Western Cape Government

Water infrastructure and opportunities for agriculture and agri-processing in the Western Cape

June 2015

(Note that the views expressed reflect the views of the contributors. These views do not reflect those of any particular organisation or government department.)

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1. Introduction

Western Cape Government policy lever: Develop new water infrastructure /opportunities for purposes related to agriculture in the Western Cape.

Across the board, exports from the Western Cape to Africa were valued at R4.2bn in 2012 compared to R3.7bn in 2011, increasing by 14%, while imports were valued at R271m in 2012 compared to R161m in 2011, increasing by 68% from a low base. Southern African Development Community (SADC) has been the largest African region for Western Cape exports of food and beverages. Fresh apples, pears and quinces were the leading export products from the Western Cape to Africa valued at R793m followed by grape wines (R486m) and fruit and vegetables juices are valued at R411m (WESGRO,2014:3).

This report sets out to broadly indicate the water opportunities that might be available for expanding agriculture, where that expansion does not necessarily indicate a substantial increase in hectares. This expansion of agriculture might take the form of increased yield, where experts in the industry indicate that this necessitates increased levels of water. The exact correlation between increased yield and water consumption needs to be further explored.

Furthermore, this study sets out to investigate some identified sectors of agriculture and agri-processing, where it is considered that there is growth potential. The irrigated crop area for fruit and pasture has been evaluated for water use by crop type, as this is an important aspect of considering current water use in the agricultural sector in different regions. Further discussion and mapping will then be required at a local regional level to understand the demands on available water and the opportunities, often innovative, for further water provision for agriculture and agri-processing.

It is useful to begin by defining ***agri–processing*** as "a set of technological and economic activities undertaken on a basic agricultural product with the aim of transforming it into a usable item such as food, fibre, fuel or industrial material" (Cohen et al, 2013)

The study by Cohen et al, 2013, outlines uses of water in the agri-processing sector as including:

- product inputs, where high quality water is required to ensure product standards are met;
- equipment cleaning, where high quality water is needed to meet health requirements;
- washing and rinsing of fruit and vegetables;
- conveying of produce;
- steam generation in boilers;
- product cooling; and
- general cleaning –lower water quality can be used.

2. Agri-processing game changer: water

Project Khulisa is one of five "game changers" that were identified by the Western Cape Government for priority focus to drive economic development. Agri-processing was selected as one of the key sectors because of its high potential for economic growth as well as job creation within the next three to five years (McKinsey report). Water has been identified as one of the key enablers for agri-processing and this report aims to provide an overview of the water situation and future potential as it relates to agri-processing In the Western Cape. This focuses on the 10 priority agricultural sectors/products identified pork, beef, wine, brandy, yoghurt, fruit juices and olive oil, essential oils, cosmetics and cereals. This report focuses on the first eight sub sectors. With regards to the cereals sub-sector only one facility has communicated the current water-use for an agri-processing facility. This amount is 66 252 m^3 per annum.

In a report by the Department of Water and Sanitation (DWS) on *the Assessment of the Ultimate Potential and Future Marginal cost of Water Resources in South Africa*, 2010, it is recommended that further studies be conducted into the value of water in different sectors and uses, to inform the possible re-allocation of resources. Social, political and strategic aspects must be considered together with the economic value of water, and it was recommended that a national strategy be developed on the preferential utilisation of the country's water resources, including guidelines on what products should be produced/grown in South Africa, and what products could or should rather be imported and thereby saving large quantities of precious water in South Africa, without imposing any unwarranted risks.

Considering the different water reconciliation strategies (WCWSS & All Towns study) that have been developed by the DWS, it becomes clear that surface water resources have for the most part been fully allocated and utilised in the Western Cape and that there is limited potential for further surface water development. Major water infrastructure projects such as the raising of the Clanwilliam Dam wall and the Brandvlei Dam system infrastructure changes have been considered, but due to the lengthy time scales involved in finalizing and completing such projects it is unlikely that they will make more water available and benefit the economy within the target period of this game changer. (B van Zyl, DWS, personal communication, 2015) It should however, be kept on the agenda for longer term planning as it has the potential to stimulate significant growth in the sector in future.

The full allocation of surface water, together with the uncertainties related to climate change, make it very clear that any future expansion/growth of agricultural production and/or agri-processing cannot rely on surface water sources, but will have to explore additional sources of water. Furthermore, in thinking of water quality for agriculture, the positioning of ecological infrastructure, such as wetlands becomes important.

Therefore, this report also considers the potential to use groundwater, the re-use of treated wastewater and/or the replacement of irrigation water with treated wastewater in favour of this water (surface water for irrigation) being used for agri-processing (subject to food safety requirements). The desalination of seawater is another option that will have to be considered for future water security for the Western Cape and it has been stated that the greater Cape Town area is likely to become totally dependent on the desalination of seawater and the re-use of water for any growth in water requirements from about 2030. Due to the high cost of desalination of seawater its potential for use in agricultural applications may be limited. The cost of the desalination process is linked to the availability and price of energy sources.

3. Water sources that are potentially available for agriculture in the Western Cape

3.1. Back ground information on the availability of additional water for agriculture

This action has investigated if there will be water available for the proposed expansion of the agri-processing sector over the next five years and where this water will be available.

3.2. Methodology for assessing the availability of further water for agriculture

A database indicating the water balance of the municipal water supply per town was sourced from Umvoto Africa, a service provider for the Department of Water and Sanitation, as well as the same department's "The development of reconciliation strategies for all towns in the southern planning region", 2011. This database indicating the municipal water supply balance was pulled into a GIS and displayed on a map, shown in figure 3.5.

A database on the wastewater treatment works (WWTW's) in the Western Cape was compiled to determine the probable availability of treated sewage effluent (TSE) as an additional water use. The volume, availability and quality of TSE were also placed on the same map in figure 3.5.

3.3. Shortcomings of the compilation of the water balance and the potential availability of water from treated sewage effluent:

- To complete the understanding of possible water sources, the Groundwater Stress Index database of the Department of Water and Sanitation also needs to be overlain with the abovementioned two databases. This will provide information on the potential availability of groundwater.
- Further verification of the WWTW database is required.
- An industrial effluent database for potential irrigation water sources needs to be generated for the Western Cape, e.g. wineries, fruit processors etc. The Department of Water and Sanitation is a source for this information.

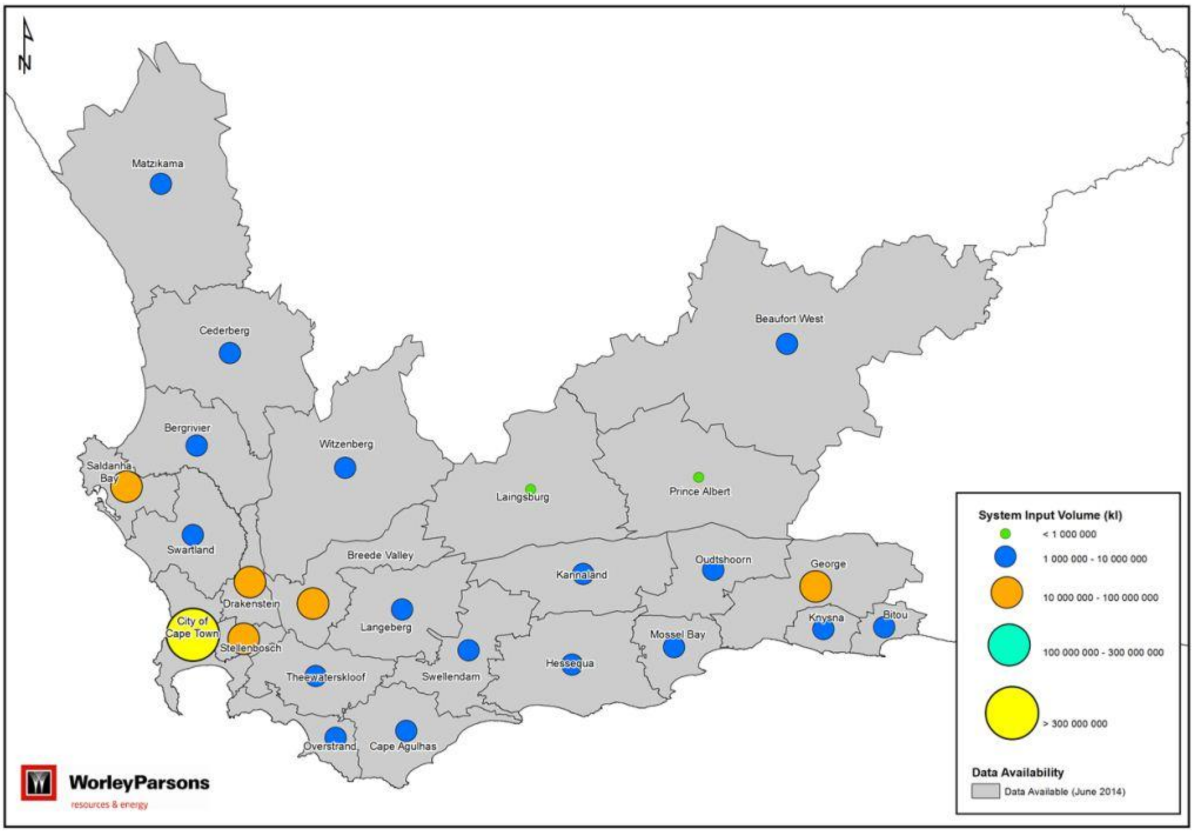


Figure 3.1: Water consumption amounts (1kl = 1 m^3) in the Western Cape (Umvoto; Worley Parsons; DWS, 2014)

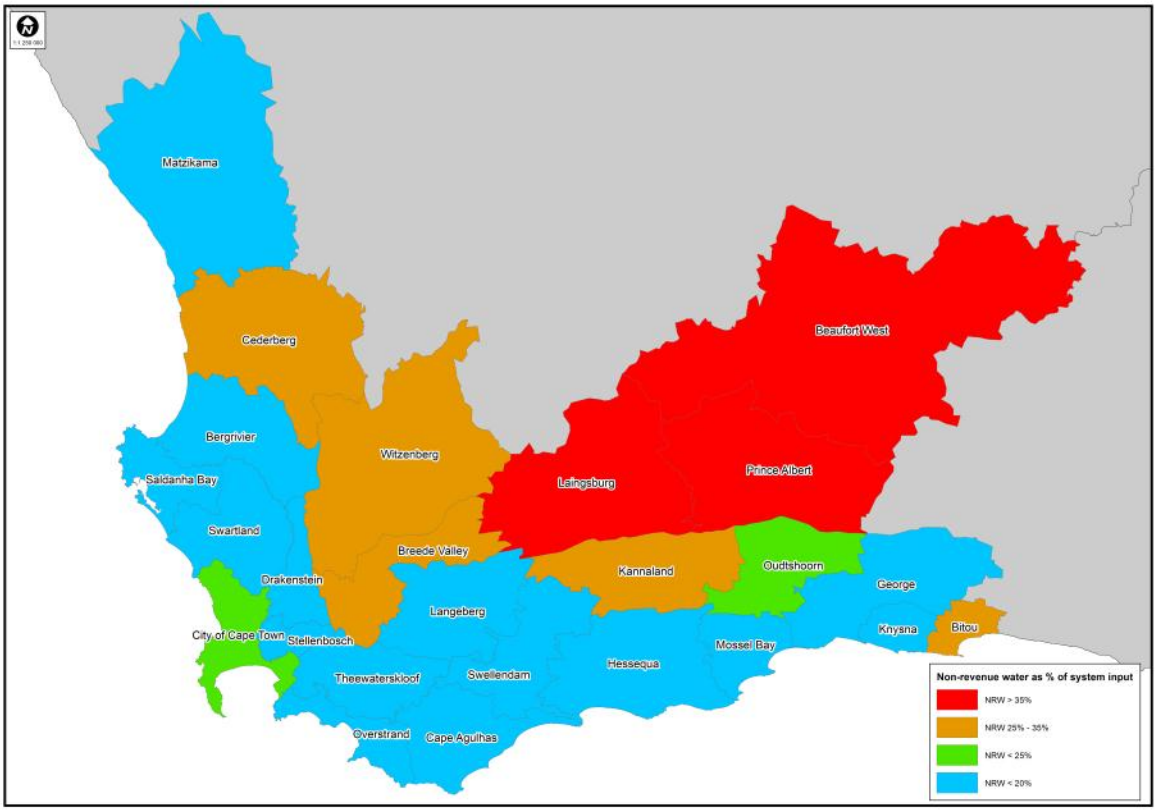


Figure 3.2: Non-revenue water consumption in the Western Cape (Umvoto; Worley Parsons; DWS, 2014)

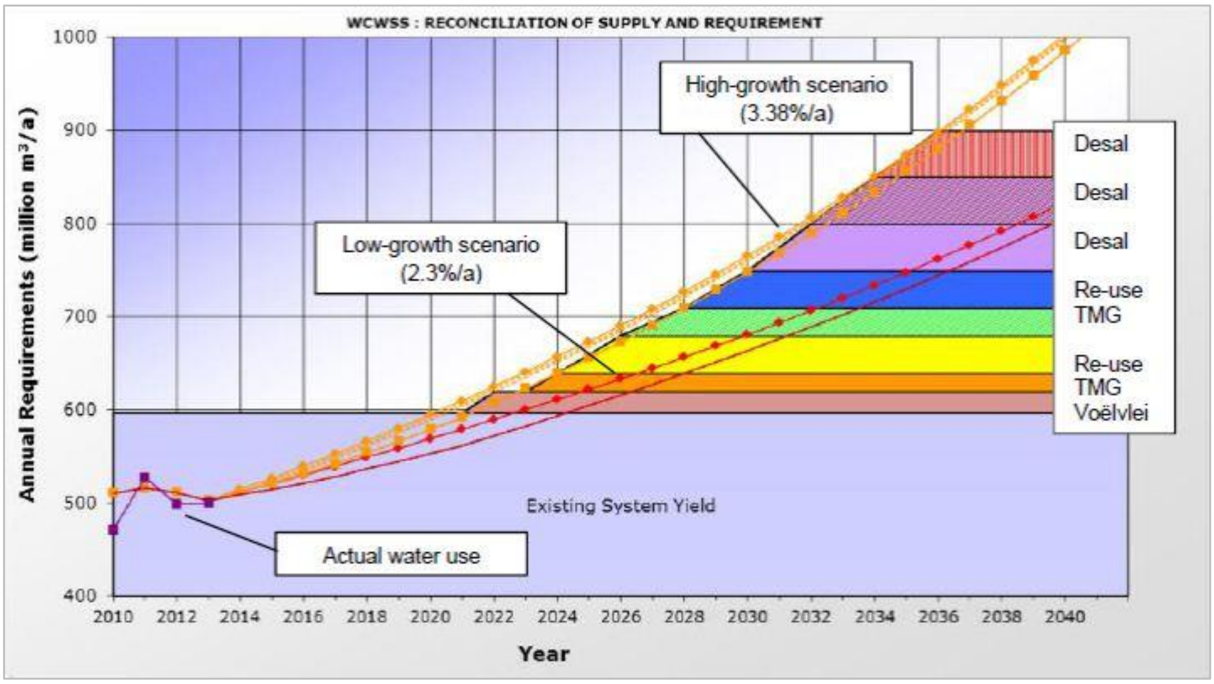
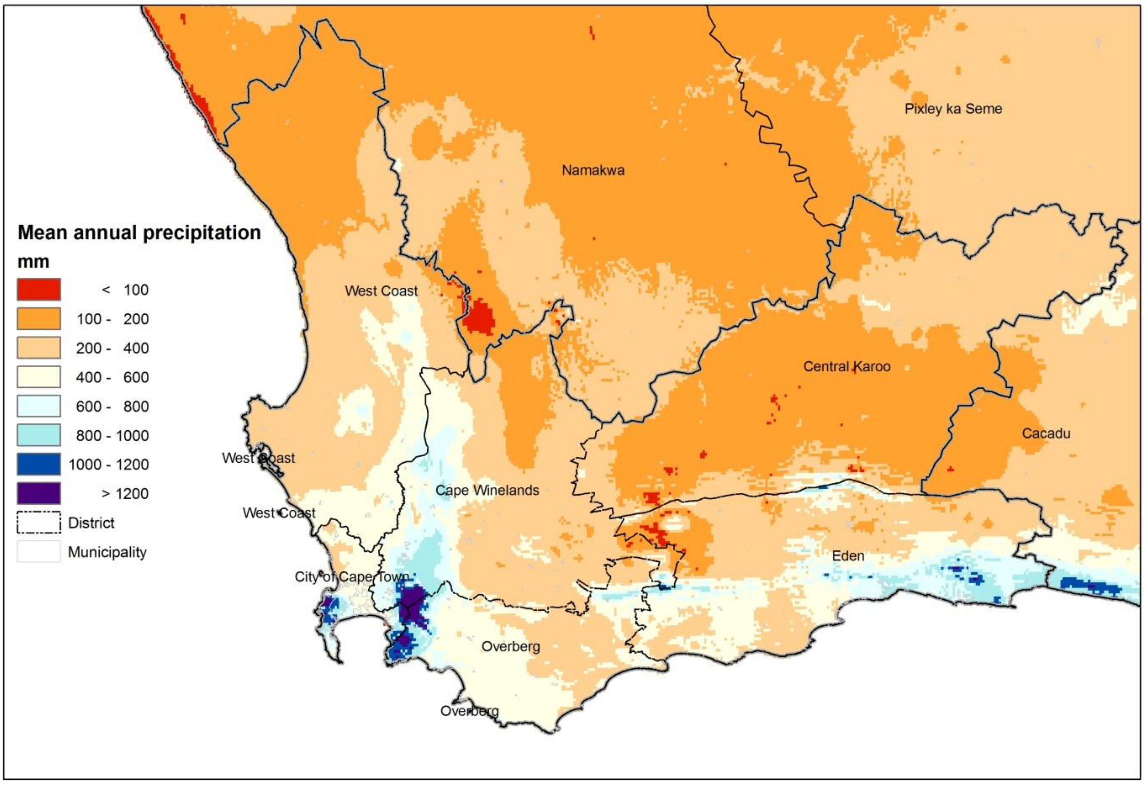


Figure 3.3: The Western Cape Water Supply System (WCWSS) requirement, given different growth scenarios



Schulze, R. E., Lynch, S. D., 2006. Annual Precipitation. WRC Report 1489/1/06. Water Research Commission, Pretoria, South Africa, Ch. 6.2.

Figure 3.4: Mean annual precipitation for the Western Cape, using data with more than fifteen years of records

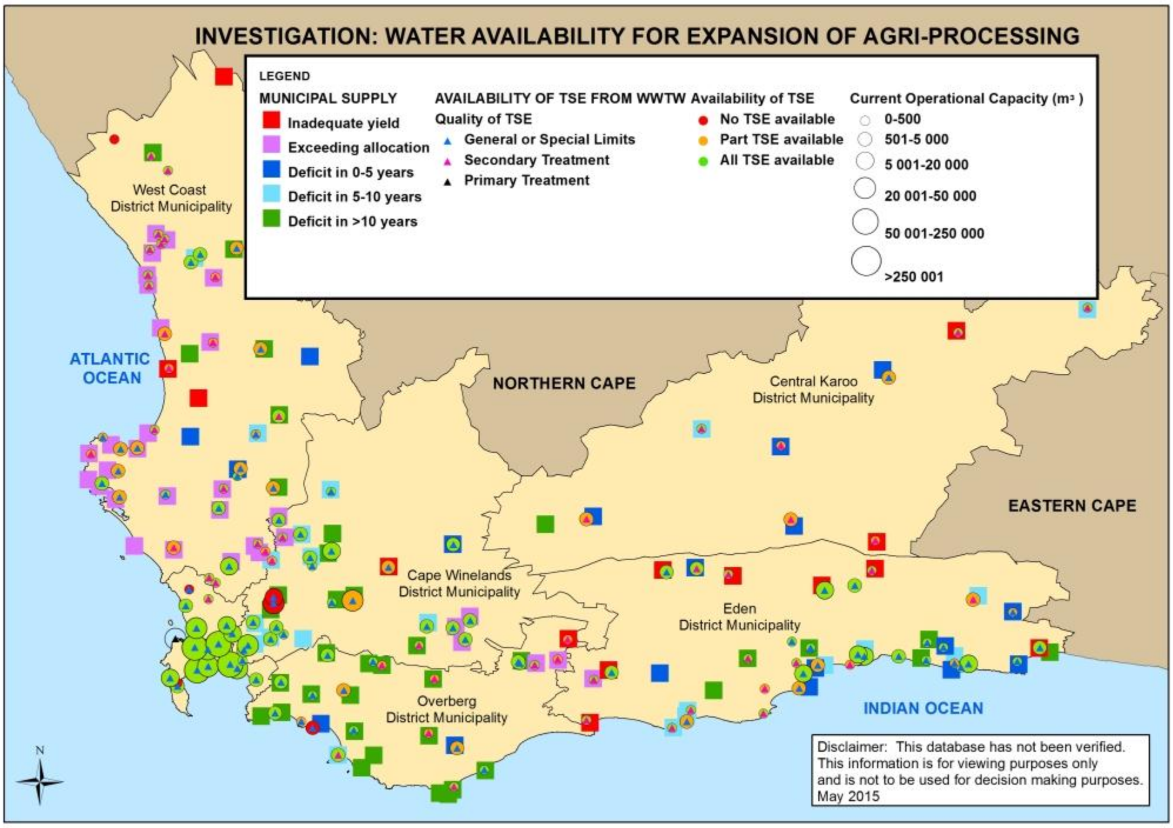


Figure 3.5: The potentially available municipal water supply (based on information from Umvoto; Worley Parsons; DWS, 2014) and treated sewage effluent from waste water treatment works (DEA&DP, 2015).

3.4. Conclusions on the availability of additional water for agriculture in the Western Cape

Geographic Information Systems (GIS) can be effectively applied as a decision-making tool for determining water availability and establishing areas suitable for expansion of agriculture/ agri-processing. The final decision is however subject to an in-depth investigation on the specific water sources/resources and the water use authorisation process in terms of the National Water Act, 1998 (Act 36 of 1998) if required. Further detail, e.g. current fruit processing factories, abattoirs, can then be added to the database to enable decision-making.

- Figures 3.1, water consumption amounts and 3.2, non-revenue water in the Western Cape, provide an overview of these parameters based mostly on river surface water and water from large dams, so that this does not reflect the total water supply source for the Western Cape.
- Figure 3.3 is included as the Western Cape Water Supply System (WCWSS)[2] requirement chart for water quantity, which provides a point of reference for

[2] The WCWSS is the Western Cape Water Supply System comprising of an interlinked system of 6 dams (Theewaterskoof, Wemmershoek, Steenbras Upper & Lower, Voëlvlei and Berg River Dams) pipelines, tunnels and distributions systems.

different growth scenarios. Note that it indicates that ground water, namely the Table Mountain Group aquifer, and reuse of treated waste water are options to be considered before desalination. As the WCWSS does not include the extensive use of agricultural water, beyond what is allocated from the larger Department of Water and Sanitation (DWS) dams the report attempts to look in its recommendations to agriculture at the wider sources of water such as precipitation and ground water availability and quality.

- It is clear in figure 3.6 that even if the percentage of non-revenue water is high in some of the smaller municipalities (e.g. Laingsburg and Beaufort West), the Cape Town metropolitan area and the larger municipalities (Breede Valley, Stellenbosch and Drakenstein) account for by far the largest volume of non-revenue water. Interventions in these larger municipalities in reducing losses would be most effective in overall reduction of non-revenue water and this would improve water supply.

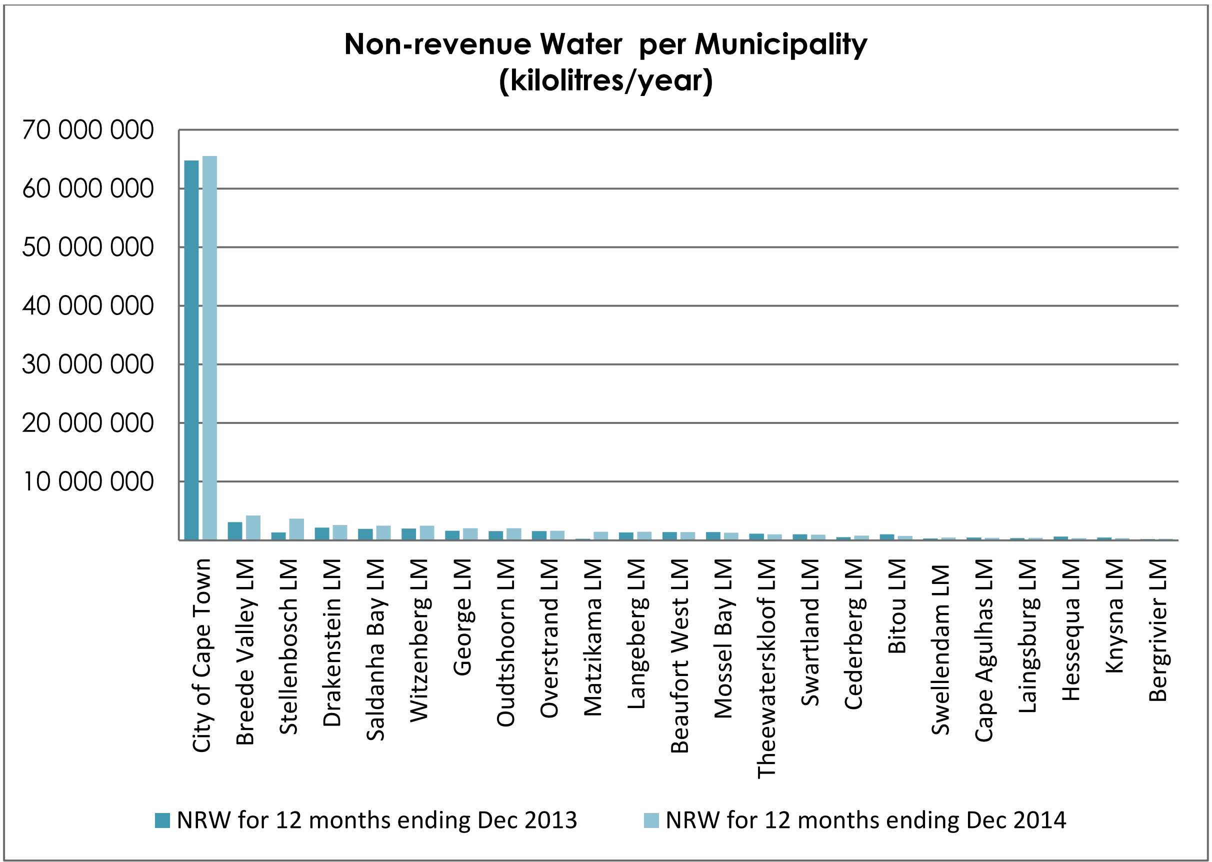


Figure 3.6: Non-revenue water per municipality (Worley Parsons on behalf of DWS, 2015)

The map, figure 3.5, which is an investigation for the water availability for the expansion for agri-processing shows:

- that there is an inadequate yield, and exceeding of yield, particularly in the West Coast District and parts of the Eden District municipalities.
- potentially that if the treated sewage effluent (TSE) around Cape Town is used then this could alleviate the pressure on potable water.
- similarly that there is the capacity for treated sewage effluent to be used along the coast of the Eden District, which would make more water available for the northern part of the Eden District municipality.
- that in the Overberg District there will only be a deficit in greater than ten years. The explanation for this is that the municipalities are using ground water to increase the availability of water.

4. Groundwater for agriculture and agri-processing, Western Cape

The importance of groundwater resources in the country and the role they will play in satisfying current and future water demand is indisputable. As a result, exploration, development and protection of aquifer systems have received attention. Provision of the appropriate information to national water resource managers and planners is a critical part of the process which aims to provide a further twelve million people with adequate access to potable water (Groundwater Quality of South Africa, 2012).

Figure 4.1 below was constructed by the former Department of Water Affairs (DWA) in 2012, and originally indicated the groundwater quality of South Africa, but has been edited to highlight the Western Cape Province. Blue to red in the legend of the map represents increasing levels of salinity.

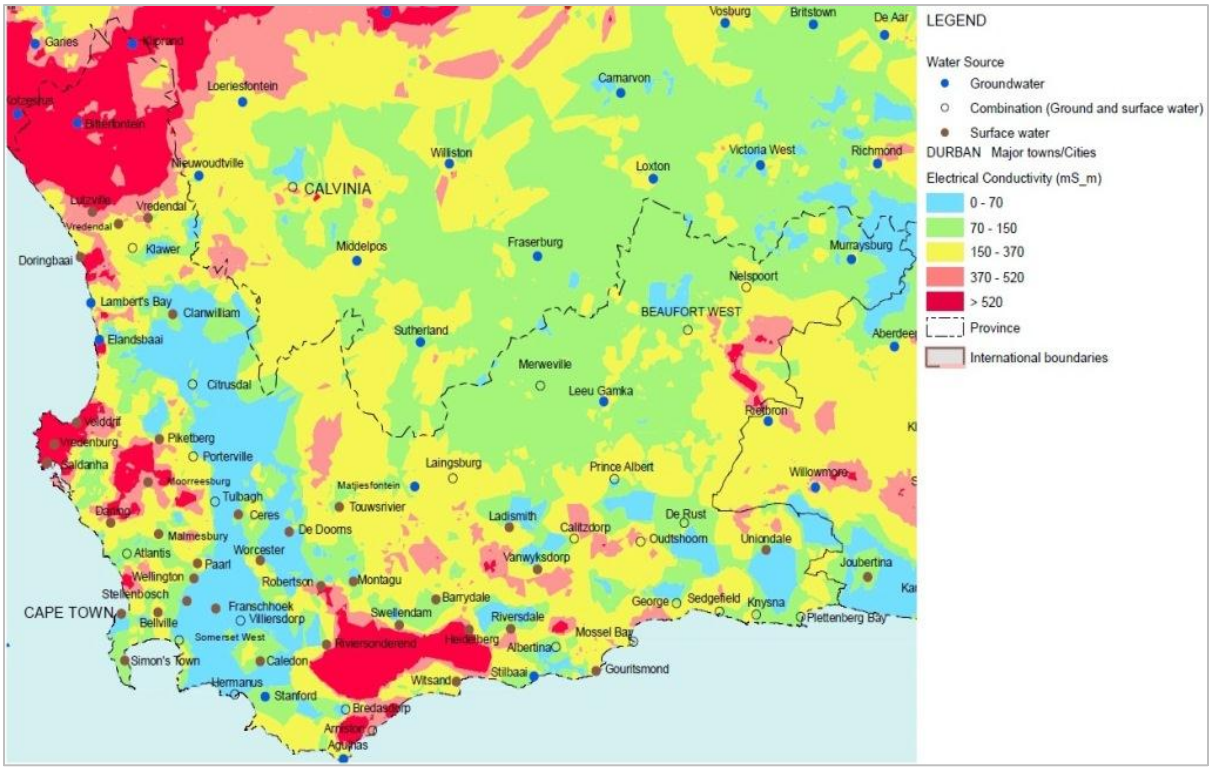


Figure 4.1: A portion of the map Groundwater Quality of South Africa produced by the Department of Water and Sanitation (former Department of Water Affairs with data provided by Murray R *et al* (2012).

Additionally, the map specifies where groundwater, surface water and a combination of both is utilised over the Western Cape. A more recent groundwater quality map indicating groundwater quality monitoring graphs for the Western Cape region has been produced by the Department of Water and Sanitation (DWS) dated February 2015. The detailed mapping shows the electrical conductivity over the region and show broad trends in groundwater quality using data from the National Groundwater Quality Monitoring Programme. Furthermore, the National groundwater monitoring sites are displayed linked to groundwater quality graphs which represent data from 1994 to 2013/2014.

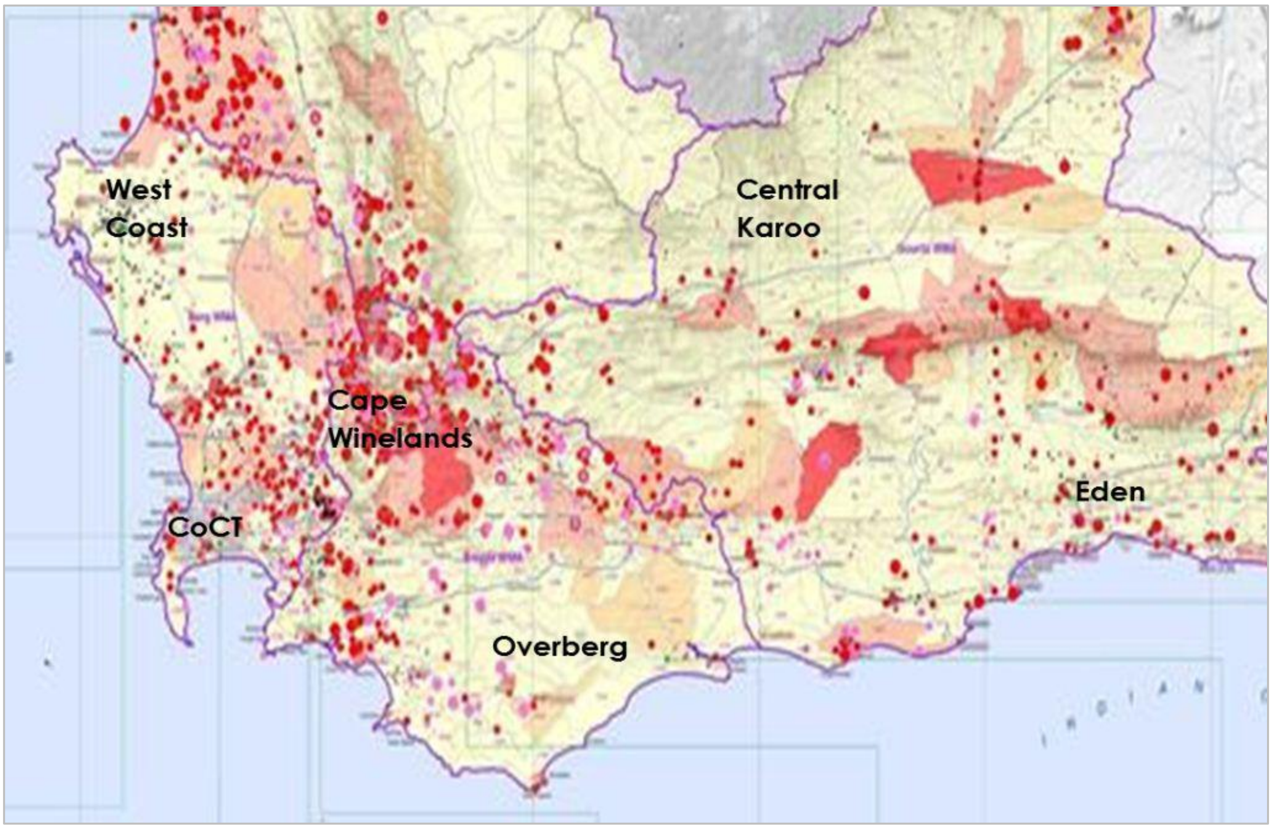
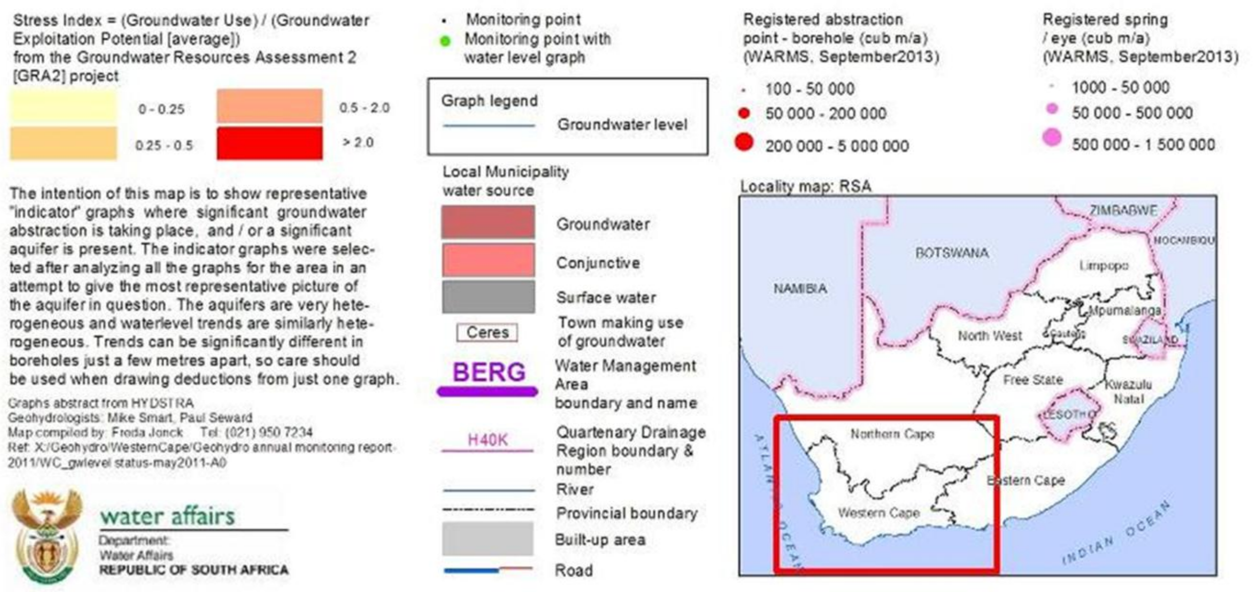


Figure 4.2: Adapted from the map Indicator Groundwater Monitoring Graphs and Groundwater Stress Index – Western Cape Region, 2011, Department of Water and Sanitation. Note: Note the purple demarcations are catchment management areas, not district municipalities.

Legend



The areas of groundwater stress are indicated in Figure 4.2 on a scale of 0 to 2, with increasing groundwater stress levels, as shown in the legend. This will be referred to in the recommendations of this report as regards the potential for water use for agriculture and agri-processing in the various district municipalities of the Western Cape. The registered boreholes are shown indicating the water that is currently being drawn off from ground water sources. It is important to note that this does not represent the full extent of water abstraction from groundwater as there are boreholes which are not registered.

Pertaining to agri-processing expansion, there is a possibility of utilising groundwater as a fit-for-purpose and/or alternative water source for the agri-processing industry. It should be noted that the way forward in this regard is to identify the general water quality as sampled, analysed and mapped by DWS officials and researchers. Subsequently, site-specific sampling of boreholes or wells should take place to explore the viability of groundwater use and identify the water quality and yield within the vicinity of agri-processing facilities. The samples would be analysed for its mineral content and water quality verified to ensure that it meets the regulatory requirements for the specific industry.

Furthermore, groundwater may also contribute to the additional water supply that would be necessary to increase production of raw materials (crops or animals) within the resultant agri-processing industries. Research on groundwater use and the importance of water quality used for poultry production in the Western Cape have been completed by Coetzee et al, 2000. In the report, the Western Cape region west of the Hottentot Holland mountain range is defined as a highly urbanised and industrialised area that is farmed intensively. The potentially precarious water supply and the high demand for water for the urban areas, industry and agriculture has caused many producers to rely on, or supplement, their water from subterranean sources (Coetzee et al, 2000). The need for a site-specific ingestion based approach to determining water quality guidelines for livestock is highlighted. Suitable groundwater that adheres to these guidelines may be available in certain areas and can lead to future water security for selected industries.

The monitoring of groundwater quality and the management of the aquifer systems are integral to ensuring successful utilisation for further growth in agri-processing within the Western Cape.

5. Irrigated Agricultural sectors in the Western Cape: Fruit and Pasture

5.1. Background to irrigated agricultural areas in the Western Cape:

The water use for different irrigated fruit crop types and pasture are analysed for the Western Cape in this section, both geographically in terms of local municipality and according to the crop types. The numerical analysis that follows on irrigation in the Western Cape is driven by the hectares covered by different crops from the Department of Agriculture Aerial (DoA) census of 2013.

5.2. Methodology for assessing the water use for irrigated fruit and pasture:

The hectares of the irrigated agricultural areas for fruit and pasture for the different local municipalities were obtained from the DoA Aerial Census, 2013. These areas were then multiplied out by the net irrigation requirement (NIR) in mm, which is obtained from the evaporation* crop factor – effective rain. The evaporation and effective rain are obtained for a given local municipality using the average of several years' worth of data for the weather station in that local municipality. In the case that there is not a weather station available for a given region, the closest and most appropriate weather station is used. In some cases there are more than one weather stations available, in which case the appropriateness of the station particularly in relation to the altitude has been considered.

The NIR is worked out monthly as the weather factors differ at different times of the year as do the crop factors and are then averaged for the years selected. These averages are then added to give the average annual NIR. The crop factors are specific to each crop type.

5.3. Findings for irrigated crops in the Western Cape:

When considering the irrigation of fruit in the Western Cape wine grapes dominate the use of the water at 54%, followed by pome fruit, consisting of apples and pears at 16%, and stone fruit, which includes peaches, apricots and olives at 11%. The lower end of the water use relates to early fruit, as opposed to late fruit irrigation and sub-intensive grape irrigation, both of which use less water for irrigation.

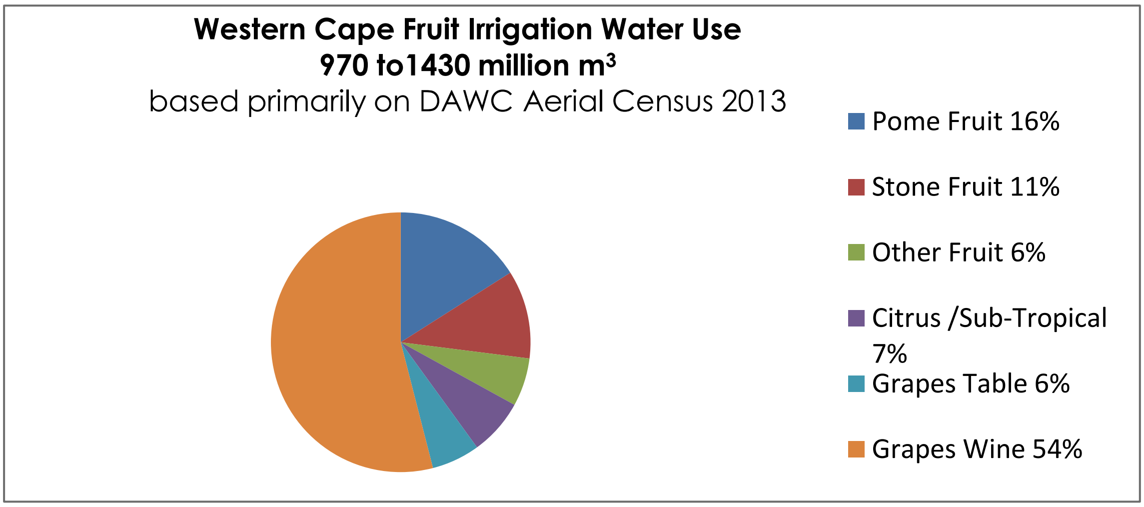


Figure 5.1: Western Cape Fruit irrigation Water Use

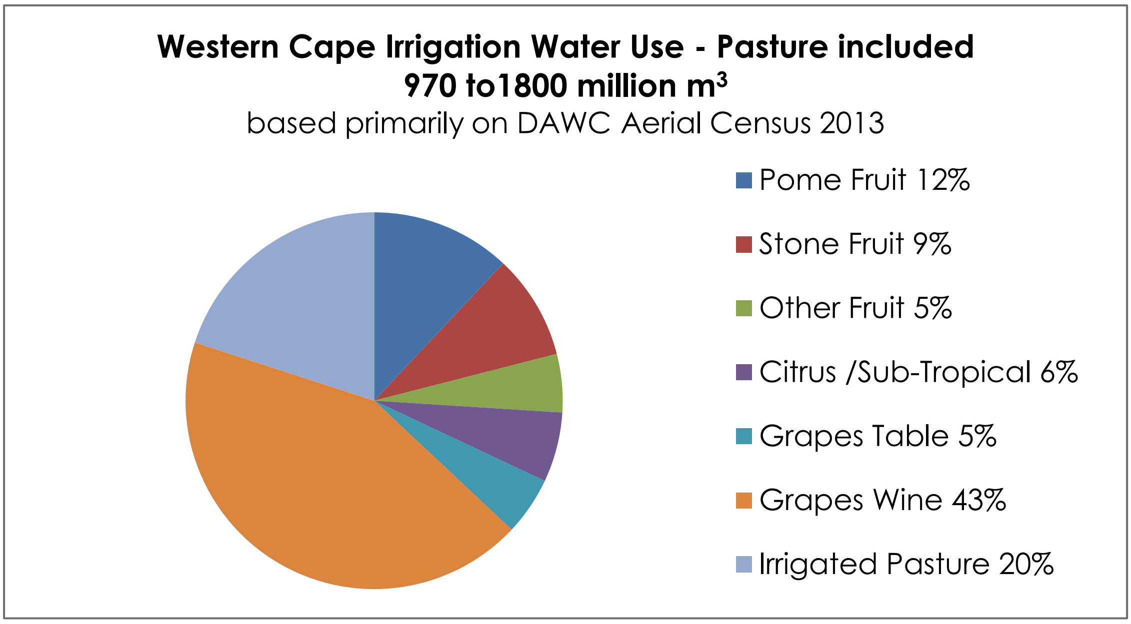


Figure 5.2: Western Cape Irrigation Water Use – Pasture Included

Once the irrigated pastures have been included the picture changes, as the irrigated pastures represent 20% of the irrigated volume. This analysis then graphically presents the water use by irrigated crop type, including pastures, within the local municipalities for the six different districts within the Western Cape to determine the drivers for water use geographically.

Firstly it can be seen that water use for wine grapes is dominant within all the local municipalities of the Cape Winelands District, with the exception of Witzenberg where water use for pome fruit is the highest. It is also in the City of Cape Town where the water use for wine grapes dominates. In the West Coast District in the Swartland and Matzikama Municipalities the water use for wine grapes is the highest, while irrigation for citrus leads in the Cedarburg.

Figures 5.3 to 5.8 showing irrigated crop water use in the Western Cape, by municipality:

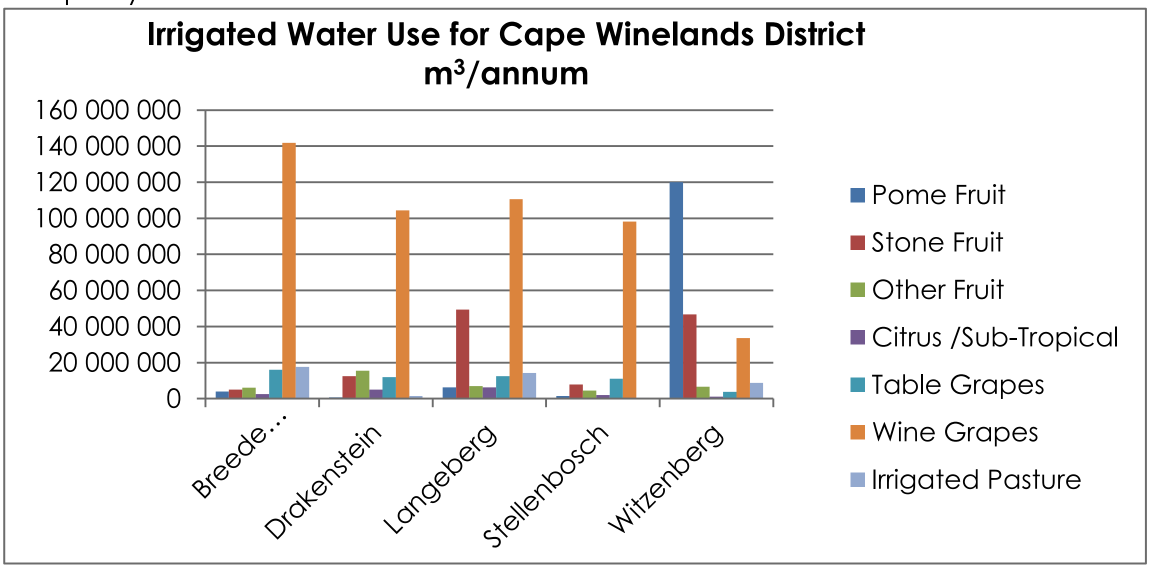


Figure 5.3: Irrigated crop water use for the Cape Winelands District

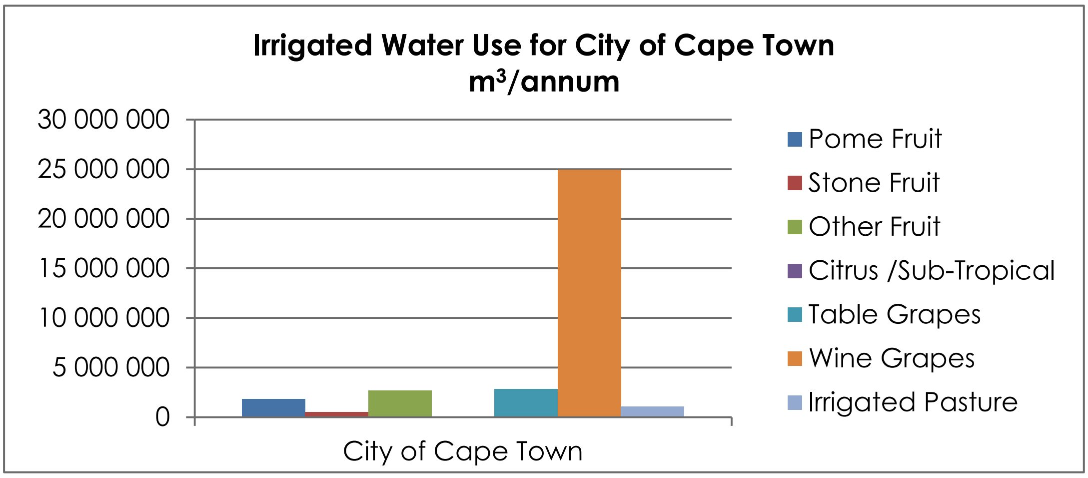


Figure 5.4: Irrigated water use for the City of Cape Town

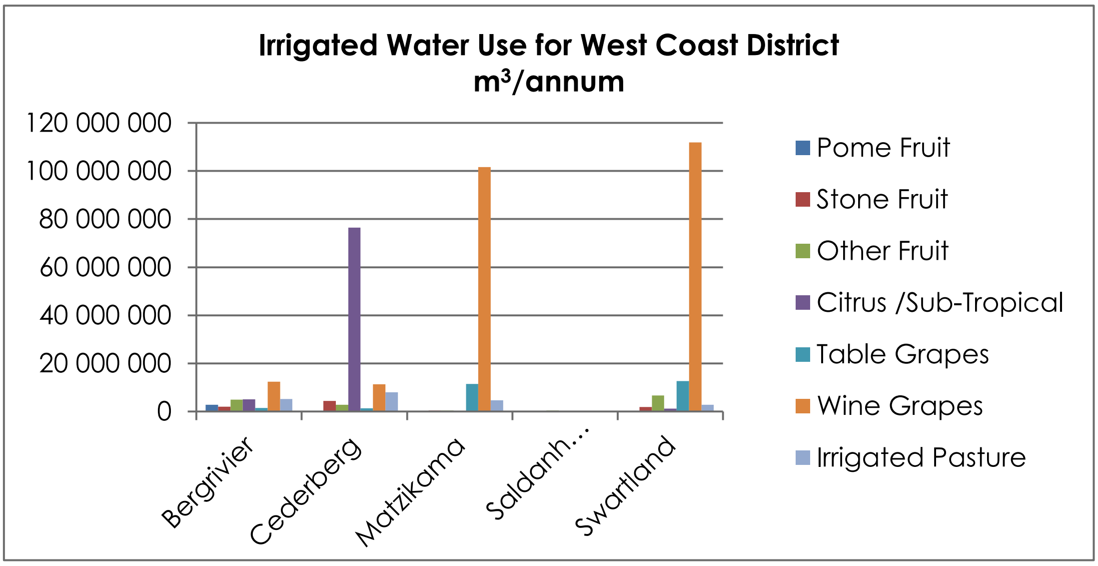


Figure 5.5: Irrigated water use for the West Coast District

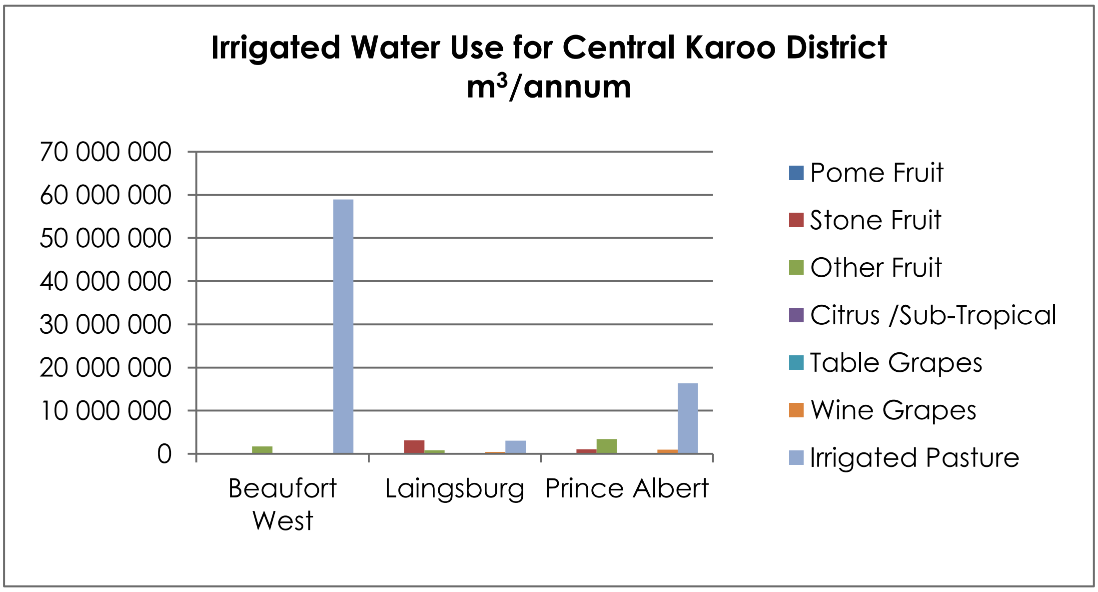


Figure 5.6: Irrigated water use for the Central Karoo District

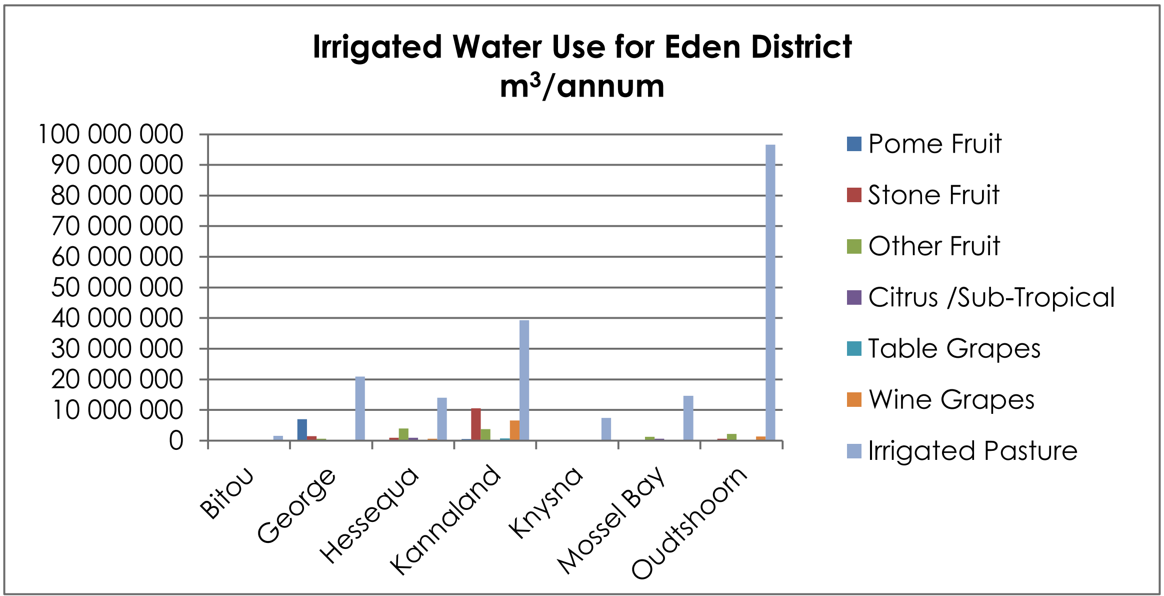


Figure 5.7: Irrigated water use for the Eden District

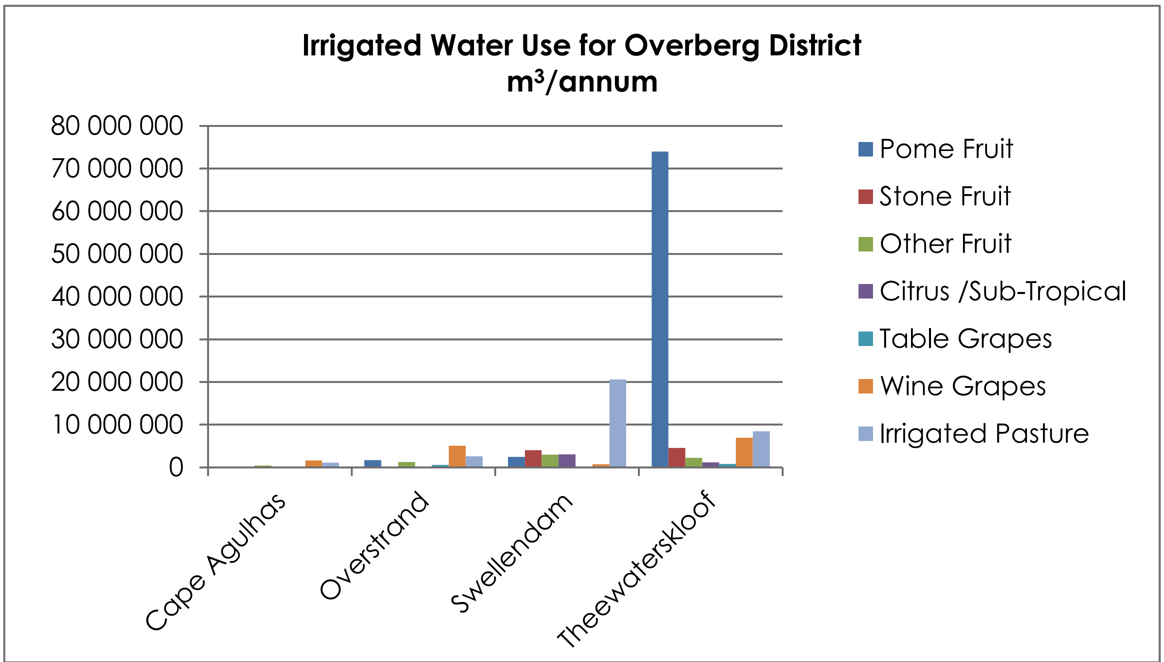


Figure 5.8: Irrigated water use for the Overberg District

The irrigated water use in the Central Karoo District has a level of just under 60 million cubic metres per annum for irrigated pasture in Beaufort West Municipality, as a prevailing use. This is also true for the Oudtshoorn area of the Eden District, where the level for irrigated pastures reaches over 90 million cubic metres per annum.

In the Theewaterskloof Municipality, within the Overberg District, water use for pome fruit is over 70 million meters cubed per annum.

5.4. Conclusions for water use for irrigated crop area

The irrigated water use for wine grapes is the highest area as driven by the associated use for the measured crop areas. The global market is experiencing a glut in the wine production, so to justify this estimated level of water use it is important that markets are opened, as anticipated in Asia, particularly in China. The water irrigation to fruit, other than wine grapes is at 37 % of irrigated water for the Western Cape. These figures it must be acknowledged do not include the irrigated water for vegetables. The reason for this is that the aerial census was done six monthly and as the rotation for vegetables can be a few weeks a rotation might be missed, so that an assessment of area for vegetables would be inaccurate. Similarly an NIR for vegetables is difficult to determine.

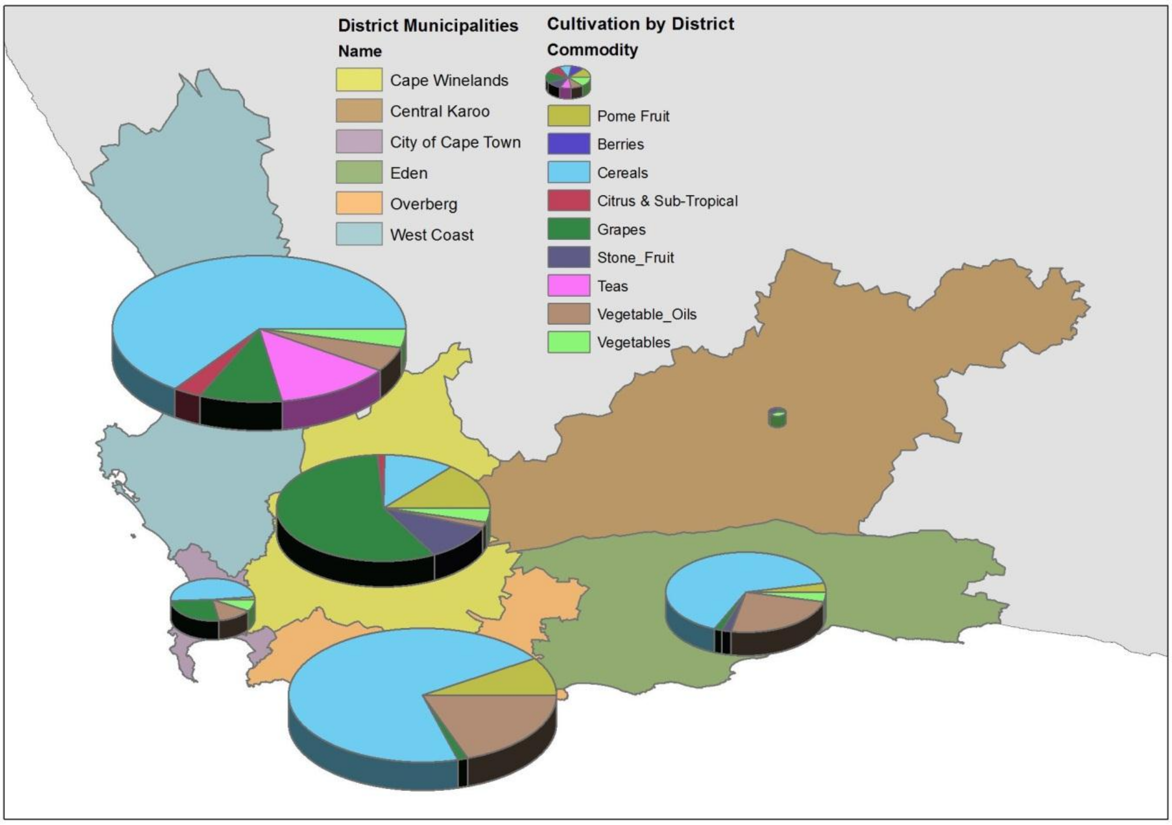


Figure 5.9: A map of the Western Cape showing the cultivated areas, by crop type, including both dryland and irrigated crops. (Based on the estimation of hectares covered by the DoA Aerial Census 2013)

6. Agri-processing sector: Fruit Juice Sub-sector

6.1. Background information on the fruit juice industry

South Africa's juice industry sells 80% of its products on the domestic market, exporting just a fifth of what it produces. This amount differs from the canned fruit industry in this regard, where these proportions are reversed. According to South African Customs data, South Africa exported many thousands of tonnes of fruit juices to countries all over Sub-Saharan Africa in the first three quarters of 2014. Table 6.1 below shows all African markets with records of over 1,000 tonnes in the period: for these countries, the total is over 133,000 tonnes (Booth, 2015).

Table 6.1: South African Juice exports to key African markets within Q1-3 in 2014.(Booth, 2015).

South African juice exports to key African markets, Q1-3 2014	
HS2009	Volume (tonnes)
Namibia	26,954
Botswana	22,795
Mozambique	20,522
Zimbabwe	10,572
Zambia	9,345
Swaziland	6,411
Mauritius	5,867
Lesotho	5,848
Angola	4,394
Ghana	4,222
Nigeria	3,965
Gabon	3,182
Tanzania	2,575
Congo	2,474
Reunion	1,427
Malawi	1,302
Benin	1,259

It is hard to gauge the extent of the growth as countries such as Namibia and Botswana have suddenly appeared on the export tables, which may be due to a change in data reporting. However, there is a marked trend of growth (Booth, 2015).

Fruit and vegetable juices (not fermented or spirited) is one of the top exported products in the Overberg district municipality and is worth an approximate R290m. Mozambique is one the top five export markets in 2013 and fruit and vegetable juice is one of the top five products exported with a value of R49m (WESGRO-Overview, 2014:10).

Furthermore, the Western Cape is home to Ceres Fruit Juice company, South Africa's long-life fruit juice market leader (with over 50 percent of market share) and one of the largest fruit-packaging companies in the world (Top 300, 2015).

6.2. Methodology for assessing the water requirements of the fruit juice industries:

The information gathered to ascertain the approximate water use for fruit juice processing facilities entailed a desktop study utilising agricultural mapping software i.e. Department of Agriculture's Cape Farm Mapper; Department of Agriculture list of persons of interest within sub-sectors and the South African Fruit Juice Association. In addition, direct communication with fruit juice producing companies to verify location and acquire water-use data was completed.

The basic methodology is outlined below:

i. Utilisation of Cape Farm Mapper to highlight agri-processing plants within the Western Cape.
ii. "Zoom in" to individual agri-processing plants within the local municipalities to identify the company name and location.
iii. Research the agri-processing plants involved in fruit processing and collate with general research of the sub-sectors within Western Cape (e.g. South African Fruit Juice Processing).
iv. Produce a list of all agri-processing plants per local municipalities to identify the quantity of sub-sector facilities within the Western Cape.
v. Contact departments or individuals within the selected companies via telephone and email requesting water-use data for specific fruit processing facility.
vi. Analyse available data and produce approximate annual water use within district municipalities.
vii. Assumptions accompanied by the water use determination include the validity of the Cape Farm Mapper agri-processing plant data with regards to the up-to-date nature of the information. Secondly, that the data acquired confidentially from the fruit juicing companies are accurate and includes all water sources (if there is more than one). Lastly, that the data can be further extrapolated as an average to project the current water-use intensity within the Western Cape.

6.3. Findings on the fruit juice industry:

Thus far, the agri-processing plants verified within the fruit juice sub-sector are mainly located in the City of Cape Town, Cape Winelands and Overberg District Municipalities. Fruit juice companies produce different quantities of different products such as fruit juice, purees and concentrates. The recent correspondence with the industry states that they are solely using municipal water supply at their plants. Table 6.2 below represents the current water use data acquired by fruit juice companies within the Western Cape district municipalities. The total water use gathered from this data is 697 703 m^3 per annum, however, this data can be extrapolated to other facilities within the areas and the amount would be double the current volume. Water-use data from these other facilities are still in the process of being acquired.

Table 6.2: Current water-use data for five fruit juice processing facilities within the Western Cape.

District Municipality	Current Water Use Data (m^3/a)
Cape Winelands	436415
Central Karoo	0
City of Cape Town	18718
Eden	0
Overberg	242570
West Coast	0
WC Total	**697 703**

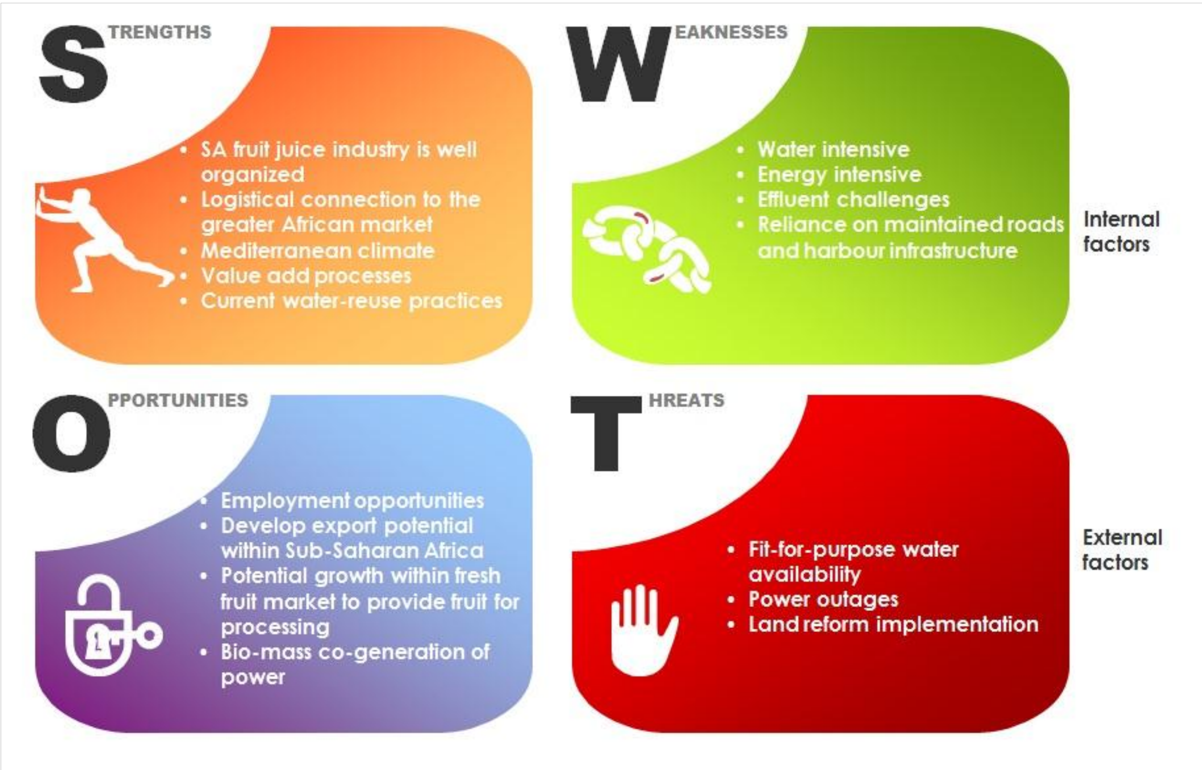


Figure 6.1: SWOT Analysis for the fruit juice industry within the Western Cape.

The current drivers are not yet fully established, however, it would appear that the fruit juice industry would be driven by export opportunities, seasonal markets and local demand which may increase due to the emphasis of healthier lifestyles within today's society.

Another interesting point noted is that water re-use within the fruit juice processing is utilised and that water is also a by-product of the process. Within the concentrate production of the industry large amounts of water is produced. A practice for one facility is to re-use this water (condensate) partially within the facility to reduce the use of municipal fresh water. However, due to its pH level and temperature it is not possible to apply it within all requirements for water in the processing plant. During processing, the most intense part which occurs from January to May, the facility can pump approximately 100 m^3 of effluent to their water processing facility every hour where it is treated prior to being pumped to the municipal waste water treatment plant. For this specific facility, no groundwater or any other non-municipal source of water is utilised.

Further opportunities for growth within the fruit juice industry could facilitate job creation in the agri-processing production side. For example, the bottling of product can be completed at an independent bottling company.

6.4. Conclusions on the fruit juice industry

Approximate water-use within local municipalities for specific fruit juice processing plants have been quantified as 2518m^3/annum to 240 750m^3/annum dependent on the size and output of the facility. Within the concentrate production facility a total of 181000 tonnes of fruit have been processed utilising approximately 334 828 m^3 of municipal water. The data set acquired for a relatively large fruit juice processing plant uses on average 12.5 litres of water to produce 1 litre of fruit juice. The total water use estimated from this data is approximately 1.4 million m^3/annum, for the Western Cape fruit juice industry. The growth within the industry would be dependent on numerous factors (e.g. water availability, logistical infrastructure, crop production) highlighted within the SWOT analysis. The recommendation of water-reuse within fruit juice processing plants is supported for all increased development within the industry. Furthermore, there is a need to research the utilisation of groundwater for agri-processing to save costs in the production processes and as a reliable water source for the industry.

7. The Wine and Brandy Industry and Water Use

7.1. Background information for the Wine and Brandy industry

The production of wine grapes represents approximately 45% of the total irrigated crop within the Western Cape Province (Western Cape AgriStats). Brandy is approximately 4.5% of wine production. The processing of wine/brandy is divided into two different types of cellars, a producer cellar and a private cellar. A producer cellar is a winery where grapes as well as wine are received and processed on behalf of a group of wine grape producers. A private cellar, as its name suggests, only processes the grapes produced on the farm on which it is located. Therefore, it is important to consider the type of cellar when assessing water use.

As background this graphical analysis indicates the changes in hectares of both wine and brandy in the past decade in South Africa. (SAWIS, 2014) A positive trend for wine grape production is shown, with a more volatile and only marginal positive trend for brandy.

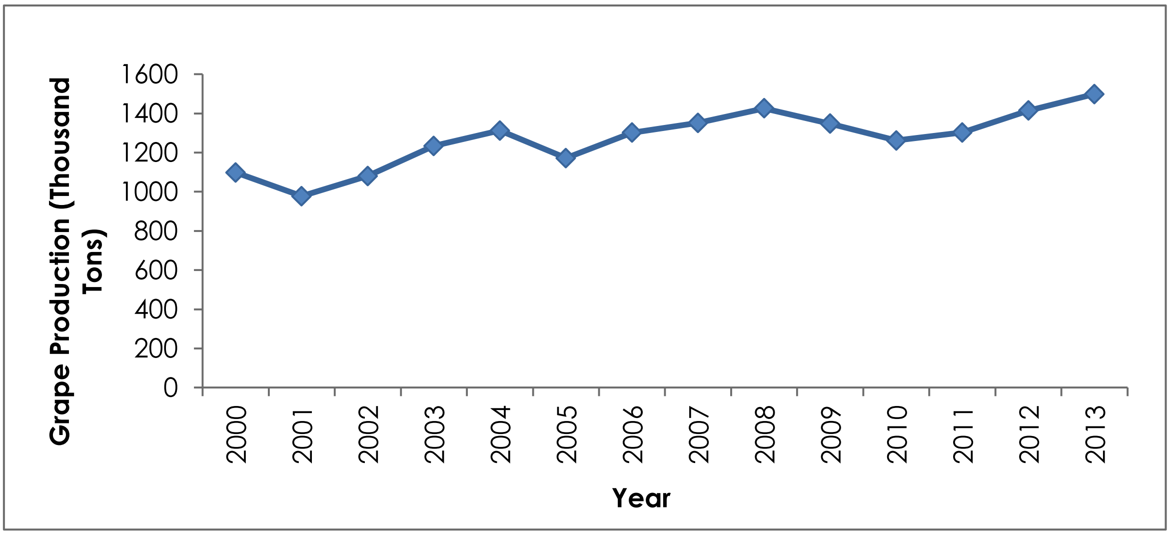


Figure 7.1: Overall Grape Production for Wine (SAWIS, 2014)

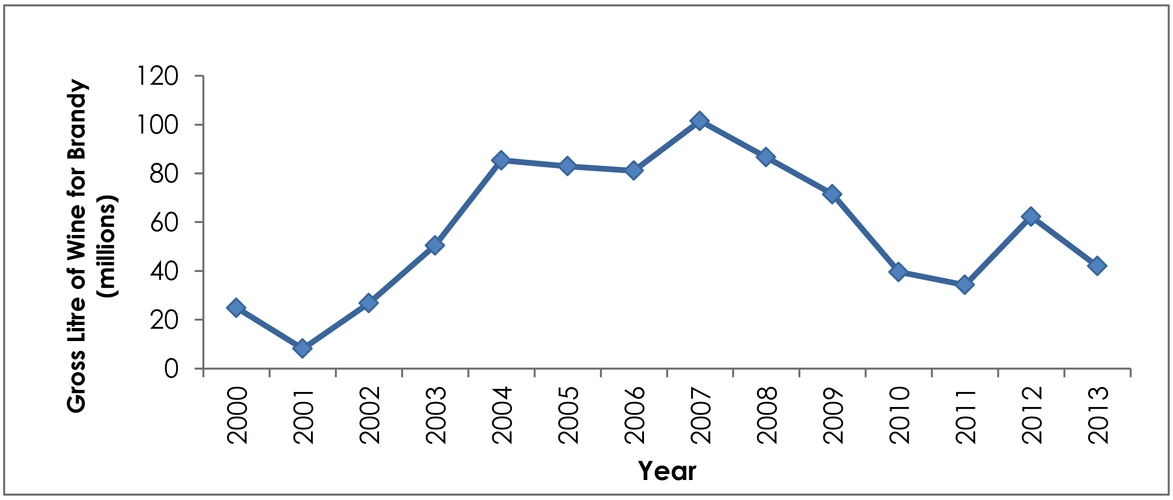


Figure 7.2: Overall Gross Litre of Wine for Brandy 2000 to 2013 (SAWIS, 2014)

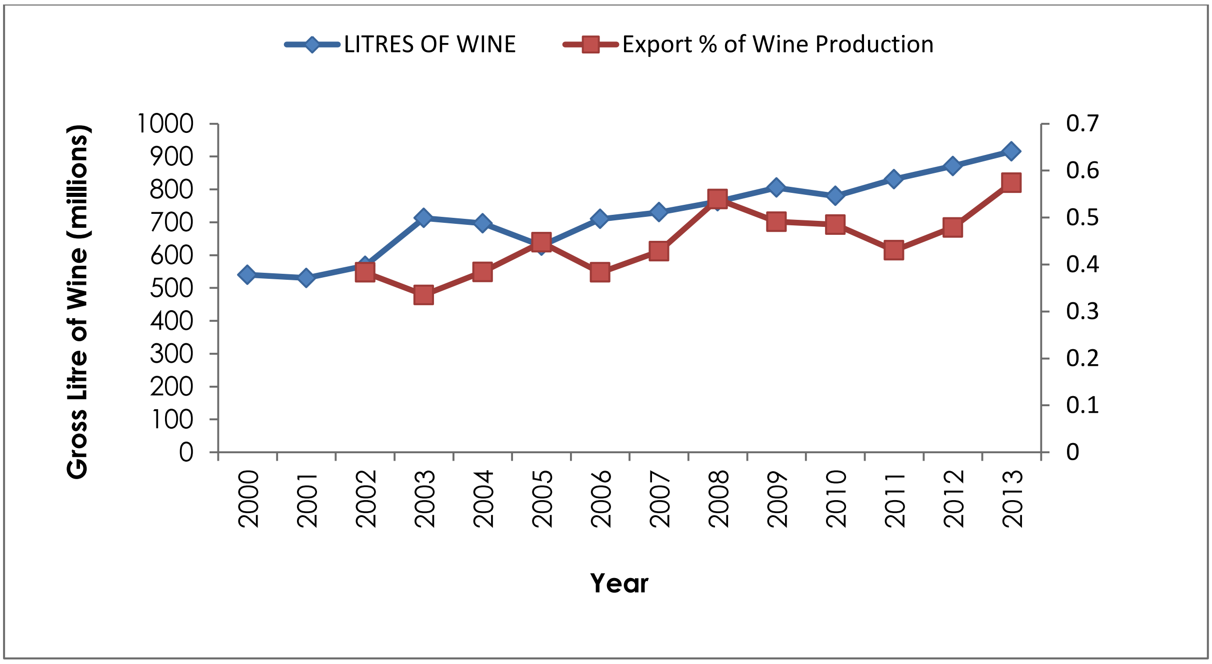


Figure 7.3: Overall Gross Litres of Wine produced, with export of wine as a percentage of production shown (SAWIS 2014).

The market position of wine and brandy sales are shown above over time, with the global downward pressure clearly indicated in the years 2008 to 2012.

In addition to the difference in types of cellars, a number of other factors influence the water used for processing. These include:

- The processing of red versus white wine
- Age of a cellar and the technology used
- Bottling of wine either on site or at a centralised location

A number of industry bodies have been established to regulate and assist the Wine Industry, these include:

- South African Wine Industry Statistics (SAWIS)- export and trade
- WineTech - research
- Integrated Production of Wine (IPW) – environmental sustainability

The three District Municipalities with the highest wine grape production are as follows:

1. Cape Winelands
2. Overberg
3. West Coast

The industry is continuing to strive to reduce the water demand of processing, and has managed to achieve reductions over a period of time.

7.2. Methodology for research of the wine and brandy industry

The current information has been sourced from Distell, based on the consumptive figures used by their respective cellars in the Stellenbosch, Drakenstein Municipalities and the City of Cape Town. Further data is acquired from South African Wine Institute of South Africa (SAWIS) in terms of regions and the hectares of wine grapes.

Water use is determined by the recordings of the effluent as reported within audit reports for the Wine Industry. The effluent reading is the reading of the metered water entering the cellar, as it is assumed the incoming measure of water equals the outgoing measure of effluent.

In calculating amount of water (m^3) per litre of wine the following assumptions were made:

- The tons of wine grapes per hectare is 14 tons
- No difference in water use between red and wine
- All wineries use the same type of technology
- Industry standard of 750 litres wine produced per ton of pressed grapes
- Water use in cellars is based on 8 known wineries, giving an average of $0.0039 m^3/l$ wine

Tons of grape pressed were multiplied by the industry average to obtain overall litres of wine produced. The total water use was then divide by the total wine production to obtain a unit of m^3/l. Wineries are already employing water conservation and demand management strategies in using the effluent for irrigating their vineyards.

7.3. Findings of water use in cellars in the Western Cape

Table 7.1: Water use for private cellars across three municipalities

Municipality	Winery	Water Source	Water Use m^3/a	Tons pressed	Litres of Wine produced	m^3 water / ℓ wine
Stellenbosch	1	borehole	1505	553	414750	
	2	borehole	4743	1464	1098000	
	3	borehole/Theewaterskloof	4959	1204	903000	
	4	fountain	780	1020	765000	
	5	Municipality	11700	2220	1665000	
		Average	**4737.4**	**1292.2**	**969150**	**0.005**
Drakenstein	1	borehole/Municipality	92010	20137	15102750	
	2	borehole	820	983	737250	
		Average	**46415**	**10560**	**7920000**	**0.006**
CCT	1	N/A	17210	9480	7110000	
		Average	**17210**	**9480**	**7110000**	**0.002**

Table 7.2: Regions of wine grapes in the Western Cape, with associated water use (SAWIS, 2014).

Region	Area Ha of Wine	Tons Produced	Litres of Wine	Water Use (m^3)	No. Of Wine Cellars
Stellenbosch	16 294	228 116	171 087 000	667 239	177
Paarl	16 106	225 484	169 113 000	659 541	132
Robertson	14 676	205 464	154 098 000	600 982	65
Swartland	13 509	189 126	141 844 500	553 194	33
Breedekloof	12 878	180 292	135 219 000	527 354	26
Olifants River	10 116	141 624	106 218 000	414 250	14
Worcester	8 814	123 396	92 547 000	360 933	56
Klein Karoo	2 637	36 918	27 688 500	107 985	26
Totals			**997 815 000**	**3 891 479**	

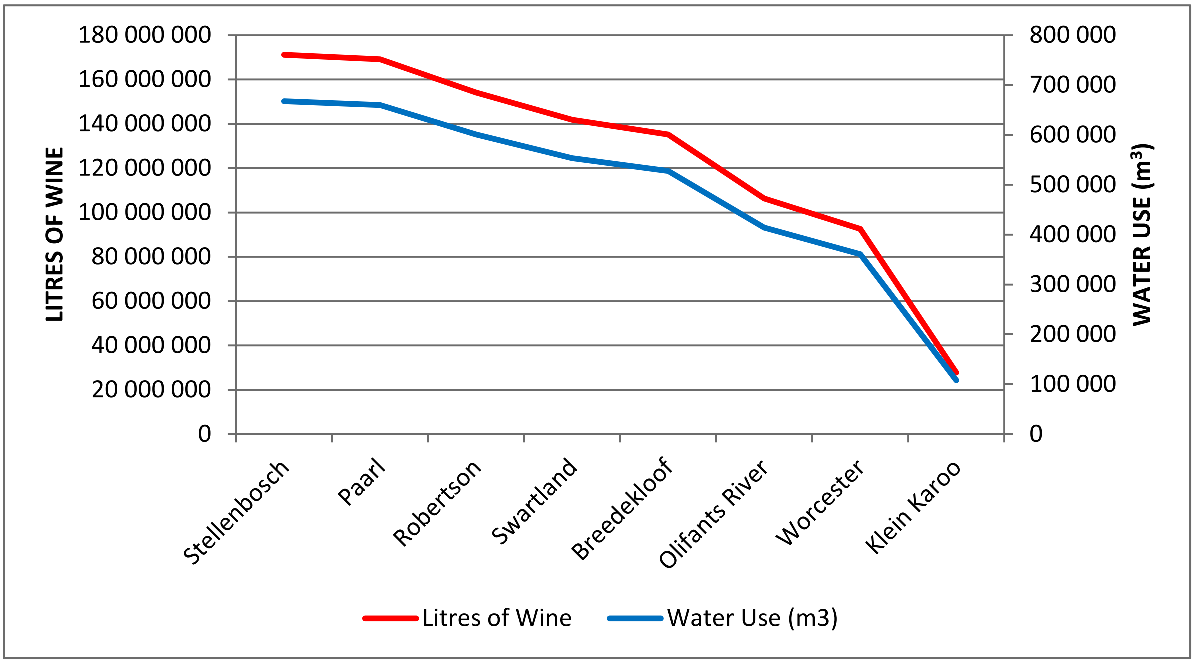


Figure 7.4: The graph shows the correlation between the quantity of wine produced in a cellar and the water used (SAWIS, 2015

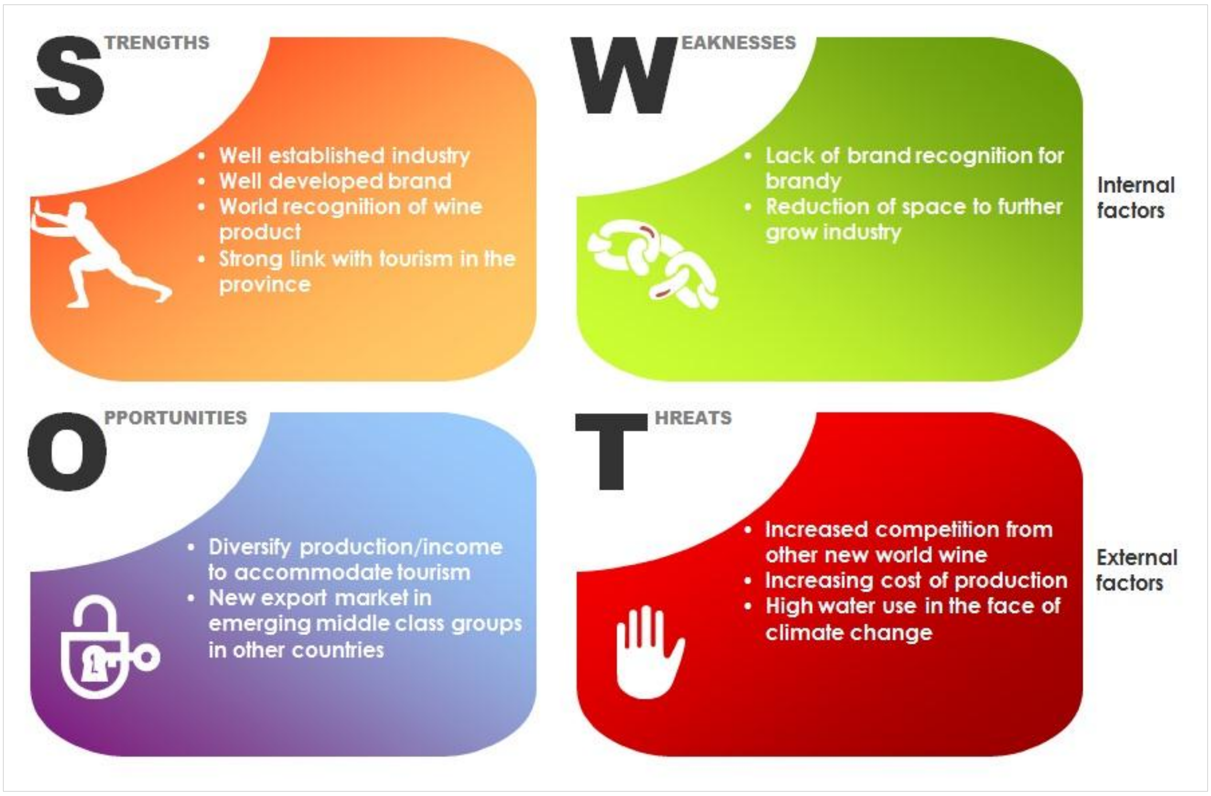


Figure 7.5: SWOT Analysis for the wine industry within the Western Cape.

7.4. Conclusions on water use in the wine and brandy industry in the Western Cape

For the Western Cape it has been shown in this study that 3 891 479m^3 of water are used for the production of 997 815 000 litres of wine. This equates to about 3.9m^3 of water for every 1m^3 of wine produced (3.9ℓ water to 1ℓ of wine). It is noted that the conversion factor has been based on a relatively small sample of eight cellars, predominantly in the Drakenstein and Stellenbosch regions.

In conclusion the larger cellars generally use larger amounts of water, while smaller cellars use smaller amounts of water, as shown graphically in figure 7.4.

8. Olives for olive oil in the Western Cape

8.1. Background to the olive oil industry

The olive tree may be the most cold-hardy of the subtropical fruit trees, and is more tolerant to drought and salt than other temperate fruit trees. The tree can grow in shallow, poor quality soil and shows remarkable responses upon improvement of the cropping conditions. A slight decrease in irrigation resulted in a substantial increase in crop yield (Fernandez and Moreno, 1999).

A global average water footprint of 14 500 m^3/ton of olive oil produced has been established. This encompasses both the growing of the tree crop and the manufacture of the olive oil. (Mekonnen and Hoekstra, 2010). Treated municipal wastewater enhanced olive productivity and limited alternate bearing (Palese et al., 2007). As in the rest of the world, South African table olive producers struggle with alternate bearing (Crous, J., 2012).

The process required to produce olive oil produces up to 95% wastewater. This wastewater is high in polyphenols, which is harmful to the environment. Studies show that treatment of olive mill wastewater can produce an extract rich in antioxidants, with little environmental impact (Agalias *et al*., 2007).

8.2. Methodology to determine the water usage for olive oil production

The olive tree hectares for the Western Cape were determined from the Department of Agriculture Aerial Census 2013 flyover. A correction factor of 0.7 was applied as not all the planted hectares are bearing fruit. It was assumed that 6 tons per hectare of olives was produced, allowing for alternate bearing years. Then 60% of the olives are taken as being for olive oil production as opposed to fresh olives, of which only 17% results in extra virgin olive oil extraction. Per ton of olive oil for extraction 200 litres or 0.2m^3 of water is used, which includes all cleaning processes. (Personal communication Costa C, Agricultural Research Council, 2015).

8.3. Findings on the water usage for olive oil production

Table 8.1: The water use for olive oil production is shown in the table below.

Crops	Olive Trees	Olive production in W Cape	Tons Olives for oil in W Cape	Tons (kl) of Olive Oil	Water Used for one ton of Olives for Olive Oil processing	Water used for creation of olive oil in Western Cape
	Size (hectares)	tons	tons		m³ per ton	m³/annum
Cape Winelands						
Breede Valley	649	2725	1635	278	0.2	327
Drakenstein	1376	5781	3468	590	0.2	694
Langeberg	380	1597	958	163	0.2	192
Stellenbosch	315	1321	793	135	0.2	159
Witzenberg	386	1619	972	165	0.2	194
DM Total	**3105**	**13043**	**7826**	**1330**		**1 565**
Central Karoo						
Beaufort West	93	390	234	40	0.2	47
Laingsburg	54	227	136	23	0.2	27
Prince Albert	284	1192	715	122	0.2	143
DM Total	**431**	**1809**	**1086**	**185**		**217**
City of Cape Town						
City of Cape Town	260	1094	656	112	0.2	131
DM Total	**260**	**1094**	**656**	**112**		**131**
Eden						
Bitou	1	4	2	0	0.2	0
George	15	64	39	7	0.2	8
Hessequa	319	1339	804	137	0.2	161
Kannaland	276	1157	694	118	0.2	139
Knysna	2	7	4	1	0.2	1
Mossel Bay	31	131	79	13	0.2	16
Oudtshoorn	156	654	392	67	0.2	78
DM Total	**799**	**3357**	**2014**	**342**		**403**
Overberg						
Cape Agulhas	30	126	75	13	0.2	15
Overstrand	151	634	380	65	0.2	76
Swellendam	368	1546	928	158	0.2	186
Theewaterskloof	161	676	405	69	0.2	81
DM Total	**710**	**2981**	**1789**	**304**		**358**
West Coast						
Bergrivier	334	1401	841	143	0.2	168
Cederberg	44	186	112	19	0.2	22
Matzikama	2	9	5	1	0.2	1
Saldanha Bay	31	129	78	13	0.2	16
Swartland	448	1880	1128	192	0.2	226
DM Total	**858**	**3605**	**2163**	**368**		**433**
WC Total	**6164**	**25889**	**15533**	**2641**		**3 107**

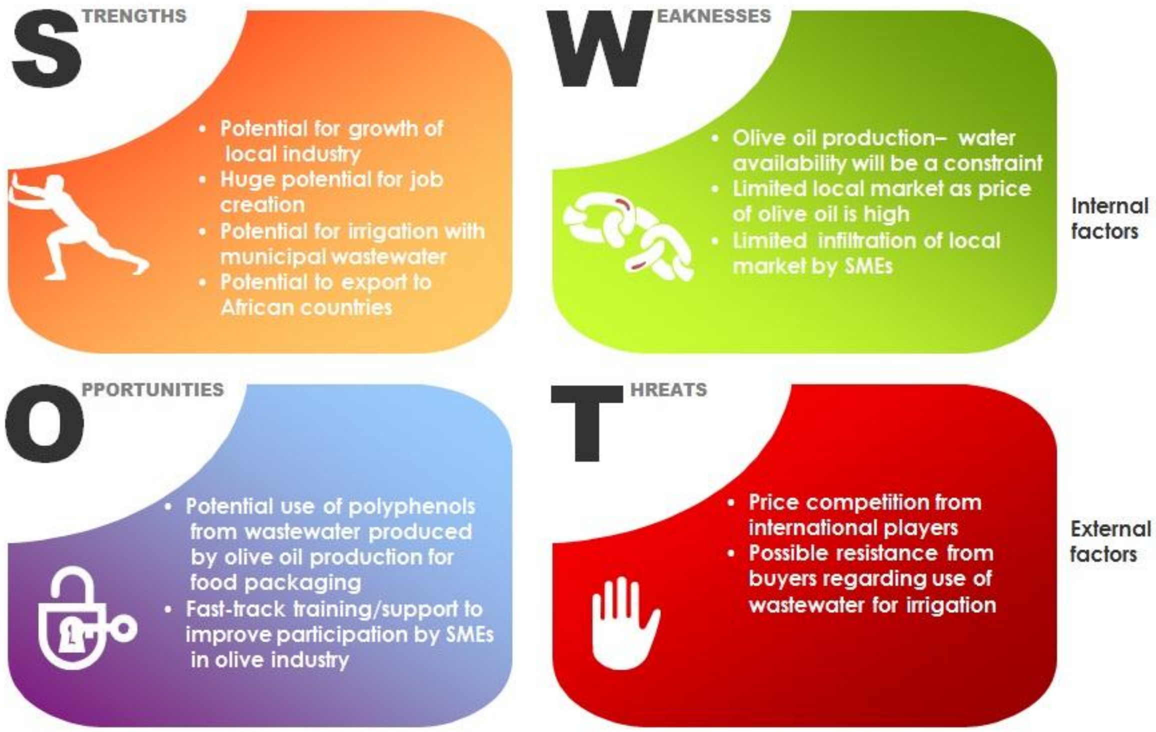


Figure 8.1: SWOT Analysis for the olive oil industry within the Western Cape.

8.4. Conclusions on the water usage in olive oil production

The results of the analysis of the Western Cape data show that just over 3000m^3 of water is used per annum to process approximately 15 500 tons of olives to produce 2.6 million litres of olive oil. This figure for olive oil production correlates with industry projection levels in the Hortgro, 2014 report. It is estimated from forums that the full time equivalent labour unit per hectare of olive orchard is 0.72 persons, such that the plantings of olives within the Western Cape provide 4438 work opportunities (personal communication, Hortgro). There would be further positions created in the processing of the fresh olives and creation of olive oil.

9. Agri-processing sector: Essential Oils

9.1. Background information on essential oils

The major producers of essential oils are India, Brazil, China, USA, Egypt and Indonesia while the major consumers are Europe and the United States (DAFF, 2013)

The trade in South African essential oil is deemed to be less than 0.1% and regarded as insignificant. The global trade in essential oils for 2010 was US$ 2.416 billion ((ITC, 2010) of which South Africa exported US$ 21.2 million and imported US$ 115.8 million. The value of exports from South Africa decreased between 2006 and 2009 from US$ 26.3 million to US$ 21.2 million (USAID 2006; ITC, 2009).

The export volumes of essential oils from international producers to SADC amounted to 115.0 tons. The value of all essential oils exported from RSA during 2009 was ZAR 118..6 million and the value of export from the Western Cape amounted to ZAR 43.7 million (DAFF, 2011)

The South African essential oil industry is comprised of about 100 small commercial producers (DAFF, 2010). The total hectares under cultivation is 1 970 ha with 77 ha under cultivation in the Western Cape (SA Essential Oil Producer, 2010). Buchu essential oil appears to be the most valuable product being produced but other crops (although no official stats could be acquired) such as lavender, orange and lemon essential oils are also produced in significant volumes.

An analysis of the value of production/trade in all essential oils in the Western Cape for 2009 is as follows in Table 9.1:

Table 9.1: Value of essential oils in the Western Cape in 2009

Area	ZAR
CoCT	14 034 124
WC DM	2 656 529
CW DM	29 654 515
Overberg DM	19 078
Eden DM	177 106

It is quite significant that, although very little cultivation of essential oils is done within the Western Cape, the trade in essential oils is quite significant. This can be attributed to the import of essential oils and then on-selling to, especially, the SADC. The actual volumes (and associated trade from cultivation within the CoCT) cannot be stratified from the total CoCT value depicted above.

From literature search completed, Buchu is fairly difficult to cultivate from cuttings but easier from seeds (Buchu, DAFF, date unknown).

Different climatic conditions and different agronomic conditions can have an effect on the ratios of 31% of (iso)menthone, 41% (ϕ)-diosphenol and 3% of (the olfactory important) cis- and trans-8-mercapto-p-menthane-3-ones, the more important components of the essential oil (van Beek et al, 1995).

Maintenance of this ration is an important marker to the quality of the extracted essential oil.

9.2. Methodology to establish water use in the essential oil industry

Very little information is available on actual volumes of especially Buchu or other essential oils produced in the Western Cape. (DTI, FRIDGE, 2011)

A Buchu plantation was established in the Genadenberg project with the sole purpose of extracting Buchu essential oils. Buchu is unique to the higher elevations and especially the mountain slopes of the West Coast of South Africa where the climatic characteristics and nutrient poor and low pH soil makes for the unique location of the plant.

Before extraction, the plant material is washed to rid from any traces of extraneous materials such as sand. The essential oil is extracted from macerated plant material using superheated steam. The essential oil content of the Buchu plant is between 1 – 2 % (Scheider and Viljoen, 2002). To produce 1 kg of essential oil it would require 150 kg of water (charged to the boiler over the period of distillation), 750 kg of water to cool the distillation unit 80 kg of macerated material (JT Kabuba, Thesis: 2009, UJ). The more sophisticated units have cooling units which saves cooling water going to waste.

9.3. Findings on the essential oil industry

The extraction units for essential oils are close to the sites of cultivation. The following depicts the Stengths, Weaknesses, Opportunities and Threats (SWOT) which has been identified for, but not limited to, buchu essential oils. Opportunities exist to build on the initiative by DTI and DST (Study to develop a strategy for the development of a viable essential oils industry in South Africa: Vols 1 & 2, August 2011).

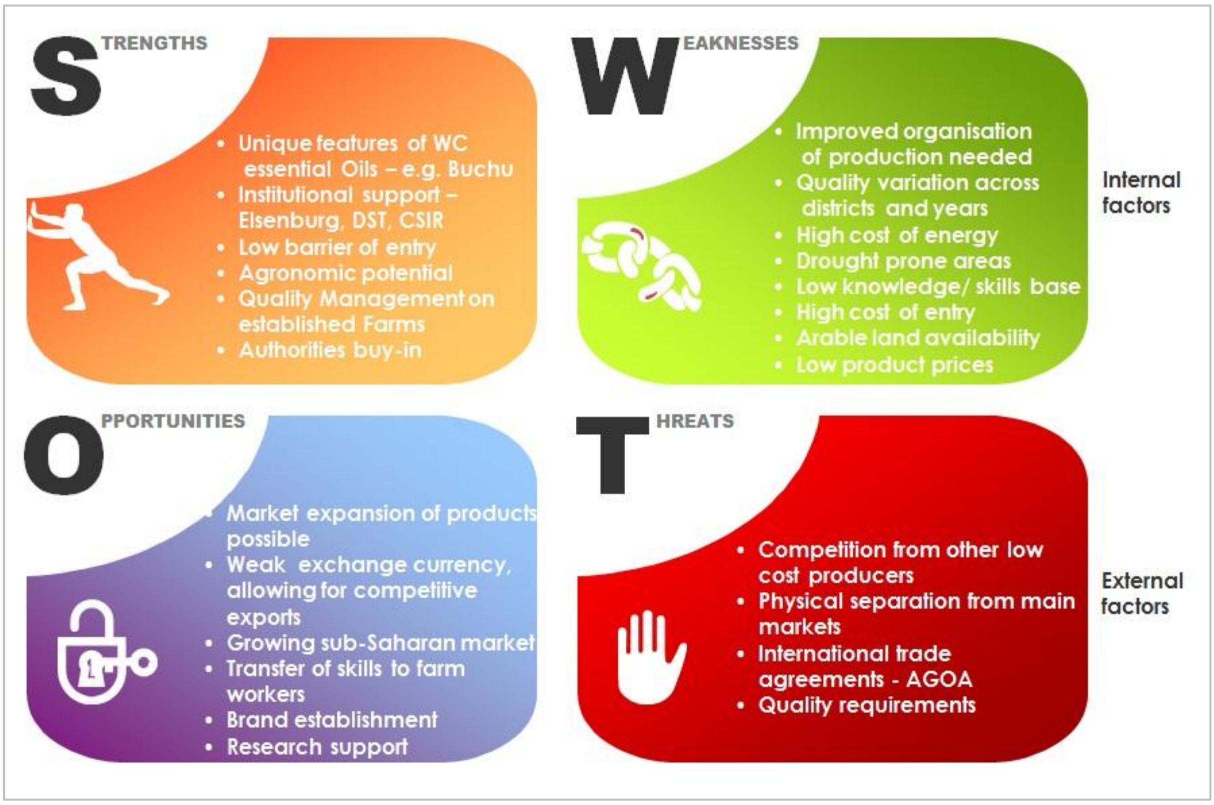


Figure 9.1: SWOT Analysis for the essential oil industry within the Western Cape.

9.4. Conclusions for the essential oil industry

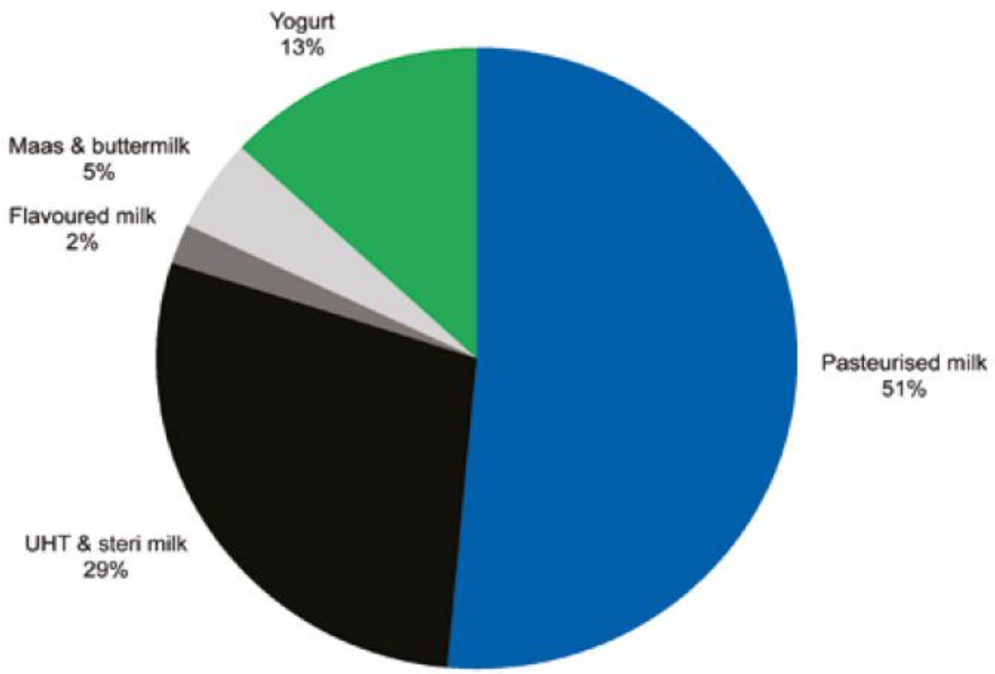
The approximate water use to produce 395 203 kg of essential oils will amount to 355 682 m^3 of water. This includes washing and cooling of the essential oil rich vapour. About 80% of this water (284 545 m^3) can be saved if a closed coolant system is used.

10. Water Use in the Western Cape Dairy Sector

10.1. Background on milk production in the Western Cape

The dairy sector has changed considerably over the last decade. Between 2007 and 2015, the number of milk producers decreased by 35% in the Western Cape and have decreased country wide. Nonetheless, annual milk production shows a steady upward trend (MilkSA, 2015). This means that the smaller producers have ceased to operate and the industry is now characterised by larger farms.

The Western Cape accounted for approximately **27% of annual production** in 2011 i.e. 708 million litres (ML) of milk (NDA, 2012). It is estimated that 60% of milk is used for liquid milk products (including yoghurt) while 40% is used for concentrated milk products (NDA, 2012). As indicated in figure 10.1, yoghurt accounts for approximately 13% of liquid milk products i.e. 55.28 ML of milk (MilkSA, 2015).



Source: Industry estimate based on BMI, as supplied by Sampro
* Milk equivalent basis

Figure 10.1: Composition of the South African liquid milk market, 2011 (MilkSA, 2015)

10.2. Geographical Distribution of Milk Producers

The geographical distribution of dairy farms and dairy cows is indicated in figures 10.2 and 10.3, respectively. The information is based on census data captured between January 2012 and May 2015 by the WCDOA and indicates a total of 584 dairy farms and 197 714 dairy cows. The numbers of dairy cows includes calves, heifers and dry cows (WCDoA, Veterinary Services, 2015). As can be seen from the figures, the majority of dairy cows are raised in the Eden and Overberg Districts.

The above information differs slightly from the information published by LactoData (2015) which indicates 533 milk producers in the Western Cape. LactoData (2015) also estimates an average herd size of 268 cows in milk. This is an estimated 142 844 cows in milk and 35 711 dry cows (Pers. comm., Prof Meeske, 2015). This total of 178 555 dairy cows is a slightly lower estimate than the WCDOA census data noted above.

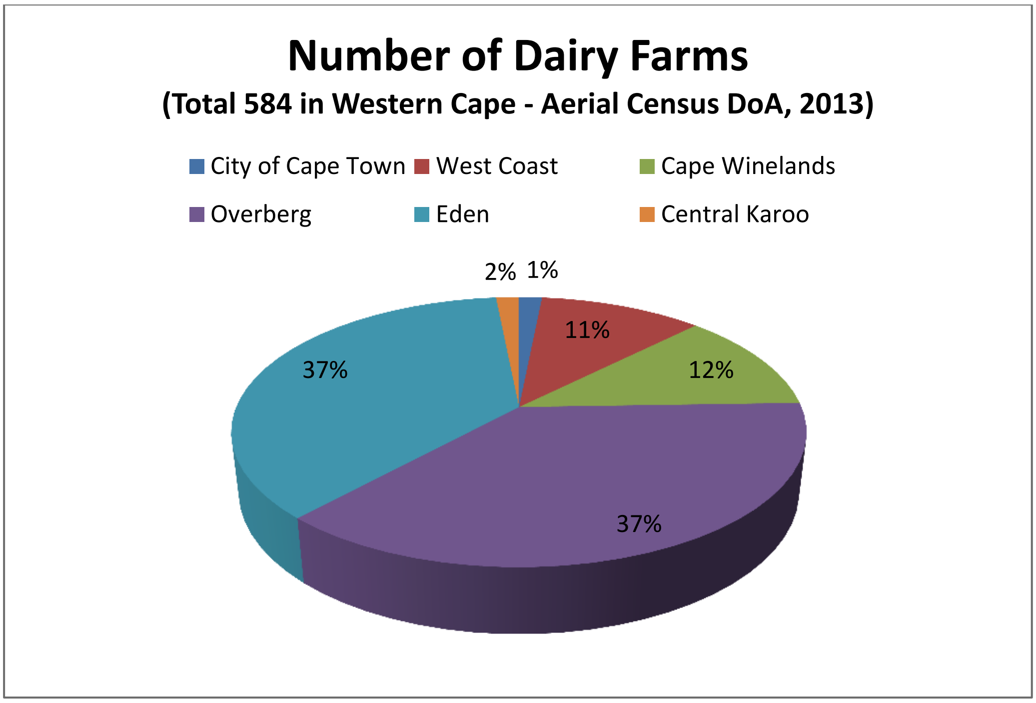


Figure 10.2: Number of dairy farms per district

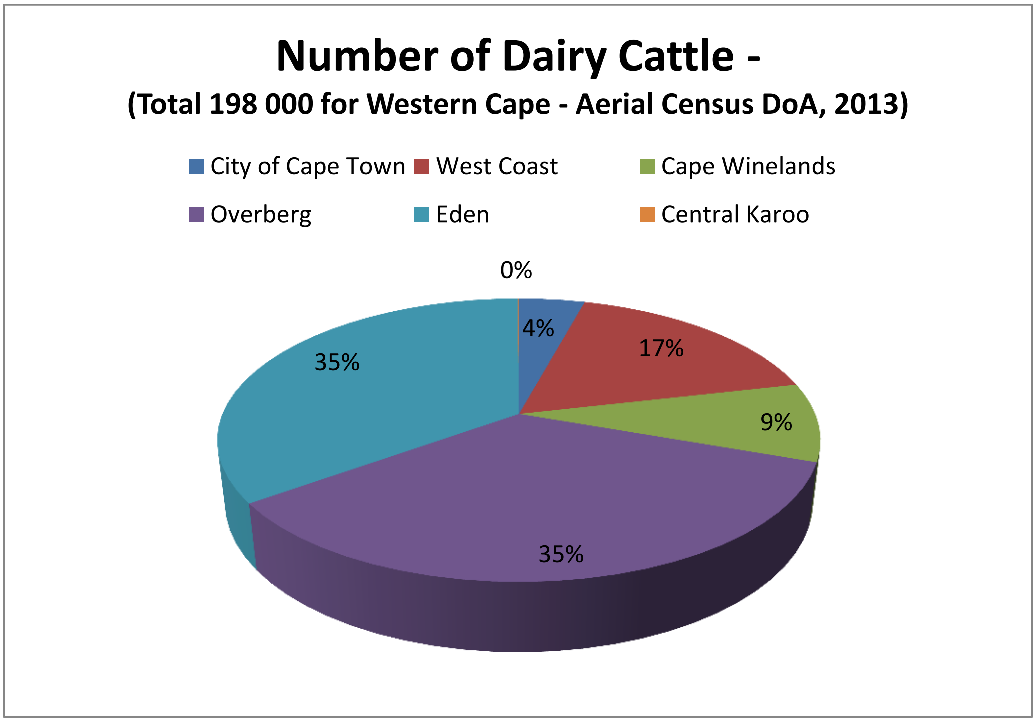


Figure 10.3: Number of dairy cows per district

10.3. Methodology for determining the water use

There appears to be little data on total water use for dairy production. A study on water and carbon footprints for livestock was conducted by the Agricultural

Research Council in 2012 but could not be obtained. Information was used from a study entitled, Life Cycle Assessment for Dairy (Greenhouse, 2011), which is based on five Western Cape farms. This study assessed water use from pasture to production.

Estimates have been derived for drinking water in a trial with Holstein-Freisian cows which drank between 95-115 litres/day in summer (Personal communication, Meeske, 2015). However, this is only a proportion of the water use in dairy production and has not been used in the calculations below.

Further data for water use during processing was sourced from the Natsurv 4 guideline on Water and Wastewater Management in the Dairy Industry (WRC, 1989). This data might be inaccurate if processing has become more efficient, since the publication is 25 years old. However, this was the only detailed information on processing that could be sourced at the time.

10.4. Findings for water use in the dairy sector

According to the Life Cycle Assessment for Dairy (2011), 520 to 1270 litres of water are required to produce 1 litre of milk (including pasture, feed, processing, packaging and transport and so called green water i.e. soil water). Pasture and feed production accounts for the bulk of this water use and all other water use is <3% (i.e. 15 – 38 litres of water / litre milk for processing, packaging and transport). If green water is excluded, blue water use (i.e. extraction of water) for feed production still accounts for the majority of water use, with milk processing between 1-3% of total.

According to the Natsurv 4 guideline (WRC, 1989) on the dairy sector, average processing water use is as follows:

- 1.7 litres water/ 1 litre milk for processing milk sachets
- 3 litres water/ 1 litre milk for processing bottled milk
- 10.2 litres water/ 1 litre yoghurt

Based on the above estimates, it is calculated that between 368 - 899 billion litres of water were used in milk production in the Western Cape in 2011, including green water. Of this, processing, packaging and transport accounts for < 3% i.e. 11 – 27 billion litres of water.

If yoghurt accounts for 13% of liquid milk products, then:

13% of 60% of Western Cape milk production

= 13% x 60% x 708 million litres milk

= 55.224 million litres of **milk** are used in yoghurt production in the Western Cape.

Assuming that 1 litre of milk produces 1 litre of yoghurt then:

10.2 litres water x 55.224 million litres of milk

= 563.285 million litres (563 000 m^3/annum) of **water** are required for yoghurt production (processing only) in the Western Cape.

Figure 10.4 illustrates water use in milk and yoghurt based on 2011 data. An upper and lower estimate is indicated based on the uncertainties in the literature.

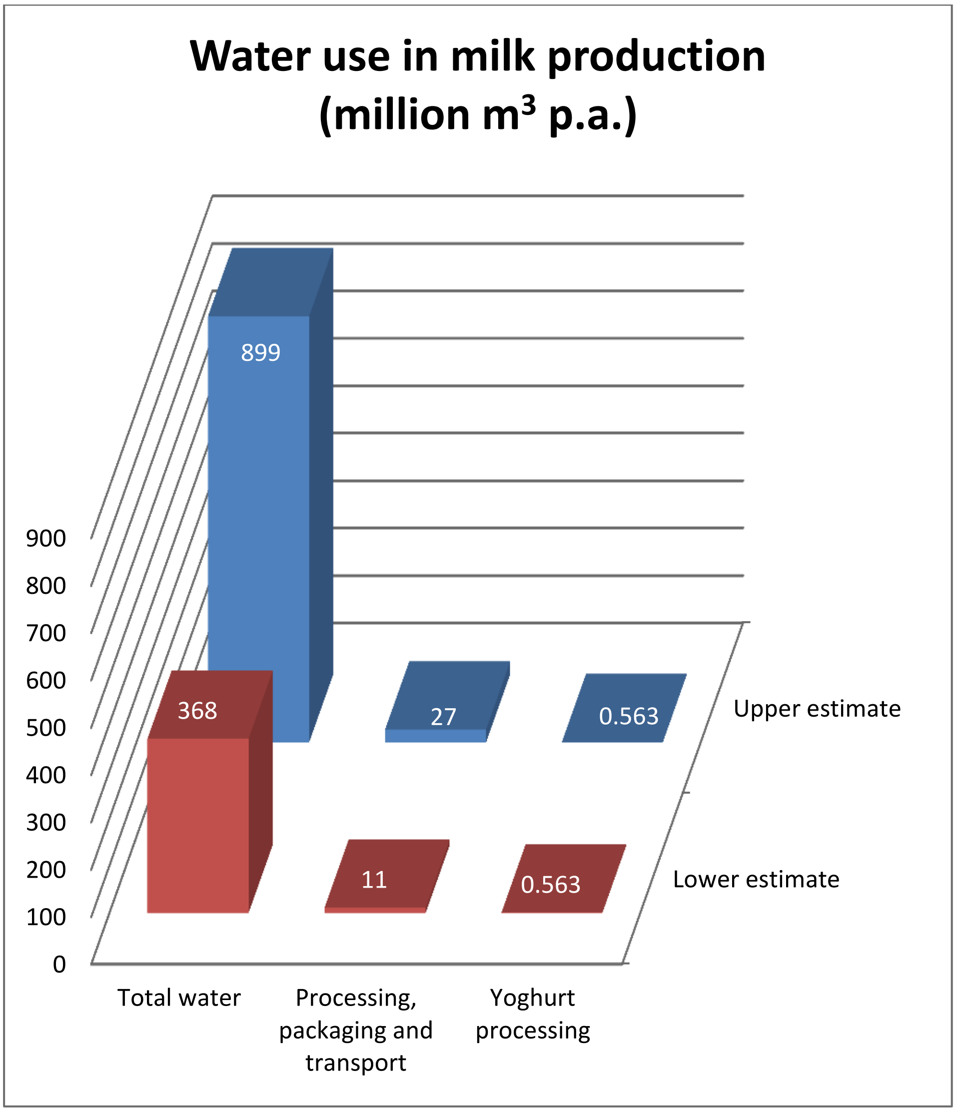


Figure 10.4: Water use in milk production and yoghurt processing

It is clear that most of the water use in dairy production is for pasture and feed. Nevertheless, the Natsurv 4 guideline (1989) indicates that 75-95% of (processing and cleaning) water is discharged as effluent. This represents a potential for recovery and reuse.

The Life Cycle Assessment for Dairy (2011) notes that the total volume of water use is not as important as the percentage of water extracted from the ecological reserve and where the feed comes from (i.e. irrigation requirements). Therefore water sources need to be determined to assess the true ecological impact.

10.5. Drivers of water use in the dairy industry

According to BFAP Baseline Agricultural Outlook 2014-2023, milk production expanded by 30% in South Africa in the past decade and is projected to expand by another 30% through the next decade. Demand for concentrated dairy products (especially cheese) has increased at a higher rate than liquid dairy products. This trend is also expected to continue, at 3.8% per annum (cheese at 6.1% per annum). Demand for liquid dairy products is projected to increase by 2.4% per annum. This increase in demand for dairy products can be expected to increase water use proportionally unless efficiency gains are made in production.

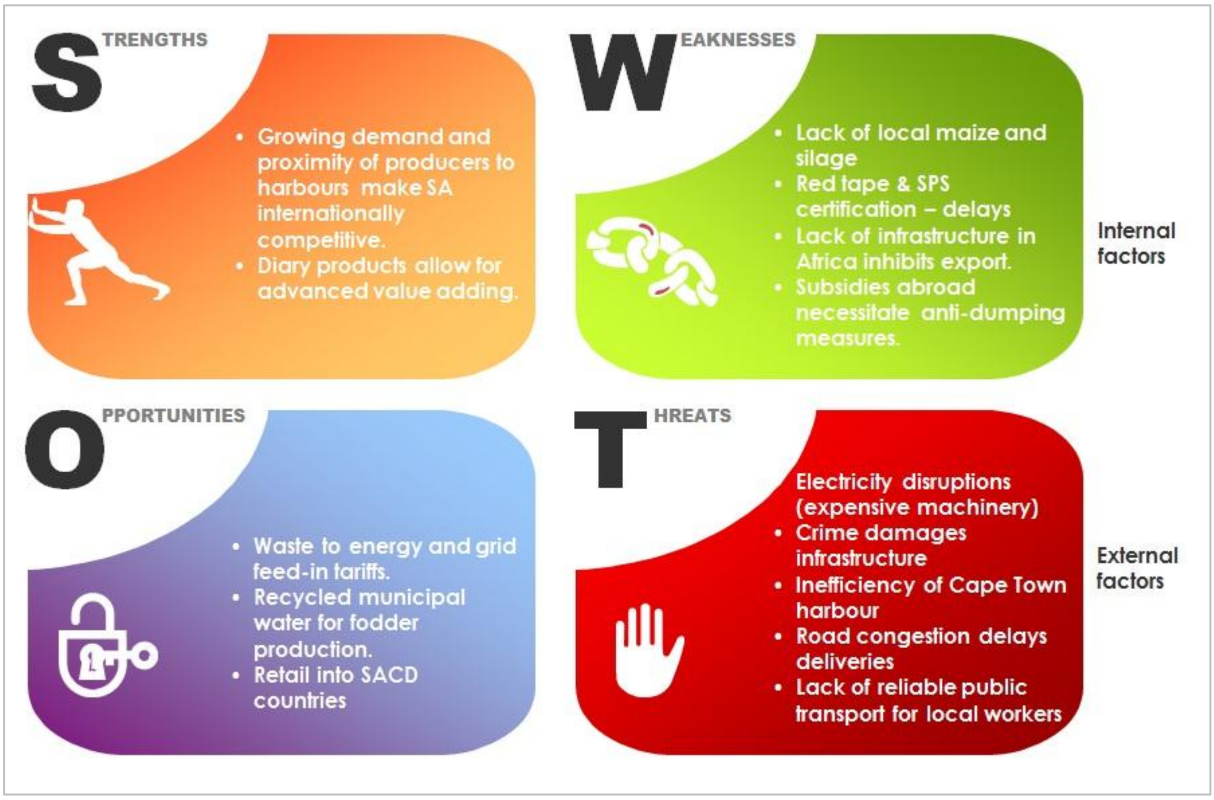


Figure 10.5: SWOT Analysis for the dairy industry within the Western Cape. (Based on an unpublished report, *Deep Dive*, by the WCDoA (2015))

10.6. Conclusions on the dairy industry

The majority of water use in the dairy sector is for feed and pasture production. The environmental impact of this water use needs to be seen in the context of the water sources available and the necessity of maintaining an ecological water reserve. Demand for dairy products is expected to continue to grow but several factors hamper expansion of the market as indicated in the SWOT analysis.

Based on the above estimates, it is calculated that between 368 - 899 billion litres of water were used in milk production in the Western Cape in 2011, including green water. The water requirement for yoghurt production (processing only) is estimated at 563 million litres (563 000 m^3) in the Western Cape.

11. Water Usage for the poultry abattoir industry in the Western Cape

11.1. Background information for the poultry abattoir industry

According to the NATSURV 9 report (WRC report no. TT 43/89), the annual water consumption in the poultry industry in South Africa was 6 000 000 m^3 with the poultry industry growing at 6-7% per annum. About 90% of this is discharged as effluent. The average water consumption per bird was estimated at 17-20 litres. The slaughtering of poultry is a water intensive practice with the largest volume of water being used for cleaning in all process areas of slaughtering. These process areas generally include the reception area, slaughter area, scalding and defeathering, evisceration, chilling, general washing and by-product processing.

From GIS imagery it is found that most abattoirs are located closer to coastal areas with higher mean annual rainfalls, with a few outliers in drier areas (Western Cape, 2015).

The poultry meat industry is the largest contributor to the total gross agricultural production in the country with 17.5% in 2013 and 15.5% in 2014 of total contributions. Income from the poultry meat industry accounted for R 33 810 million of the R218 045 million estimated gross value of agricultural products in the country (Department of Agriculture, Forestry & Fisheries, 2013 and DAFF 2014). The average price for fresh poultry product increased by 7.8%, from R23.66/ kg in 2013 to R25.48 /kg in 2014 (South Africa Poultry Association, 2015).

The value added in the Western Cape Agriculture (14.7 billion in 2011) accounts for 23% of the national agricultural value added (64 billion); the regional economy only accounts for 14.2% of the national GDP. Animal and animal products accounts for 42% of commodities in the province and poultry accounts for 51% of these products (Western Cape Government, 2013).

11.2. Methodology for assessing water use in the poultry abattoir industry

The aim of this project was to gather information in order to determine the water usage for poultry/chicken abattoirs in the Western Cape. The first step was to compile a list of chicken abattoirs with contact details from the Western Cape Department of Agriculture (WCDoA). Once this information was received, the abattoirs were then directly contacted to request information on water usage for the facility, amount of birds slaughtered (in a given time) and the average water consumption per bird. Background research was also conducted on water usage and the value of the poultry industry in South Africa; specifically within the Western Cape.

11.3. Findings for water use in the poultry abattoir industry

Information received by the WCDoA indicates that there are 14 registered poultry/ chicken abattoirs in the Western Cape (Kloppers, personal communication 2015, May 12). During our information gathering exercise it was found while some abattoirs could readily produce information on the number of birds slaughtered, they could not provide information on water usage as they did not monitor this. Many facilities also had no information available at all. The following information for 5 abattoirs in the Western Cape area was obtained:

Table 11.1: Information sourced from five poultry abattoirs in the Western Cape.

Poultry/ chicken abattoir	Average no. of birds slaughtered per month	Estimated water usage per bird
1	338 279	20.31 litres
2	880	
3	30 000	14 litres
4	60 000	
5	150 000	

The table above shows the information gathered via direct communication with five chicken abattoirs in the Western Cape. From our telephonic and email correspondence with the WCDoA (Kloppers, personal communication 2015, May 12), it was found that the average value used for water consumption in chicken abattoirs is estimated at 13-15 litres per bird.

Using the information collected in Table 11.1 and the information gathered from the abattoirs as well as that in the NATSURV 9 report we estimated the average water usage per bird as follows:

Table 11.2: The calculated average water usage per bird in the Western Cape.

Source of information	Water usage per bird in litres
WCDoA	14 (average of 13 &15)
NATSURV 9	18.5 (average 17 & 20)
Poultry/ chicken abattoir 1	20.31
Poultry chicken abattoir 3	14
AVERAGE	**16.7 litres per bird**

Table 11.3: Estimated annual water usage for five poultry abattoir in the Western Cape.

Using this average the volume of water used per abattoir was estimated follows: **Poultry/chicken abattoir**	Average no. of birds slaughtered per month	Estimated water usage per bird (litres)	Estimated water usage per abattoir per month (m^3)
1	338 279	20.31	6 871
2	880	**16.7**	15
3	30 000	14	420
4	60 000	**16.7**	1 002
5	150 000	**16.7**	2 505
Total monthly water usage for 5 abattoirs			**10 812**
Total annual water usage for 5 abattoirs			**129 747**

The number of birds slaughtered per facility varies significantly depending on the size of the facility and therefore water usage per facility will also vary considerably. The water usage per facility is also dependant on the processes and the type of technology used at a facility. Smaller facilities would generally have a higher water usage as they operate on a stop-start basis and do not have the personnel available for intensive water management practices. They also deal with smaller volumes of water and therefore not much consideration is given to water management practices (WRC report no. TT 43/89).

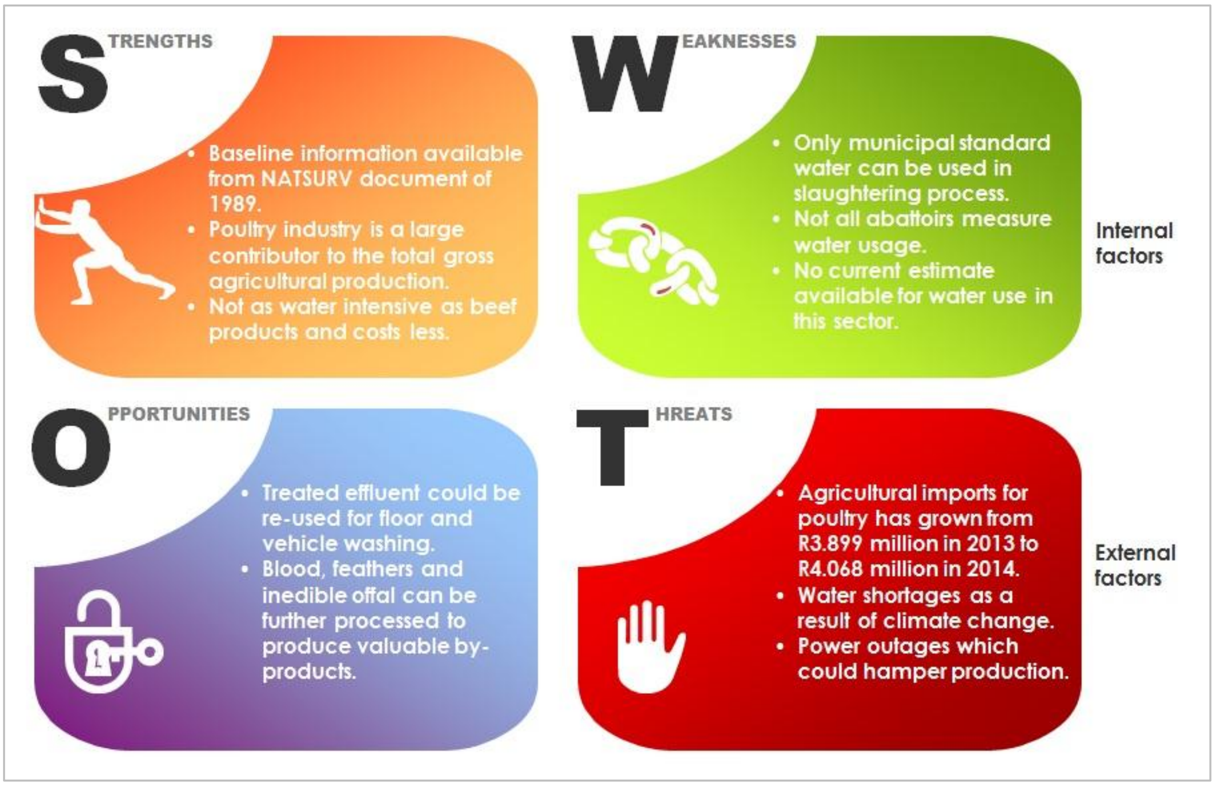


Figure 11.1: SWOT Analysis for the poultry abattoir industry within the Western Cape.

11.4. Conclusions for water use in poultry abattoirs

If the average water consumption for the poultry industry in South Africa in 1989 was 6 000 000 m³ with an annual maximum growth of 7%, then by calculation the average water consumption for 2014 should be 32 564 576 m³. The accuracy of this assumption would be based on water saving technologies in the poultry industry and other water conservation and demand management initiatives put into practice over the last 25 years.

From our calculations, using various sources of data gathered, we found that the mode for water usage for the poultry/ chicken abattoir industry in the Western Cape is estimated at 16.7 litres per bird. Using the information gathered on the amount of birds slaughtered, we find that the water usage for only five of the 14 abattoirs registered with the WCDoA is 129 747 m^3 per annum. By extrapolation the water usage for poultry abattoirs for the Western Cape is 363 292 m^3 per annum.

In order to obtain more accurate figures for water consumption in the poultry/ chicken abattoir industry for the Western Cape more data needs to be gathered from the remaining nine abattoirs. This would assist in estimating a more accurate figure for the average water usage per bird as well as a better overall figure for water usage in the province. It is likely that there are more (smaller) poultry abattoirs in the Western Cape not currently registered with the WCDoA and water usage data from these abattoirs should also be considered in the overall figures for the Western Cape.

12. Agri-processing sector: Livestock Abattoir industry in the Western Cape

12.1. Background information on the livestock industry

The water usage for abattoirs and pasture fed livestock were analysed in the Western Cape region. Potable water is a requirement for many of the processes at abattoirs, as it directly impacts on the quality of the final product. Some of the main uses of water in abattoirs include the product inputs, equipment cleaning, steam generation in boilers, product cooling and general cleaning (Cohen B, et al, 2013).

To a large extent, rainfall patterns in the province influence the type of livestock production. Although sheep and goat farming is found throughout the province, they are more adept to arid regions, like the Central Karoo, while cattle production is mainly located towards the coast. Figure 12.1 depicts rainfall patterns while figure 12.2 depicts distribution of livestock production throughout the province. Notice the correlation of heavy rainfall and cattle farming intense regions.

Figure12.1: Rainfall patterns throughout the province. (Cape Farm Mapper, DoA)

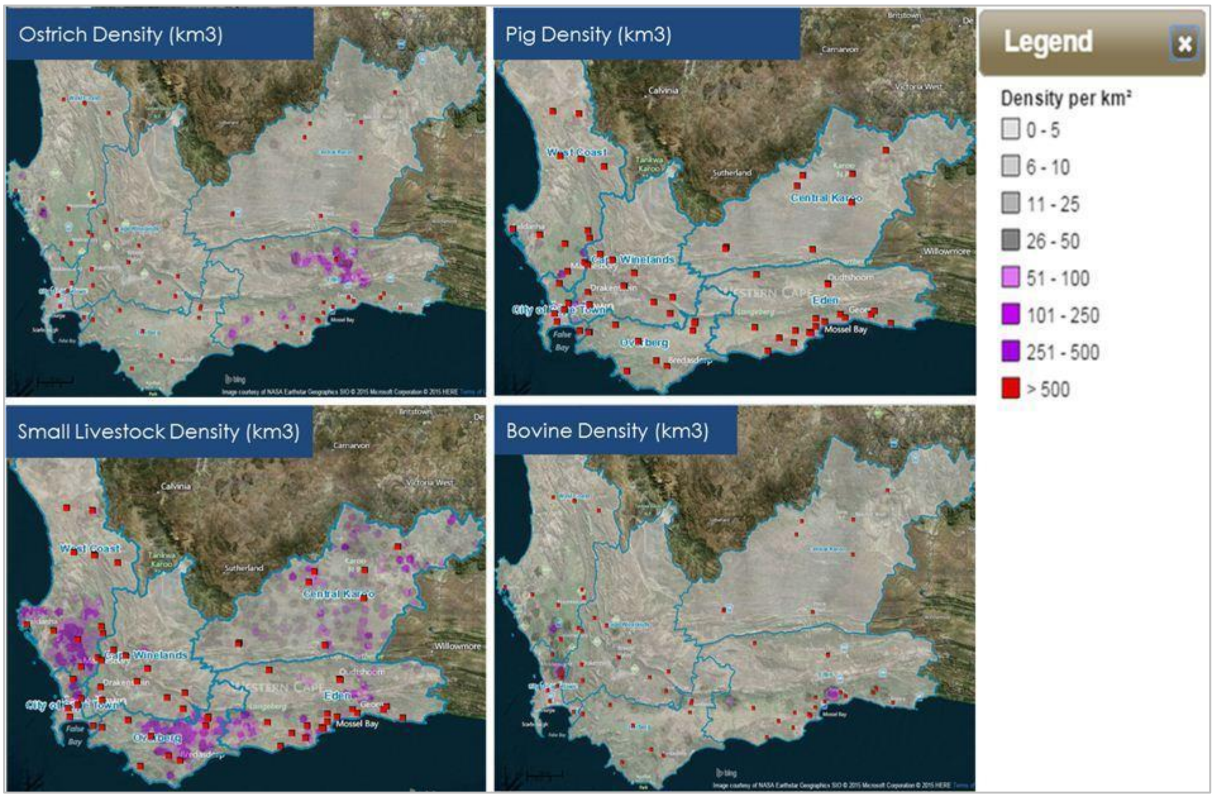


Figure 12.2: Livestock production versus Abattoir distribution in the Western Cape (Cape Farm Mapper, DOA). Red dots are abattoirs and purple indicates high concentrations of livestock.

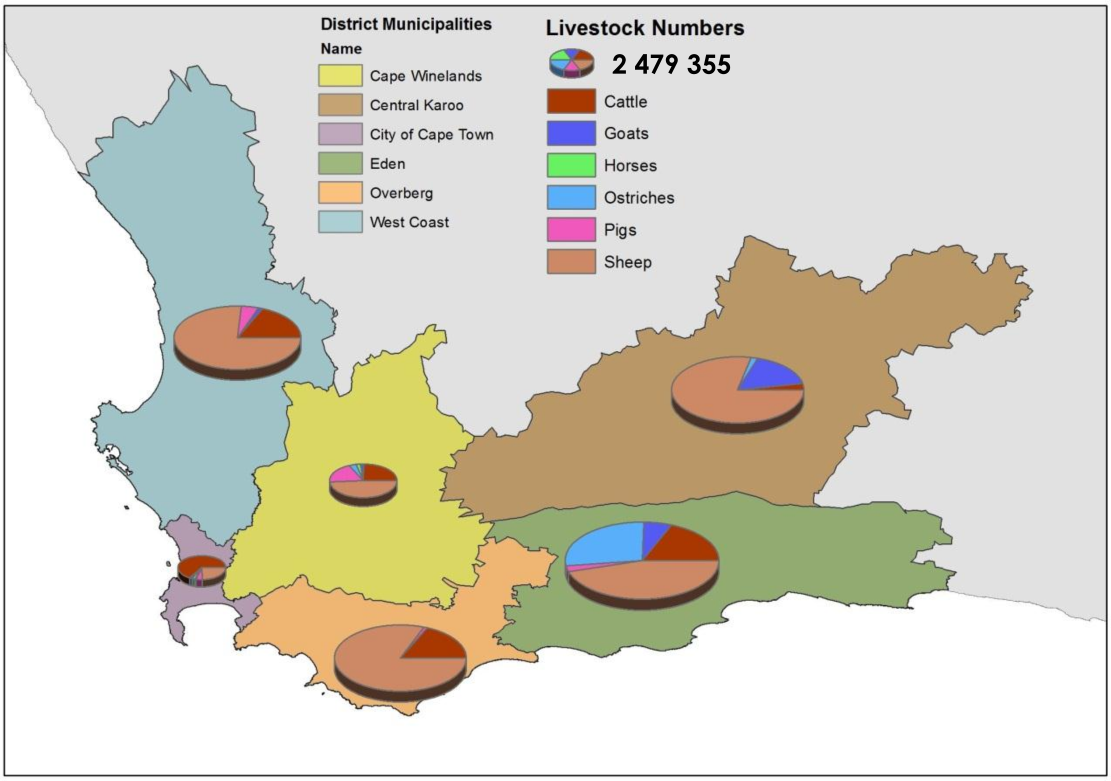


Figure 12.3: Livestock types by percentage split are indicated by district municipality, Aerial Census DoA, 2013

12.2. Methodology for gathering information on livestock abattoirs

The information gathered to ascertain the approximate water use for abattoirs entailed a desktop study utilising agricultural mapping software i.e. Department of Agriculture's (DoA) Cape Farm Mapper (Figure 12.1 and 12.2); Department of Agriculture list of abattoirs registered throughout the Province. In addition, direct communication with abattoirs to verify location and acquire water-use data was completed.

The basic methodology is outlined below:

i. Obtain a list of registered abattoirs within the Western Cape.
ii. Utilisation of Cape Farm Mapper to highlight abattoirs within the Western Cape.
iii. The DoA's Statistics GIS Tool was used to determine the number of abattoirs within the various District Municipalities.
iv. Correlate registered abattoirs with GIS information from Cape Farm Mapper and Statistics Tool
v. Contact individuals (telephone and email) at abattoirs within the various District Municipalities to query the type of animals slaughtered per day versus numbers per species versus water usage.
vi. Analyse available data and produce approximate annual water use within district municipalities.

Literature searches for water usage at abattoirs during slaughtering of various animals were done to correlate data obtained from the contacted abattoirs.

12.3. Findings on livestock abattoirs

There are 60 abattoirs registered with the Western Cape DoA. These abattoirs are not specific to a type of animal slaughtered, i.e., cattle, sheep, pigs and chicken may be slaughtered at one facility. Generally, the process for slaughtering pigs (per animal weight) uses more water than the slaughtering of chickens, sheep and cattle. None of the farmers contacted makes use of ground water for the processing of the animals and they all rely on municipal water. Furthermore, while all the persons contacted knew approximately how many of each specific species animal was slaughtered daily, not all of the facilities kept track of water usage.

Unfortunately, the data gathered from the abattoirs contacted throughout the province could not produce an accurate value for average water usage. This is mainly due to the inability of the facilities to give account of their water usage and the number of responses received. Average water usage at abattoirs in the Western Cape remains inconclusive. As a result, assumptions have been made based on the Red Meat Regulations (Gazette No. 8056, DoA, No. 1072 of 17 September 2004, Meat Safety Act, 2000 No. 40 OF 2000) and on personal communications from the WCDoA, 2015.

Table12.1: Water usage for equivalent quantities of slaughtered animal types - Red Meat and Ostrich Regulations (m^3).

1 Cow/Bull/Ox/Horse/Sausage Pig	0.9
6 Sheep	0.9
2 Calves	0.9
2 Ostriches	0.9
4 Small Pigs or 2 Bacon Pigs	0.9

Water usage for pasture fed animal production could be determined from aerial census data provided by the DoA's Statistics GIS tool. The following graphs demonstrate water consumption of livestock on a Provincial and Local Municipal Level.

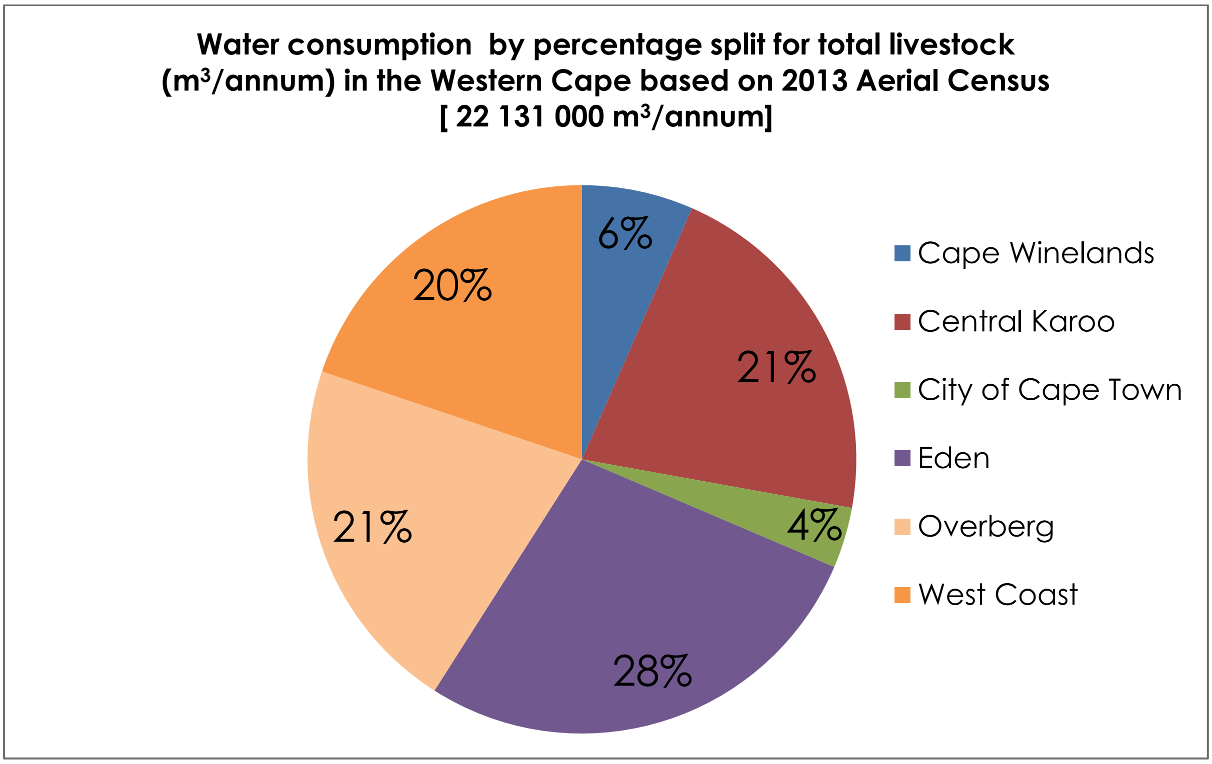


Figure 12.4: Water consumption for livestock in Western Cape.

From analysis of the data, it is clear that total water consumption of pasture fed livestock is almost equally distributed throughout the province, except for the Cape Winelands District Municipality and the City of Cape Town. This could be due to other priority sectors within these districts demanding more water usage, and therefore less livestock production capacity.

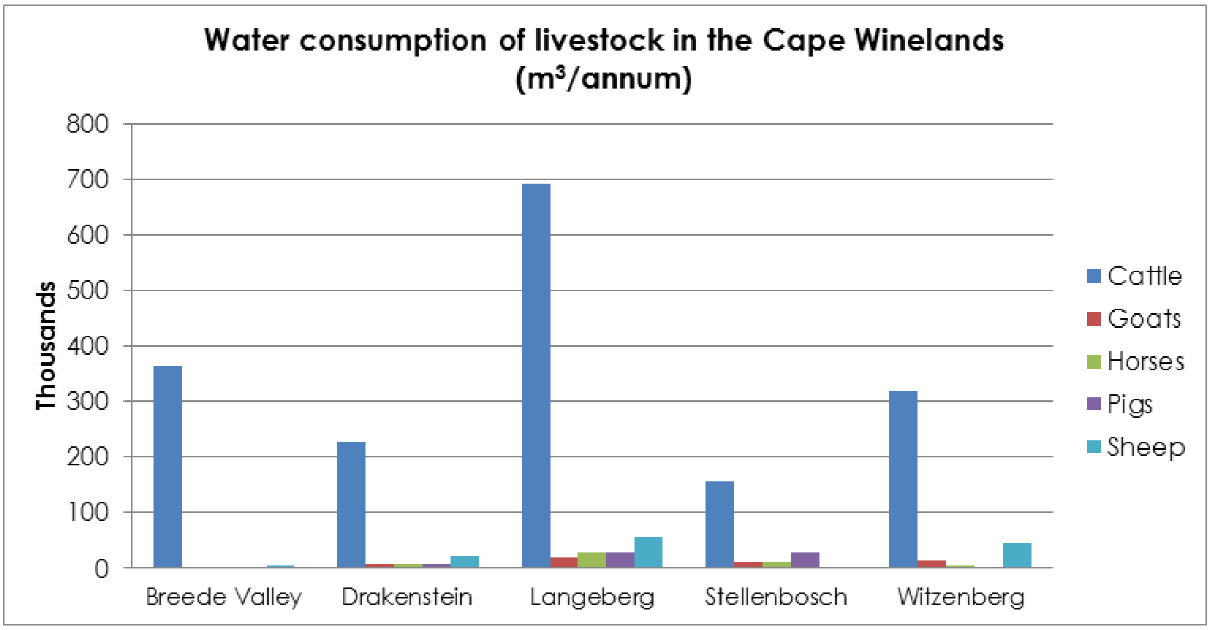


Figure 12.5: Water consumption of livestock in the Cape Winelands

While a diversity of animals are found in the Cape Winelands district, cattle are by far the biggest water consumers in the region, at just under 7 million cubic meters per annum consumed in the Langeberg Municipal area. Analyis of the data further indicates that the presence of livestock in the Cape Winelands is significantly less that other districts and therefore there is lower water consumption by livestock. This is demonstrated in the following graphs.

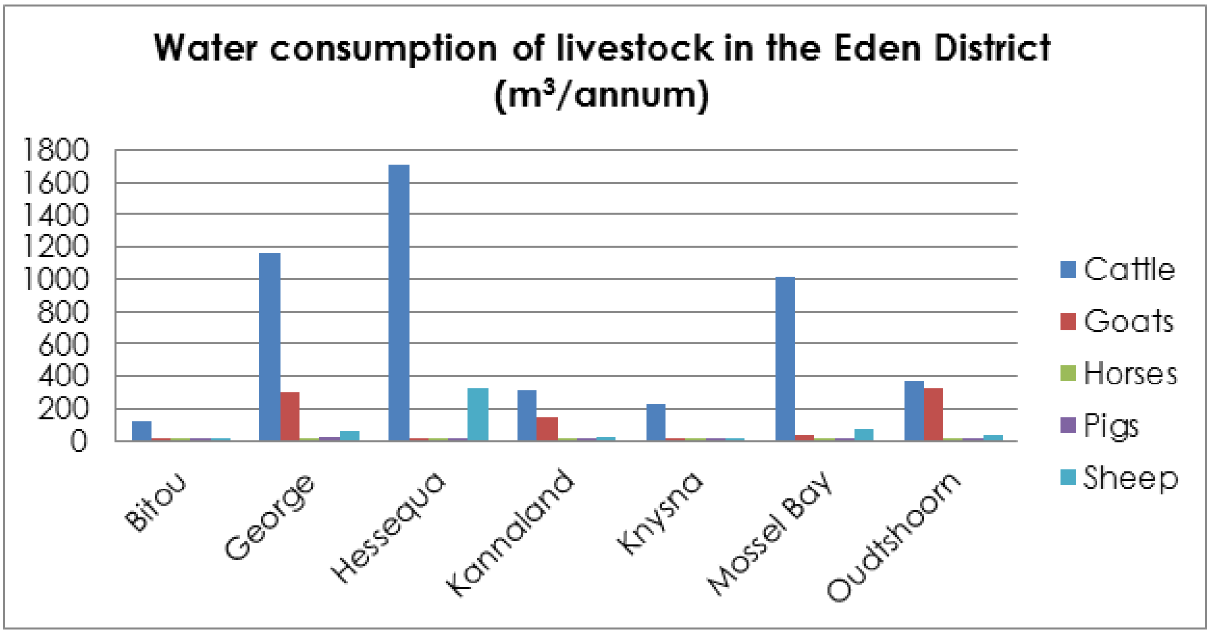


Figure 12.6: Water consumption of livestock in the Eden District

The Eden district shows similar trends than that of the Cape Winelands with regard to diversity of animals produced, however, cattle numbers are much greater here, with an estimated water consumption of 17 million cubic meters per annum in the

Hessequa Municipality. This finding correlates with rainfall patterns and livestock distribution in the province.

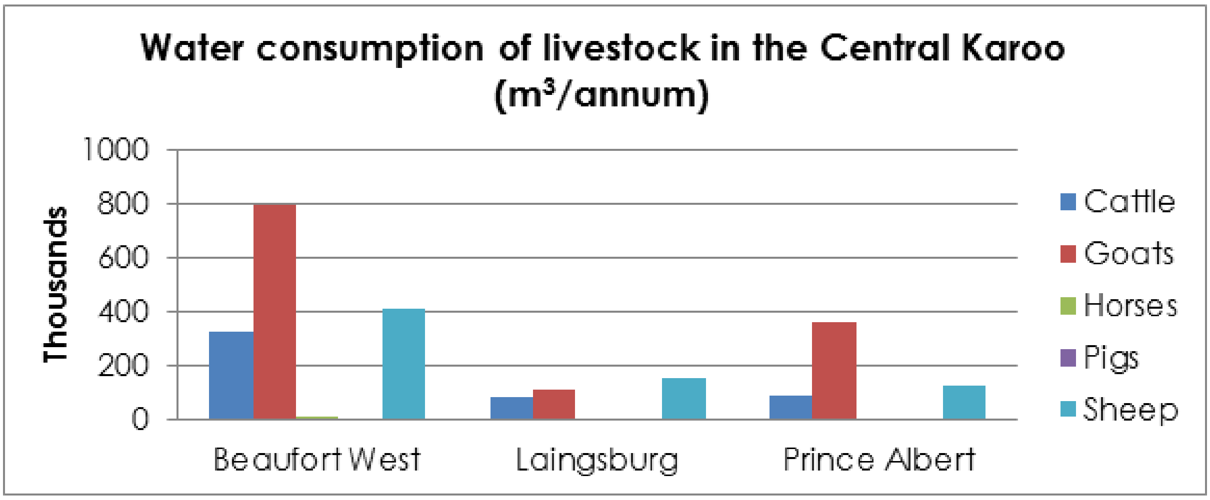


Figure 12.7: Water consumption of livestock in the Central Karoo

In stark contrast to the Eden District, the Central Karoo has a much greater concentration of goats and sheep. Annual water consumption by goats in the Beaufort West is estimated to be 8 million cubic meters.

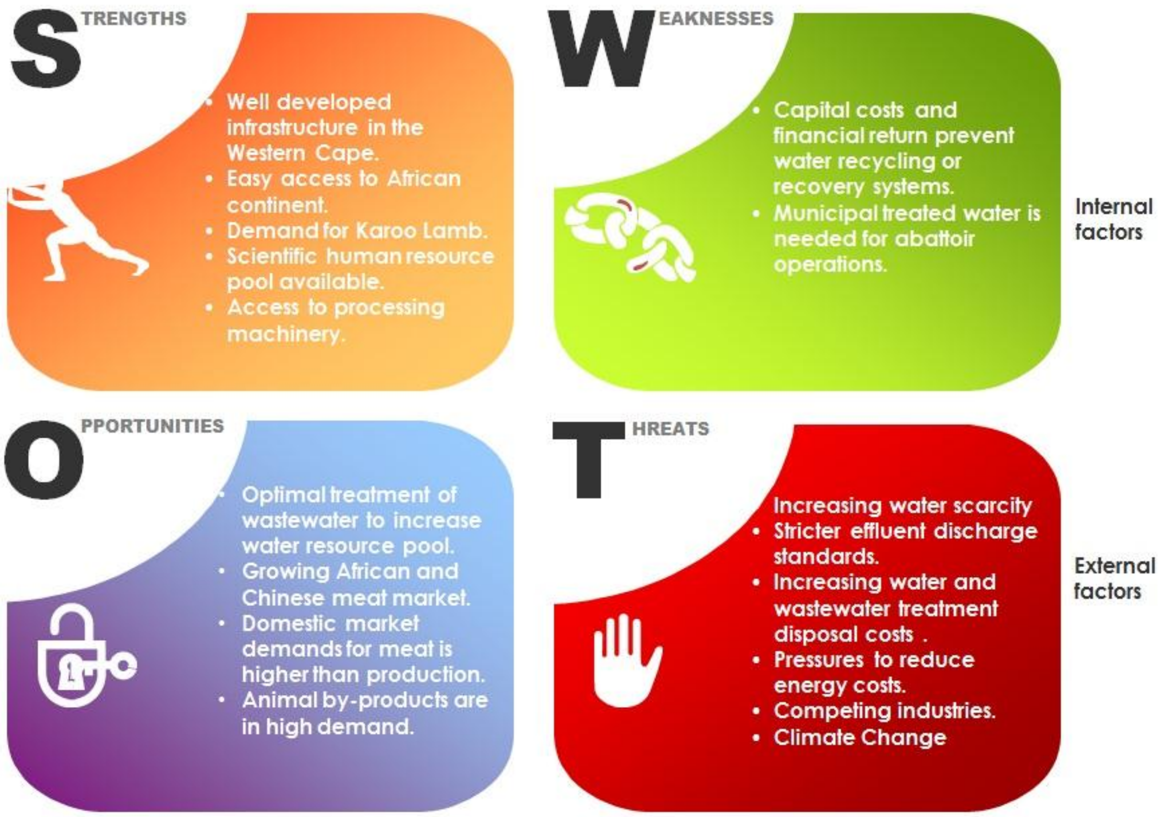


Figure 12.8: SWOT Analysis for the abattoir industry within the Western Cape.

Opportunities for export of animal by-products, raw hides & skins, leather, fur-skins and articles thereof; saddlery & harness; travel goods, handbags & similar containers have increased 331.48% for the period 2012-2013 (Western Cape Provincial Profile, 2014). Live animal and animal product exports increased 19% for the same period which amounted to R3.9 Billion. Furthermore, demand for meat and luxury items in Asia is an extension to the development of the abattoir industry and secondary industries.

While water scarcity and climate change is a great concern to the industry, the growing global demand for meat and meat products should be the incentive for the implementation of water treatment and recovery systems at abattoir facilities.

12.4. Conclusions on livestock abattoirs in the Western Cape

While the average water use of abattoirs remain inconclusive due to facility owners' reluctance to share water usage data; focussing data gathering efforts on municipalities will allow for more complete data sets. None of the farmers contacted makes use of ground water for the processing of the animals and they all rely on municipal water.

The Cape Winelands District Municipality and the City of Cape Town has other priority sectors demanding more water usage, and therefore has less livestock production capacity resulting in less water consumption by livestock in general. The greatest water consumption by livestock is in the Eden district, where cattle herds have the biggest concentration. By stark contrast, the Central Karoo District has very little cattle production capacity. However, water consumption by goats in this region is greater than that of cattle the Cape Winelands. Climate change therefore can have greater impact in the Central Karoo due to high water demand by pasture fed livestock.

Water consumption for livestock in the Western Cape is estimated at 22 131 000m^3/annum. Water consumption by pasture fed animals will increase, should we want the efforts to increase this sector's outputs to succeed. Unfortunately, water saving/reduction has to be conducted at the abattoir level as animals cannot consume less water than what is required for their healthy growth. Stricter policy with regard to effluent volumes and discharge standards by abattoirs, coupled with Government incentives to help implement water saving/reducing technology, should facilitate water saving/re-use to spur on growth of this sector.

13. Overall findings by District Municipality in the Western Cape

This section covers the water availability for agriculture and agri-processing by district municipality and will be the basis for the recommendations for further use of water for possible agricultural expansion.

As shown in figure 13.1, based on the DoA Aerial Census 2013 below, the agri-processing plants, within the demarcated local municipalities, are concentrated in certain areas of the Western Cape, namely the Cedarberg and Berg River, Saldanha, Drakenstein, Stellenbosch, City of Cape Town and Mossel Bay. The agri-processing plants are often in urban areas where supportive facilities and infrastructure is available and yet this hub is close to the agricultural supply.

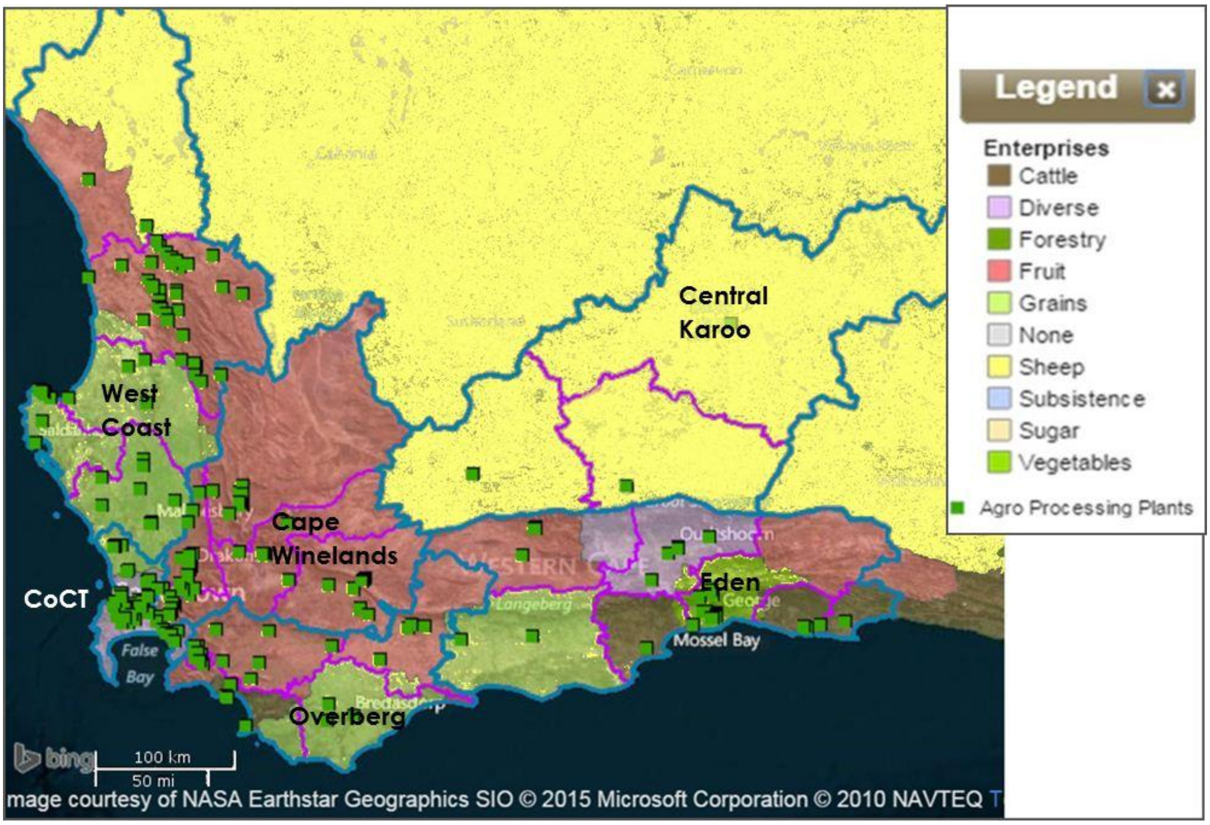


Figure 13.1: The agri-processing plants of the Western Cape, based on the DoA Aerial Census 2013

The water availability by district municipal area has been summarised in the Table 13.1 below, together with the existing and potential crops.

Table 13.1: Water availability affecting agriculture and agri-processing in district municipal areas in the Western Cape

	West Coast	**Cape Winelands**	**Overberg**	**Eden**	**Central Karoo**	**City of Cape Town**
Average Rainfall (mm/annum)	200 - 400	100 - 800	200 - >1200	200 - 1000	<100 - 400	200 - >1200
Municipal Supply Allocation Availability	Exceeding Allocation	Some Water Available	Water Available	Some Water Available Note: Coastal Zones Only	Inadequate Yield	Water Available
Options for Increased Municipal Supply	> Desalinisation > Possibility of Ground Water in certain areas	> TSE* Re-use > Some surface water available	> Groundwater > Some surface water available	> Surface Water > Water Conservation and Demand Management	Limited	>TSE* Re-use >Water Conservation and Demand Mangement >Desalinisation
Ground Water Availability (stress and quality)	Stressed Supply Salinity Levels mixed - high range	Limited Supply Stressed in certain areas Quality - fair	Available Supply Augmenting municipal supply	Limited Supply Varied potential across region	Available Supply Varied stress across the region	Moderately Stressed Supply Predominantly good quality
Existing Dominant Sectors	Livestock Poultry Yoghurt Olive Oil	Fruit Juice Wine & Brandy Poultry Yoghurt Olive Oil Essential Oils	Fruit Juice Wine & Brandy Livestock Poultry Yoghurt Essential Oils	Livestock Poultry Yoghurt Olive Oil Essential Oils	Livestock	Poultry
Sector for Potential Growth	Olive Oil Essential Oils	Berries Fruit Juice Wine & Brandy	Olive Oil Essential Oils	Yoghurt Essential Oils Olive Oil	Livestock Olive Oil	Livestock (Pork) Fruit Juices Speciality Yoghurts
Legend	High Water Use Medium Water Low Water Use					

Note: TSE is treated sewage effluent

For this section on the findings on water availability and agriculture and agri-processing for the district municipal area the following figures in this report are of key importance throughout.

Municipal supply: The potentially available municipal water supply and treated sewage effluent from waste water treatment works, DEA&DP, 2015, figure 3.5

Rainfall: Mean Annual Precipitation for the Western Cape, based on Schulze & Lynch, 2006, figure 3.4

Groundwater availability: Indicator Groundwater Monitoring Graphs and Groundwater Stress Index – Western Cape Region, 2011, figure 4.2

Groundwater quality: Groundwater Quality of South Africa, 2012, figure 4.1

Cultivated areas: Crop type in the Western Cape, figure 5.9

Livestock types by percentage split: Livestock types by district municipality, figure 12.3

13.1. West Coast District

Municipal water supply

The municipal supply is exceeding allocation, as there is little surface water and there is no more surface water, with considerable abstraction from the aquifer. If a desalination plant is developed at Saldanha in the future then this would make more surface water available.

Rainfall

200 to 400mm per annum rainfall is received.

Groundwater availability

The groundwater stress level is from 0.5 to 2.0, where the range is from a lowest level of 0 to highest stress level of 2. This indicates that the ground water yield is poor.

Groundwater quality

The salinity levels of the groundwater is from 0 to 1000 milli Siemens/metre (mS/m) and in the northern side this is >1000 mS/m. It is noted that at an electrical conductivity of 270 mS/m only moderately tolerant crops can grow, with a 90% yield.

Existing agriculture

The West Coast District crop type is predominantly dryland cereals, with the smaller sectors being grapes, teas, vegetable oils, vegetables and citrus. The area is dominated by dry land grains. The livestock is predominantly sheep at 75% and then made up of cattle at 16%. This livestock represents 20% of the Western Cape's livestock. The total livestock for the Western Cape is approximately 2.48 million (own calculations, DoA Aerial Census, 2013).

Potential agriculture

The potential crops are as dryland essential oil plants, particularly on the slopes of Piketberg, where only a little irrigation will be required to establish these. Another possibility is olive trees, where partial treated sewage effluent (TSE) is available, particularly near the Saldanha region. There is a net import into South Africa of olives, so there is an internal market for olives. Although there are no real phytosanitary concerns with irrigating olives with TSE, this may not be accepted by some external markets.

As the groundwater is extremely valuable in the West Coast District care needs to be taken not to contaminate this water source, in effluent management practices, such as from waste water treatment works (WWTWs) and feed lots. The sandy soils of the West Coast District are extremely permeable, which poses an additional risk to groundwater.

13.2. Cape Winelands

Municipal water supply

The municipal supply is from ground water and surface water. In the south east of the Cape Winelands the water abstracted is exceeding supply, while in the south west the position is more tenable with a deficit only expected in 5 to 10 years time. Where TSE is being treated to discharge standards, this return to the Berg River is calculated as part of the water flow for irrigation allocations.

Rainfall

There is considerable variation in rainfall with the western side receiving 600 to 800mm, the central to eastern part 200 to 400mm per annum and the north eastern side 100 to 200mm per annum.

Groundwater availability

There is current ground water use. In certain areas there is limited supply and water stress at levels of 0.5 to 2.0.

Groundwater quality

The ground water quality is good, for crop growth/ animal management, however on the western side the salinity level is higher. The salinity levels are linked to the flushing of the geological shale formations with the higher levels of precipitation.

Existing agriculture

There is a domination of wine, although increasingly table grapes are being planted. Cereals and fruit, both pome and stone, are the remaining dominant sectors. Of the livestock 49% are sheep, 25% cattle and 17 % pigs, however this is only 7% of the livestock of the Western Cape (own calculations, DoA Aerial Census, 2013). A warning is given in this report about feedlots which are close to the rivers and their tributaries, as bacteriological, phosphate and nitrate contamination of the water can occur if effective effluent management is not followed. This caution would apply to all agricultural areas as a global caution, however in this context we think especially of the need to manage the water quality of the Western Cape.

Potential agriculture

It is considered that the Cape Winelands offers opportunities for further fruit juice plants and speciality fruit processing. There is the potential for the development of the high value berry market, such as blue berries and pomegranates. The wine industry could invest further in the specialised area of brandy making.

13.3. Overberg

Municipal supply

There is a manageable supply of water for the most part with a deficit expected in greater than ten years. This supply is also dependent on ground water which could be further exploited, as the groundwater stress level is 0 to 0.25. In the north east corner there is an inadequate yield of municipal water, as well as the allocation being exceeded. The demand for municipal water use along the coast from tourists in the summer is very high, although it is understood that the tourists contribute to the economic well-being of the area.

Rainfall

The eastern side receives 200 to 400mm, the western side 400 to 600mm and the extreme west 1000 to 1200mm per annum.

Groundwater availability

There is the potential for groundwater development with a low water stress level of 0 to 0.25.

Groundwater quality

There is a range of ground water quality, although north of Bredasdorp area the salinity is higher at >1000mS/m

Existing agriculture

Theewaterskloof municipality is supplying water for fruit growth. The crops are predominantly dryland cereals and the vegetable oils. Of the livestock 16% are cattle, 82% sheep and 1% pigs in the Overberg District Municipality. This represents 21% of the livestock of the Western Cape (own calculations, Aerial Census DoA, 2013).

Potential agriculture

In the Overberg District Municipality fruit processing could be further developed in the Theewaterskloof area. There is the potential for further olive growth and olive processing. Essential oils could be grown in dryland areas.

13.4. Eden District Municipality

Municipal supply

The Klein Karoo is very dry and there is an inadequate yield in some places. Along the coast there is generally an adequate supply of water, with a deficit only being envisaged in more than ten years.

Rainfall

The southern half of Eden District Municipality receives 400 to 1000mm of rainfall, while the northern half receives far less at 200 to 400mm rainfall per annum.

Groundwater availability

The Klein Karoo is drawing off groundwater which would contribute to the higher water stress levels of 0.5 to >2.0. There is potential for groundwater extraction, with 0 to 0.25 stress levels, below the Klein Karoo towards the coast, although Plettenberg Bay, and Stillbaai to Gouritzmond are groundwater stressed, with levels of 0.5 to 2.0.

Groundwater quality

There is a range of groundwater quality with salinity levels indicated by a range of conductivity of 70 to 1000mS/m.

Existing agriculture

Eden has 28% of the Western Cape's livestock, with 16% cattle, 47% sheep and 2% pigs for the district municipal area. This indicates that Eden is carrying the highest numbers of livestock in the Western Cape. The crops are predominantly dryland cereals and then also the vegetable oils.

Potential agriculture

It is considered that Eden District Municipality with its towns in Mossel Bay and George is well suited for specialist agri-processing relating to the meat and dairy industry. This could include special preparations for the Halaal market and well as the dairy industry sectors, such as yoghurt. The potential for further poultry development is a possibility, although with the import of lower value cuts of poultry, particularly from the United States, this is considered a risk. In the Klein Karoo there are olive orchards and these could be expanded. Essential oil crops could fill in some of the smaller crop areas. The national highway, the N2, runs through these towns, enabling fast transport to the cities eastwards, Port Elizabeth and East London, as well as westwards to Cape Town.

13.5. Central Karoo

Municipal supply

There is an inadequate yield of municipal water in certain parts, such as Beaufort West, however it is considered that this town could further exploit its groundwater, as the stress level is only at 0.25 to 0.5. Beaufort West is attempting to improve its high levels of non-revenue water. This town is already using treated sewage effluent as an additional water source. In other parts of the Central Karoo there will be a water deficit in some towns in 0 to 5 years.

Rainfall
There is a low rainfall of 100 to 200 mm per annum, accompanied by a high level of evaporation.

Groundwater availability
The groundwater is predominantly in the lower level of water stress in a range from 0 to 0.25. In the Leeu Gamka area there is a ground water stress of greater than 2, and Beaufort West, as described above, from 0.25 to 0.5.

Groundwater quality
The groundwater quality shows a salinity level with a conductivity from 70 to 300mS/m, rising to 300 to 1000mS/m east of Beaufort West. The question arises as to why there is little ground water abstraction on the western side of the Central Karoo. Is it possible that the ground water is too deep so there is a high cost implication for this water abstraction.

Existing agriculture
The Central Karoo has 21% of the Western Cape's livestock. Sheep predominate at 79% of the livestock, with goats following at 16%. Cattle at 2% are of lesser importance. The level of pigs is very low at 0.2%.

Potential agriculture
There is the potential in the Central Karoo for the development of beef cattle, using breeds that are well adapted to the dry conditions. Possibly the veld has already reached carrying capacity. The high levels of goats suggest the possibility for the expansion of certain goat's milk products and cheeses to the market. This would involve direct marketing to consumers in the supermarkets, as these would probably be products which are unknown to potential buyers. Goats milk cheese products are probably a high end market product. Clothing fashions do change but there is also the opportunity for exploration around the attractive organic look of home spun, dyed and created goats and sheep fibre jerseys.

13.6. City of Cape Town

Municipal supply
There is a high amount of treated sewage effluent from the large and numerous waste water treatment works that still need to be exploited. The prognosis of a deficit of municipal water in 5 to 10 years reflects a better position than a number of other towns in the Western Cape.

Rainfall

The rainfall is predominantly from 400 to 600mm per annum, with areas having 1200mm per annum.

Groundwater availability

There are high levels of existing registered abstraction. Predominantly the water stress for ground water is recorded at 0.5 to 2.00, which indicates a moderately stressed system.

Groundwater quality

The salinity levels of the ground water are predominantly recorded at 70 to 300mS/m conductivity. The northwest area of Blouberg in the City of Cape Town, has a much higher salinity level of water of 300 to 1000mS/m.

Existing agriculture

The crop types are made up of 50% cereals with the remainder being grapes, vegetable oils and vegetables. The City of Cape Town has only 4% of the livestock of the Western Cape, where 64% are cattle, 24% sheep and 6 % pigs (own calculations, DoA Aerial Census 2013). Poultry also exists as an important sector in the City of Cape Town.

Potential agriculture

There might be the possibility in the City of Cape Town of developing the free range sector of the poultry market further, although market research would need to be undertaken to show whether this is feasible in terms of demand. It is thought that unique products can be developed in agri-processing, such as speciality yoghurts. Also where certain social groupings whether local or for the export market, have dietary requirements, such as the Halaal market this could be catered for in the Cape Town metropole.

14. Conclusions for water availability and agriculture and agri-processing in the Western Cape

14.1. The importance of local knowledge for decision making

While this report has made broad observations about water availability and agriculture and agri-processing in the Western Cape it is important that there is a local approach for decision making. To make good local water allocation decisions accurate information on the water use and availability and agricultural need at the time is needed. The overall drivers with reference to potential availability or loss of water should be known. There needs to be an awareness of areas where there is water stress, for any given cause, such as population growth, or natural factors relating to ground water quantity or quality or precipitation levels affecting surface water or groundwater recharge.

14.2. The consideration of the effect of the agricultural activity on water quality

Water quality aspects of the agricultural activity need to be taken into account, while thinking of the sensitivity of the area and the other aspects such as the needs of downstream users. What for instance would be the effect on the environment of piggeries situated close to a river and how should the effluent be managed? The processing of fresh olives create high levels of brine and acidic vinegar which the creation of olive oil does not do. Olive oil production requires less water than the production of fresh olives. In any area the brine and vinegar used in the production of fresh olives needs to be carefully managed. Similarly, solutions need to be designed for the effluent from dairy feedlots.

14.3. The exporting of water in the form of agricultural products, such as fruit and wine

Consideration needs to be given to food security for South Africa – and which products are necessary for this? If the global warming pattern for the Western Cape proceeds as predicted then rainfall is expected to decrease as higher rainfall moves east. Will cereals which are part of the staple diet of the poorer community be able to be sustained without irrigation? Should more water be allocated to vegetables as part of food security? Does some allocation need to be made for the future in keeping with the need for food security in relation to potential global warming patterns? Does the agricultural sector of the Western Cape need to manage the amount of water it allocates for future food security, as compared with the water it exports in the form of agricultural products such as wine and fruit? Furthermore how should job security and agricultural risk in emerging markets be managed, while finding the balance of looking after existing jobs and also growing jobs and local wealth?

15. Recommendations for water availability and agriculture and agri-processing by District Municipality in the Western Cape

- The export of water in the form of agricultural products such as fruit, and wine needs to be carefully managed in relation to the need to ensure food security for the Western Cape.
- Water allocation decisions for agriculture and agri-processing need to minimise the further pollution of the rivers of the Western Cape and take into consideration the needs of the water users downstream. Abstractions of water need to accommodate the ecological reserve requirement, ensuring that rivers continue to sustain aquatic life and to reach the sea.
- Climate change patterns predicted by climate scientists, might cause a shift of the precipitation eastwards. Forward thinking needs to minimise over allocation of water in the Western Cape, given that possibly in the future current dryland cereals might need to be irrigated to ensure that staple food requirements are met.
- From our investigation water availability in the West Coast, Central Karoo and Little Karoo area of the Eden District is limited. By contrast in Overberg, Eden coastal, Cape Winelands and the southern region of the Western Cape, including City of Cape Town there is potentially water available for further use. In the City of Cape Town there is an opportunity for the use of treated sewage effluent as a source of water. This could possibly be used to replace irrigation water which could free up some water for agri-processing. Consideration needs to be given to the planning and development of appropriate water related infrastructure.
- This report provides a broader view of water availability and agri-processing opportunities, however it is important to consider the detail of the local situation for agri-processing and agriculture and the water constraints associated with this.
- There is low groundwater stress on the western side of the Central Karoo, which suggests that there could be further abstraction, given the low levels of registered boreholes. Possibly there are more boreholes than shown in figure 4.2, as there is no requirement for the registration of schedule 1 use in terms of the National Water Act, 1998 (Act 36 of 1998). The recommendation is for small scale water usage, although larger usage might be a possibility. Any agri-processing or agricultural development as already recommended, requires a local analysis of the water constraints.
- In the West Coast District Municipality dryland essential oil plants, particularly on the slopes of Piketberg, where only a little irrigation will be required to establish these are recommended. Another possibility is olive trees, where partial treated sewage effluent (TSE) is available, particularly near the Saldanha region.

- It is considered that the Cape Winelands offers opportunities for further fruit juice plants and speciality fruit processing. There is the potential for the development of the high value berry market, such as blue berries and pomegranates. The wine industry could invest further in the specialised area of brandy making.
- In the Overberg District Municipality fruit processing could be further developed in the Theewaterskloof area. There is the potential for further olive growth and olive processing. Essential oils could be grown in dryland areas.
- It is considered that Eden District Municipality with its towns in Mossel Bay and George is well suited for specialist agri-processing relating to the meat and dairy industry. This could include special preparations for the Halaal market and well as the dairy industry sectors, such as yoghurt.
- There is the potential in the Central Karoo for the development of beef cattle, using breeds that are well adapted to the dry conditions. Possibly the veld has already reached carrying capacity. The high levels of goats suggest the possibility for the expansion of certain goat's milk products and cheeses to the market.
- There might be the possibility in the City of Cape Town of developing the free range sector of the poultry market further, although market research would need to be undertaken to show whether this is feasible in terms of demand. It is thought that unique products can be developed in agri-processing, such as speciality yoghurts. Also where certain social groupings whether local or for the export market, have dietary requirements, such as the Halaal market this could be catered for in Cape Town.
- Strategic long-term planning is required for the release of water from major water infrastructure projects such as the raising of the Clanwilliam Dam wall and the Brandvlei Dam system.

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