
 - Production of disease free plants for agriculture
 - Production of ornamental plants
 - Regeneration and propagation of transgenic plant material
 - The wine industry procures plantlets from cuttings generated from a variety of specific motherblocks
 - The leaf roll virus has affected nearly all of South Africa's vines. This has resulted in a reduced lifespan of the vines from 50 years to 18 years and increased production loss
 - The preferred solution would be to introduce virus free motherblocks from which to propagate new vine material as well as to provide additional ongoing pathogen monitoring and diagnosis and vector control
- Biopharma contract manufacturing

In addition the following areas were seen as potential focus areas:

- Yeast technologies
- Industrial enzyme identification and culturing
- Environmental improvement biotech
- Wine biotech (non-GMO)

Many of the focus areas mentioned above are limited to the parastatal or tertiary education environment. Table 3 shows the technology developments and innovations that are being pursued by commercial entitiesvi:

Table 3 Selected examples of technology developments and innovation in the Western Cape

Type	Application	Producer
Cyclodextrin drug delivery	Analgesic	Shimoda Biotech
Diagnostic, predictive and carrier testing	Genetic testing	Genecare Molecular Genetics
Single-stranded RNA polymers	Used to produce double-stranded RNA	Ribotech (Cape Town, South Africa)
Expressed sequence tag, mRNA analysis software	Bioinformatics	Electric Genetics
Bioprocess / Liquid fermentation	Microbially derived secondary metabolites	Synexa
Vaccinia Virus complement control protein	Inflammation control	K-Biotec

4.4.2 Technology challenges

The sector has comparatively few technology challenges and those that do exist are relevant only to a small grouping of sector players. Most of the technologies used commercially are in widespread use; it is their specific application to resolving a problem that poses the challenges. In some instances it is the further development of the technology that is the entity's driving purpose. Technology challenges faced in the Western Cape include:

- Obtaining needed technology at an affordable price
- Obtaining staff competent in a particular technology

One of the primary barriers that the sector faces is the lack of understanding from the international firms such as the big trial companies, regarding the existing technology and infrastructure in the Western Cape. The Western Cape has through the various universities and companies access to sophisticated laboratory facilities that could easily be leveraged to promote large firms with the necessary support facilities.

The sector is positioned to make a positive impact on the Western Cape economy. It has already managed to attract capital to fund its research capacity and now faces the challenge in taking the

research out of the laboratory and turning it into a self-sustaining business. As a new sector, there is little embedded technology that is obsolete and most equipment can be easily imported if funding is available. Skills and capital shortages represent significantly greater impediments to progress than any challenge posed by technology.

5 BIOTECHNOLOGY SECTOR VALUE CHAIN

In the biotechnology sector, the concept of a value chain is somewhat different to that of most traditional industry sectors. Most value is generated through the creation of intellectual property; only in certain instances will actual production take place. This section will explore a few ways of viewing the value creation paths and networks that are utilised in the biotechnology sector.

5.1 BIOTECHNOLOGY SECTOR VALUE CHAIN

The biotechnology sector is best described through the cluster model as shown in Figure 5, not the usual sequential value chain utilised by most industry sectors. Players can act at several, non sequential, points in the chain. For example, a university department attached to a hospital may perform research and conduct clinical trials once the research has been commercialised, despite not conducting any applied research nor being involved in the proof of concept or the capitalisation of the company producing the compound under investigation.

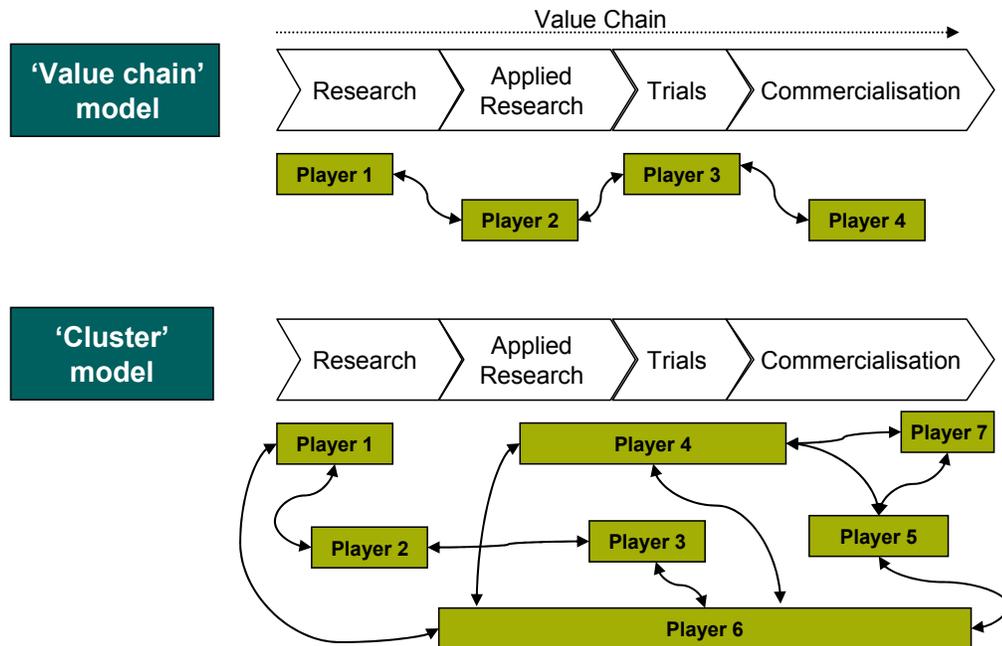


Figure 5 Value chain vs. Cluster Modelⁱⁱ

There may also be different activities within the cluster model, depending on which sub-sector within which the individual company operates. Laboratory and clinical trials form a step in the value chain for companies involved in human health; while companies involved in bioinformatics would perform beta testing and companies performing enzyme extracts will only perform laboratory tests. Despite these differences, the generic value chain shown in Figure 6 can be used as a rough indication of the stages involved in the commercialisation of a biotechnology concept.

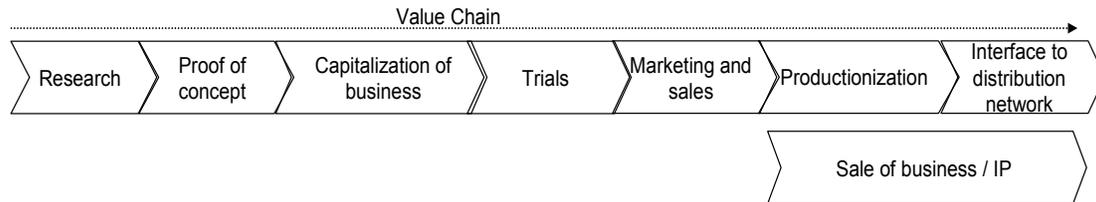


Figure 6 Generic value chain for biotechnology in the Western Cape

The bulk of people employed in the sector are employed at the research stage (both within academia and industry), a few groups are conducting proof of concept and even fewer have capitalised their businesses, conducted trials and marketed their product or gone into production. In several instances, trials as well as marketing may take place before the business is capitalised. This supports the assertion by many interviewees that the skills to set up independent business entities are in very short supply and that most researchers lack business science crossover skills and stick with those activities they are comfortable with.

6 BIOTECHNOLOGY SECTOR FACTOR CONDITIONS

For any regional industry to begin its path to a successful industry cluster, a range of factor conditions need to be in place. In this section we will explore some of the factor conditions in the biotechnology sector against the stated key success factors identified for the development of bioclusters in other locations internationally, which have similar constructs to the Western Cape's start-up biotechnology industry of some three years.

6.1 INVESTMENT AND CAPITAL

6.1.1 Skills development incentives

A skilled workforce is a key imperative within a biocluster, as well as the ability to attract key staff. Currently there are few incentives for skills development in the sector. The skills development levy is widely regarded as imposing excessive administrative overheads on start-up and small firms that characterise the sector. This is an area currently acknowledged by the CBT.

The Skills Support Programme offers training grants to local and foreign firms, with the objective of encouraging greater investment in training and creates opportunities for the introduction of new skills. The training grant is in the form of a cash grant and applies to a new or expansion of an existing project or an approved training program. The grant is focussed to benefit investors engaged in manufacturing, high-value agricultural projects, agro-processing, aquaculture, biotechnology, tourism, ICT, recycling and cultural industries.

A maximum of 50% of the training costs, the development of a training curriculum, and / or land and buildings related to training, and up to 30% of the total salaries of the company will be granted for approved training programmes. Capital cost of up to R3 million may be provided for capital training equipment in respect of an approved training school. The grant is payable for up to three years.

The South African Research and Innovation Managers Association^{xvii} may, along with other management forums, assist in the development of management skills in biotechnology companies.

For the biocluster to develop effectively, specific skills development targets would need to be established around a wide range of training requirements that need to be developed by firms in the Western Cape biocluster.

6.1.2 Business start-up incentives

The sector has considerable choice when it comes to funding of start-up businesses. Much research is conducted initially within the university or parastatal environment where funding is available from:

- The National Research Foundation's (NRF) THRIP programme
- The European Union's Sixth Framework Programme provides significant early stage funding for projects involving at least one EU collaborator

When ideas reach the initial stages of commercialisation, funding can be obtained from:

- Cape Biotech (DST's public funds)
- Acorn Technologies (GODISA funds)
- Bioventures (Venture Capital)
- Catalyst (Venture Capital)
- Phakamisani Ventures (Venture Capital)
- Business Partners
- Industrial Development Corporation (IDC)
- Angel investors
- Retail financial institutions

In addition, the University of Cape Town has a Technology Transfer Office (TTO) tasked with commercialising university research output. The University of Stellenbosch has both an Office for Intellectual Property and a technology incubator, Unistel Technologies. The MRC has technology transfer competency responsible for commercialisation of intellectual property. Some interviewees suggested that licensing technologies for revenue, although favoured by government, lack appeal for venture capital due to uncertainties around the duration of licence agreements and the perceived instability in intellectual property rights within South Africa.

6.1.3 Local Investment

Once businesses are up and running many government incentives is available, these includex:

- The Small and Medium Enterprise Development Programme (SMEDP) from the dti which assists in the acquisition of assets for SMME's
- The Skills Support Programme (SSP) which assists SMME's with skills development
- The Competitiveness Fund (CF) which covers the cost of 50% of marketing, product and service development cost of companies striving to become globally competitive
- The Bumble Bee Programme (BBP) provides free consulting to manufacturers with less than 20 employees
- The Sector Partnership Fund provides funds to groups of five or more companies aiming to increase sector competitiveness and productivity
- The Business Linkage Challenge Fund (BLCF) provides funds to develop business linkages that enhance competitiveness
- SME's may claim up a 100% write off on manufacturing assets in the first year of operation

6.1.4 Foreign investment

The Cape Biotechnology Trust estimatesⁱⁱ that the South African biotechnology industry attracted approximately R945 million of investment per year. In addition to this amount further funding was obtained through:

- Frontier programmes
- Grants, FDI, donor investment
- EU 6th framework programme
- Bill and Melinda Gates Foundation
- Ellison Medical Foundation
- Kirsch Foundation
- Rockefeller Brother Fund – SA
- Open Society Foundation for SA
- The Mellon Foundation
- The Carnegie Corporation of New York

- The Charles Stewart Mott Foundation
- The WK Kellogg Foundation

This additional investment appears to largely be in the form of grants from foreign sources. Interviewees were of the opinion that almost all commercial funding was obtained locally from the entrepreneurs themselves, government sources and venture capital businesses, as foreign investors were either not aware of the market, had concerns about exchange controls, intellectual property rights and exportation of intellectual property. Most venture capitalists also appear to prefer to operate in markets they are geographically close to.

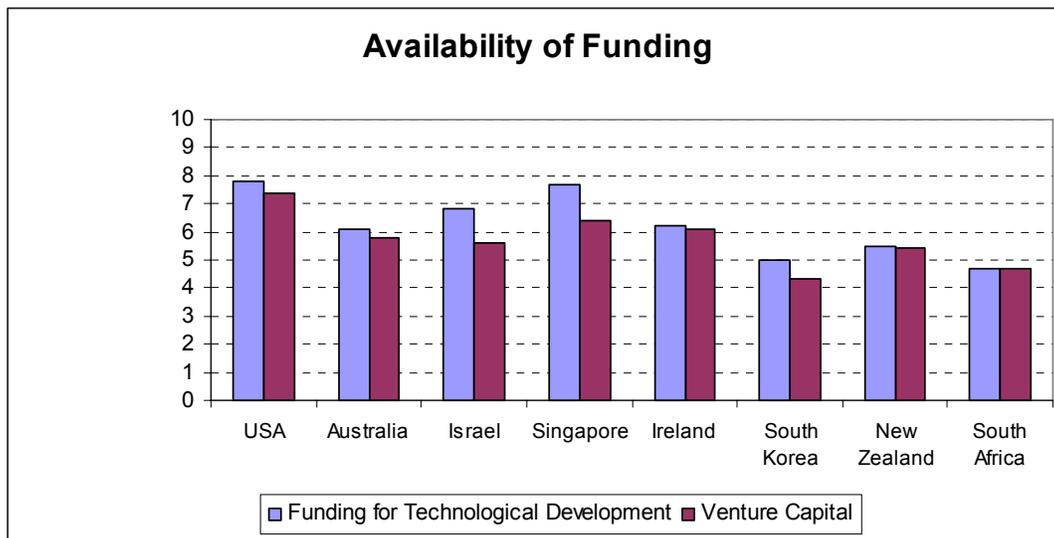


Figure 7: Availability of Funding^{xviii}

On a scale from 1 to 10 the ease of obtaining funding has been measured and it is clear from Figure 7 that South Africa's total science expenditure is below the average of a comparative group of nations.

Although the information reflected is not specifically aimed at biotechnology only, it can be deduced that the information is just as applicable for the biotechnology sector. In a further analysis the R&D spend as a percentage of GDP was evaluated for a number of developed and developing countries in Figure 8.

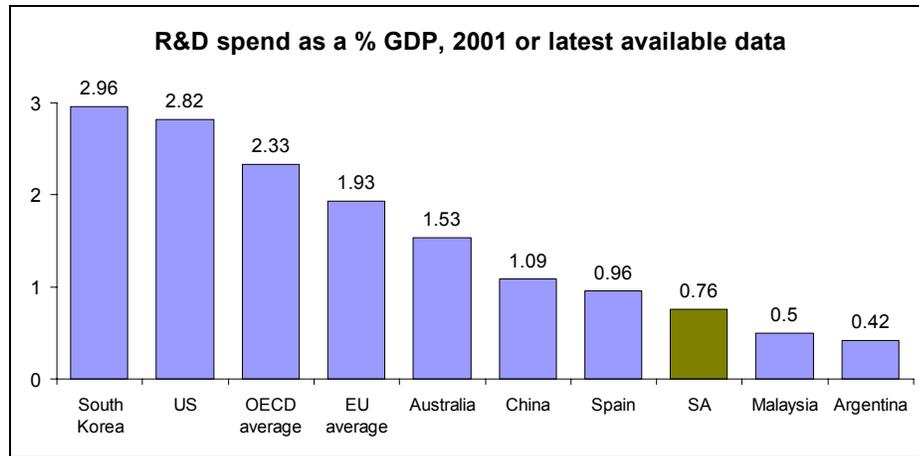


Figure 8: Investment in R&D (US\$ Bn)^{xix}

South Africa rated third last on this scale, rating slightly higher than Malaysia but only 50% compared to Australia.

Considering the 2003 GDP of the Western Cape of approximately R134 000 million and taking into account the estimated funding that was made available to the CBT of R130 million, the Western Cape biotech R&D spend rates considerably below the lowest rating at 0.0975%.

6.2 LABOUR

Highly skilled labour is probably the most significant sector input for the biotechnology sector. In this section we will explore the issues around vital input.

The Cape Biotechnology Trust has estimatedⁱⁱ that there are more than 1 100 people employed in the sector, with approximately 350 people involved in core biotechnology. It is estimated that the majority of these people are employed in academia or parastatal bodies. University enrolment in biotechnology related degrees is increasing however; there are still insufficient graduates from disadvantaged backgrounds to meet industry demand^l. Despite increasing undergraduate and post graduate student numbers, the industry is too small to absorb even a fraction of the graduates. Some are absorbed into the university network while others find work in one of the parastatal bodies. The commercial biotechnology industry in the Western Cape, even with a 10% staff turnover, a high figure for tertiary education and parastatal bodies, is unlikely to absorb more than 35 graduates. This is approximately half of the University of Cape Town's current 3rd year class in the department of Cellular and Molecular Biology. Furthermore, the Department of Microbiology at Stellenbosch University has annual graduate figures of approximately 40 degree course students, and another 30 post grad students. Given that several other courses and institutions supply graduates into the market, it is clear that there is an oversupply to labour in general. Interviewees

however indicated that it was the supply of highly experienced staff in a number of key areas that were limited.

6.2.1 Labour trends

With significantly higher salaries available in other regions and other sectors offering graduates better salaries and access to a career in business disciplines, retention of graduates in biotechnology is highly problematic. Black graduates in particular have a wide range of other, more profitable and less risky, options which encouraged their exit from the sector. Interviewees reported that the industry was predominantly female with few males being attracted to the industry. Interviewees also noticed that while there is an increased number of South Africans returning, low salaries and a shortage of opportunities are hindering their entry into the sector. Indications are that un-experienced PhD candidates can earn up to R17 000 per month and experienced PhD candidates in the region of R300 000 per year. These salaries tend to be more or less driven by and in line with academic equivalent salaries. It seems as if this trend had prevailed for at least the last two years.

Locally the most graduates could potentially find employment at some of the larger companies such as SAB and SASOL, but if they would like to get involved in larger pharmaceutical R&D the best options would be to explore international opportunities at companies such as Du Pont. Locally there are few new pharmaceutical manufacturing capabilities.

In an evaluation conducted for the World Competitiveness Report in 2003, South Africa was rated amongst some of its peers as the country with the lowest access to skilled labour. Although this position is not necessarily directly applicable to the biotechnology industry or the Western Cape it is indicative of the ability to compete on an international level. This position is further aggravated by the fact that South Africa is the country most affected by the brain drain in a similar class.



Figure 9: Availability of Skilled Labour^{xx}

In a study conducted by the HSRC^{xxi} in 2004, the deduction is made that students are reluctant to enter into the biotechnology study field due to the low availability of potential jobs. Most of the graduates are then also relocating to international destinations in order to find employment in the field of study. The study further remarked that much of the research taking place in the biotechnology sector is based upon individual research and that there is not enough multidisciplinary research.

6.2.2 Skill mix in the sector

The National Research Foundation (NRF) has found that the Western Cape is home to 41% of South Africa's leading and internationally acclaimed researchers and that 27% of these are involved in biotechnology^{xxii}.

These researchers are mainly involved in:

- Immunology and disease research
- Virology
- Vaccinology
- Genomics
- Genetics
- Systems biology

- Aquaculture / mariculture
- Enzymology
- Bioprocessing
- Bioinformatics

This pool of excellent skills however only consists of some 43 people. Our interviews and those conducted in previous studies^{ix} give a mixed message around what skills are available. In some instances there appears to be an oversupply of undefined biotechnology skills, in others a single vacancy is extrapolated to a sector wide skills shortage. What is consistent is that the quality of research skills is widely regarded as too low. There are not enough experienced Masters and PhD researchers capable of working innovatively in any of the biotechnology sub-disciplines and there has always been a short supply. Technical staff that are able to perform routine work appear to be in good supply. No current quantitative data documenting skills demand (vacant, funded positions) and skills supply (qualified staff, unemployed or working out of the sector and wishing to gain access to the sector) exists.

6.2.3 Skill requirements

The most frequently cited skills requirement is for staff with science-business crossover skills. The lack of independent commercial biotechnology companies and the large supply of university graduates support this assertion. Most science graduates appear to have a limited understanding of business, or possibly a lack of entrepreneurial skills, particularly for risky entrepreneurial business that is characteristic of successful biotechnology clusters. On the other hand local universities have well renowned business schools which currently address the business learning needs of managers at all levels and from all disciplines; however, no courses addressing the business side of science are available. The introduction of specifically tailored short-term or modular courses aimed at specifically imparting business skills to innovative scientists would benefit not just the biotechnology sector, but also the wider science community. The University of Stellenbosch has now introduced an entrepreneurial course as part of their graduate course in the Institute for Plant Biotechnology.

Where specific science skills are required, there appears to be no central portal or service providing search and recruitment services to the industry. This again appears to be due to the small size of the industry and the low profitability such a business would have given salary levels and impediments to paying such agents commissions. Interviewees have suggested that an industry portal may help alleviate this bottleneck and create more global visibility for the sector. Development of any specific programme to supply one or two people with specific skills sets is unlikely to be commercially viable.

The Cape Biotech Trust and Acorn Technologies, in collaboration with other partners, are busy launching an innovative internship programme^{xxiii}. Interns are sponsored to work with biotechnology companies in areas where there are distinct shortages. This type of programme will ensure that learners, particularly from disadvantaged backgrounds, are given commercial biotechnology exposure. This goes some way to satisfying the requirement, but a broader based approach will be necessary to develop the necessary portfolio of skills required to supply the envisaged biocluster in the Western Cape.

6.2.4 Biotechnology SETA support

The biotechnology sector has no dedicated SETA and companies belong to a range of SETAs. Interviewees indicated that smaller biotechnology companies may fail to utilise the sector training levy as the SETA they are required to pay levies to, do not facilitate training relevant to their requirements. It was also suggested that small companies may not draw on the resources of the SETA as the administrative overheads associated with claiming for training are in excess of the benefits derived.

To support the development of the Government's technology missions such as biotechnology, the full qualification framework would need to be developed for the industry, to enable access to funds for training. Denial of the funds from the Skills Development Levy (SDL) for strategic sector development in the economy appears to currently be a serious shortcoming.

6.2.5 Conclusions on the sector labour conditions

A shortage of highly skilled labour is one of the biggest issues facing the biotechnology sector. Science has traditionally been regarded in South Africa as a "calling" and, given the education levels required, low salaries the norm. Funding allocations are frequently loaded in favour of equipment and non labour operating expenses at the expense of salaries. An oversupply of graduates combined with low salaries at all levels has probably contributed to pushing skilled graduates into other sectors with greater job security and higher salary levels. The small size of the industry is also limiting absorption of graduates and greater focus on the establishment of new commercial entities is required if the supply is to be absorbed.

Science-business crossover skills are desperately needed in the sector. While business training for scientists may help alleviate this problem, most interviewees feel that the biggest benefit will come from recruiting scientists who have started and run their own businesses, preferably in biotechnology. Locally this type of skills base is almost nonexistent; however some interviewees suggested that retired life sciences executives from other parts of the world could be induced to assist the sector through some form of residency programme.

Probably the most significant cause of the current shortage of skilled labour is the fact that the sector requires a highly educated and diversely skilled workforce yet it is these people who are most able to find employment in other sectors at significantly higher remuneration.

6.3 SOCIAL AND ENVIRONMENTAL FACTORS

Despite the many obvious advantages of modern biotechnology in various areas of the economy, there remains a significant group of critics who have a variety of concerns about genetic engineering. These concerns can be grouped as follows:

- Concerns about the safety of genetically-modified (GM) foods in terms of the health of the consumer. There is currently no requirement to label genetically modified foodstuffs as such in South Africa. There is however considerable debate about this and South Africa may introduce labelling requirements to fall inline with global trends. A survey conducted in 2002^{xxiv} indicated a positive attitude to labelling of foodstuffs however debate of how and when this is to be implemented continues. These concerns include:
 - Potential toxicity
 - Potential allergenicity of GM foods
 - Antibiotic resistance
 - Alteration of nutritional quality of foods
- Concerns about the safety of genetically engineered biomedical products that might cause unknown secondary effects in patients. Many of the safety concerns regarding biotechnology based biomedical products relate to the production process:
 - Microbial safety
 - Tumorigenicity
- Concerns about possible negative effects of GM organisms on the environment. The release of genetically modified organisms into the environment is a highly emotive issue and has at times been contested by organisations such as BioWatch and COSATU^{xxv}. Companies whose products or service involve field trials are likely to face increased administrative workloads in managing release issues^{xxvi}.
 - Pollen transfer from GM plants
 - Possible creation of new viruses and toxins

- Seed control and crop genetic diversity
- Like the rest of South African industry sectors, biotechnology faces the challenge of becoming more representative of communities in which it functions. Interviewees stressed that although the sector had a high level of female representation; it had a very long way to go to reach the Government's minimum requirements for BEE and the specific requirements for the manufacturing sector.
- The following ethical - religious concerns have been raised:
 - Human safety and environmental concerns
 - Economic considerations
 - Interference with strong religious beliefs regarding food provision

The essence of these concerns is the fear of the capacity of modern biotechnology to alter the course of nature. It is essential that these concerns should be addressed to ensure the realisation of the full economic potential of modern biotechnology.

6.4 INNOVATION

Internationally the protection of intellectual property rights through the registration of patents is one of the key focus areas of biotechnology companies. The number of patents registered also serves as a good indication of the level of activity and progress being made. The growth in Patent Cooperation Treaty (PCT) applications over the 10 year period 1990 to 2000 clearly shows the high-level activity taking place in the plant biotechnology environment worldwide.

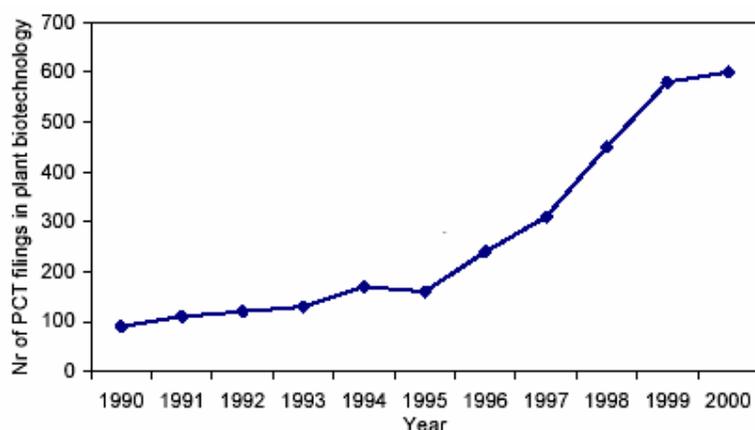


Figure 10: The number of PCT filings in plant biotechnology during the last decade³⁸.

While tertiary education and parastatal bodies conduct significant amounts of research and have been in the forefront of innovation, only a few innovations have been commercialised, due mainly to the infancy of the biotechnology industry in the Western Cape. The Government is on drive to improve the utilisation of academic and science council research, as was reported in a NACI commissioned report on the topic^{xxvii}.

Commercial research conducted outside this environment is poorly documented and given current funding and tax dispensation, costly to the organisation wishing to embark on research. Given the poor track record of tertiary education and parastatals in taking innovation to market, some interviewees suggested that funding should be re-directed to commercial entities that currently are excluded from many sources of funding.

A recent study^{xxviii} in the national biotechnology environment observed that the predominant source of innovations of companies are from within the organisation itself rather than through collaboration with external stakeholders, which indicate that the culture of collaboration is largely lacking due to the high secrecy of new developments in the sector.

The same study^{xxix} determined that the primary driver for innovation by the various biotechnology organisations is to gain access to new markets or increasing market share, this is surprising since so little new products have actually been introduced into the market from primary research in the past five to ten years. Liebenberg and Nicholson-Herbert^{xxx} further determined that the primary reasons why local firms struggled with innovation was due the long pay-off period of innovations and the excessive cost of innovation. It is estimated that to bring a New Chemical Entity (NCE) to market, through the various clinical approvals required, the cost would be \$800 million - \$1billion, or 5-7 times the total annual South African biotechnology budget of approximately US\$150 millionⁱⁱ.

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Similarly American pharmaceutical research has shown that the excessive timelines to launch a new product is also a hurdle hampering progress.

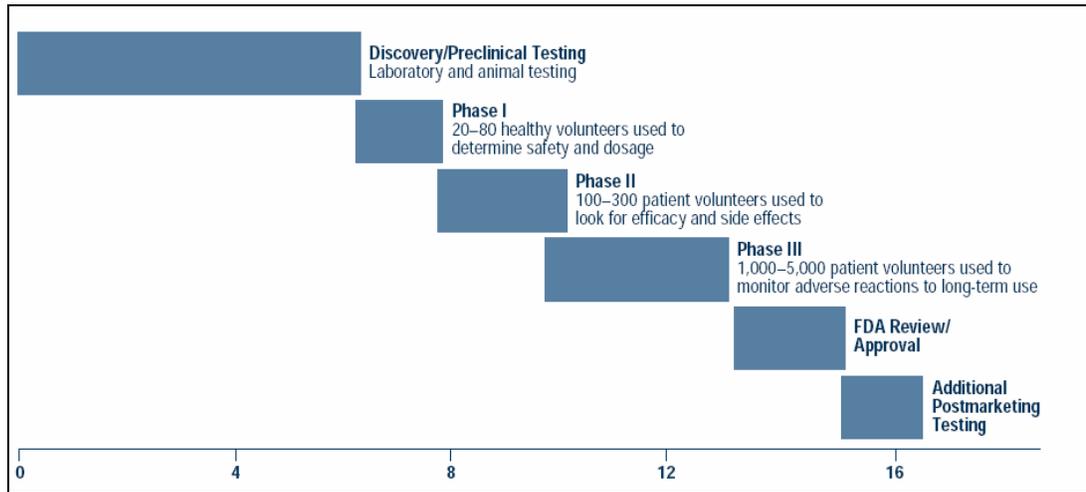


Figure 11: Drug development timeline (years) ^{xxx1}

The effect of the limited funding is evident in the number of patents and scientific articles published by South African scientists.

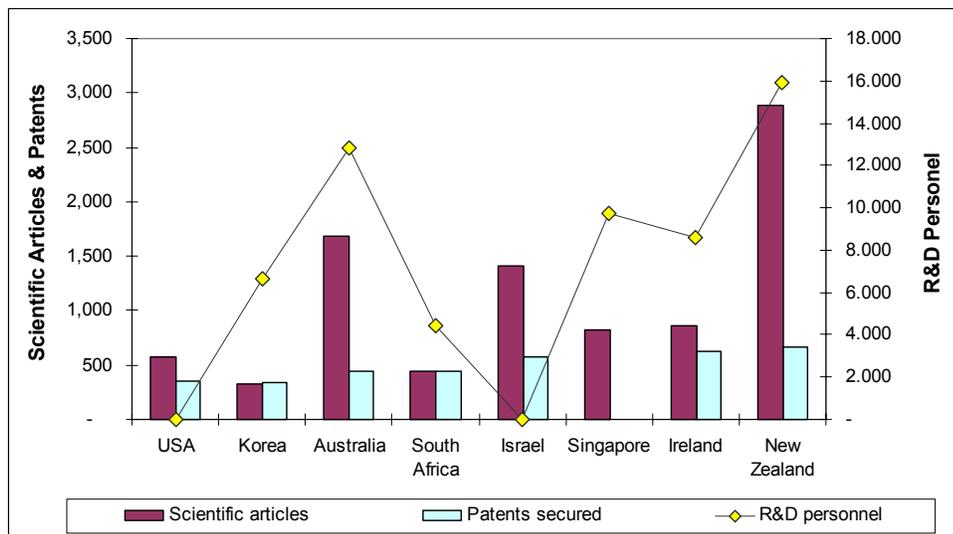


Figure 12: Scientific Output (per US\$ bn spent) ^{xxxii}

It does not appear, from Figure 11, as if there is a clear relationship between the number of researchers and the number of commercial opportunities or patents and articles.

The number of research groups active in the Western Cape has been reported to be in the region of 400 according to the National Biotechnology Survey. It is however unclear how many patents and

articles were published by Western Cape players; companies such as Synexa holds a few local and international patents on their technologies.

7 SECTOR STRATEGY

The dynamism and pressure created by vibrant local rivalry is perhaps the most important stimulus to innovation and upgrading an industry^{xxxiii}. This rivalry, coupled with a growth or product excellence strategy, can, given a facilitating company and cluster structure, further enhance the strength of the cluster.

The biotechnology sector in the Western Cape, as primarily represented by the Cape Biotechnology Trust (CBT), has developed a specific regional biotechnology industry strategy for the Western Capeii. The strategy is has yet to be endorsed by sector players. The preliminary strategy is to focus on a number of key focus areas which have already shown promise in the region. Three strategic thrusts will be pursued by CBT to collectively close gaps in the regional biotech industry: a long term investment in focus areas, broad-based cluster initiatives, and opportunistic investment.

The action plan is divided into key programmes, which is grouped in five related initiatives. These initiatives include:

- Partially develop and license novel natural NCEs to address the key health challenges facing South Africa and developing nations by systematically creating an extensive medicinal compound library from South Africa's rich biodiversity
- Conduct end-to-end development of medium-cost and volume therapeutic and prophylactic vaccines to address the key health challenges facing the South African people and developing nations
- Promote nutraceuticals industries in the Cape that utilise biotech processes to create employment and export revenues through products which address healthcare and nutritional deficiencies in South Africa and the developing world
- Develop niche market therapeutics with affordable drug delivery platforms and generic actives to improve the effectiveness of treatments for first and developing world diseases of relevance to South Africa
- Develop and manufacture novel, cost-effective, easy-to-use, point-of-care diagnostics for major developing world health issues which are relevant to South African society.

Annual business plans have now been developed to secure funding to implement the strategy and measurable objectives are being refined based on the generic set of key performance indicators

previously mentioned. The first cost estimate to close critical gaps in focus areas is R450 million. Further investigation and consultation is to continue.

The PlantBio vision is targeted towards developing a sustainable plant biotechnology industry that is competitive and world class in specific areas by 2014 and its strategy has the following commercial and social objectives^{xxxiv}.

- To increase the contribution to South Africa's GDP, by facilitating the creation of a plant biotechnology industry and to enable the creation of plant biotechnology entities that are profitable in the future
- To build South Africa's competitive advantage by increasing the intellectual capital and the commercial exploitation thereof, and increase the relevant capacity like platform technologies, scientific and managerial skills
- To create a positive social impact (better quality of life) by assisting the development of better products and addressing food security needs, and by supporting the development of skills and employment opportunities
- To make PlantBio sustainable by raising additional funds and to invest, realize value and re-invest funds

Both the objectives identified and initiatives set by CBT and PlantBio provides direction for the Western Cape biotechnology sector to develop from extensive analysis and consultation by both organisations. These strategies are largely aligned to ensure that the national strategic imperatives are met. Alignment to sectors, able to be impacted by biotechnologies, at the Provincial level does not appear to be clear and should be undertaken to ensure an eventual return on the funding investment for the Western Cape.

Of the companies operating in the sector, only two could be regarded as being in the same market although they do produce different products. It would thus appear, as is expected in a young emerging biocluster than there is little, if any, regional competition at a market level. Competition is most apparent for limited inputs such as staff and funding.

Within the tertiary education competition is primarily limited to competition for students who bring fee revenue and government subsidy revenue. Given the surplus of school leavers and the limited university and technikon available places, the competition is mainly around attracting students of exceptional ability who will later move on to postgraduate study.

8 MARKET DEMAND

The biotechnology sector has two distinct markets. For intellectual property, which is highly portable and scalable, the global market is a viable and highly attractive market. For physical goods the sector produces low bulk high value products which, while cost effective to transport globally, also carry considerable administrative and marketing costs associated with global distribution.

Generally the biotechnology industry in South Africa has three different market segments, which apply equally to the different demarcated biotechnology regions in South Africa. The first market is defined by the national imperatives such as the provision of food security to alleviate poverty, providing healthcare and specifically treatment and cures for pandemics such as HIV / AIDS and diseases such as malaria and tuberculosis. The second market is the regional market and the needs identified by the Western Cape Province to stimulate growth and the third is opportunistic markets where products are developed that fall outside of the CBT focus areas and where revenues can be generated without particularly solving a particular need. Some R36 million has been appropriated by the CBT for its opportunistic investment programme in the 2005/6 financial year.

8.1 MARKET PROSPECTS

Given the diverse nature of biotechnology products and services, market prospects vary significantly from company to company.

The Biovac Institute, SAAVI and Genecare focus on providing products and services that are relevant to South African and African markets. With increasing prevalence of HIV, the need for affordable vaccines targeting diseases prevalent to Africa and increased government willingness to procure locally developed medical products; it is likely that both SAAVI and the Biovac Institute will find improved market conditions. With the growth in proactive treatment for lifestyle diseases, Genecare is likely to see considerable growth opportunities in the local market.

For those companies who are currently exporting goods or services, the current strength of the Rand has weakened their position as exporters. Companies such as Faizyme, Serevac and Electric Genetics will face increased price competition as other biotechnology clusters in developing countries with weaker currencies start to export. Companies focussing on the South African market (e.g. Genecare and Biovac) will, by providing products and services tailored to the local market, have many advantages over foreign producers. It should be noted that South African consumers are often biased in favour of foreign products and services and that local companies will often have considerable difficulty in dislodging suppliers of foreign products, despite the technical and price advantages of the local product.

Further opportunities to be explored exist within the area of clinical trials. South Africa is viewed as a very attractive option for conducting clinical trials because of amongst other factors the access to

six academic medical faculties, and a world class reputation in HIV research, South Africa offers experienced investigators and motivated patients. Furthermore, South Africa is a very cost effective destination due to the number of patients per site being much larger than studies in the U.S. or Europe, leading to efficiencies in both patient recruitment and site monitoring. While South Africa has a modern first-world infrastructure, the costs for travel, accommodation, investigator grants and printing are significantly lower and consequently clinical trials in South Africa are usually 25-50% less costly than Europe or North America, including purchase of other drugs required for the trial. In addition the ability to rapidly recruit candidates and patients for trials leads to overall shorter study timelines and lower costs. Examples of one clinical trial company’s ability to recruit patients for trials include:

- 3 000 patients for 46-site vaccine study in 9 days
- 1 388 paediatrics enrolled at 16 sites in 12 days
- 298 perennial allergic rhinitis patients at 30 sites in 3 weeks
- 24 Parkinsons patients enrolled in 2 weeks

South Africa also offers operational advantages - due to the geographical position of South Africa being located in the southern hemisphere, South Africa is ideal for seasonal studies such as influenza, pneumonia and allergic diseases. Furthermore with an extremely high prevalence of HIV/AIDS and other major diseases including cardiovascular, diabetes, hypertension, mental illness, cancer, tuberculosis and respiratory infections are also on the rise, making South Africa a prime location for studies of anti-infective products. Communication is both simple and convenient. English is widely accepted for protocols and case record forms. Operating on the European time zone, South Africa shares the same business hours. An advanced cell phone infrastructure and networks are widely used and makes communication easy even in remote rural areas.

Currently approximately 300 trials are under way at any point in time in South Africa, with the national annual budgets for these trails ranging between R1 million and R 3 billion. There is a huge opportunity to provide local support to the big international trial companies such as Quintiles and PRA both of which have offices in the Western Cape. Both companies have had operations in South Africa since the early 1990’s. Quintiles is a leading force in South Africa's pharmaceutical product development industry due to the fact that they have completed more than 200 trials involving 1 000 sites and some 30 000 patients in the past 15 years.

Quintiles have experience across a broad range of therapeutic areas, including:

Table 4: Types of trials completed by Quintiles in South Africa

Disease / disorder	Studies	Sites	Patients
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Disease / disorder	Studies	Sites	Patients
Anti-Infectives	66	704	11 183
Cardiovascular	10	100	1 342
CNS	22	68	740
Immunology	5	47	7 372
Metabolic Disorders	6	73	1 072
Oncology	12	80	911
Respiratory	15	135	1 838
Women's Health	9	98	1 471

These international trial companies provide not only a vast amount of cash flow through support of the local industry, but also provide the opportunity for knowledge and technology transfer to take place by being able to work closely with world leading experts. The promotion of the Western Cape as a prime clinical trial site, with access to world class universities and facilities, could be a valuable strategy to pursue to stimulate the sector growth in the Western Cape.

The biotechnology sector in the Western Cape currently has very few products and services that are market ready, or organisations that could be described as fully dependant commercial entities, as many still rely heavily on government and NGO funding to sustain them. There are however a few exceptions which are described below.

8.2 BIOTECHNOLOGY PRODUCT EXPORT AND IMPORT

8.2.1 Exports

As an industry in its early development stages, the biotech sector is focussed on growing capacity and has very limited export volumes at this stage of the bioclusters lifecycle. It is likely that fewer than five of the core biotechnology companies perform any export activities. Exports currently include purified enzymes and biological compounds of natural (non-GMO) origin, plant and algal extracts and software. Most products are high value low bulk products. 1st generation biotechnology products (e.g. Aloe extract) have had considerable export successes however, most

core biotechnology companies must mature further before export contributes to revenue in any significant way.

Synexa is a young company, established in 2002, focussed on refining and optimising the bioprocess technology and has had considerable success in exports. Through the refinement of this technology they have discovered that not only can they market the technology, but are also in a position to manufacture niche products. Synexa's compound production facility specialises in the manufacture of microbially derived secondary metabolites by using a combination of standard and proprietary fermentation technologies, together with state-of-the-art mass directed auto-purification systems. All of Synexa's key products are being exported.

No numeric data on exports is available due to the wide variety of classifications into which biotechnology products and services may fall. Further study, requiring detailed disclosure of financial data, will be required before an accurate picture of the economic and financial impact of exports from the sector is available.

8.2.2 Imports

The industry is heavily reliant on the import of high technology equipment, laboratory-ware and reagents. High capital cost items include centrifuges, sequencing equipment, computer equipment, HPLC/GC equipment. Reagents and consumables such as enzymes and specialised proteins are amongst the imported high value items. Local firms are well equipped technically to supply many of the enzymes and proteins used by the sector however; economies of scale limit the attractiveness of the local market unless the products can also be exported. Import replacement of high cost capital items is also hindered by the small size of the local market. Local manufacture of power supplies, fine chemicals and consumables, such as pipettes and Petri dishes, with applications outside the sector (e.g. pathology or quality control to the food industry) has been a feature of the sector for several years.

8.3 MARKET SHARE

The biotechnology sector competes in numerous different markets. Vaccines from a company such as the Biovac Institute could find their way into both the global and local healthcare market. Software from Electric Genetics falls into the software market. Transgenic maize could be classified as part of the agricultural or foods market. Where statistics are available they tend to vary considerably between sources and it is often not clear into which sector a particular product or service falls. The reasons for this lack of clarity stems from a number of factors including:

- Certain products may be defined as of biotechnology origin in one survey yet not in another. For example GM maize sold in retail outlets could either be regarded as part of the biotech market or the agricultural products market

- Many biotechnology companies focus on growing the value of the company's intellectual property and aim to sell the company or its intellectual property for commercialisation in another sector. For instance, a company focusing on creating new technologies for the introduction of genes into maize may be sold to a seed supplier without ever having made any sales revenue. Immense wealth can be created without any product or service reaching the end user market.
- Large pharmaceutical companies often purchase small start-ups or their intellectual property directly from their owners with little disclosure as to the sale price.

What is clear is that, even assuming a large percentage of overstatement, the global markets for biotechnology or the products of biotechnology are substantial:

- It was estimatedⁱⁱ that in 2004, the global market for biotechnology itself was \$47 billion
- Biotechnology products are an growing component of the \$22 billion diagnostics marketⁱⁱ
- The global neutraceuticals market was \$150 billion in 2001ⁱⁱ
- The global vaccines market has revenues of \$7 billion per annum and has shown a compounded growth rate of 10% per annum since 1992ⁱⁱ
- Transgenic plants: In the agricultural industry, even though South Africa has adopted agricultural biotechnology on a large scale, one must make a clear distinction between imported agricultural biotechnology and biotechnology products developed within South Africa. The USA is the clear world leader in the field of developing new agricultural biotechnology products. In fact, global agricultural biotechnology is concentrated on a few crops in a few countries with four crops (soybeans, maize, cotton and canola) accounting for over 99% of the GM crop area and 99% of global transgenic crops (on 67.7 million ha) grown in six countries. Comparatively South Africa had .4 million hectares of transgenic crops in 2003 which accounted for .6% of the world total.

In South Africa, where agricultural biotechnology has been adopted on a large scale over the past few years, the South African based seed industry virtually disappeared and multinational companies, like Monsanto, are supplying almost all seeds of crops planted in South Africa, both GM and non-GM. The implication of this is that these mostly US-based companies receive all the profits from seed sales in South Africa³⁸.

- The worldwide market for in vitro diagnostics (IVD)s (including all laboratory and hospital-based products, and over-the-counter product sales) was estimated at \$27.7 billion. This market is expected to grow 7% per annum to \$39.9 billion by 2008^{xxxv}.

Table 5: Worldwide in vitro diagnostic reagent sales by country/region, 2003 (actual), 2008 (projected) Source: Kalorama Information (New York City)³³

Country / Region	2003 Sales (\$millions)	2003 Share (%)	2008 Sales (\$millions)	2008 Share (%)	CAGR (%)
North America	11 900	43	16 360	41	7
European Union	8 585	31	11 710	30	6
Japan	3 065	11	3 550	9	3
China	620	2	1 300	3	16
Latin America	570	2	1 190	3	16
India	340	1	900	3	21
Eastern Europe	250	1	400	1	10
Rest of World	2 360	9	3 900	10	11
Total	27 690	100	39 310	100	7

Few of the Western Cape's biotechnology sector's companies have ability to become significant global players in their own right and value is thus best generated through sales or licensing of intellectual property. The alternative strategy of becoming a preferred supplier to a global player may also generate value however; it does not provide venture capital companies with an easy exit and may thus hinder the company's ability to raise venture finance.

8.4 TECHNOLOGY PROMOTION

Promotion of the biotechnology sector in the Western Cape has been primarily addressed through the following channels:

- The Cape Biotechnology Trust has, through the use of their website, mailing list, personal contacts, Cape Biotech Conference, BioBuzz events, Frontiers in Biotechnology Lecture Series and Bio2Biz promoted the local industry^{xxxix}.
- Acorn Technologies has co-hosted a technology promotion competition and is in the process of developing an internship programme.

- Wesgro^{xxxvi} has produced a fact sheet on the biotechnology industry^{xxxvii} although this is no longer available from their website. A new industry fact sheet is being planned and is due to be republished before the end of 2005.
- National government has funded a national biotechnology survey in 2003^x which has both documented and highlighted the industry at a national and regional level.

8.5 EXPORT INCENTIVES / DISINCENTIVES

There are currently no export incentives aimed specifically at the biotechnology industry. Given the sector's current limited production it would seem unlikely that any incentives would yield a significant impact on the sector.

The Biodiversity Act of 2004 has, while safeguarding resources, made the export of technologies and intellectual property more administratively complex. Entities involved in bio-prospecting are likely to need legal and regulatory assistance in determining their compliance to the Biodiversity Act. Given that many interviewees see a lack of business and administrative skills as a significant hurdle to the establishment of the biotechnology industry in the Western Cape; this may be seen as a disincentive to export.

8.6 COMPLIANCE AND INTERNATIONAL STANDARDS

In developing the sector and preparing for export, the sector needs to take cognisance of the following international standards and compliance hurdles:

- HACCP- Hazard Analysis and Critical Control Point focuses on identifying and preventing hazards from contaminating food. It permits more efficient and effective government oversight, primarily because the recordkeeping allows investigators to see how well a firm is complying with food safety laws over a period rather than how well it is doing on any given day.
- The Cartagena Protocol on Biosafety came into effect on 11 September 2003. This protocol requires that governments of the signatory nations be informed of any potential living GMO entering into a signatory country with the intention of introducing this GMO into the environment.
- GMP - This refers to the Good Manufacturing Practice Regulations promulgated by the US Food and Drug Administration under the authority of the Federal Food, Drug, and Cosmetic Act. These regulations, which have the force of law, require that manufacturers, processors, and packagers of drugs, medical devices, some food, and blood take proactive steps to ensure that their products are safe, pure, and effective. GMP regulations require a

quality approach to manufacturing, enabling companies to minimize or eliminate instances of contamination, mix-ups, and errors. This in turn, protects the consumer from purchasing a product which is not effective or even dangerous. Failure of firms to comply with GMP regulations can result in very serious consequences including recall, seizure, fines, and jail time.

- Food and Drug Administration (FDA) in the USA has to approve any medical and food products before it can enter the United States of America
- EU – Common Agricultural Policy (CAP): Due to the size of the European Union’s agricultural production and its market, the impact of the EU’s CAP reaches far beyond Europe and has major implications for trade in agricultural goods all over the world including the SADC member states. Since the nineties the CAP has undergone gradual but constant changes including the lowering of intervention prices for commodities such as beef and cereals and the shift towards more direct payments. On 26 June 2003 the EU farm ministers agreed on the perhaps most fundamental reform of the CAP so far. Through the CAP developing countries, including the SADC countries, are particularly locked into the EU’s complicated system of protectionist regulations and subsidies on the one hand and preferential access on the other hand.
- EU – Foods regulator has introduced the Labelling Act of 1997. This Act, passed by the EU parliament, requires all GM products to be labelled according to its GM content. The stringent labelling and traceability policy introduced in October 2002, sets very high barriers to potential exports to the EU.

9 BIOTECHNOLOGY SUPPORTING INDUSTRIES

For the core companies within the biotechnology sector in the Western Cape to function effectively and efficiently, an array of related industries need to provide the necessary support. This section will explore the related and supporting industries located in the Western Cape.

9.1 BUSINESS SUPPORT SERVICES

Biotechnology does not just require excellent science and technology; it also requires a significant business component to ensure long term viability. Venture capital or other funding is required to take an idea and give it physical substance and in a forthcoming section of the report we describe the funding components of the industry. Once the concept is given physical substance, business advisory skills and networking are needed if it is to be fully developed into a saleable product; it is here that incubators are able to assist.

Acorn Technologies^{xxxviii} “is a biomedical, bioengineering, and biotechnology start-up business incubator based in Cape Town”. It was started in March 2002 “as part of the Government's Godisa Program and provides residential & laboratory facilities, business expertise and a supportive environment for entrepreneurs and their newly formed life science companies”. Acorn also supplies early stage funding and mentoring. “Cape Biotech^{xxxix} was awarded funding to develop a Biotechnology Regional Innovation Centre (BRIC) under the sanction of the National Biotechnology Strategy, implemented by the Department of Science and Technology (DST). The Cape Biotech Trust (CBT) promotes and develops the Biotechnology sector in the Western Cape and represents the interests of all stakeholders in the region, including industry, academia, government and service providers to the sector. Through a regionally focussed portfolio of projects, some regional and some national, the CBT BRIC aims to act as a nucleus for the development of a range of businesses and new product offerings, as well as have the capacity to support these. The CBT is one of three BRICs - the other three being, BioPad (Biotechnology Partnerships and Development) and Lifelab. Plantbio is another innovation centre but has a national focus. As a commercial entity, The CBT has two major functions: industry stimulation and capacity creation; and disseminating and managing government funds by investment in promising projects. With an interest in capacity creation, portfolio and knowledge management, The CBT is therefore a cluster development initiative in addition to a funding body”.

The Cape Town HIV Vaccine Clinical Trials Consortium was established in October 2002 and comprises of a multifaceted group of researchers who conduct multidisciplinary research in HIV and are part of South African Aids Vaccine Initiative (SAAVI). The consortium offers a fully functional and sustainable HIV Vaccine Clinical Trials Unit in Cape Town, able to conduct Phase I and II human trials of HIV/AIDS candidate preventative vaccines under good clinical and ethical practice

for all age and ethnic groups in South Africa. It is currently actively engaged in socio-behavioural, educational and infrastructural development of Phase III sites in the communities of Masiphumelele and Nyanga / Mitchell's Plain, Cape Town.

To date, the consortium has focused on site, protocol and research tool development; the commencement of two retention studies; the national incidence study; enhancing communication between community structures and researchers; and, developing culturally attuned education programmes.

South Africa has a limited number of credible patent attorney practices. These include Spoor and Fischer, Fisher Hofmann, Adams & Adams and Ramsey Webber. It is estimated that a full international patent filing of a biotechnology patent can cost up to R500 000^{xi}, which is one of the factors that hampers the ability of South African firms to produce internationally competitive products

9.2 EQUIPMENT AND CONSUMABLE SUPPLIERS

The Western Cape has a comprehensive equipment and consumable supplier base to the biotechnology sector. This is in all likelihood due to the fact that these suppliers also supply the Agriculture, Wine and Food and Beverage industries as well. No interviewees expressed concerns about a lack of availability of equipment and consumables however, the cost, particularly that of imported equipment, was frequently cited as an issue.

The National Bio-informatics Network (NBN) is tasked with providing the infrastructure for bioinformatics and functional genomics. The bioinformatics role of NBN is focussed on providing resources around the areas of biotechnology, information technology and telecommunications. NBN is responsible for providing the infrastructure like hardware, software and resources achieved by the provision of right type of skills through curriculum development, courses and training. The infrastructure will include high bandwidth transmission lines, high powered computing capability and to co-ordinate multiprocessing environments across nodes.

9.3 INFRASTRUCTURE SUPPLIERS

Regional infrastructure was regarded by interviewees as good with adequate road and rail networks. Airports and airlines were regarded as good however, an interviewee expressed a desire for more direct flights to the United States stating that this is a major market for biotechnology companies and more direct flights would ease interaction with this market.

The cost and quantity of bandwidth available was considered to be a major issue by several interviewees. This is also borne out by the National Biotechnology Network (NBN) who has increasingly experience problems with bandwidth. With the relaxing of regulation on the provision

of bandwidth, supply is likely to increase and cost will drop as Telkom relaxes its monopoly. Power supplies were not an issue.

9.4 LOGISTICS SUPPLIERS

For biotechnology companies, the quality and speed of logistics suppliers are critical. Most biotechnology companies rely on biochemical reagents that are imported and require careful handling. The physical outputs of the sector are mostly low bulk, high value and again require careful handling and rapid delivery. The Western Cape has several freight forwarding agencies with good international co-operation agreements with both airlines and agencies in other parts of the world. Customs delays were not reported to be an issue however, the handling costs associated with import and export may become an issue as the sector expands and volumes increase.

9.5 PUBLICITY ON BIOTECHNOLOGY

The Department of Science and Technology has established a biotechnology instrument to handle the publicity surrounding biotechnology, called Public Understanding of Biotechnology (PUB). This government body has a mandate of communicating on the issues surrounding biotechnology in an unbiased manner. Several issues surrounding the mandate of PUB are up for consideration and are in the process of being addressed. Duplication of services also exists in that, within the regions and in the Western Cape in particular, the CBT embarks upon its own communication campaign, regarding its strategy and the focus areas within which it is currently working.

Biowatch, a Cape based NGO focussed on the hazards of biotechnology, has issued several papers on the hazards of biotechnology and maintains a website informing the public of these hazards and other biotechnology related issues. Biowatch^{xii} South Africa “is a national non-governmental organisation dedicated to publicising, monitoring and researching issues of biological diversity, genetic engineering and sustainable livelihoods”.

AfricaBio^{xiii} another NGO represented in the Western Cape seeks to “promote the safe, ethical and responsible research, development and application of biotechnology and its products” and appears to function as a lobby for the industry.

9.6 GOVERNMENT

Government currently offers the sector a considerable number of choices in support programmes and initiatives. These initiatives are driven by a wide range of government departments, with the Department of Science and Technology (DST) providing and coordinating the bulk of initiatives. The DST is further supported by the National Advisory Committee on Innovation (NACI) and the still to be established Biotechnology Advisory Committee.

9.6.1 Department of Science and Technology:

Since the National Biotechnology Strategy was published in 2001 and the Biotechnology Advisory Committee was set up to advise the then Department of Arts, Culture, Science and Technology (DACST) on biotechnology, there have been a considerable number of government initiatives in Biotechnology. As mentioned previously, the three Biotechnology Regional Innovation Centres (BRIC's) that have been established are:

- BioPad^{xliii} based in Gauteng
- Cape Biotech Trust^{xxxix} based in Cape Town
- Lifelab / ECoBio^{xliv} based in Pietermaritzburg

Further to this a national biotechnology innovation centre exists, namely

- PlantBio located in Pietermaritzburg with an office in Cape Town

These are all supported by two special support organisations, namely:

- The National Bioinformatics Network^{xlv} with administrative centre in Cape Town
- Public Understanding of Biotechnology (PUB) based in Pretoria

All of these so called instruments have been established to channel public funds from the Department of Science and Technology (DST), through the various instruments into the industry and support regional or specific interest groups within the industry.

The DST has also produced a National Research and Development Strategy (NR&DS) in 2002 which creates a unified approach to research, including biotechnology research. Following on from this has been a technology roadmap published as "Biotechnology Platforms: A Strategic Review and Forecast"^{xlvi} which outlines technology focus areas for the biotechnology industry.

The National Advisory Council^{xlvii} on Innovation is an advisory body that coordinates and stimulates the National System of Innovation (NSI) and advises the minister on issues around innovation. The National System of Innovation is "a set of functioning institutions, organisations and policies which interact constructively in the pursuit of a common set of social goals"^x to enhance innovation in South Africa^v

A key part of the NSI is the National Research Foundation^{xlviii} (NRF) which was established "to support and promote research through funding, human resource development and the provision of the necessary research facilities in order to facilitate the creation of knowledge, innovation and development in all fields of science and technology, including indigenous knowledge and thereby

contribute to the improvement of the quality of life of all people of South Africa”x. The NRF is probably one of the most significant funders of biotechnology research in South Africa, using programmes such as THRIP and the innovation fund which has biotechnology as one of its focus areas. The NRF also funds the iThemba Labs in the Western Cape which are involved in radiobiology and may be included as a biotechnology research facility.

The DST, together with the dti, Department of Labour and European Union has established the GODISA fund which aims to stimulate the SMME sector through the provision of incubation facilities. In the Western Cape, Acorn Technologies is funded by GODISA and provides assistance to start-up in the biotechnology and medical devices sectors.

9.6.2 The Department of Trade and Industry (the dti)

The dti has established the Industrial Development Corporation (IDC) to fund industrial development requiring large capital expenditure. The IDC has been involved in supporting at least two biotechnology companies in South Africa and was one of the founders of Bioventures, South Africa’s only specialist biotechnology venture capital company. The dti also funds Trade and Investment South Africa (TISA) which, together with provincial agencies, co-ordinates export and investment opportunitiesx. The dti also runs Khula Enterprise Finance^{xlix} which provides wholesale access to finance for SMMEs; these funds may then be accessed by biotechnology companies meeting certain requirements. The department has numerous assistance programmes such as the Technology Transfer Guarantee Fund, which is used to provide loan guarantees to SMME’s for the acquisition of technology. Many of these programmes have either a technology focus or a SMME focus, both of which are applicable to most biotechnology companies.

9.6.3 Other Government Departments

Apart from the previous two departments mentioned, there are a number of other government departments which have a vested interest in the biotechnology sector. These departments include:

- The Department of Health
- National Department of Agriculture
- The Department of Environmental Affairs and Tourism: The Department of Environmental Affairs and Tourism (DEAT) drafts and implements legislation such as the National Biodiversity Act of 2004, which is of particular significance to biotechnology groups utilising indigenous resources. For many 1st, 2nd and 3rd generation biotechnology companies and research groups who make use of indigenous flora and fauna, these acts ensure a continued supply of raw material, bio-prospecting opportunities and raise certain hurdles in exporting products and technologies based on this indigenous flora and fauna.

- Department of Labour
- Department of Education
- Department of Finance

10 COMPETITIVE POSITIONING

The biotechnology sector offers a multitude of opportunities to both government and investors. Taking these opportunities and innovations and producing a social or financial return is however a risky and lengthy undertaking. In this section we will explore the factors that influence the sectors competitive positioning.

Studies performed by the Department of Trade and Industry in the United Kingdom have indicated that successful bio-clusters display the following attributesii:

- Strong science base: Leading research organisations, critical mass of researchers, world leading scientists
- Skilled workforce: Skilled workforce, training courses at all levels
- Ability to attract key staff: Critical mass of employment opportunities, image as biocluster, attractive place to live
- Entrepreneurial culture: Culture of commercial awareness and entrepreneurship, role models, 2nd generation entrepreneurs
- Effective networking: Shared aspiration to be a cluster, trust, frequent collaborations, trade associations, shared infrastructure.
- Availability of finance: Venture capitalists, business angels, government seed funding
- Premises and infrastructure: Incubators, premises with wet labs and flexible leasing arrangements
- Good transport links: Motorways, Rail, International airport
- Business support services & large companies: Specialist business, legal, patent, recruitment, and property advisors services
- Large companies in related sectors (healthcare, chemical, agrifood)

- Supportive policy environment: National & sectoral innovation support policies, and fiscal and regulatory framework
- Support from RDAs and other development agencies: Sympathetic planning authorities
- Growing company base: Thriving spin-out and start up companies. More mature 'role model' companies

These biocluster key success factors are directly applicable to the biotechnology sector of the Western Cape economy. The Cape Biotech Trust has compared the local sector's performance against these key success factors and the industry has performed poorly.

	Key success factors	Capability*	Summary of major gaps**
1.	Strong science base	Average	Comparable science base, but lower than average scientific output
2.	Skilled workforce	Below average	Shortage of skilled workforce, particularly business / technology cross-over skills
3.	Ability to attract key staff	Below average	Poor ability to attract & retain staff (brain drain, few biotech job opportunities)
4.	Entrepreneurial culture	Below average	Lacking entrepreneurial culture
5.	Effective networking	Below average	Research culture is not collaborative and local companies have below average collaboration levels. Cluster awareness & culture is in its infancy.
6.	Availability of finance	Poor	South Africa ranks somewhat weaker than its peer group in availability of seed and venture capital funding.
7.	Premises and infrastructure	Below average	South Africa does not rank well in general infrastructure.
8.	Business support and large companies	Below average	Lacking in highly specialised business support (biotech IP) & large, biotech-related companies (e.g. large pharma R&D)
9.	Supportive policy environment	Average	Government seen to have good intentions, but lacking in execution of policy.
10.	Growing company base	Poor	New company growth rate is reasonable, but is starting off a very low base.

Figure 13 The South African Biotechnology industry as compared to the global industry ⁱⁱ

The Western Cape does not seem to be above average on any of the success factors as can be seen in Figure 13.

10.1 SUCCESS FACTORS

The Cape Biotech Trust identified the following detailed issues in their competitiveness surveyⁱⁱ which also would apply to Plantbio initiatives in the Western Cape.

Strong Science Base

- Some strong science, but projects & scientists are too fragmented. There is insufficient collaboration among scientists and institutions. There is a poor research utilisation culture that is introspective with individual agendas opposed to commercial orientation.

- The Cape has very few world-leading scientists, despite the fact there is a high concentration of researchers in the Western Cape, especially in plant biotechnology
- Researchers are spending too much time teaching and on administration
- Scientist working conditions are not of a sufficiently high standard; remuneration is lacking, there is generally a working environment that only covers operating costs
- Research funding is provided in sub-optimal amounts. Scale of research groups are sub-critical
- Researchers are evaluated on publications, etc. but not on commercialisation, although this is set to change as the government addresses its strategy to improve research utilisation
- Insufficient grant funding is available for research work being conducted within companies, although significant progress is being made in this area with large amounts of funding starting to be committed for the 2005/6 financial year
- Insufficient use of international funding opportunities (e.g. USA's NIH, NSF, Dept of Defense, etc.). This needs to be addressed in future.

Availability of finance

- Insufficient funding to get biotechnology research into commercial phase. Not enough pre-proof of concept and seed funding. Development phase seems to be neglected in terms of financing.
- Long turn-around time of funding is a problem. Funding is cumbersome, difficult, and inefficient.
- Confusion between Innovation and BRIC funding. They occupy same space in value chain.

Skills - Technical & Business

- Commercial - science cross-over skills are hugely lacking, which is having a significant impact on the industry.
- Lack of skilled workforce to support emerging industries (even when working on 3rd world diseases, we will require overseas development, manufacturing and commercialisation skills)
- Lack entrepreneurial culture. It is the way we teach scientists.

Networking and Communication

- There is a big de-link between industry and research. Have persistent culture of non-collaboration.
- Low level of communication by CBT to the community on its vision and financing instruments.
- Many researchers are not aware of incubators and their support services.
- South African biotechnology is not promoted / branded overseas.
- Afro-pessimism is a big hurdle to overcome in the global arena.
- South Africa is too low down in the value chain. For example researchers have lots of tissue samples, but are not doing the value added research thereafter.

Infrastructure for biotechnology development

- Sharing of equipment and technologies is a big problem. Universities are not helpful.
- Current equipment is becoming antiquated. Lacking good quality technology platforms.
- SA is not currently in a position to be able to build large scale manufacturing facilities.
- The BRICs are not functioning the way they were intended to. They should fund pre-competitive R&D institutes and there should be more integration between BRICs and incubators.

Ability to attract key staff

- Insufficient job opportunities.
- Too few post-doc opportunities.

Commercialisation

- Lack of managing IP and funding of IP protection. Protect technologies too soon. Insufficient understanding of IP issues among scientists.
- Technology Transfer Offices (TTO's) are reactive and do not play a significant role in promoting development. They do not empower scientists to commercialise. Scientists lack business / commercialisation support.

- TTOs are cost centres with little chance of making returns. Internationally they have low or negative returns.
- TTOs are too un-entrepreneurial themselves. Need different/better people.
- South Africa has a higher than average deal transaction cost (contracting, long due diligences, poor IP management).

11 GROWTH PROSPECTS IN THE BIOTECHNOLOGY SECTOR

With approximately 400 research groups, world class universities, a good supplier base and government support, the biotechnology sector in the Western Cape is well positioned for growth. The growth challenge faced by the sector is how to move biotechnology out of academia and into a commercial setting where self sustaining job and wealth creation can take place.

11.1 GROWTH OUTLOOK – MEDIUM TO LONG TERM FORECASTS

Medium to long term growth forecasts for technology based industries are notoriously unreliable however; it is informative to look at how similar industrial clusters in other parts of the world have performed. Both Israel and New Zealand have developed biotechnology industries off a similar base to that in the Western Cape. Israel has seen a 27% per year growth rate while New Zealand has seen a 15% growth in exports while global biotechnology growth is estimated to be 12% per yearⁱⁱ. If these figures are used to extrapolate the national biotechnology industry turnover figures to 2014, the industry is likely to have a turnover of R1 billion per year in conservative case and up to 4 billion Rands in an optimistic case (Figure 14). The portion of this attributable to the Western Cape is unknown however given that 37% of biotechnology firms are based in the Western Cape; it is not unreasonable to assume that a similar proportion may be attributable to the region.

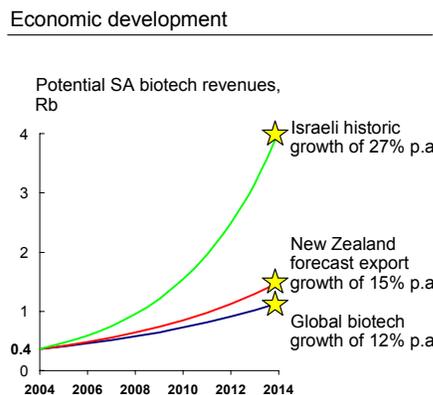


Figure 14 Extrapolated Biotechnology Revenues for South Africa ⁱⁱ

Notwithstanding these projections, it should be realised that if one or two small companies are able to commercialise products with global demand, they are either likely to push revenue far higher or realise multi billion revenues due to the sale of their companies, as was the case with Mark Shuttleworth's sale of his IT company Thawte. Biotechnology is a high risk – high return sector with returns typically requiring greater than 5 years of investment¹.

11.2 TRENDS IN THE SECTOR GROWTH

The biotechnology sector nationally appears to be in a rapidly evolving stage, with industry reports listing two new companies established nationally each year since 1992ⁱⁱ. In the Western Cape there is no quantitative evidence to support this growth rate. Between the National Biotechnology Survey of 2003^x and the Cape Biotech Strategy Reviewⁱⁱ of 2004, the reported company numbers have remained constant. Our research, even allowing for differences in definition of a biotechnology company, identified similar numbers. Anecdotal evidence suggests that this apparent stasis is due to a mixture of new entrants, exiting companies and companies shifting their focus from biotechnology.

To further complicate matters, biotechnology in the Western Cape is represented by two structures. Cape Biotech represents biotechnology regionally but excludes plant biotechnology which is represented nationally by PlantBio. As a result plant biotechnology goes largely unnoticed in many reports on biotechnology in the Western Cape.

Interviewees however reported that trends in the following areas might contribute to the development of the industry - medical devices, enzyme production and bioprospecting.

11.3 FUTURE AREAS OF FOCUS

The Cape Biotech Trust has, through a highly structured and objective processⁱⁱ, identified five high level goals for the sector. These goals effectively take advantage of the major opportunities in the sector.

- Partially develop and license novel natural NCEs to address the key health challenges facing South Africa and developing nations by systematically creating an extensive medicinal compound library from South Africa's rich biodiversity.
- Develop and manufacture novel, cost-effective, easy-to-use, point-of-care diagnostics for major developing world health issues which are relevant to South African society.
- Develop niche market therapeutics with affordable drug delivery platforms and generic actives to improve the effectiveness of treatments for first and developing world diseases of relevance to South Africa.

- Promote nutraceuticals industries in the Cape that utilise biotech processes to create employment and export revenues through products which address healthcare and nutritional deficiencies in South Africa and the developing world.
- Conduct end-to-end development of medium-cost and volume therapeutic and prophylactic vaccines to address the key health challenges facing the South African people and developing nations.

12 PRELIMINARY RECOMMENDATIONS

The following preliminary recommendations could be considered in terms of further research and initiatives to be undertaken:

- A survey of Western Cape biotechnology organisations, with respect to funding revenue contribution, employee numbers and growth, and planned growth needs to be undertaken more frequently, say every two to three years, as the number of core biotechnology companies is not currently known, and reliance is currently being placed on the NBS conducted in 2002.
- An inventory of patents needs to be developed in the Western Cape and revenues generated from the same tracked on a planned against actual basis.

These are important indicators that need to be monitored and tracked to establish the progress over the planning periods for regional development, and the CBT and PlantBio could in future play an important role in facilitating the measurement of the rate of development and the realisation of the expected investment returns.

The National R and D Strategy and the National Biotechnology Strategy are largely as policy documents rather than strategies as they have content that has longevity and less emphasis on strategic objectives and initiatives. The establishment of the biotechnology industry is therefore driven by these policies and the execution thereof needs to be formulated into a more definitive strategy for the Western Cape Province.

- For the biocluster to develop effectively, specific skills development targets would need to be established around a wide range of training requirements that need to be developed by firms in the Western Cape biocluster.
- No current quantitative data documenting skills demand (vacant, funded positions) and skills supply (qualified staff, unemployed or working out of the sector and wishing to gain access to the sector) exists

- Tailored short-term or modular courses aimed at specifically imparting business skills to innovative scientists would benefit not just the biotechnology sector, but also the wider science community. The existing science courses can also be enhanced by involving international experts on the curriculum course panels
- no central portal or service providing search and recruitment services to the industry
- as there are currently no export incentives aimed specifically at the biotechnology industry incentives could further motivate firms to promote their IP and products in foreign markets
- create a residency programme which will allow experienced foreign biotechnology executives from abroad to live in Cape Town and assist start-ups and Cape Biotech.
- create a residency programme for foreign biotechnology executives as well as motivating South African experienced Biotechnology practitioners currently working abroad to return and invest in their knowledge in South Africa and the Western Cape.
- include visits to biotechnology companies and facilities when planning the itineraries of visiting trade delegations or industry bodies so as to create foreign awareness of the sector.
- Most “representative bodies” have little or no industry representation and are overweight in academics and government representation. This lack of commercial experience will undoubtedly hamper the development of a sector that is able to compete effectively without ongoing government support.
- establish an independent TTO / ‘one-stop shop’ for startups offering services such as business, legal and IP support. An example of such an organization is the Unistel structure at the University of Stellenbosch.
- investigate the ability to secure some fraction of the Public Investment Commission fund of R309bn, to be reallocated to biotech as a higher risk, high return investment.
- promote networking in the sector by actively addressing the culture of non-collaboration in research with specific relevance to competition for funds. Structure funding to incentivise collaboration, avoiding duplication and fast-track research.
- More optimised leveraging of available infrastructure and laboratory facilities from the tertiary institutions in the Western Cape could benefit all the players. Optimal capacity loading and utilisation of the facilities will be beneficial.

These are the main initiatives that need to be considered to develop the biotechnology sector in the Western Cape that would eventually contribute to the higher level performance indicators of the sector growth in the province.

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