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# Trends and Outlook: Agricultural Water Management in Southern Africa **COUNTRY REPORT SOUTH AFRICA**

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## Acronyms

ADA	Agri-business Development Agency
AMD	acid mine drainage
ANC	African National Congress
ARC	Agricultural Research Council
ARDC	Agricultural and Rural Development Corporation
AWC	Arthur W. Creighton
CAADP	Comprehensive African Agricultural Development Program
CASP	Comprehensive Agricultural Support Programme
CMA	Catchment Management Agency
CSFP	Comprehensive Farmer Support Programme
CSIR	Council for Scientific and Industrial Research
DAFF	Department of Agriculture, Forestry and Fisheries
DEA	Department of Environmental Affairs
DWA	Department of Water Affairs
FANR	Food, Agriculture and Natural Resources [Division]
FAO	Food and Agricultural Organization of the United Nations
GDP	Gross Domestic Product
ha	hectare
IWMI	International Water Management Institute
LBPTC	Lesotho Basic Permanent Technical Committee
LHWC	Lesotho Highlands Water Commission
LPL	lower-bound poverty line
mg/l	milligram per liter
NEPAD	New Partnership for Africa's Development
NGO	non-governmental organization
NSK	Nordelike Sentrale Katoen
NTK	Noord Transvaal Kooperasie [North Transvaal Cooperative]
O&M	operation and maintenance
OTK	Oos Transvaal Kooperasie [East Transvaal Cooperative]
pa	per annum
PPP	Public Private Partnership
PTO	Permission to Occupy
PWC	Permanent Water Commission
RAP	Regional Agricultural Policy
RDP	Reconstruction and Development Programme
ReSAKSS – SA	Southern Africa Regional Strategic Analysis, Knowledge and Support Systems
RESIS	Revitalisation of Smallholder Irrigation Schemes
RSA	Republic of South Africa
RSAP IV	Regional Strategic Action Plan IV



SADC	Southern African Development Community
SAPWAT	South African Procedure for estimating irrigation WATER requirements
SPI	standardized precipitation index
TCTA	Trans-Caledon Tunnel Authority
TPTC	Tripartite Permanent Technical Committee
UPL	upper-bound poverty line
USAID	United States Agency for International Development
WARMS	Water Authorisation, Registration and Management System
WMA	Water Management Area
WRC	Water Research Commission
WSA	Water Services Authority
WSDP	water services development plan
WSP	Water Services Provider
WTE	Water Trading Entity
WUA	Water User Association

## Acknowledgements

This report is one of the outputs of the research project ‘Trends and Outlook: Agricultural Water Management in Southern Africa’. This research project was implemented by the Southern Africa Regional Program of the International Water Management Institute (IWMI) as part of the Southern Africa Regional Strategic Analysis, Knowledge and Support Systems (ReSAKSS - SA) project. The study covers agricultural water management at the regional level, with a focus on national agricultural water management in Malawi, South Africa, Zambia and Zimbabwe. A team of researchers has contributed to the project’s realization: M. Akayombokwa, Y. Altchenko, P. Chilonda, T. Dlamini, H. Gemo, M. Hanjra, J. Jiyane, F. Kalibwani, I. Kumwenda, G. Lacombe, J. Lautze, S. Madyiawa, G. Matchaya, M. Matete, A. Mishra, J. Mutiro, C. Nhemachena, S. Nhlengethwa, J. Stevens, B. van Koppen, K. Villholth, C. Xueliang and C. Zawe.

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# 1 Introduction

## 1.1 Agricultural water management for poverty alleviation and sustainable growth

About 70 percent of citizens of the Southern African Development Community (SADC) depend on rainfed agriculture for their livelihoods (SADC 2003). Moreover, enhanced and sustainable development of this sector is the engine of improved economic growth, socio-human development, food and nutrition security and alleviation of poverty (SADC 2014a). Broad-based agricultural growth with agriculture-based industrialization can replace the extractive, capital-intensive and often ‘jobless growth’ path as currently persists in SADC’s dual economies. Inclusive agricultural growth not only contributes to national food security at affordable prices, export and foreign currency; it also creates employment for the rapidly growing new generations, narrows the wealth gaps, and stabilizes SADC’s young democracies.

However, rain fed agriculture is directly exposed to the hazards of climate. SADC’s rainfall patterns are characterised by high and unpredictable variability over the seasons, years, and decades. Moreover, Southern Africa is predicted to warm up faster than the rest of the world (IPCC, 2014). It is one of the few regions in the world that will experience significantly drier conditions, more extreme and unpredictable dry spells, droughts, and floods, while sea levels will rise faster here than elsewhere. These increased temperatures and less predictable, more variable extreme events hold SADC’s farmers and economy ‘hostage to hydrology’. This is also true where average rainfall is abundant. These predictions of long-term climate-induced changes render the need for ‘no regret’ measures today even more urgent.

A key ‘no regret’ measure that turns these climate hazards into opportunities is improved agricultural water management, or ‘agwater management’. Agwater management encompasses a broad menu of techniques ranging from improved on-field water harvesting and soil moisture retention to year-round water storage for year-round fully controlled irrigation of crops, trees and livestock feed; improved water supplies for livestock; and the development of fisheries and aquaculture. Agricultural water management was a vital component in Asia’s Green Revolution to boost the ‘trickle-up’ growth path through poverty alleviation (Jazairy, 1992).

The CAADP of the African Union’s (AU’s) New Partnership for Africa’s Development (NEPAD) recognized this unlocked potential throughout Africa by prioritizing the first of its four pillars, that of ‘Sustainable Land and Water Management’. In pillar one, African states committed to the doubling of irrigated area from the 3.5 percent at the time to 7 percent by 2015 (CAADP 2009).

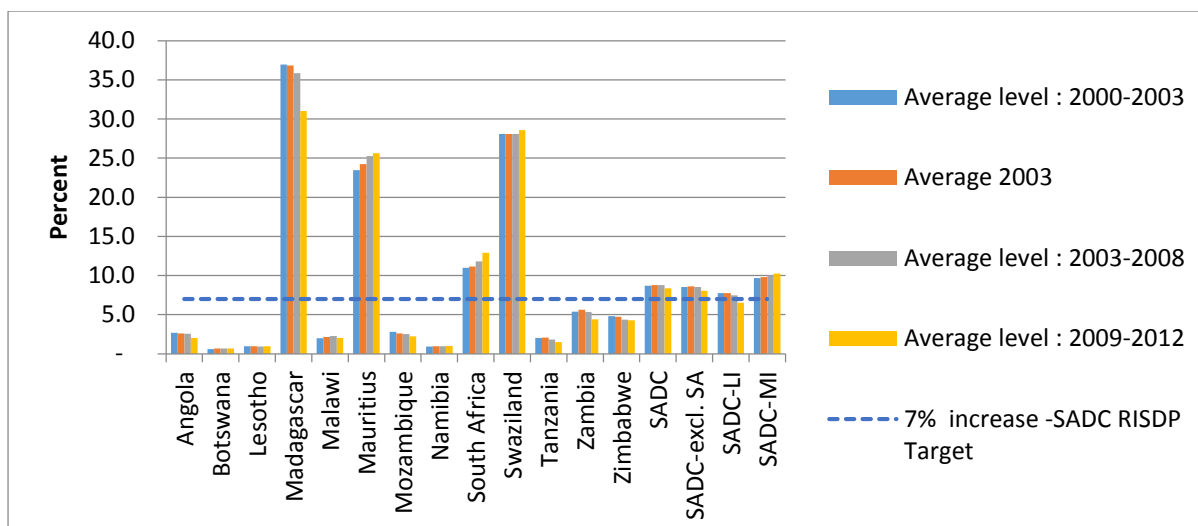
SADC's Regional Indicative Strategic Development Plan (2003, revised in 2007 and 2015) re-affirms CAADP goals, including pillar one. SADC operationalizes this through both its Water Division and the Food, Agriculture and Natural Resources (FANR) Division. The SADC Regional Agricultural Policy (RAP) (SADC 2014a) envisages the improvement of the management of water resources for agriculture (SADC 2014a, section 10.5). In the results framework, outcome 1.4 foresees that water infrastructure for agriculture is expanded and upgraded. The RAP commits to assess the effective utilisation of existing irrigation infrastructure and to promote new infrastructure development (SADC 2014a, section 16.1 (75)). In terms of monitoring, the RAP results framework signals the need to provide baseline data on the number of dams, irrigated area and irrigation management practiced in the SADC region (SADC 2014b).

The Regional Strategic Action Plan IV (RSAP IV) (SADC 2015), which is based on the SADC Water Policy (2006) and Strategy (2007) aims at 'An equitable and sustainable utilization of water for social and environmental justice, regional integration and economic benefit for present and future generations'. Noting that there is about 50 million hectares (ha) of irrigable land available within the SADC Region of which only 3.4 million ha (7 percent) is currently irrigated, the RSAP IV emphasizes the importance of infrastructure development and water resource management for food security in the water-food nexus, and the stronger urgency to take action in the view of climate variability and change. RSAP IV also highlights the benefits of multipurpose dams for both energy and irrigation. At local level, SADC Water commits to conduct action-research to develop and sustainably implement resilient water-related infrastructure; and to innovate affordable and appropriate technologies and innovative approaches and practices. Priority interventions are the demonstration and upscaling of community-based water for livelihoods projects (SADC 2015).

## 1.2 Trends in irrigated area

In spite of the major unlocked potentials and strong policy commitments, the average percentage of arable land in SADC has only slightly increased from 7.6 percent in 1990 to 8.4 percent in 2012 according to the Food and Agricultural Organization of the United Nations (FAO's) AQUASTAT (see Figure 1). A peak was reached a decade earlier. Moreover, the high average percentage of irrigated land is largely the result of irrigation by large-scale agribusiness in only four countries (Madagascar, Mauritius, South Africa and Swaziland). Moreover, both smallholder irrigation in South Africa and irrigated land area in Madagascar declined.





**Figure 1: Irrigated area as proportion of arable area**

Source: FAO AQUASTAT

This raises a pertinent question: why is irrigation expansion stagnating, and how can this be turned around? Unfortunately, there is no systematic regional body of knowledge to analyze these trends and provide answers. As the Regional Agricultural Policy observes, there is not even a base line on irrigation management practiced in the region, neither for the upgrading of existing infrastructure nor for new investments.

Moreover, in spite of the clearly related common goals of the Water and FANR divisions in SADC and in national states, forums to bring these sectors and other relevant stakeholders together are rare. Potential synergies between sectors that would allow each sector to better achieve its goals remain untapped.

The present study on ‘Trends and Outlook: Agricultural Water Management in Southern Africa’ seeks to fill these gaps. The project is part of the ReSAKSS – SA project, implemented by the Southern Africa Regional Program of the IWMI. It is supported by USAID’s Feed the Future Program through USAID’s Southern Africa Regional Program. At the interface of both water and agriculture, the IWMI is well placed to enable such dialogue and provide a robust knowledge base on inclusive agricultural growth in general, and agwater management in particular.

### 1.3 Study aim and method

In order to explain the current stagnation and find ways to overcome this, the following questions will be answered:

- What are the precise hydrological hazards of climate variability and change, and what is the meaning of ‘water scarcity’ for agriculture in SADC?

- What lessons can be learnt from past and current investments in agwater management in SADC, in particular from their strengths and weaknesses in sustainably contributing to poverty alleviation, food security and agricultural and economic growth?
- How can SADC and national government, non-governmental organizations (NGOs) and donors build on these strengths and overcome weaknesses?
- What are the untapped synergies between the public sector agencies with mandates in agriculture and those with mandates in water management, so that both sectors can achieve their goals more effectively?

The method to answer these generic questions consisted of both an extensive literature review and analysis of past performance (Mutiro and Lautze 2015), as well as interviews with key stakeholders at SADC and national levels. Further national studies with illustrative in-depth case studies were conducted in four selected countries: Malawi, South Africa, Zambia and Zimbabwe. This report is the Country Report for South Africa.

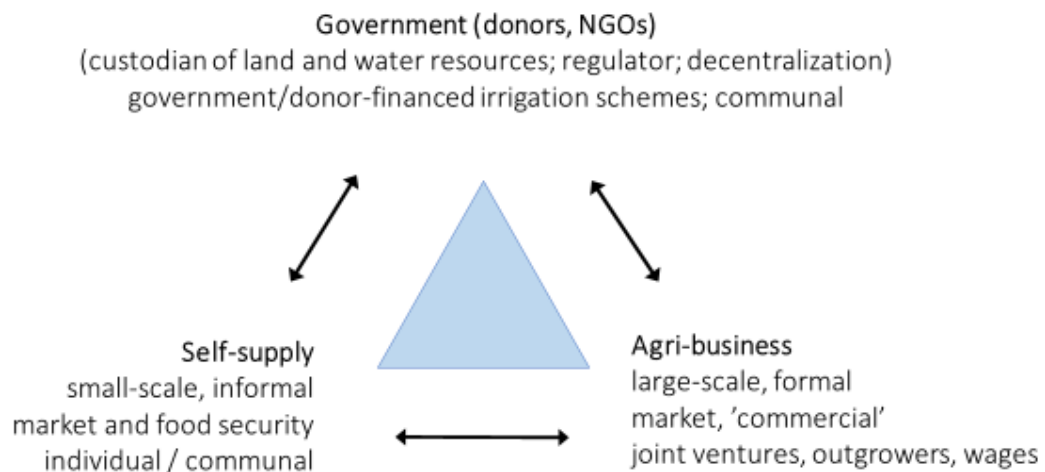
The Synthesis Report and the four country reports of the Trends and Outlook: Agricultural Water Management in Southern Africa Project are available at [www.iwmi.org](http://www.iwmi.org) - Southern Africa Regional Program.

#### 1.4 Definitions and research approach

Agwater management encompasses a wide range of interrelated hard- and software measures to ensure that the right quantities of water of the right quality reaches the right sites of agricultural (and other) uses at the right time. Improved water control enables crop diversification, stabilizes and increases crop yields, and enables more cropping seasons, including the slack and hunger seasons. Storage in dams or in 'green infrastructure' (such as recharged aquifers or managed wetlands) attenuates floods. Hardware typically includes (combinations of) infrastructure to harvest and store precipitation and run-off water by recharging aquifers, to convey and apply water, and to drain excess water. This study focuses primarily on water supply to crops through infrastructure that extends beyond in-field soil and water conservation alone.

There are various classification systems of agwater management – and even more blends: by source (well, surface storage, stream, wetland, groundwater); by technology (which often determines the scale as well); by ownership and/or management either by individuals or communal groups; by plot size and/or scheme size; by goal of investment and type of beneficiaries (household food security; marketing); by formal or informal in terms of formalized, written and state-backed rules; whether privately invested in capital costs and/or operation and maintenance (O&M), and rehabilitation, or by government, NGOs or otherwise; etc.

## Classification based on investments in water infrastructure



**Figure 2: Classification of types of investments in irrigation based on types of investors**

For the present purpose of learning lessons for investments, we build on the latter; so the main criterion to distinguish the different types of irrigation is: who is the main investor in the construction and installation of infrastructure? Capital costs are usually the most expensive part of irrigation. Moreover, claims to the water stored and conveyed tend to go together with investments in the infrastructure and subsequent maintenance ('hydraulic property rights creation') (Coward 1986). As we will see, although their performance varies widely, each type is quite specific in terms of the historical and political-economic context in which it emerged and continues to exist, and its strengths and weaknesses in contributing to poverty alleviation and socio-economic growth.

The first type of irrigation investments are by governments, both before and after independence. International donors and financiers typically work through governments, while most NGOs also work in close collaboration. Government- or NGO-financed schemes are typically collective schemes. They may be accompanied by resettlement at local or wider scales. The involvement of government can range from very strong (in government-run schemes) to a role that is limited to design and financing of the infrastructure construction and sometimes rehabilitation, leaving all other tasks to communities. In addition to investing in infrastructure, governments also play unique roles as regulator and custodian of the nation's land and water resources in SADC's evolving resource tenure systems. Governments influence the next two types of irrigation in both capacities.

The second type of irrigation investments are by citizens – also known as self-supply – where citizens are the key investors in infrastructure for their own benefits. That is done by

individuals or groups, and often is seen as informal. Adaptation to climate variability through these investments has been at the heart of agrarian societies' survival since time immemorial. One strategy for people is move to and from water through their settlement patterns. Both farmers and pastoralists look for the better-watered areas with better rainfall and fertile soils throughout the seasons, also using receding floods and water that accumulates in valley bottoms or entire floodplains for dry season cropping and grazing. People's other age-old strategy is to make water move to them, which requires investments in infrastructure. Household wells provide groundwater for domestic uses, livestock, and small-scale production at and around homesteads. Free gravity energy has long been tapped in mountainous areas in river-diversions, sometimes with night storage. These are typically for domestic uses, irrigation, brick making and other uses. The availability of new appropriate technologies boosts innovation. Multi-purpose infrastructure is the rule; single uses are the rare exception, because rural (and peri-urban) people have multiple water needs, and multi-purpose infrastructure is more cost-effective. People also use and re-use the changing multiple water sources for greater environmental resilience.

The public sector plays a role in supporting technology development and uptake, for example by stimulating market-led equipment supply chains. The Regional Agriculture Policy (SADC 2014a) promotes the removal of import tariffs on equipment for that reason. Effective forward and backward linkages as a result of broader agricultural support for inputs, marketing and skills development are a key 'pull' factor to convince farmers to invest in infrastructure. Further, government's land and water policies, laws and regulations also affect investments for self-supply.

The third type of investments in infrastructure are those by agri-business. Colonial settlement and state formation was largely shaped around this type of investment, and it forms the basis for SADC's dual economy of highly mechanized, often export-oriented large-scale farming; alongside largely manual smallholder agriculture, lack of electricity, poverty and unemployment. The financial crisis of 2008 fuelled further foreign or national investments in SADC's abundant land and related water and mineral resources, also dubbed as 'land and water grabs' (Mehta, 2012). Governments play key roles in these investments through their national investment policies, public-private partnerships and, especially, their post-colonial custodianship of both land and water resources.

In South Africa with its specific colonial history, the dominant form of agricultural production is by this last form of investors: medium- to large-scale farming. These capital-intensive farms cover most of the country's 12.7 million hectares (ha) that are cultivated (which is 10 percent of the total land area). Slightly more than 1.3 million ha of this cultivated land (i.e. 10 percent) is under irrigation (DAFF, 2010). Only an estimated 3 percent of these are irrigation schemes in the former homelands, cultivated by smallholders. The Sections two to six (by Joe Stevens of the University of Pretoria) provide a detailed national analysis of what is largely

agri-business agriculture and overall water resources availability and sectoral uses, water policies, laws, institutions and investments and national food security, nutrition and poverty. The case study in Section seven focuses on the Flag Boshielo (smallholder) Irrigation Scheme in a former homeland of one of the poorest provinces: Limpopo Province (by Barbara van Koppen, IWMI). Four comparative small case studies were compiled by Janane Jiyane and Barbara van Koppen.

## 2. Water resources

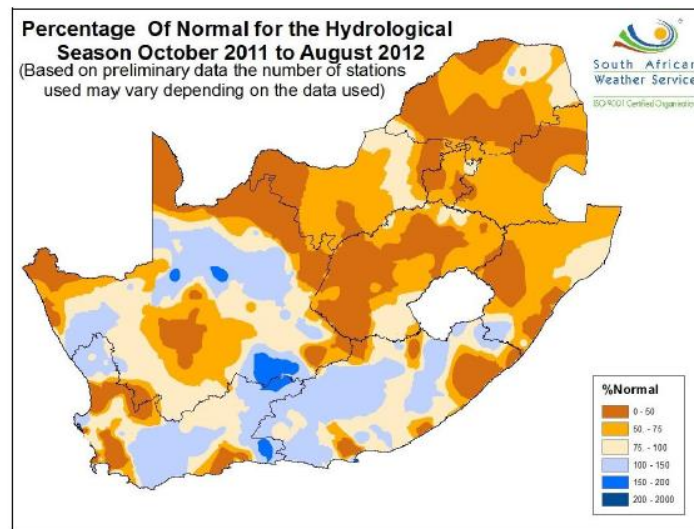
Water is a common thread that connects the three critical issues of food, energy and climate change. It is one of the key focus areas in enabling growth and development, and plays an important role in the green economy. Water is essential for social and economic developments and for the maintaining of healthy ecosystems. Sustainable economic development is only possible if we recognise the limited capacity of ecosystems to supply the necessary water needed for agriculture, industry, energy, generation and the production of many goods and services required by society. The National Development Plan: Vision 2030 identifies water as a strategic resource that is critical for social and economic development (National Planning Commission, 2011).

### 2.1 Climate

Climate includes processes such as precipitation or rainfall, evaporation and temperature that are variable, and can have important implications on runoff, dam storage levels, and supply of water for domestic purposes, rain-fed agriculture, groundwater recharge, forestry, and biodiversity, as well as for maintaining or changing sea levels. A reduction in rainfall or its variability and an increase in evaporation due to higher temperatures have impacts on the country's scarce water resources. The climate varies from desert to semi-desert in the west to sub-humid along the eastern coastal areas. The natural availability of water across the country is highly uneven due to the poor spatial distribution of rainfall. This is compounded by the strong seasonality of rainfall over virtually the entire country, and the high within-season variability of rainfall.

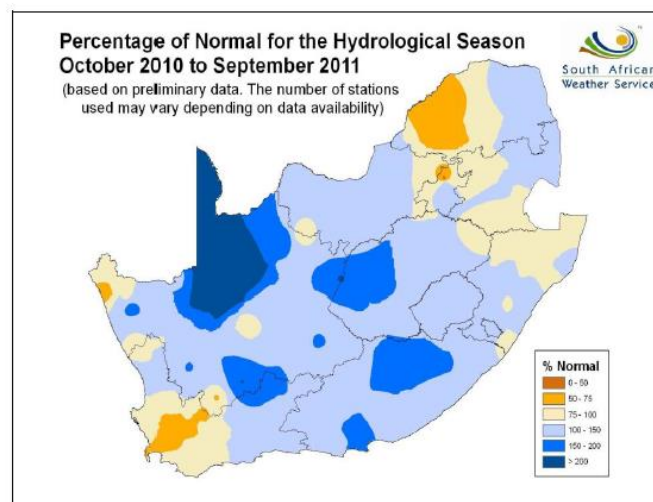
The country's average annual rainfall is 450 mm per year, well below the world's average of 860 mm, while evaporation is comparatively high (Stats SA, 2010). Only 10 percent of the country receives an annual precipitation of more than 750 mm, and approximately 62 percent of South Africa's water resource is used for agricultural purposes. Rainfall in South Africa has a water supply potential per capita of just over 1 100 m<sup>3</sup> pa. Both commercial farming and especially subsistence farming may be affected by less availability of water owing to adverse climate change. This is expected to vary across the different agro-climatic zones, provinces and different agricultural systems in the country. In general, less rain was received during the 2011/12 hydrological year (Figure 3) as compared to the previous period of

2010/11 (Figure 4). The central part of the country receives its rain mainly in summer. However Figure 3 shows that the central interior experienced heavy rainfall in June; this could be a contribution of changes in climate. Figure 3 shows that approximately half of the country experienced dry to very dry conditions. Only parts of Western, Eastern and Northern Cape Provinces received fair rainfall. The month of May was the driest month as almost the whole country received very little or no rain (Figure 3).



**Figure 3: Percentage of normal rainfall for the hydrological season 2011/12**

Source: SAWS in DWA undated



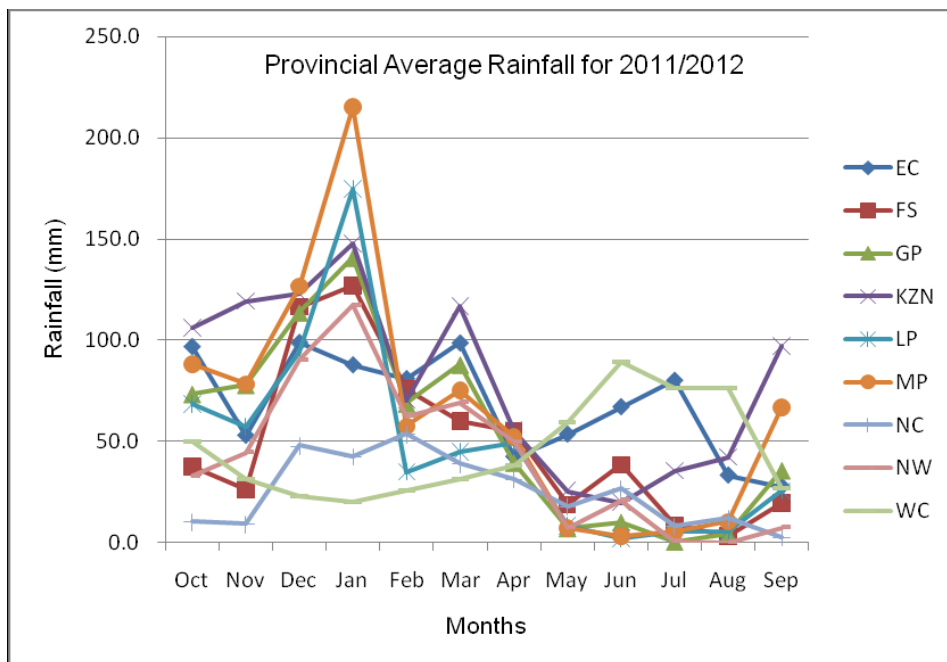
**Figure 4: Percentage of normal rainfall for the hydrological season 2011/12**

Source: SAWS in DWA undated

Figure 5 shows the average provincial rainfall for 2011/2012, and according to this figure most provinces experienced high rainfall during the months December and January 2011/2012. Mpumalanga and Limpopo Provinces received the most during January as a result of the tropical cyclone Dando, which caused floods during that time. KwaZulu-Natal



was hit by tropical cyclone Irina in March, resulting in the high rainfall. The Western Cape received the highest rainfall during June-August as it was expected as the southern-western region of the country receives winter rainfall.



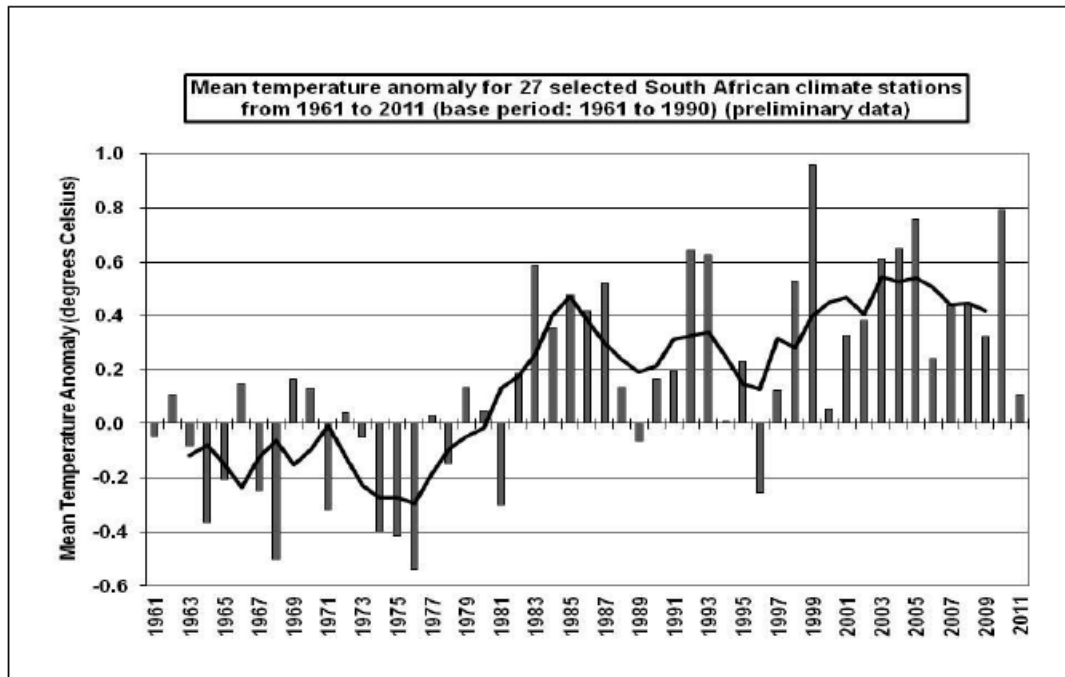
**Figure 5: Provincial average rainfall (mm) for the period of October 2011 to September 2012**

Source: DWA undated

The rainfall trend, per province, over an 11 year period, is showing a downward trend in rainfall as of 2001-2009. The country received the least rain ( $\geq 40$  mm pa) between 2005 and 2009, with the exception of the Western Cape which received between 60-80 mm pa.

## 2.2 Temperature

There has been a noticeable increase in temperatures across the country in the past 40 years. During the summer months of 2011/12, temperatures greater than 26 °C were observed in the Northern Cape, North West, Limpopo and northern parts of KwaZulu-Natal Provinces (SAWS, 2014). The winter months saw temperatures soaring to below 10 °C, resulting in some parts of the country experiencing cold conditions and snow fall. The statistical evidence is showing that South Africa is getting hotter over the past four decades. Kruger and Shongwe (2004) analyzed climate data from 26 weather stations across the country (Figure 6). Of these, 23 showed that the average annual maximum temperature had increased, in 13 of them significantly. Average annual minimum temperatures also showed an increase, of which 18 were significant. In general, their analysis indicates that the country's average yearly temperatures increased by 0.13°C per decade between 1960 and 2003, with varying increases across the seasons: fall 0.21°C, winter 0.13°C, spring 0.08°C and summer 0.12°C. There was also an increase in the number of warmer days and a decrease in the number of cooler days.



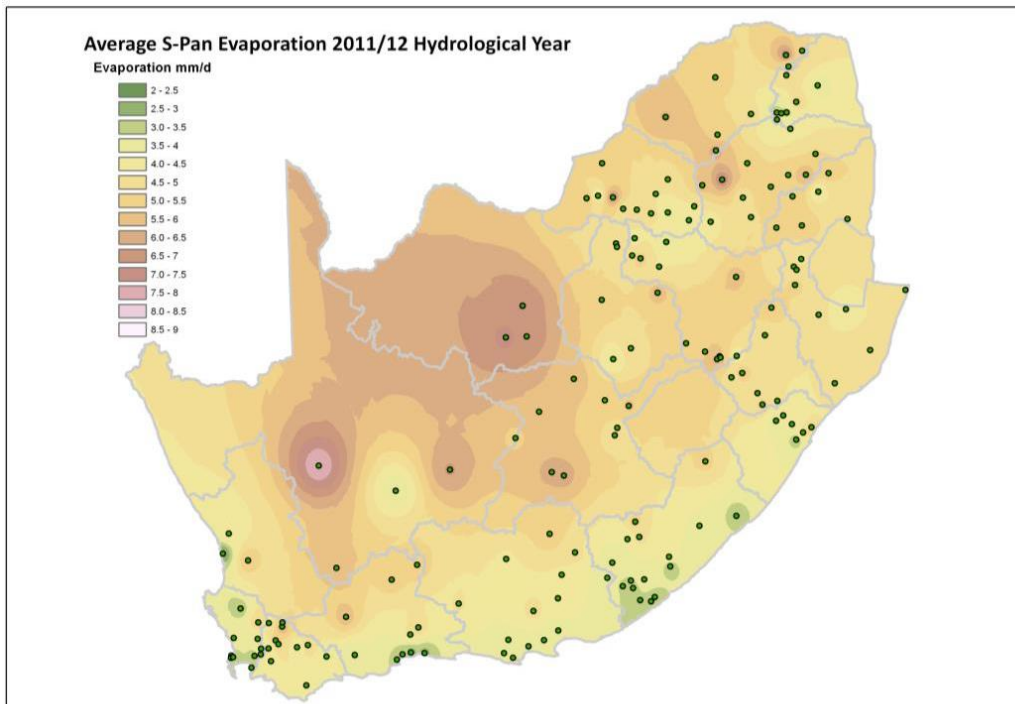
**Figure 6: Annual mean temperature anomalies (base period 1961-1990) of 27 climate stations in South Africa**

Source: Kruger et al 2012

These changes in temperature, together with the already scarce water resources in the country are expected to have a significant effect on all sectors of the economy, in particular agriculture. For example, anecdotal evidence suggests that climate change could lead to a fall of about 1.5 percent in the country's gross domestic product (GDP) by 2050 – a fall roughly equivalent to the total annual foreign direct investment in South Africa at present. Moreover, climate change and the resulting loss of biodiversity could do irreparable damage to the country's tourism industry, which is worth an estimated R100 billion/pa (about USD 10 million).

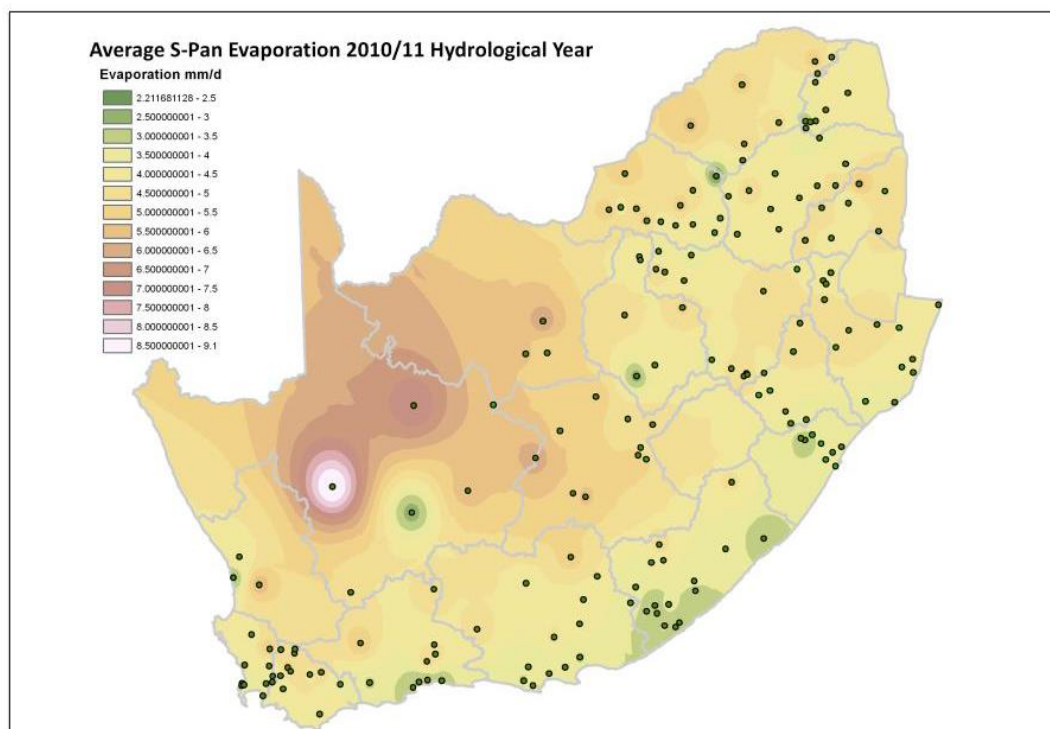
### 2.3 Evaporation

As shown in Figures 7 and 8, evaporation appears to have increased over a wide area in South Africa. In 2011/12 the Lower Orange and Lower Vaal Water Management Areas (WMAs) being the most affected and Limpopo to some extent. In 2010/11, the most affected area was in the Lower Orange WMA. The high evaporation in these areas can be linked to very high temperatures between January and March 2012.



**Figure 7: Average S-pan evaporation 2011/2012 hydrological year**

Source: DWA undated



**Figure 8: Average S-pan evaporation 2010/2011 hydrological year**

Source: DWA undated

## 2.4 Surface runoff and water availability

The surface runoff is the total amount of water from precipitation flowing into a river or a stream or the sum of the direct run off and base flow. Direct runoff is the sum of surface and interflow (Stats SA, 2010). About one third of the precipitation that falls over the land runs into streams and rivers and is returned to the oceans. The other two thirds is evaporated, transpired or infiltrates into groundwater. The drainage, vegetation, land use and soil types have an influence on runoff. Also human factors such as urbanisation and development can reduce infiltration. In South Africa the construction of drainage networks, removal of soil and vegetation (degradation) and cultivation of land surface, increase the runoff volumes and shorten runoff times into streams and rivers. During the period 2011/2012 the surface runoff was generally lower than previous years, except for the southern and Western Cape, as these areas experienced heavy winter rains which caused flooding in July 2012 (DWA, 2013b).

South Africa experiences uneven spatial distribution and seasonal rainfall as illustrated, and therefore some of the country's catchments and water management areas are experiencing water stress. The uneven distribution of rainfall together with the rapid population growth (approximately 52 million people (Stats SA, 2013) and economic development are exacerbating the problem of adequate supply. Approximately 9 500 km<sup>3</sup> pa of the total requirements for water of 12 871 km<sup>3</sup> pa is abstracted from the surface water resources, while the remainder comes from groundwater, the re-use of return flows and the interception of water by afforestation. Total requirements therefore represent approximately 20 percent of the total Mean Annual Runoff of 49 040 km<sup>3</sup> pa. A further 8 percent is lost by evaporation from storage and conveyance along rivers, and 6 percent through land use. Approximately 66 percent of the Mean Annual Runoff country wide remains in the rivers. The temporal flow distribution of the remaining water has been significantly altered as a result of upstream regulation and use, and it therefore no longer reflects the characteristics of the natural stream. It however fulfils the substantial requirements of the Ecological Reserve and the downstream international commitments.

### 2.4.1 National water storage levels

Generally, the surface water resources are highly developed over the country, with about 350 major dams and many smaller storage dams, having a total capacity of more than 37 000 km<sup>3</sup>, or more than 66 percent of the Mean Annual Runoff. This includes the draining of Lesotho (4 800 km<sup>3</sup> pa) and Swaziland (500 km<sup>3</sup> pa).

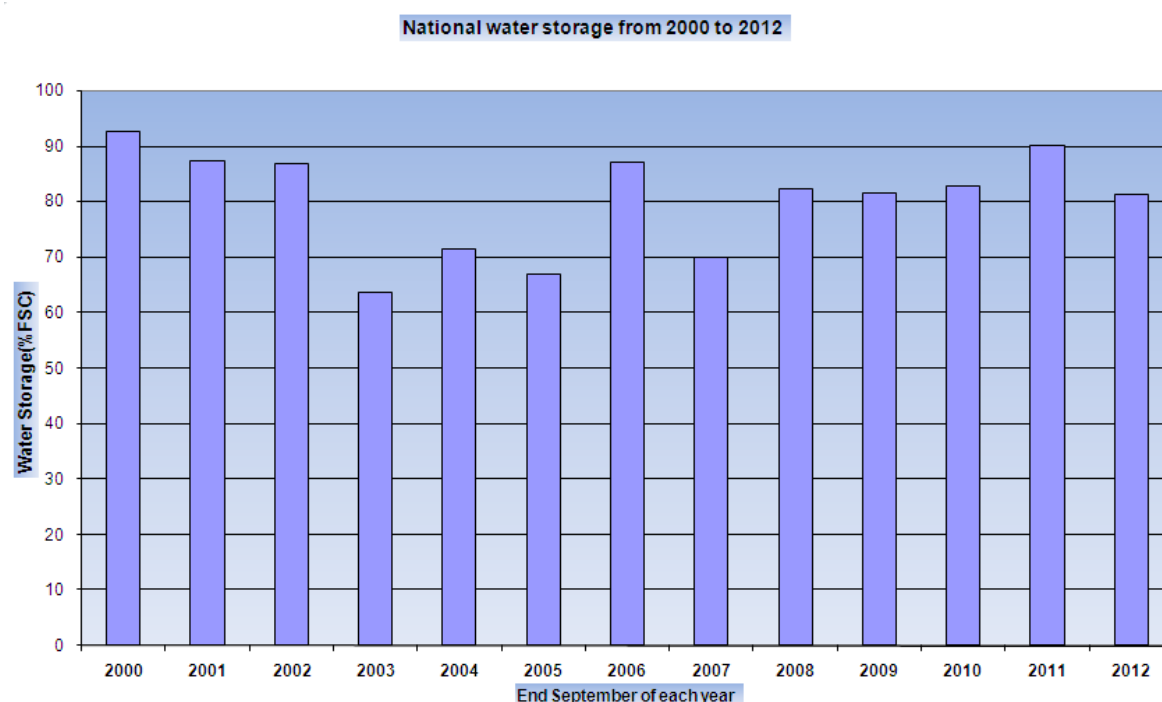
In South Africa 4 755 dams were registered up to 2012 in terms of section 120 of National Water Act. In terms of this Section, all dams with a safety risk (i.e. if the wall height exceeds 5m and if the storage capacity exceeds 50 000 m<sup>3</sup> must be registered by the dam owners (DWA, 2013b). Table 1 provides the distribution of registered dams according to reservoir storage capacity.

**Table 1: Distribution of registered dams according to reservoir storage capacity**

Capacity( $\times 10^6 \text{ m}^3$ )	Number	percent
<b>0.00-0.05</b>	152	3.1
<b>0.05-0.10</b>	1 181	24.8
<b>0.10-0.25</b>	1 710	36
<b>0.25-1.00</b>	1 078	22.7
<b>1.00-10.00</b>	437	9.2
<b>10.00-100.00</b>	129	2.7
<b>100-1 000</b>	60	1.3
<b>1 000-10 000</b>	8	0.2
<b>Total</b>	<b>4 755</b>	<b>100</b>

Source: DWA 2013b

There have been fluctuations in the storage levels in the past 13 years with 2011/2012 being the 9<sup>th</sup> highest in total storage (DWA, 2013b). This could be an indication of the lower rainfall and runoff experienced during 2011/2012 (Figure 9). The storage levels in 2011/12 showed a decrease in storage till June 2012, thereafter a gradual increase. Generally the storage (2011/12) was lower than during 2010/11 (DWA, 2013b).



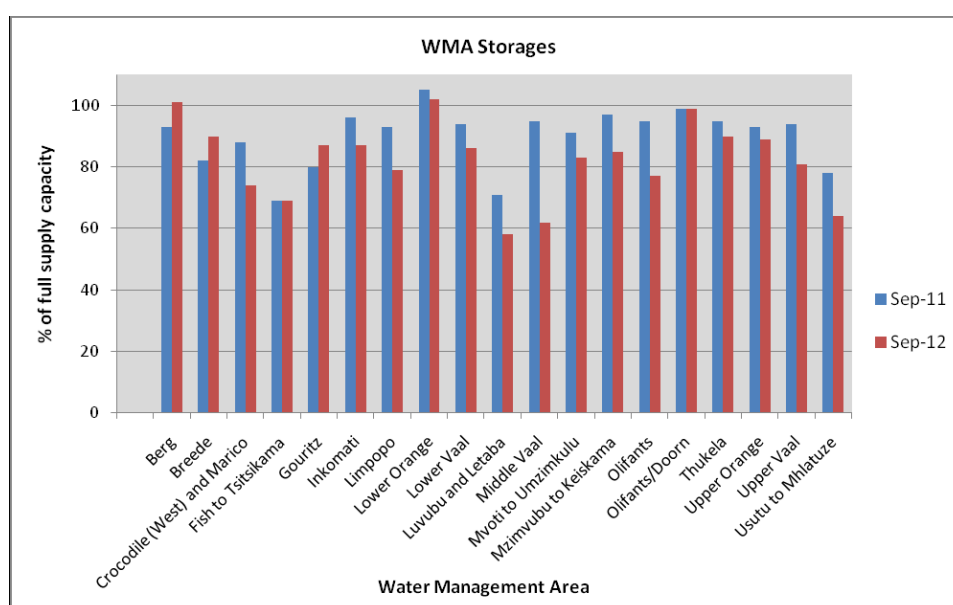
**Figure 9: The national water storages for the period 2000 till 2012**

Source: DWA 2013b

Some provinces have dams with large capacities while others have small capacity. The Free State Province has five large dams with total full supply capacity of greater than 1 000 million

m<sup>3</sup> namely; Gariep, Vanderkloof, Sterkfontein, Vaal and Bloemhof. Gauteng has only 5 very small dams with total full supply capacity of 114.8 million m<sup>3</sup>. Northern Cape has few small dams with total full supply capacity of 145.5 million m<sup>3</sup> which is the lowest of all the provinces. The Western Cape has many very small dams with Tweewaterskloof Dam being the largest. The storage situations of reservoirs within the provinces for 2011/12 were lower compared to the previous hydrological year with the exception of the Western Cape, which showed higher storage than the previous period (DWA, 2013b). This could be attributed to less rainfall experienced during the reporting period. The high rainfall in the Western Cape caused flooding in some areas.

The Upper Orange WMA had the highest full supply capacity followed by the Upper Vaal and Usutu to Mhlathuze. Because of the volumes of water in the Upper Orange, there are a number of transfers to other catchments (Figure 10). The Upper Vaal receives a transfer from the Lesotho Highlands to ensure it meets the water demand. The Lower Vaal, Lower Orange and Olifants/Doorn have the least number of dams with very low capacities. Although Usutu to Mhlathuze has eight dams, their total capacity is low at 115.3 million m<sup>3</sup>.



**Figure 10: Comparison of water storages per WMA for 2011 and 2012**

Source: DWA 2013b

Table 2 illustrates the storage status of 25 major dams in the country.



**Table 2: Status of 25 major dams in South Africa**

Dam	River	WMA	FSC (10 <sup>6</sup> m <sup>3</sup> )	Actual capacity (10 <sup>6</sup> m <sup>3</sup> )		%	Purpose
				Sep 2011	Sep2012		
Rhenosterkop	Elands	3	204	181	200	98.1	Domestic, Irrigation and Industrial supply
Molatedi	Groot Marico		200	78	67	33.8	Domestic and Irrigation
Midmar	Mgeni		235	203	186	79.2	Irrigation, and primary use
Rhenosterkop	Elands	3	204	181	200	98.1	Domestic, Irrigation and Industrial supply
Hartebeespoort	Crocodile		186	184	184	99.0	Irrigation, domestic and Industrial
Loskop	Olifants	4	362	343	353	97.7	Irrigation, primary and industrial use
Erfenis	Groot Vet		207	86	152	73.7	Industrial and domestic use
Driekoppies	Komati	5	250	180	245	97.8	Irrigation, industrial and water transfer
Pongolapoort	Pongolo	6	2 267	1732	1742	76.8	Irrigation, industrial and for primary use
Goedertrouw	Mhlatuze		301	188	197	65.6	Irrigation, primary and industrial use
Woodstock	Tugela	7	380	366	326	87.5	Transfer to vaal System
Spioenkop	Tugela		270	193	228	84.6	Irrigation, domestic, industrial,
Ntshingwayo	Ngagane		194	169	152	78.2	Primary use, industry and irrigation
Grootdraai	Vaal	8	354	267	301	86.3	Hydropower and industrial use
Vaal	Vaal		2 603	2326	2420	93	Domestic and industrial supply
Sterkfontein	Nuwejaarspruit		2 616	2563	2557	97.7	Back up for the Vaal dam in cases of drought
Bloemhof	Vaal	9	1 240	1108	1134	91.5	Primary use, industry and irrigation
Albert Falls	Mgeni	11	288	261	236	82.2	Irrigation, industrial and domestic use
Inanda	Mgeni		241	221	215	90.6	irrigation and domestic use
Zaaihoek	Slang		185	174	167	90.8	Transfer and & Industrial supply
Mthatha	Mthatha	12	248	136	195	78.5	Domestic, industrial and primary use
Kalkfontein	Riet	13	318	64	107	33.2	Irrigation, primary and industrial use
Vanderkloof	Orange		3 171	3093	3086	97.53	Irrigation , Domestic use and Hydropower
Gariiep	Orange		5 341	4458	4224	81.3	Irrigation, Domestic use and Hydropower
Brandvlei	Brandvlei	18	284	2 2 7	2 1 5	75.9	Irrigation
Theewaterskloof	Sonderend		480	487	450	93.9	Water supply

Source: DWA 2013b

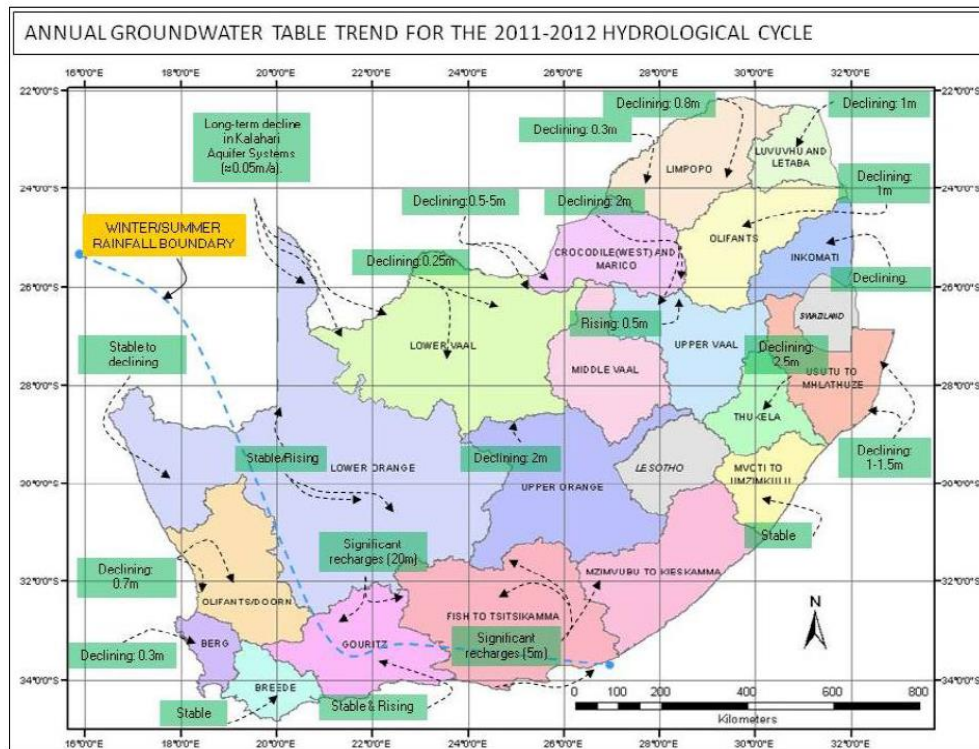
## 2.5 Groundwater

Responses of groundwater quantity and quality are different from surface waters in that groundwater depends on geological structures, soil conditions, rainfall patterns and anthropogenic activities in the recharge zones of the aquifer systems. Aquifer media in South Africa is classified as illustrated in Figure 11. The Department of Water Affairs (DWA)<sup>1</sup> has produced Hydrogeological Maps at a scale of 1:500 000 covering most of the country, indicating aquifer types and related aquifer properties. The Department also developed a National Groundwater Strategy in 2010 (DWAf, 2010). One of its aims is that the knowledge and use of groundwater is increased along with the capacity to ensure sustainable management. Some aquifers extend across international borders (transboundary aquifers), resulting in a joint responsibility for their management and development.

<sup>1</sup> The name was Department of Water Affairs and Forestry. When Forestry moved to the department of agriculture, the name became Department of Water Affairs (DWA), as used in this report. In 2014 the name changed to Department of Water and Sanitation (DWS).

The Utilizable Groundwater Exploitation Potential in South Africa is estimated at 10 343 km<sup>3</sup> per year (7 500 km<sup>3</sup> in a drought year), allowing for factors such as physical constraints on extraction, potability, and a maximum allowable drawdown (DWAF, 2010; Middleton and Bailey, 2009). The country only uses between 2 000 km<sup>3</sup> and 4 000 km<sup>3</sup> per year of this groundwater currently. This is approximately 16.1P of the country's total water use (both surface and groundwater) based on the information registered in Water Authorisation, Registration and Management System (WARMS) (DWAF 2007). The actual percentage is perceived to be higher considering that Schedule 1 use is not registered in the system. The biggest challenge for South Africa is that the groundwater resources are not evenly distributed, but spread variably over the country. This can be an advantage in providing water for small-scale local use, but for distributing it to centres of need will require a large number of boreholes and connecting pipelines.

Groundwater level trends for 2011/12 are illustrated in Figure 11. The north-eastern parts of the country received "below normal" rainfall, which affected groundwater recharge, resulting in the decline in groundwater levels. Due to continuation of local abstraction rates, a general decline in the aquifer saturation levels has been observed in some areas specifically the Limpopo Region (Limpopo, Luvuvhu and Letaba and the Olifants Catchments). These are the catchments that experience a long-term declining condition (water table recession rates in the order of 0.3 to 1 m pa). Towards the west, ground water level trends are also declining, although varying between 0.2 and 5 m pa. High water level declines were observed at bulk water supply schemes such as Grootfontein (5 m since June 2012) and certain dolomitic aquifer compartments in Gauteng (2 m since October 2011 in the Far West Rand). The annual rainfall for this region was significantly lower during 2011/12, with only 490 mm measured in Pretoria East, unlike the previous year where prolonged and heavy rainfall events were experienced from mid-December 2010 and led to significant recharges. Groundwater levels in KwaZulu-Natal reported similar declining trends (DWA, 2013b). The south-western regions of the country experienced significant groundwater recharges. High winter rainfall and snowfall in some regions initiated a replenishment of aquifer systems thus the rising water levels. Aquifer saturation levels of the Brandwag Aquifer Unit (east of Beaufort West) increased by almost 38 m due to the good rains received during that time. This particular recharge event was enhanced by significant snowfalls and associated winter rainfall in the Western Cape during the past two hydrological years (2010/11 and 2011/12) (DWA 2013b).



**Figure 11: Groundwater level trends (2011/2012 hydrological year)**

Source: DWA 2010

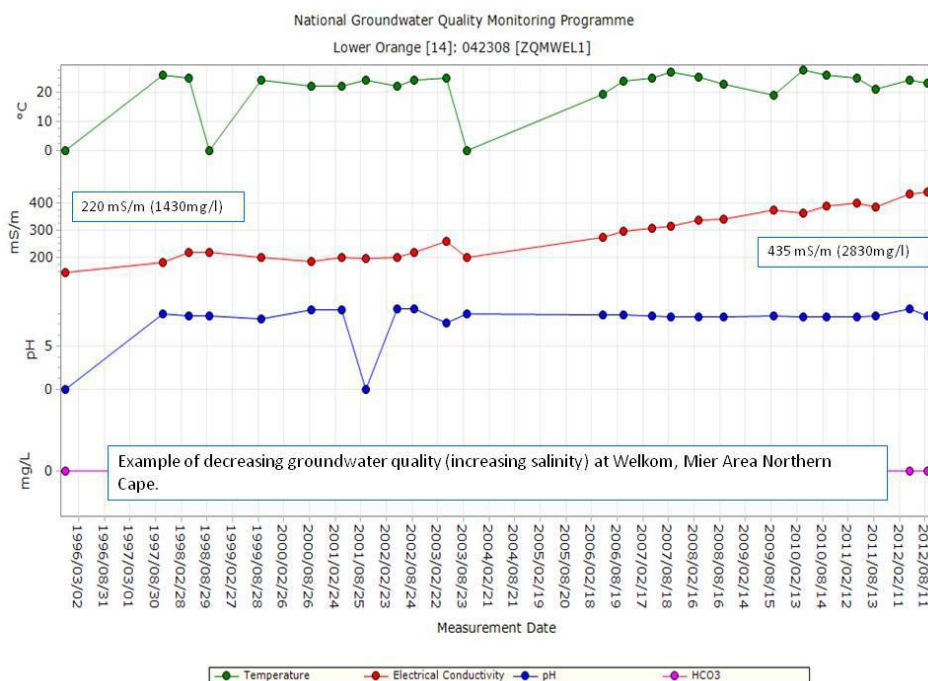
Concerning is the fact that very little research could be found on the groundwater-surface water interaction and related impacts. DWA is currently using a surface-ground water interaction model to quantify the impact; however the applicability on a large scale is questionable (DWA, 2010).

## Groundwater quality

The north-western parts of the country indicate low quality conditions with electric connectivity recording above 520 mS/m. Groundwater quality deterioration in the northern sub-catchment of the Lower Orange, i.e. the Nossob and Auob Rivers flowing from Namibia, is a concern, and the cause for that is not clear yet. The groundwater salinity trends for the 2011/12 hydrological year are illustrated in Figure 12. For the larger part of the country, salinity trends were quite stable and varied (standard deviation) between < 5 mg/l (almost stable) and 50 mg/l. These are representing small water quality oscillations due to internal aquifer quality modulation and annual recharge events replenishing the aquifer systems with good quality rainwater.

Groundwater salinity improved in the Limpopo and Olifants Catchments and some localised aquifer systems in the Crocodile-West and Marico Catchments. Similarly, salinity improved in the northern parts of the Lower Vaal. In other areas groundwater quality deteriorated mainly showing higher salinity values. Although these increasing salinity values were significant (in the order of 205 -160 mg/l), they manifested after April-May 2012, and could be an

indication of sporadic local pollution due to local recharge events after a long dry period, especially those in the Gouritz, Fish to Tsitsikamma and the Mzimvubu to Keiskamma Catchments. However, the salinity increase in the Upper Orange and Lower Vaal is part of a long-term decreasing water quality trend in the order of about 15 mg/l pa.



**Figure 12: Increasing salinity trend of one of the monitoring boreholes of the Lower Orange catchment**

Source: DWA 2010

To illustrate the alarmingly rapid deterioration of groundwater quality in the Lower Orange, Figure 12 was plotted showing salinity trends from 1996 to 2012. Since then, electrical conductivity increased from 220 mS/m to about 435 mS/m in this borehole.

The acid mine drainage (AMD) is one of the water quality challenges emanating from mining activities. The seepage water from abandoned open pits, mine waste dumps, tailings, stockpiles and mine shafts is highly acidic. The most affected areas by AMD are the gold mines in the Western Basin (Krugersdorp area), the Central Basin (Roodepoort to Boksburg) and the Eastern Basin (Brakpan, Springs and Nigel areas) of the Witwatersrand. Mining in these areas ceased in 2010, and since then the underground voids have been filling up with AMD. Other areas affected by mining activities include Mpumalanga, Limpopo and Kwa-Zulu Natal. Various remedies are being implemented:

- Reducing the ingress of water into the underground workings to reduce the volumes of water which need to be pumped out and treated to more acceptable levels.
- Reducing or stopping decant of AMD into the river system, and only releasing during high water flows.

- Treating and neutralising the water that is pumped out to enable productive uses (well-controlled irrigation) or discharge to river systems.
- Implementing waste discharge charges to be paid by mines.

Lastly, DWA is also tightening the control of hydraulic fracturing in areas like the Karoo and Free State. Uncertainty exists regarding the impact of this on the environment, and especially on groundwater quantity and quality, and also on the provision of water.

## 2.6 Transboundary water resources

The bulk of South Africa's water resources are transboundary in nature and this has implications for quality, quantity and environmental and disaster management. South Africa shares four international river basins, namely Orange, Inkomati, Limpopo and Maputo with six neighbouring countries, namely Botswana, Lesotho, Namibia, Swaziland, Mozambique and Zimbabwe (Table 3). To ensure good management of water resources, bilateral cooperation agreements were signed between South Africa and each of the countries involved. South Africa is signatory to the SADC Protocol on Shared Water Courses, making an obligation to cooperate with its neighbours in the management of water resources.

**Table 3: Transboundary aquifers within South Africa**

Transboundary River basin	Riparian States	Transboundary aquifers within the river basin	Aquifer riparian state within river basin
<b>Orange</b>	Botswana Lesotho Namibia South Africa	Gariiep Coastal Aquifer Karoo Sedimentary Aquifer  Kalahari Aquifer Promfret Vergelegen Dolomite Aquifer	Namibia-South Africa Lesotho-South Africa Botswana-South Africa Botswana, Namibia, South Africa Botswana -South Africa
<b>Limpopo</b>	Botswana Mozambique South Africa Zimbabwe	Pafuri Aquifer Tuli-Sashe Aquifer Ramotswa Dolomite Aquifer Limpopo Granulite Aquifer	Mozambique, South Africa and Zimbabwe
<b>Incomati</b>	Swaziland Mozambique South Africa	Incomati Coastal aquifer	Mozambique, South Africa and Swaziland
<b>Maputo</b>	Swaziland Mozambique South Africa	Incomati Coastal aquifer	Mozambique, South Africa and Swaziland

Source: Turton et al 2005

Table 4 illustrates the allocation agreements and specifications by transboundary river basin.

**Table 4: Allocation agreements and specifications by transboundary river basin**

Basin	Year	Water Allocation Specifications
Incomati	1991	South Africa is required to release 2 m <sup>3</sup> /s averaged over a cycle of 3 days
	1992	Swaziland: 15.1 Mm <sup>3</sup> at High Assurance; 260.2 Mm <sup>3</sup> at Low Assurance; 46 Mm <sup>3</sup> for afforestation South Africa: 157.8 Mm <sup>3</sup> at High Assurance; 381.0 Mm <sup>3</sup> at Low Assurance; 99 Mm <sup>3</sup> for afforestation
	2002	South Africa: 336.6 Mm <sup>3</sup> /year (First priority supplies); 786 Mm <sup>3</sup> /year (irrigation supplies); 475 Mm <sup>3</sup> /year (Afforestation) Swaziland: 22 Mm <sup>3</sup> /year (First priority supplies); 261 Mm <sup>3</sup> /year (irrigation supplies); 46 Mm <sup>3</sup> /year (Afforestation) Mozambique: 19 Mm <sup>3</sup> /year—with up to 87.6 Mm <sup>3</sup> /year reserved (First priority supplies); 280 Mm <sup>3</sup> /year (irrigation supplies); 25 Mm <sup>3</sup> /year (Afforestation)
Maputo	1980	South Africa is required to supply 5 cusecs (142 l/s) of water from the Pongolapoort Dam to Swaziland for irrigation and rural use at Lavumisa, in addition to the construction of storage reservoir near Lavumisa. One cusec (28 l/s) is used by the Swaziland Water Services Corporation to provide municipal water services to Lavumisa town. The other 4 cusecs (114 l/s) were made available for economic development.
	2002	South Africa: 242 Mm <sup>3</sup> /year (First priority supplies); 532 Mm <sup>3</sup> /year (Irrigation supplies); 198 million Mm <sup>3</sup> /year (Afforestation) Swaziland: 44 Mm <sup>3</sup> /year (First priority supplies); 413 Mm <sup>3</sup> /year (class 1), 114 (class 2) (irrigation supplies); 82 Mm <sup>3</sup> /year (Afforestation) Mozambique: 6.0 Mm <sup>3</sup> /year – with up to 87.6 Mm <sup>3</sup> /year reserved (First priority supplies); 60 Mm <sup>3</sup> /year (Irrigation supplies); 0 Mm <sup>3</sup> /year (Afforestation)
Orange-Senqu	1986	Annex 2 of the Treaty on the Lesotho Highlands Water Project specifies the amount of water to be delivered annually from Lesotho to South Africa between 1995 and 2020. South Africa: from 57 Mm <sup>3</sup> /year in 1995 to 2 208 Mm <sup>3</sup> /year after 2020. Lesotho: hydropower and capital payment from project
	1992	20 Mm <sup>3</sup> /year is allocated for the Vioolsdrift and Noordoewer Joint Irrigation Scheme, with 11 Mm <sup>3</sup> /year designated for farmers on the South Africa side and 9 Mm <sup>3</sup> /year for those in Namibia
Limpopo	1988	Department of Water Affairs (Republic of Bophuthatswana): 5.0 Mm <sup>3</sup> /year (primary purposes); 20.6 Mm <sup>3</sup> /year Water Utilities Corporation (Botswana): 7.3 Mm <sup>3</sup> /year (primary purposes) Department of Water Affairs (South Africa): 10.6 Mm <sup>3</sup> /year (irrigation)
	1989	Flows in the Ngotwane, Marico and Limpopo rivers where they constitute the border shall be shared equally between states with an estimated quantity of roughly 116.67 Mm <sup>3</sup> /year for Botswana and South Africa

Source: CSIR 2010

## 2.7 Climate related disasters

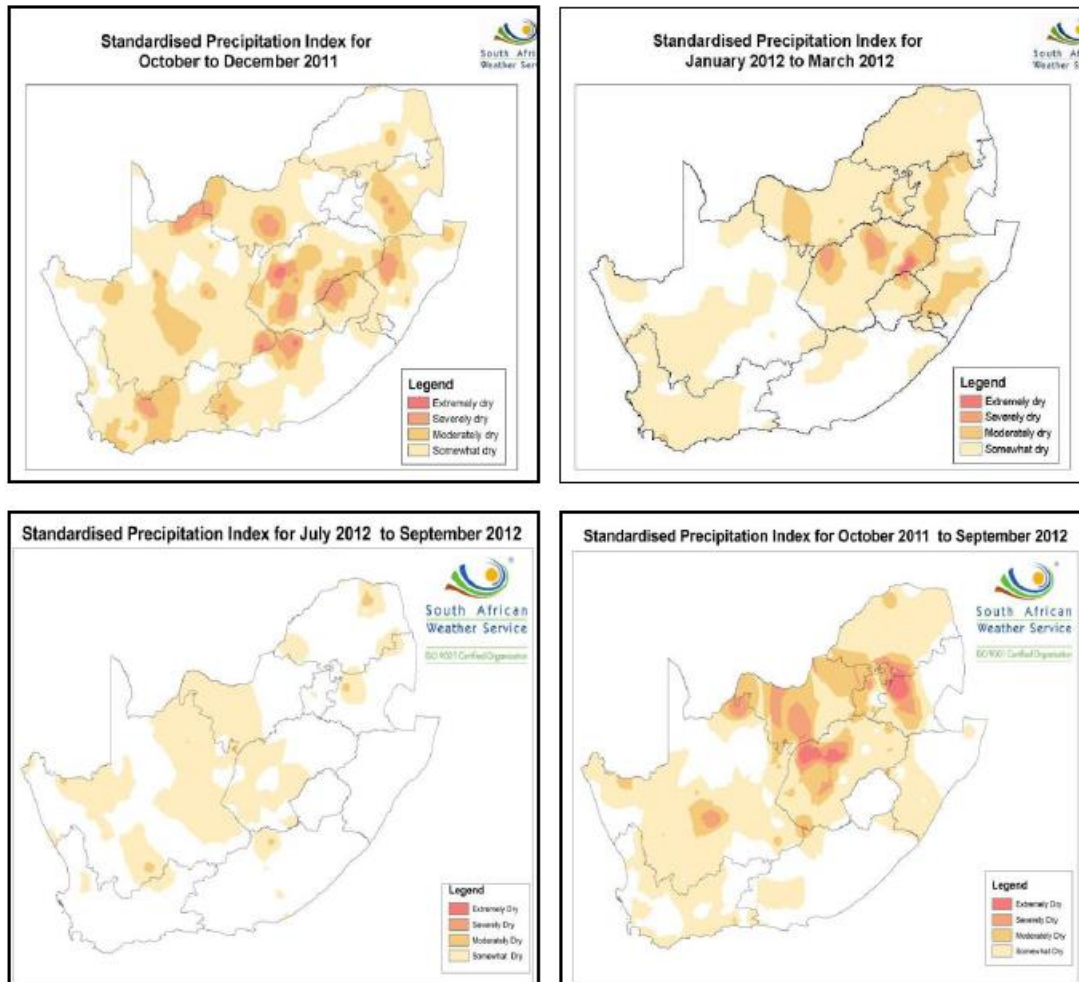
The most common extreme events in South Africa are drought and floods. These can be destructive resulting in loss of life and damage to infrastructure. Floods can also have positive effects such as recharging natural ecosystems. The impact of drought is usually shown by reduction in flows, as there is less or no rain at all. Reduced flow could translate into low dam storage.

### 2.7.1 Droughts

Drought is usually driven by natural climate variability which also affects the availability of water. The percentage of normal rainfall has been fluctuating in terms of space and time over the past few years. Very dry conditions are putting severe pressure on South Africa's scarce resources, and are therefore a threat to food security. Drought conditions are also a threat to livestock farming as it diminishes food and water supply. It contributes to poverty, poor health, malnutrition as communities cannot plant or crops become damaged. In the coastal



areas, when freshwater runs low, seawaters move in rendering water saline. The levels of groundwater, dams and flows in rivers are affected during drought conditions resulting in limited resources. Water restrictions are usually implemented in some areas as a way of managing resources.



**Figure 13: Indication of dry conditions in South Africa using Standard Precipitation Index**

Source: DWA undated

Drought conditions are a result of low rainfall and very high temperatures, resulting in less runoff, low storage levels and loss of soil moisture. Dry conditions are usually indicated by using a standardized precipitation index (SPI). Twelve- and twenty four-month SPI maps give an indication of areas where prolonged droughts existed because of below-normal rainfall recorded over a period of one year or longer. Figure 13 illustrates the extent of dry conditions experienced in the country. There is clear indication that parts of North West, Limpopo, Free State, Mpumalanga and Northern Cape Provinces were affected by moderate to extremely dry conditions.

### 2.7.2 Floods

Flow gauging stations are used for early flood warning both in the country and in neighbouring states. Unfortunately, some of the stations are no longer working well because some of the instruments and telemetry systems were damaged during heavy rains and were never repaired. A majority of the big dams have free overflow spillways; which means that, when they are full, the quantity of water that flows in flows out at the same time. This gives a challenge as these dams have limited options to be operated for flood management. In January 2012, heavy rains fell in south east Africa (including Mozambique) affecting the Limpopo and Mpumalanga Provinces of South Africa. Roads were damaged and bridges washed away and lives were lost. In South Africa, the Hoedspruit area was the most affected with people having to be lifted to safety from trees and rooftops. The flooding was as a result of a severe tropical low pressure system Tropical Cyclone Dando, a fourth storm to hit the country during the season. The January floods were influenced by La Nina.

In March 2012 flooding also hit St. Lucia, Richards Bay and Durban in the Kwa-Zulu Natal Province due to Tropical Storm Irina which caused severe damage to houses and infrastructure. The storm also affected Mozambique and Swaziland. The Liesbeek River burst its banks. The Western Cape experienced floods in the third quarter of the hydrological year which were accompanied by very cold weather. Port Elizabeth and surrounding areas in Eastern Cape had its share of flooding and snow in July 2012.

## 2.8 Status of irrigation

Of the total cultivated land area estimated at 12.7 million ha (about 76 percent of total potentially arable land), 11.2 million ha is dryland farming, and 1.8 million ha irrigated (producing about 25–30 percent of the country's agricultural products). The total dryland (rainfed) crops in 2002 were just over 3 million ha, which totalled over 16 million tons production. Of the total agricultural production of USD 2 311 900 000 in 2002, irrigation agriculture produced 55 percent of the agricultural produce by value, making this a key role player in the South African economy.

**Table 5: Area irrigated in various provinces of South Africa**

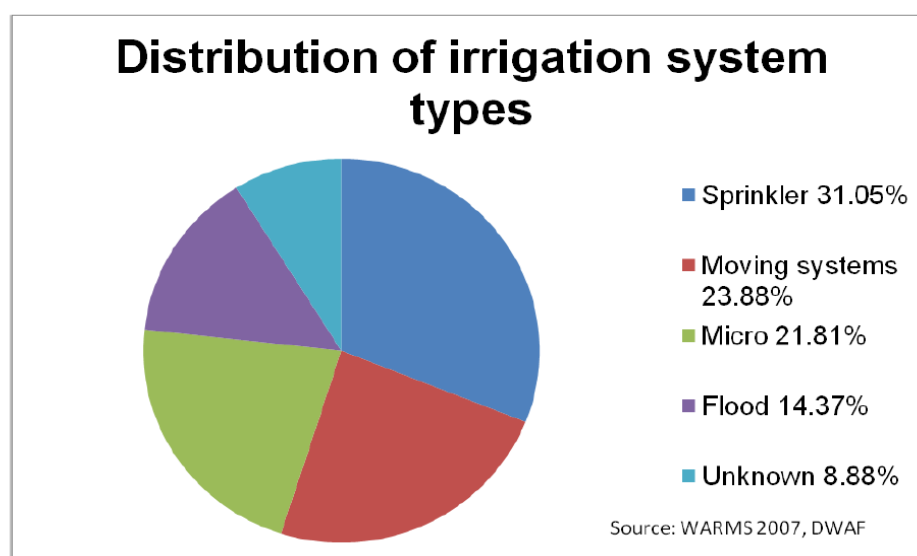
Province	Area irrigated (ha)
Western Cape	286 004
Northern Cape	188 903
Free State	137 887
Eastern Cape	188 901
KwaZulu Natal	131 032
Mpumalanga	129 308
Limpopo	161 127
Northwest	101 593

Province	Area irrigated (ha)
Gauteng	29 372
<b>Total</b>	<b>1 354 127</b>

Source: DAFF 2010

According to DAFF (2010) approximately 1 354 127 ha is currently irrigated (Table 5) of which 3 percent are small scale irrigation schemes.

Various irrigation methods are used for the irrigation of the approximately 1.3 million ha (Figure 2.12).



**Figure 14: Distribution of irrigation methods**

Source: DWA 2007

The distribution of farm activities in the nine provinces indicates that all the provinces except Gauteng are important for farming, with varying degrees of importance in the four main farm activities. Large proportions of field crop farming are located in the arid zone of the Free State (32 percent), the North West (17 percent) and Mpumalanga (14 percent), and also in the winter rainfall zone in the Western Cape (14 percent) with the least in Gauteng. The winter rainfall zone of the Western Cape Province (45 percent) is also the most important area for horticulture, followed by the desert zone of the Northern Cape Province (16 percent). In the arid zone the most important provinces for this activity are Limpopo (14 percent) and the Eastern Cape and Mpumalanga (6 percent each), with the least important being Gauteng. Mixed farming is also more prominent in the Northern Cape (24 percent), the Western Cape and the Free State (15 percent each) and least prominent in Gauteng. This implies that field crop farming is most suitable in the arid zone, horticulture in the winter rainfall zone and livestock farming in the desert zone. The Free State, Limpopo, Mpumalanga, North West, Eastern Cape, Western Cape and Northern Cape are important provinces for

farming activities in the three agro-ecological zones. The sub-tropical wet zone (mainly the KwaZulu-Natal Province) is particularly important for sugar cane.

The main irrigated field crops produced (covering just below two thirds of the irrigated area) include maize, wheat, dry beans and soya beans. The horticulture crops (on over one third of the irrigated area) include a huge variety of deciduous fruit (peaches, apricots, plums, prunes and table grapes); pome and stone fruit (apples and pears); citrus; subtropical fruit (banana, mangoes, papaya, etc.), viticulture (wine grapes) and the huge vegetable industry. The real gross income from horticulture crops moderated from 4.4 percent registered in 2012 to 2.4 percent during 2013. Among the horticulture crops, vegetables (35.6 percent) deciduous and other fruit (24.5 percent), viticulture (14.3 percent) and citrus (13.4 percent) accounted for 85 percent of the total real income of horticulture products in 2013 (BFAB, 2013).

The real gross income of field crops during 2013 is mainly attributed to maize (49.3 percent), sugar (16.1 percent), wheat (11 percent), sunflower seed (5.8 percent) and soya beans (5.3 percent). Together these five commodities accounted for 88 percent of the total real income of field crops, of which a small percentage is produced under irrigated conditions.

### 3. Water policies, legal frameworks and institutions

#### 3.1 Legislation and policies

In South Africa there are various policies and Acts steering the management and protection of agricultural water resources. The relationships between the Constitution, the National Development Plan: Vision 2030, the National Water Act and the National Water Resource Strategy are important to understand as it provides:

- The national framework for managing water resources.
- The framework for the preparation of catchment management strategies.
- Provision of water-related information.
- Identification of development opportunities and constraints.

In 1994 the newly elected government put forward as its manifesto the Reconstruction and Development Programme (RDP). This initiative was based on the fundamental concept that people who are affected by decisions should take part in making them, and it set out five key programmes: meeting basic needs; developing our human resources; democratising the state and society; building the economy; and implementing the RDP. Water is an essential ingredient in each of these programs.

The Constitution of the Republic of South Africa (RSA, 1996) contains both a Bill of Rights and the framework for government in South Africa. Two provisions of the Bill of Rights are

particularly relevant to the management of water resources. These are sections 27 and 24, which state that:

- Everyone has the right to have access to sufficient food and water, and the state must take reasonable legislative and other measures, within its available resources, to achieve the progressive realisation of these rights.
- Everyone has the right to an environment that is not harmful to their health or wellbeing, and to have the environment protected, for the benefit of present and future generations, through reasonable legislative and other measures that prevent pollution and ecological degradation, promote conservation, and secure sustainable development and use of natural resources while promoting justifiable economic and social development.

These two documents provided the impetus for a complete review and revision of the policy and law relating to water, and resulted in the development of the National Water Policy for South Africa (RSA, 1997a) and the National Water Act (RSA, 1998). The Policy and the Act are founded on the principles of equity, sustainability and efficiency. The 1994 Water Supply and Sanitation Policy White Paper (now superseded by the Strategic Framework for Water Services (DWAF, 2003)), and the Water Services Act, 1997 (RSA, 1997b), which deal with the provision of potable water and sanitation services, are particularly closely related to the Act.

The National Water Resource Strategy (DWA, 2013a) responds to South Africa's vision for 2030, as articulated in the National Development Plan and to the national government outcomes outlined in National Government's Programme of Action for 2010-2014. These priorities are key drivers for change and, as such, are the national strategic imperatives that shape this Strategy. In its Vision 2030, the National Development Plan articulates the national development goal of eradicating poverty and sharply reducing inequality by 2030 (NPC, 2011). To achieve this, government has defined a New Growth Path, one of inclusive growth and development, with a focus on diversification and wide participation by South African citizens within a vibrant and growing economy. As water plays a central role in all sectors, including agriculture, energy, mining, industry, tourism, urban growth and rural development, the allocation, development and protection of water is an essential prerequisite for inclusive economic growth, poverty reduction and the significant reduction of inequality in South Africa. The National Water Resource Strategy provides a framework that ensures water is protected and conserved over the long-term, but also contributes to the attainment of the social and economic goals of the country. Above all, the National Water Resource Strategy warns that it will be increasingly difficult and costly to meet the growing demands for water. A range of measures are initiated (DWA, 2013a):

- Greater focus on water conservation and demand management.
- Increased utilisation of ground water.
- Re-use of water at the coast as well as in inland systems.
- Using the most cost-effective and suitable sites for dams and transfer schemes.

- Desalination of sea water and de-acidification of mine water.
- Catchment rehabilitation, clearing of invasive alien plants and rainwater harvesting.

### Land reform and policy

The establishment of an “integrated and inclusive rural economy” has been identified in the National Development Plan as one of the key goals for achieving their vision 2030. In real terms (measured in 2013 values) more than R69 billion ZAR (USD 6,9 billion) has been spent by the state on the three main subprograms of land reform since 1994, with a variety of instruments that have changed over time. Yet, these programs share one characteristic, namely they all represent attempts to solve the problem of skewed distribution of land in South Africa. The impact of this land reform on agriculture and especially irrigation is immense, since it not only applies to the transfer of productive agriculture land to new owners but also reallocation of water to newly established irrigation schemes. Therefore the National Development Plan (NPC, 2011) is quite clear: land reform has to start with the (re-)creation of a comprehensive farmer support program whose main aim is to ensure that new entrants into agriculture can farm profitably at whatever scale they decide. It has become clear that a systematic withdrawal of support from white farmers since the 1980s was not replaced by farmer support to new entrants over the past two decades since 1994. Different institutions adhere largely to an application-based or demand-led approach to post transfer support. This means that land reform beneficiaries who need support must approach project officers working for Provincial Departments of Agriculture. The lack of farmer support that exist has compounded the ill effects of South Africa’s distorted rural space, while the little support that exists is not aimed at addressing the legacy of “betterment” nor of the Marketing Act, and has left the country bereft of food processing and trading enterprises.

The National Department of Agriculture’s Comprehensive Farmer Support Programme (CFSP) and the Landcare Programme as well as the Strategic Plan for South Africa Agriculture describe the kinds of farming support it seeks to offer.

## 3.2 Public organisations and departments

Various public organisations and departments are involved in the administration, management and protection of water resources and implementing of policies and legislation (Table 6).

**Table 6: Role of public organisations and departments in management and implementation of policies and legislation**

Public organisations and departments	Main function
<b>National:</b>	
<b>Department of Agriculture, Forestry</b>	Legislation, administration, farmer support programs, development



Public organisations and departments	Main function
<b>and Fisheries (DAFF)</b>	of infrastructure on small scale irrigation schemes and aquaculture
<b>Department of Water Affairs (DWA)</b>	Legislation, administration, bulk water supply, regulation and pricing, water strategies
<b>Department of Environmental Affairs (DEA)</b>	Environmental impact assessment (biodiversity) and protection of wetlands, lakes, mountain catchment areas, mineral and petroleum resource development and estuaries like Lake St Lucia
<b>Council of Geoscience</b>	Groundwater studies and research
<b>Research organisations such as: Water Research Commission (WRC) Council for Scientific and Industrial Research (CSIR) Agricultural Research Council (ARC)</b>	Research on a various aspects regarding water use and agwater
<b>Department of Rural Development and Land Reform</b>	Agrarian reform
<b>Department of Mineral Affairs</b>	Mining and pollution (AMD)
<b>Department of Tourism</b>	Protection of conservation areas (SANPARKS: all the declared conservation parks; Ecological Reserve and pollution)
<b>Department of Energy</b>	Power generation, use of coal, integrated resource planning
<b>Department of Trade and Industry</b>	Industrial Policy Action Plan: job creation, agro processing
<b>b. Provincial:</b>	
<b>Provincial Departments of Agriculture (9)</b>	Implementation of agriculture policy at provincial level (Landcare and Farmer Support Programme)
<b>CMSa</b>	Management and administration of water at catchment level (9)
<b>Water boards (15)</b>	Supplying water to municipalities
<b>WSPs</b>	The main objective is implementation of the Water Services Act (Act 108 of 1997) which incorporates providing for the right of access to basic water supply
<b>WSAs</b>	Any municipality responsible for ensuring access to water services in the Act. It may perform the functions of a WSP

### 3.3 Water services and agwater management institutions

The National Water Act (1998) provides the framework for water resource management and outlines the different water management institutions as well as the specific functions of the different institutions.

#### 3.3.1 Department of Water Affairs (DWA)

DWA is responsible for administering all aspects of the National Water Act delegated to it by the Minister or Director-General. As the various water resource management institutions are established and the responsibility and authority for water resource management is delegated or assigned to them, the Department's role will change. It will increasingly focus on national policy, a regulatory framework for water resource management, and ensuring that other institutions are effectively fulfilling their roles and responsibilities.

### 3.3.2 Catchment management agencies (CMAs)

CMAs represent the second tier of the water resource management framework. A CMA will be established in each of the 9 water management areas. Each CMA is responsible for the progressive development and broad implementation of a catchment management strategy. The catchment management strategy must be consistent with the National Water Resource Strategy, within its WMA. Currently two CMAs are well functioning namely Inkomati and Breede Overberg.

In order to facilitate the management of water resources, the country was divided into 19 WMAs. In 2012 the number has been reduced to nine. Each area is managed by a CMA (Figure 15).



**Figure 15: Nine water management areas in South Africa**

Source: DWA 2013a

### 3.3.3 Water User Associations (WUAs)

WUAs are associations of individual water users that undertake water-related activities for their mutual benefit. Water management activities may be devolved to WUAs in which case they become the third tier of water management institutions. The precise modalities have been under review since 2014.

### 3.3.4 International water bodies

In addition to CMAs and WUAs, the Act provides for the following types of water management institutions:

a. Bodies responsible for international water management such as:

- Trans-Caledon Tunnel Authority (TCTA): state owned entity with mission to finance and implement bulk raw water infrastructure. It was created in 1986 to develop Lesotho Highland Water Project. In 2012 the TCTA Lesotho Highlands Water Commission (LHWC) was established (Lesotho, RSA).
- Swaziland/RSA Joint Water Commission.
- Orange/Senqu River Basin Commission (Botswana, Lesotho, Namibia and RSA).
- Limpopo Basin Permanent Technical Committee (LBPTC) (Botswana, Mozambique, RSA and Zimbabwe).
- Botswana/RSA Joint Permanent Technical Water Committee.
- Mozambique/RSA Joint Water Commission (joint development and utilization of water resources of the Komati River Basin).
- Permanent Water Commission (PWC) (Namibia, South Africa).
- Swaziland/Mozambique/RSA Tripartite Permanent Technical Committee (TPTC).

b. Any other persons or bodies that fulfil the functions of a water management institutions in terms of the Act.

### 3.3.5 Water services provision

The main objectives of the Water Services Act (Act 108 of 1997) (RSA 1997) is to provide for the right of access to basic water supply and sanitation necessary to secure sufficient water and an environment not harmful to human health or well-being. The Act also establishes the institutional arrangements for water services provision, and sets out the responsibilities for each of the institutions. The following are the key institutions in water service provision.

a. Water boards

Government-owned water boards play a key role in South African water sector. They operate dams, bulk water supply infrastructure, some retail infrastructure and some wastewater systems. Some also provide technical assistance to municipalities. Through their role in the operation of dams they also play an important role in water resource management. The water boards report to DWA. There are 15 water boards in South Africa. The three largest

Water Boards are Rand Water in Gauteng Province, Umgeni Water in KwaZulu-Natal Province and Overberg Water in the Western Cape.

b. Water Services Authority (WSA)

A WSA is defined as any municipality responsible for ensuring access to water services in terms of the Act. It may perform the functions of a WSP, and may also form a joint venture with another water services institution to provide water services. In providing water services, a WSA must prepare a water service development plan (WSDP) to ensure effective efficient, affordable and sustainable access to water services. The WSDP should be in line with the catchment management strategy of that WMA. The plan provides a linkage between water services provision and water resources management.

c. Water Services Provider (WSP)

The main duty of a WSP is to provide water services in accordance with the Constitution, the Water Services Act and by-laws of the WSA, and in terms of any specific conditions set by the WSA in a contract.

## 4. Investment in agwater

The departments responsible for investing in agwater development and the necessary infrastructure required for the distribution of bulk water in the country are DWA and DAFF.

### 4.1 Department of Water Affairs (DWA)

DWA develops, maintains and rehabilitates the bulk national water resource infrastructure to meet a basic social need and ensure economic growth. However, significant challenges remain in addressing the backlogs in maintenance, rehabilitation and refurbishment that impact on the operational efficiency of the national water resource infrastructure. In response to these problems, the department started a dam safety rehabilitation programme in 2005 to rehabilitate and refurbish 25 dams throughout the country. A similar programme has been started to rehabilitate the water conveyance infrastructure. Implementing the appropriate pricing structures for bulk raw water supply will ensure that water resources are used and managed in a sustainable and effective manner. Under the current pricing strategy, annual water tariffs increases are capped and exclude certain categories of users from paying cost-recovering tariffs. The longer term aim is to ensure that tariffs will be reflective of the costs of maintaining, rehabilitating and refurbishing water resource infrastructure. Greater emphasis will be placed on eradicating the licence backlogs to ensure that water is equitably distributed and managed effectively.

In Table 7 the total expenditure of DWA for the last eight years are indicated, with an indication of the expenditure on infrastructure development in the department. The purpose

of this program is to ensure a reliable supply of water, with accessible risk, from bulk raw water resources infrastructure to meet demand for South Africa and to solicit and source funding to construct, operate and maintain bulk raw water resources infrastructure in an efficient and effective manner by strategically managing risks and assets.

**Table 7: Total expenditure of DWA on water infrastructure development**

Year	DWA Total budget (ZAR)	Total expenditure on infrastructure development (ZAR)	% expenditure on infrastructure development
<b>2006</b>	385 190 000	85 250 000	22.1
<b>2007</b>	480 290 000	118 590 000	24.7
<b>2008</b>	579 530 000	164 430 000	28.4
<b>2009</b>	734 260 000	251 940 000	34.3
<b>2010</b>	702 370 000	213 240 000	30.4
<b>2011</b>	816 490 000	238 400 000	29.2
<b>2012</b>	864 150 000	225 150 000	26.1
<b>2013</b>	1 037 560 000	256 520 000	24.7

In 2009/10, DWA was restructured to focus its attention on its core functions of policy formulation, water resource management, infrastructure development, capacity building, intergovernmental and intra-sectoral coordination, and water regulation. As a result of the restructuring, the forestry function was moved to the Department of Agriculture, Forestry and Fisheries, while the sanitation function was moved to the Department of Human Settlements (and moved back to the Department of Water and Sanitation in 2014). The total expenditure increased from R3.9 billion in 2006/07 to R7.3 billion in 2009/10, at an average annual rate of 24 percent. This significant increase is driven by expenditure on the development of bulk water infrastructure. This includes funds allocated for the construction of new dams and ancillary infrastructure such as water treatment works and distribution pipelines, and the rehabilitation and repair of existing bulk infrastructure. Between 2006/07 and 2009/10, expenditure in the National Water Resources Infrastructure program increased at an average annual rate of 43.5 percent, from R852.5 million to R2.5 billion. This made it the fastest growing program within the department.

**Table 8: Major infrastructure projects with DWA**

Project name /implementing agent	Project objective	Total Project Cost (USD)
<b>Lesotho Highland Water Project Phase 11</b>	To augment the Vaal river system (hydropower and water transfer)	750 000 000
<b>Komati (TCTA)</b>	Water pipeline in Mpumalanga	170 000 000
<b>Mokolo Crocodile water augmentation project (TCTA)</b>	Delivering of water in Limpopo province	150 000 000

Project name /implementing agent	Project objective	Total Project Cost (USD)
<b>Mkomazi water project Smithfield dam (KZN)</b>	Augment water supply to eThekweni , uMgungudlovo and surrounding areas	100 000 000
<b>Lusikisiki regional water supply scheme: Zaludam on the Xura river</b>	To secure water supply for domestic and small scale irrigation in Lusikisiki and surrounding areas	500 000 000
<b>Lower Orange River: Vioolsdrift dam</b>	To increase the yield of the Orange river to cater for the increasing demand in the area	560 100 000
<b>Mooriver –Welverdiend dam</b>	To secure water supply to domestic and industrial areas in the Lower Mvoti basin area (Stanger area)	100 000 000
<b>Western Cape water supply: Voëlvelei supplement scheme</b>	Augment water supply to cape town and surrounding areas	500 000 000
<b>Midvaal regulatory and sanitation</b>	Increase capacity of water waste treatment system in Gauteng	500 000 000
<b>Koonap River- Foxwood Dam</b>	To secure water supply for domestic and small scale irrigation in Adelaide and surrounding districts (Eastern Cape)	40 000 000
<b>Mzimvubu water resources development (KZN)</b>	Dam for hydro electricity and ensure water supply to northern parts of Lower KZN during dry periods and for irrigation	65 000 000
<b>Olifants river resource development (Limpopo)</b>	Dam and bulk water distribution	16 100 000 000

Source: DWA, 2012

## 4.2 Department of Agriculture, Forestry and Fisheries (DAFF)

Total expenditure increased from R3.6 billion in 2008/09 to R5 billion in 2011/12, at an average annual rate of 11.7 percent, and is projected to increase to R6.3 billion over the medium term, at an average annual rate of 8.4 percent (Table 9). The historical increase is due to funds transferred to the department from DWA and DEA for forestry and fishery in 2009/10 and 2010/11.

**Table 9: Expenditure trend of the DAFF (excluding the allocation for administration)**

	Agric production, health & food security (USD)	Food security and agrarian reform (USD)	Trade promotion and market access (USD)	Forestry (USD)	Fisheries (USD)	Total (USD)
<b>2008</b>	116 764 100	79 793 400	18 661 400	80 414 300	17 821 300	313 454 500
<b>2009</b>	102 923 000	90 061 900	18 521 800	86 158 700	20 004 100	224 969 500
<b>2010</b>	123 440 700	104 845 400	14 533 300	68 212 900	25 904 100	336 936 400
<b>2011</b>	168 975 700	125 394 000	20 539 800	89 535 000	34 553 200	358 397 700
<b>2012</b>	189 160 300	140 863 500	21 203 300	12 617 750	41 179 100	518 583 700
<b>2013</b>	194 846 400	160 026 300	22 383 200	119 335 800	35 241 000	531 832 700



Moreover, the conditional grant allocation for the Comprehensive Agricultural Support Programme (CASP), Ilima/Letsema, and LandCare, mainly to support small scale and newly established farmers, increased from R1.4 billion in 2011/12 to R2.2 billion in 2014/15, at an average annual rate of 9.9 percent. Table 10 illustrates the percentage expenditure of the total expenditure on farmer support and agrarian reform, which varies between 25 and 30 percent of the total annual expenditure by the national Department of Agriculture.

**Table 10: Expenditure on farmer support program as percentage of total expenditure by DAFF**

Year	2008	2009	2010	2011	2012	2013
% expenditure of total expenditure	25.5	28.4	31.1	28.6	27.2	30.1

Provincial Departments of Agriculture like Limpopo and KwaZulu Natal (see Box 1 below) allocate a substantial percentage of the provincial budget for infrastructure development of small scale irrigation schemes in the respective provinces.

**Box 1: KwaZulu-Natal Department of Agriculture and Environmental Affairs expenditure trends**

The budget of the Department increased from R2.850 billion in 2013/14 to R3.241 billion in 2016/17, which is an annual average increase of 4.4 percent in nominal terms. The Department's budget provides for the following agricultural activities:

- **Crop production:** The Department will continue in its efforts to realise the potential of agricultural land through its mechanisation program, with the aim of ploughing and planting more than 20 000 ha. It will continue to ensure that its current mechanisation fleet will be optimally utilised and hence only replacement tractors and implements will be acquired. The Department will also continue with the liming program that commenced in 2011/12, with more than 4 000 ha to be limed in 2014/15.
- **Livestock development:** The livestock intervention program is a long term program, focusing on primary animal health care and provision of basic infrastructure. In 2014/15, the focus will be on animal identification due to the increased number of incidents of stock theft and livestock wandering around causing accidents. Further activities will include provision of water (i.e. scooping of dams), drilling and equipping of boreholes, rehabilitation and building of new dip tanks, training of farmers and Livestock Associations, de-worming and vaccination of animals, livestock auction sales, etc.
- **Land reform:** The Department will continue to provide post-settlement support to new farmers on commercial farms transferred to them. The transfer of Agri-business Development Agency (ADA) to the Department has been concluded and will result in a more effective and efficient coordination and implementation strategy. Key among ADA's programmes is to develop and broaden access to the value chain to black commercial farmers, thereby integrating previously marginalised farmers into the main stream economy. In line with the agricultural policy to support the National Development Plan's target of creating one million jobs in agriculture by 2030, over R7 billion will be spent on conditional grants to Provinces to support about 435 000 subsistence and 54 000 smallholder farmers and to improve agricultural extension services.
- **Food security:** The Department will continue to support households through a range of food security interventions to alleviate food insecurity and grow the production capacity of farmers.
- **Transfers to Mjindi:** (R12.286 million in 2013/14 financial year): The rehabilitation of the irrigation infrastructure will remain a major priority for Mjindi, ensuring that farmers receive an efficient

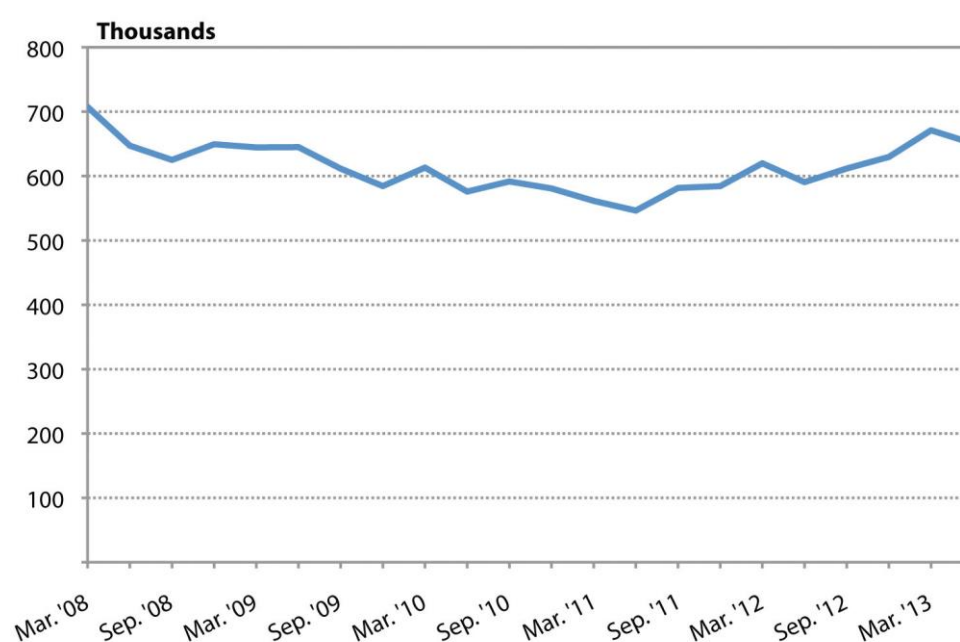


uninterrupted supply of water. This will enable the scheme to operate at optimal capacity and improve the quality of life for the farmers and the people of Umkhanyakude. This will also improve the Province's food security.

- **Transfers to the ADA:** The Agency's 2014/15 strategic goals include improving agricultural productivity and competitiveness of previously disadvantaged commercial farmers, and increasing income and employment in commercial agriculture. The Agency will continue to focus on three sectors along the value chain, namely livestock development, sugar cane, and fruit and crop production.

### 4.3 Employment in agriculture

The agriculture, forestry and fisheries sectors contributed 2.4 percent to GDP in 2010, a decrease from 2.9 percent in 2009. By contrast, the tertiary sector contributed 67.2 percent to GDP. In total, the agriculture, forestry and fisheries sector employed approximately 672 000 workers in 2013. Based on the annual average of the quarterly observations (to address seasonal fluctuations and limit the effect of the rolling sample base) employment in agriculture in 2008 was 657 000 people from where it decreased by 88 000 to reach 568 000 in 2011. From 2011 it increased slightly by 103 000 to reach 672 000 during 2013 (Figure 16).



**Figure 16: Employment trend 2008-2013 in agriculture**

The National Planning Commission believes that agriculture has the potential to create one million new jobs by 2030. This target is set in the context of the sector shedding almost one million jobs over the last three decades. The agriculture value chain is one of the priority sectors in government's Industrial Policy Action Plan 2 for economic growth and job creation. With the implementation of agro-processing initiatives under this plan and plans to elevate agriculture to a priority sector in the new growth path, the department will attempt to reverse declining employment trends over the medium to long term. Resources will be

redirected to smallholder farmer support programmes, such as extension services, and farmer training and market access support. Important is that the expansion of employment should be supported by domestic and international markets.

## 5. Water allocation, pricing and investments

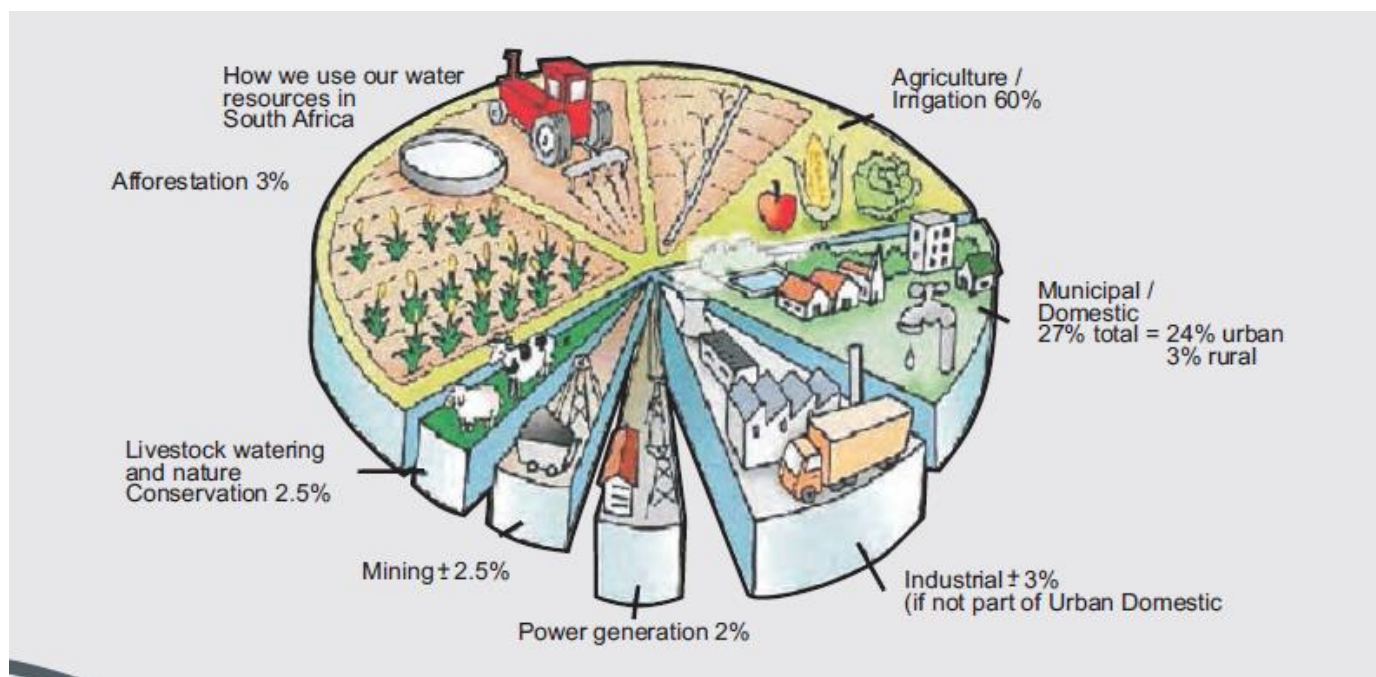
Irrigation is the largest water user. Because of water scarcity, water use needs to be regulated in terms of a system of permissions and authorisations (RSA, 1998).

### 5.1 Water used for agriculture as per WMA

There is a large variation in water requirements across the country due to the different water use sectors and their requirements with respect to quantity, quality, distribution in time and assurance of supply:

- Rural requirements, mainly domestic use and stock watering.
- Urban requirements, which include all water used in urban areas such as domestic, industrial, parks and communal.
- Mining and bulk users, with the latter essentially representing large industrial users outside urban areas.
- Power generation.
- Irrigation for agricultural production.
- Afforestation as a formally declared stream flow reduction activity.
- Transfers of water out of a particular area, which constitutes a requirement for water from that area.

Figure 17 displays the proportions of use of water withdrawals by sector in South Africa, showing that irrigation is by far the largest user (60 percent).



**Figure 17: Relative use of water withdrawals per sector**

Source: DWA 2013a

## 5.2 Water allocation

Due to water scarcity, there is a need to regulate the water usage to ensure sustainable, equitable and efficient utilization of the resource. The National Water Act distinguishes permissible use, General Authorisation, Existing Lawful Use (before 1998), and licensed water use (for water uptake after 1998). Equitable access to water, or the benefits derived from its use, is critical to the eradication of poverty and promoting economic growth. Equity means that everyone has fair opportunities to access, use and control of the water resources. The system of water allocations uses water pricing, limited term allocations and other administrative mechanisms to bring supply and requirements into balance in a manner which is beneficial in the public interest. (NWA, 1998). One of the fundamentals of water allocation is that any form of abstraction, transfer, storage or other influence on a natural stream gives effects in the entire downstream river system.

The DWA is running a water allocation reform program, with objectives to ensure meaningful transformation in water use. The process of *compulsory licensing* is used to convert Existing Lawful Uses into licenses so that there is one single water law system. In this process, over-allocations or unused allocations are taken away in order to implement the Reserve and re-allocate water to achieve more equity. Compulsory licensing has been initiated in three catchments namely Tosca (Northern Cape), Jan Dissel (Western Cape), and Mhlathuze (KwaZulu-Natal) during 2012 (DWA, 2013a).

### 5.3 Water pricing and charges

The Raw Water Pricing Strategy specifies the determination of the costs incurred to make water from a water resource available to users. The costs included in making water available to users include the following elements:

- Cost of operation and maintenance (O&M) of publicly provided schemes.
- Capital costs, comparing a return of paid-up assets, repayment of loans and, in some cases, contributions to fund a new scheme to make sure that this does not necessitate a sudden tariff increase.
- Overheads such as the administration and support required to operate such schemes.
- Allowance to provide for the depreciation, replacement or refurbishment of state owned infrastructure.
- Catchment management costs.
- Social and environmental costs.

The Pricing Strategy, which relates to charges for any water use, is established in terms of the process described in section 56 of the Act. The full pricing strategy applies to the use of water described in section 21 of NWA, which includes taking water from a resource, discharging waste into the resource, storing water, and other uses such as the recreational use of water. It also addresses the setting of tariffs by DWA and water management institutions established in terms of the Act. It does not deal with treated water supplied in bulk by, for instance, water boards, and distributed to households via WSAs, as this is dealt with in the Water Services Act. All water use charges are specific to each of the four end-use sectors, namely:

- Municipal (WSAs)
- Industry, mining and energy
- Agriculture
- Stream flow reduction activities (currently forestry only)

For irrigation, Table 11 provides an overview of the use per ha, and the total use of irrigation water. Water allocations per ha have been calculated according to the following:

- In government water schemes, water user association schemes and irrigation board schemes: Water quotas in cubic metres per hectare have historically been determined and were as such taken up in every water use entitlement; and
- For private irrigation outside of such schemes, the average annual crop water requirement of the likely crop mix in that specific area is determined with the South Africa Procedure for the estimating WATER requirements (SAPWAT), taking local conditions and climate into account.

Table 11 also shows the irrigation tariffs (c/m<sup>3</sup>) in the 19 catchments initially envisaged as WMAs for the 19 CMAs. This highlights considerably variability. Tariffs depend on the

infrastructure involved, the cost of managing it, the socio-economic circumstances, and the demographic characteristics of each area. Commercial agriculture attracts the full charges, while the emerging farmers using government water schemes receive subsidized rates for five years at a progressively decreasing rate from inception of the subsidy on a specific scheme. Depreciation charges will be phased in over the sixth year. The price of water varies according to location and is calculated on a system, catchment or sub-catchment basis. It included O&M and capital costs.

**Table 11: Summary of irrigation water use per ha and cumulative in 19 catchments for 2002**

	Water management areas	Weighted average irrigation allocation (m <sup>3</sup> /ha)	Estimated irrigation water use (m <sup>3</sup> )	Cost of irrigation water (c/m <sup>3</sup> )
1	Limpopo	7 725	168 602 202	1.1
2	Luvuvhu to Letaba	9 622	86 190 884	0.6
3	Crocodile west and Marico	6 977	147 858 418	4.0
4	Olifants	8 300	925 96 793	1.8
5	Incomati	10 064	359 810 260	1.5
6	Usutu to Mhlatuze	11 150	468 008 927	1.7
7	Thukela	7 700	137 126 990	0.9
8	Upper Vaal	7 211	455 888 149	1.8
9	Middle Vaal	6 762	180 540 943	2.8
10	Lower Vaal	9 111	77 983 239	4.5
11	Mvoti to Umzimkulu	4 600	71 706 660	3.3
12	Mzimvubu to Keiskamma	7 642	832 631 624	1.1
13	Upper Orange	9 975	384 614 358	2.4
14	Lower Orange	14 347	328 673 347	1.3
15	Fish to Tsitsikamma	11 651	305 340 806	3.4
16	Gourits	6 987	959 890 800	3.1
17	Olifants/Doring	12 000	959 918 774	2.8
18	Breede	7 223	372 918 774	6.9
19	Berg	7 467	126 921 070	4.3
	Total		6 906 906 864	

Source: Stats SA, 2010

The existing and future CMAs for each of the nine WMAs are responsible for management, including the setting of charges and the collection of revenue for water use in their jurisdiction. Water resource management charges are calculated on the basis of the actual costs of water resource management activities within the catchment per unit of water (m<sup>3</sup>) that is used. Charges are based on recovering the costs of managing the total volume of water that is allocated for use in each WMA. This is determined by deducting the requirement of the Reserve, water required used by downstream WMAs and by any specific water reserved for transfer via water works to neighbouring areas from the total volume of water available in the area. For billing purposes these unit charges will be added to the

annual water use charge. The water resources management charges are invoiced monthly according to a farm's water allocation, regardless of the amount of water that was used during that specific time.

#### Non-revenue water

South Africa experiences the continuing problem of “non-revenue water”, or water that is lost before it is delivered to customers. Water losses currently stand at 36.8 percent. Physical leakages account for a total of 25.4 percent of all water losses with the balance stemming from theft or inaccurate metering. Non-revenue water stems mainly from practices such as poor planning, limited financial resources to implement the necessary programs, poor infrastructure asset maintenance and lack of capacity, but also the lack of proper auditing. An estimated 1.58 billion m<sup>3</sup> of supplied water is unaccounted for each year in South Africa. At a nominal cost of R4.50 per m<sup>3</sup>, this represents a loss of more than R7 billion (USD 758 million). Agriculture, which accounts for 60 percent of all water withdrawals experiences estimated water losses of between 30 percent and 40 percent. Cutting of non-revenue water in municipalities receives considerable attention.

### 5.4 Investments in water resource infrastructure

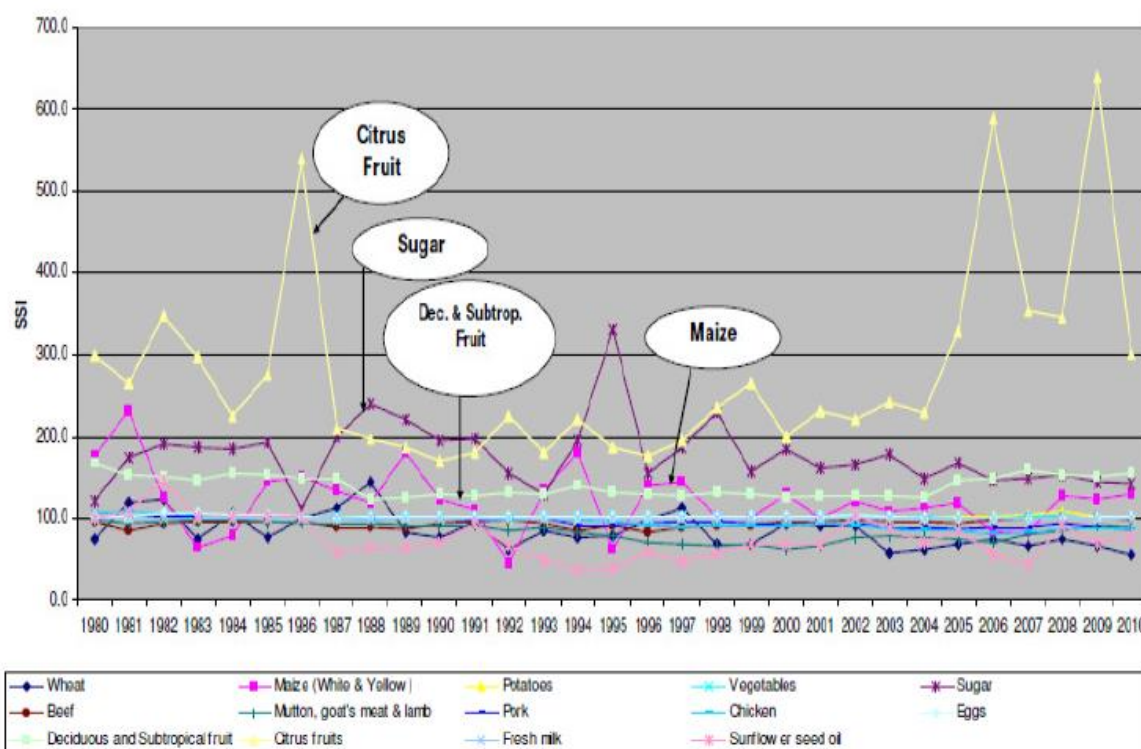
Water resource infrastructure is either financed by National Treasury or ‘off-budget’ through the TCTA. In addition, the Water Trading Entity (WTE) was established within DWA to promote the efficient management of bulk infrastructure. However the entity is currently facing severe technical, financial and management challenges, which are limiting its capacity to finance and manage the bulk water infrastructure efficiently (DWA Budget Review, 2012).

The TCTA operates as a special purpose vehicle responsible for the financing and building of large water infrastructure that is identified by the department. The TCTA borrows finance from markets in its own capacity, with government providing explicit guarantees. Once the infrastructure is built, DWA is responsible for the O&M of the infrastructure. The TCTA usually services the debt over a period of 20 years with payments from DWA, and after the debt is repaid, the ownership is transferred to DWA.

In 2012 the TCTA had approximately USD 229 million worth of infrastructure on its balance sheet and another USD 210 million was planned for the next few years. The Department of Water Affairs estimated that the national financing backlog in 2012 was approximately USD 130 million, of which USD 101 million alone related to dam safety and rehabilitation. In 2010, DWA spent approximately USD 85 million on the construction of the de Hoop Dam and canal rehabilitation alone.

## 6. Food security, nutrition and poverty

South Africa is largely deemed a food secure nation producing enough staple foods or having the capacity to import food, if needed, in order to meet the basic nutritional requirements of its population (Hart et al, 2009). Figure 18 illustrates that South Africa is food self-sufficient or nearly self-sufficient in all major food products.

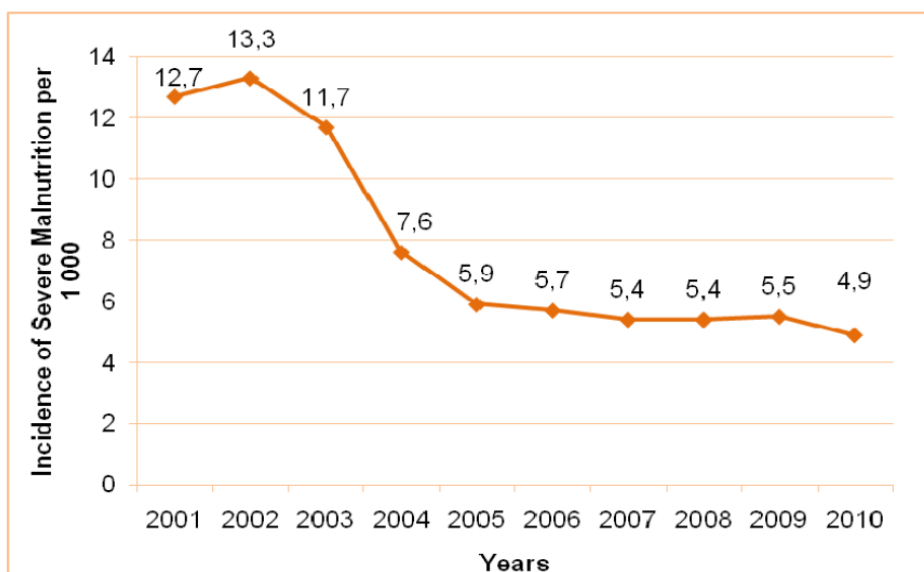


**Figure 18: National food self-sufficiency index**

Source: DAFF 2009

However, food security at household level and nutritional status reflects the country's inequalities. South Africa is characterised by a continued double burden of over- and under-nutrition. Recent findings (SAHANES-1, 2013a) indicate increasing rates of overweight and obesity (23.6 percent of girls and 16.2 percent of boys between ages 2 and 14 years) co-existing with persistent Vitamin A (43.6 percent) and iron (9.2 percent) deficiencies in children. The majority of South Africa adults are overweight (24.85 percent) or obese (39.2 percent), while many women also suffer from the consequences of micronutrient deficiencies i.e. anaemia (22 percent) and Vitamin A deficiency (13.3 percent) (SAHANES-1, 2013b). At the same time, malnutrition in children under five years remains high, although it has significantly declined (see figure 19). Severe malnutrition incidence is the number of children who weigh below 60 percent of the expected weight for that age per 1 000 children.

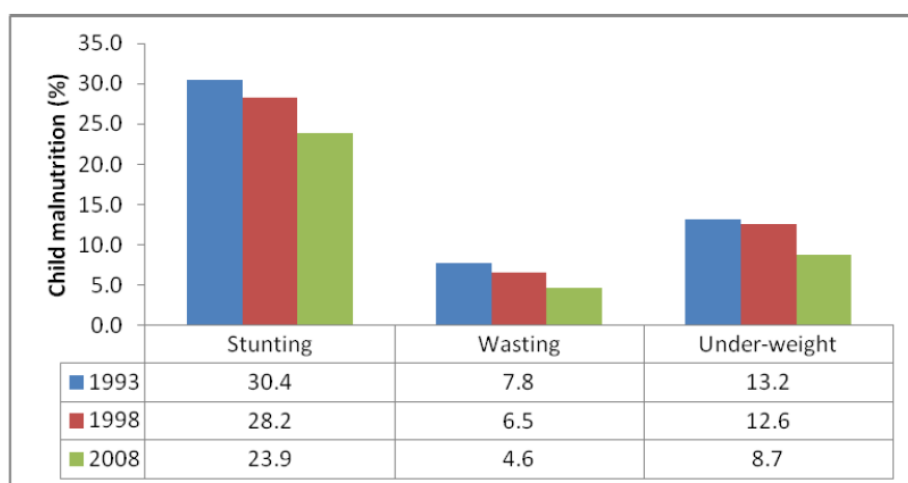




Incidence)

**Figure 19: Incidence of severe malnutrition among children under five years (2001-2011)**

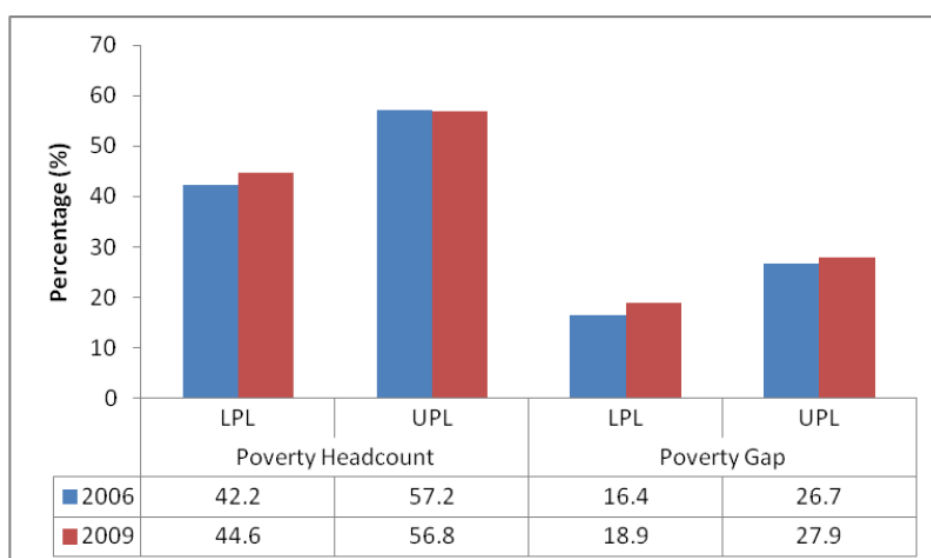
A similar decline has taken place in child malnutrition derived from anthropometric data, namely stunting, wasting and underweight (showed in Figure 20). Almost a quarter of children remain stunted.



**Figure 20: Changes in child malnutrition (stunting, wasting and under-weight) from 1993-2008**

There was a slight increase in income poverty based on the cost of both food and non-food basic needs in South Africa. This indicator has a lower-bound poverty line (LPL) of R433 per person per month (in 2011 prices) and an upper-bound poverty line (UPL) of R620 (in 2011 prices). Households living below the LPL have to sacrifice some essential food items in order to obtain essential non-food items such as clothing, housing and transport, amongst others, while households at the UPL can purchase both adequate food and non-food items. Figure 21 indicates a modest increase in head count and stronger increase for the poorest between

2006 and 2009, which can partly be attributed to the global financial crisis of 2008/09 (MDG Report, 2013).



**Figure 21: National poverty lines: poverty headcount and poverty gap**

Source: MDG Report 2013

These inequalities are examined in the case studies below.

## 7. Case study: Flag Boshielo Irrigation Scheme in Limpopo Province

In South Africa, national food security and agricultural exports by large-scale capital-intensive farming go together with widespread poverty and child malnutrition. Poverty rates are highest in the former homelands, where agriculture remains the mainstay for 2.7 million black smallholders and their families (Aliber and Hall, 2011). We take a historical approach, because the creation of this dual agrarian structure was crafted over more than a century. Yet, it holds lessons for policy makers today on where to direct which support for any of the three types of irrigation investments: by government, smallholders or agri-business. The choice for the one can have major implications for the other options. In the following, we first describe the political-economic context of smallholder irrigation (Section 7.1). We then analyse these trends in detail for the Flag Boshielo Irrigation Scheme (Sections 7.2 – 7.5) and four smaller schemes in Limpopo Province (Section 7.6).

### 7.1 Political-economic context

The dualism in South Africa's economy, agriculture and irrigation was the deliberate choice of the colonial settlers to promote agriculture by the white settlers *at the expense* of competing agriculture by Africans. The first act of the Union of South Africa after its establishment in 1910 was a 'land grab'. The Land Acts of 1913 and 1936 declared 87 percent of the land as

owned by whites, relegating Africans to 13 percent of Bantustans (homelands). This was followed by major state investments in settlers' agriculture, in particular irrigation. In the British-Boer 'alliance of maize and gold' incomes from mining served to make such investments, in particular in dams for irrigation, cooperative formation, strengthening of forward and backward linkages and research. Africans were exclusively involved as wage laborers for a fraction of the wages that whites received.

By the 1970s, the agrarian transition in this white economy set in, especially in Gauteng, the hub of the expanding manufacturing, industrialization and services sectors. When whites increasingly opted for jobs in the urbanizing economy, the massive investments in white irrigation schemes stopped. In parallel, the government stepped up its 'hydraulic mission' to serve Gauteng, which is on a water-scarce plateau. An ever-expanding net of bulk water supplies of pumping houses, dams, reservoirs, canals, and tunnels was constructed to bring water from elsewhere in the country and from Lesotho, the region's water tower. The current estimated replacement value of this bulk water infrastructure is USD 16 billion (DWA, 2013a).

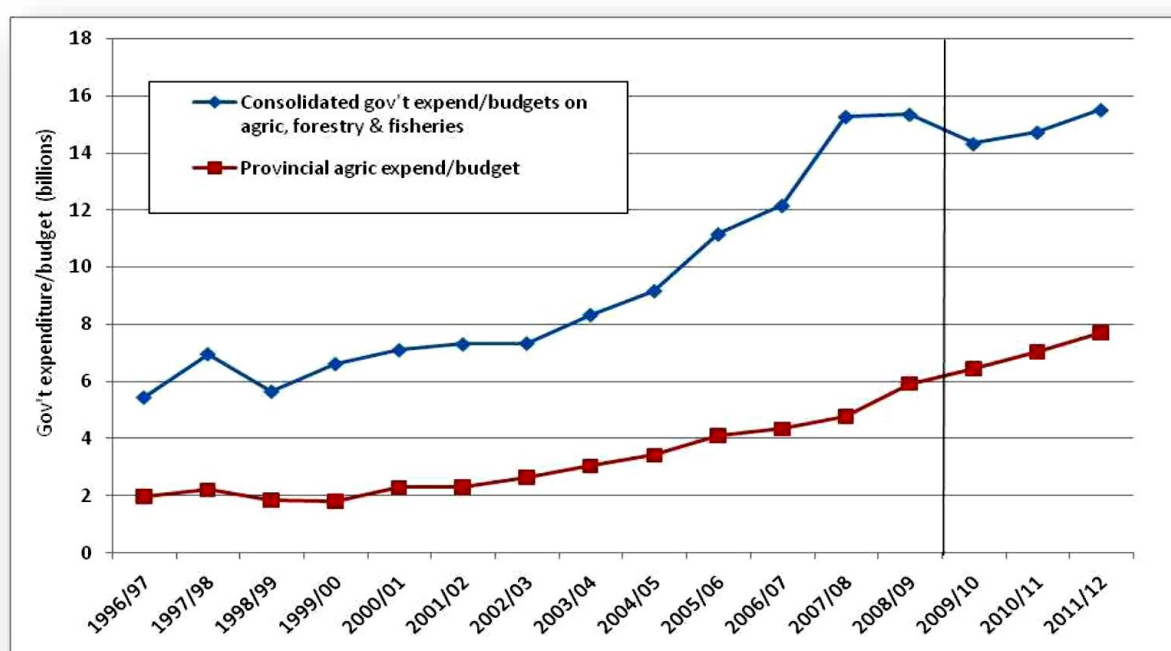
Thus, white agriculture on abundant well-watered land and with cheap labor, had served its role of engine for growth for the settlers' economy. Farmers became a smaller share of the white population, contributing a smaller share to the GDP. Their farms became larger-scale and further mechanized. As mentioned, using 60 percent, agriculture remains the main user of water withdrawals. Yet, sector-based figures ignore the intra-sectoral and people-based differences. These differences are wide. The result of this skewed infrastructure-driven 'water grab' for rural areas is that 1.2 percent of the rural population (mainly large-scale farmers and mines) uses 95 percent of the rural water withdrawals (Cullis and Van Koppen, 2008).

By the 1970s this skewed economy led to ever-growing structural unemployment of Africans. By 1970 more than 20 percent of the potential labour force was unemployed. This rose to almost 40 percent in 1995. Inequalities among Africans also widened. From 1975 to 1991, the income of the top 20 percent of African households increased by 38 percent, while the income of the poorest 40 percent declined by 42 percent (Terreblanche, 2002). This skewed pattern of high-skilled, capital-intensive economic growth continued after 1994, but was often 'jobless growth'. Or worse, jobs were shed. As mentioned, the further mechanizing of large-scale farming sector evicted many laborers and tenants. While overall unemployment rates were quite stable post-1994, continued population growth implied increasing numbers of unemployed, especially among the youth.

Smallholder agriculture declined after 1994. The dissolved homeland boundaries further enabled the entrance of the food distribution markets. This eroded markets for smallholders even more. Currently, a national food production and distribution system of the produce of

the large-scale farmers reliably provides food almost anywhere in the country. Four large supermarket chains retail about 60 percent of the food. The poor are increasingly passive consumers of the produce of white large-scale farmers (Van Auerbeke et al, 2011). The country's massive social grants programs of USD 12 billion for 15 million South Africans serve humanitarian goals and also boost a consumer market. Recent studies in the Eastern Cape show that only 10 percent of the fields were ploughed annually. At present, crop production occurs mostly in home gardens. Farming today mainly serves as an additional source of food (Van Auerbeke et al, 2011). Increased competition in retail markets reinforced this process.

This decline happened in spite of rising budget allocations to DAFF, which mainly targeted smallholders. As shown in Figure 22, budgets more than doubled between 1996/97 and 2011/12 (Treasury, 2011). So it was not a lack of available funding but the design of this support (Aliber and Hall, 2011). The case studies highlight how this applied to irrigation support.



**Figure 22: Agricultural sector expenditures/budgets (2008 Rand)**

Source: National Treasury (various) and National Treasury 2009; cited in: Aliber and Hall 2011

## 7.2 Smallholder irrigation

Also going back in history, an early description of smallholder irrigation and the type of support provided by the then apartheid government is found in the Irrigation Chapter 29 in the 1956 Tomlinson Report, the basis for the government's homeland policies (Houghton, 1956). This reported vibrant irrigation by black people at the time. Some had taken up

irrigation on their own initiative and explicitly requested government to support. For example, the Tomlinson Report mentioned how Pedi farmers in the current Sekhukhune district, had voluntarily contributed labour to construct 60 earthen dams in collaboration with the agricultural section of the Native Department. 11 300 bags of wheat were produced (Houghton, 1956). The report also mentions a total of 122 smallholder irrigation schemes in the Union of South Africa. Most of those were in the north-eastern regions of the Transvaal (currently Limpopo and Mpumalanga Provinces). Within this region, the Olifants River was particularly important: 36 were along the Olifants River (and will be analysed in the case study). Other schemes were mainly in current Eastern Cape and KwaZulu-Natal.

Government's growing investments in these irrigation schemes served a mix of political-economic goals. First, employment in irrigated agriculture was expected to reduce any movement of Africans to the white Republic of South Africa. Irrigation would mitigate the risk of 'black inundation'. Second, schemes provided food security (maize) for the few who got a plot. By the late 1980s, only 30 percent of the food consumed in the homelands was produced internally; the large majority of black people depended on the purchase of food produced by white farmers. Surplus maize and the cash crop of wheat, the other crop that was imposed to be grown, also provided for national food security. Third, schemes along rivers that separated the white Republic of South Africa from the homelands became well-controlled boundaries. Fourth, irrigation schemes allowed settling and pacifying the victims of forced removals from across the river or from larger distances that accompanied the apartheid's government rigorous territorial segregation. White farmers who had to leave their farms in future homelands received a monetary compensation. Fifth, by favoring allied chiefs of the region with plots, 'Pretoria' (the seat of government) could better impose its rule. Sixth, these irrigation schemes provided employment to the development corporations and white engineering and irrigation management firms. Especially from 1980 onwards (Van Averbeke et al, 2011), development corporations and the white engineering firms in the homelands accelerated their efforts in a next round of investments. They upgraded the schemes to more expensive, more energy consuming, and more centralized technologies. These were 'excessively capital intensive, based on the most sophisticated modern technologies'. This had a reason: 'Since consultants always received a fee based on a percentage of the capital expenditure, it was to their advantage to plan the most capital expensive system. The South African government funded only capital expenditures and not running costs and it was thus easy to convince homeland governments to go for capital intensive projects, rather than those with higher running costs, e.g., labour intensive ones' (Laker, 2004). It started a trend in which 'design solutions appear to have been scaled down versions of first world technology rather than finding a solution that would work well for smallholder farmers' (Machethe et al, 2004). Over the course of the years, this centralized mechanization ensured full white control over the production process, thoroughly enforcing dependency.

Lastly, the divide-and-rule policies through these investments were gendered: they served to pacify men by giving them more power over the labor of their wives. Across South Africa, crop cultivation used to be the domain of women and their daughters-in-law. Men focused more on livestock. Male migration strengthened the importance of women's crop cultivation to reproduce the labor force by rearing the new generations of laborers, by caring for the sick and by providing a home for the elderly. Apartheid irrigation development tried to change these gender relations by introducing the European and Afrikaner notion of the nuclear family, solely engaged in farming, with the male household head as the natural and sole household member entitled to land, technologies, and other productive resources. The latter included the fruits of their wives' labor. Thus, the Tomlinson Commission recommended a size of 1 or 1.5 morgen (1.28 ha) because: 'Out of the various farming and settlement systems, irrigated farming is undoubtedly the enterprise for which the Bantu has proven that they are able, under white management and leadership, to make an economic living out of full-time farming and to use the land economically for food production. Unlike rainfed agriculture, the man does not avoid activities here – the man and his whole family are active on the plots'. The Tomlinson Commission explained that a size of 1.5 morgen would allow such nuclear family to cultivate full-time. Citing studies from the Olifants River scheme, the Commission explained how a gross income of 110 pounds could be derived from 1.5 morgen (1.28 ha). This was seen as enough income for a reasonable livelihood – according to white perceptions of Bantu standards. The Commission also gave strict instructions that all those who got plots should give up other farming and work full-time on the irrigation plots. Plot holders were not allowed to leave their homes for more than 14 days without written permission of the (white) scheme manager. Also, no other families were allowed in the dwellings of the irrigating households without permission of the manager (Houghton, 1956). The promoters of these relative privileges for men were silent about the culling of men's livestock under the notorious earlier betterment programs and men's ultra-exploitation in the white wage economy. Commenting how native men often went for migrant labor, while women continued cultivation, magazines like the 'Bantu' stated that irrigation was the best way to raise men's interest in irrigated cultivation, so that men would stop migrating (Bantu 1970).

In sum, government's support to smallholder irrigation never had any ambition to initiate 'economically viable' irrigation or to avoid a dependency syndrome. The irrigators, who in reality were still mainly women, were no more than laborers in their own fields, bearing all the risks.

After 1994, the new government dismantled the apartheid's development corporations; many of its staff were retrenched and joined the private sector firms. The farmers bore the brunt being told that they 'now had to stand on their own feet'. Many of the by then about 300 smallholder schemes in the country, half of which were in Limpopo Province, collapsed.

From 2000 onwards, the Department of Agriculture initiated a 'Revitalisation of Smallholder Irrigation Schemes' (RESIS) . This was most active in Limpopo Province. RESIS envisaged spending a total amount of USD 108,688,000 over five years 2004-2010, i.e. USD 18 114 000 pa. In this period, 126 schemes were planned to be revitalized, including the Flag Boshielo scheme, covering a total of about 19 730 ha and directly involving 12 432 farmers. The replacement value of the infrastructure was estimated at USD 400 million and was 'mostly dilapidated, moribund and none productive' (Shaker, 2005). RESIS aimed at re-building, socially uplifting and profitable agri-business through a 'comprehensive programme to structure, train and capacitate smallholder farmers to run their scheme profitably and sustainably' (DAFF, 2015). An integrated and participatory process-oriented approach was envisaged, with extensive investments in human capital, besides upgrading of infrastructure. It envisaged responding flexibly to a wider range of community priorities, including homestead food production. It considered multiple uses of water, also for livestock, and interrelationships with dry land crop production (Van Averbeké et al ,2011).

However, in late 2004 the new leadership in the Limpopo Department of Agriculture radically abandoned this approach, changing to 'RESIS Recharge'. In this approach, government engaged in a public-private partnership with a commercial farmer as 'strategic partner' in a 'joint venture' with government and smallholders. The commercial farmer was supposed to provide for capital, forward and backward linkages and entire production, and receive a share of the net income. Government would provide for land and irrigation infrastructure. Farmers would give up their land and water infrastructure, and receive the other share, while bearing the risks.

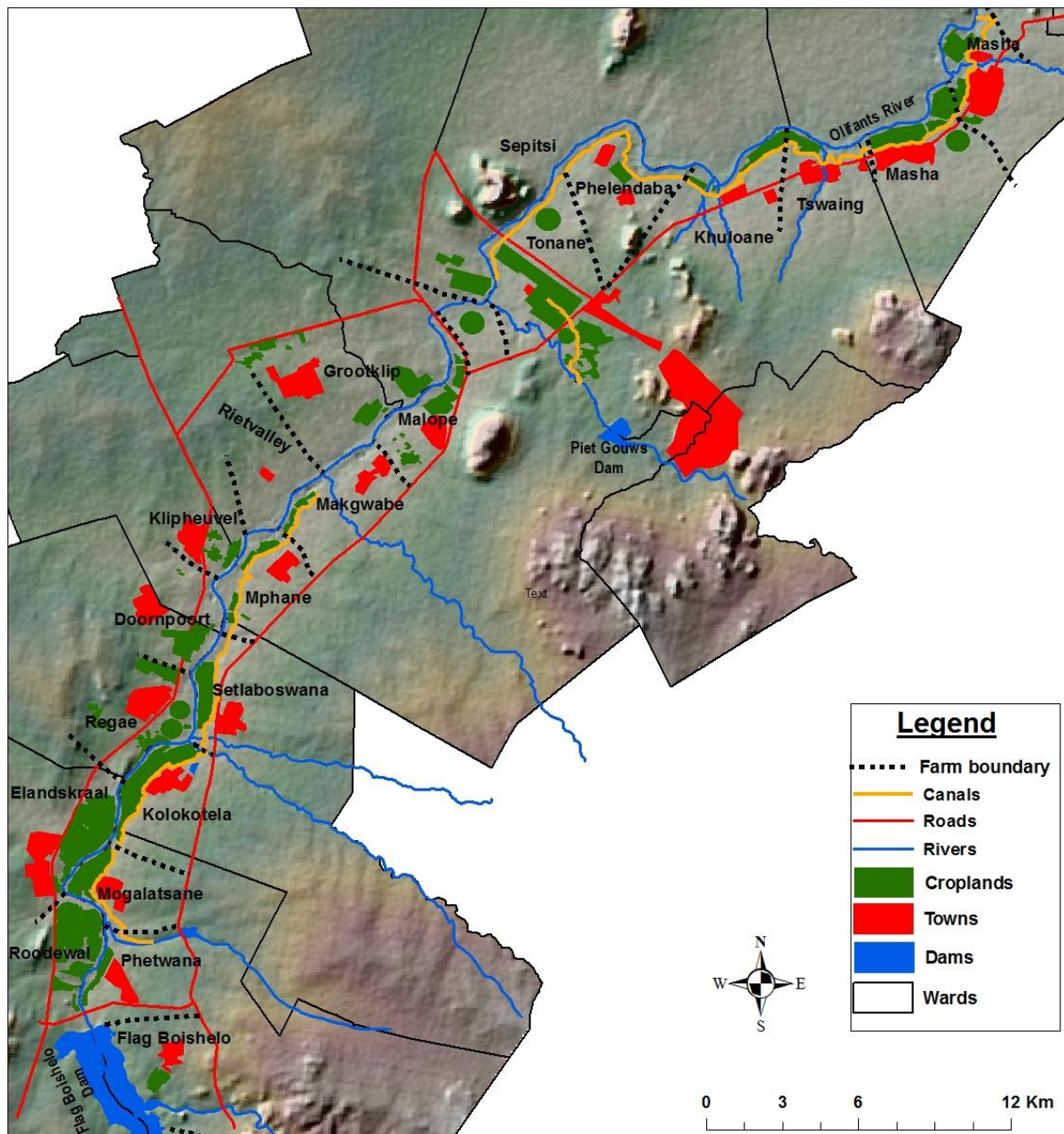
The overall results have been weak. By 2010, it was estimated that 206 schemes were still operational, but that 90 schemes, a third of the total, had collapsed (Van Averbeké, 2011). On the two thirds of the schemes that were still operational, less than two third of the farm area was, on average, cultivated (Denison and Manona, 2007). The water technology that had been installed influenced performance. Percentages of functionality were highest, 81 percent, for gravity-fed canals, which have lowest operation costs and can be controlled best by farmers. In contrast, only 70 percent of pumped surface irrigation schemes (65 percent for overhead irrigation and 56 percent for micro-irrigation) were still operational. The following case study shows how RESIS Recharge worked out in the Flag Boshielo scheme.

### 7.3 The Flag Boshielo Irrigation Scheme in the pre-independence era

The Flag Boshielo Irrigation Scheme in Limpopo Province lies some 300 km north east of Pretoria. The Olifants River and its large dam constructed in 1987 provide year-round water to the left and right bank. The potential command area is well over 2 000 ha. The surrounding region is rich in minerals. This case study focuses in particular on the row of the 12 black



smallholder sub-schemes (or ‘farms’) on the right bank, and one farm, Elandskraal, on the right bank (see Figure 23).



**Figure 23: Flag Bushel Irrigation Scheme**

Source: Google Maps and L. Nhamo IWMI

The following details about the history of the scheme illustrate the complexity at stake. Up to the mid-1800s, the prime riparian land along the Olifants River was occupied by the Pedi, the ethnic group living in this part of South Africa. It is very likely that they also irrigated. This changed with the arrival of the Afrikaner Boers. They had left the Cape area in search of more land and for access to harbours for trade. They were followed by the British. As elsewhere in the colony, the settlers declared large portions of land under the British title deed system as their own, initially mainly for speculation purposes (Lahiff, 1999). This ‘lawful’ encroachment

was enforced by the British imperial army, in particular by defeating paramount Chief Sekhukhune in 1879 (Delius, 1984).

Surveyors carved out 14 blocks of land of an area between 50 and 250 ha (called 'farms' or schemes), and individuals with both Afrikaner and English names obtained title deeds from 1871 to 1873. Through sale, inheritance, and bankruptcy, all farms changed hands at least once and some as often as five times. In 12 of the 14 farms, the farms were transferred to mineral speculation companies, who separated the mineral rights, which they retained for themselves. The surface land rights were further transferred. By the 1930s, all land (minus the mineral rights) was in private hands. The Pedi inhabitants of the area were probably subjugated as tenants or farm workers (Lahiff, 1999).

The title deeds also mention water levies for irrigation activity paid to the Middleburg Irrigation Board. The latter was one of the first white Irrigation Boards established. By establishing that this part of the Olifants River had to be regulated by the 1926 Water Court normal flow apportionment, the white settlers also 'lawfully' exerted their self-declared rights to the passing waters, dispossessing the Pedi of their prior water rights as well (Lahiff, 1999). A river abstraction weir, abstraction pump house and earth canals were constructed in 1933.

The apartheid government of 1948 started a gradual resettlement of Africans on what was then state land. The Tomlinson Report noted that, initially, 'the local population was very unwilling to take up irrigation'. However, by 1952 '472 plots had been allocated' each of usually 1.28 ha, plus a house (Houghton, 1956). After 1969, these plots were held on the basis of a Permission to Occupy (PTO) according to the Bantu Areas Land Regulations (Proclamation R188 of 1969) (Lahiff, 1999).

With the promulgation of Lebowa's declaration of internal self-government in 1972, the apartheid government could consolidate the appointment of a Lebowa government of allied chiefs reporting to, and implementing orders and investments by 'Pretoria'. The settlement and irrigation development in the Olifants Scheme served the goals mentioned above, following the farms from upstream to downstream. The allocation of the two most upstream farms, Hindoestan (later Phetwane) and Coetzeesdraai (later Mogalatsane), were allocated to Chief Frank Sikoane Matlala Maseremule. This Chief with his followers from the Ba-Kone tribe was first removed from Pietersburg, and settled in and around Jane Furse (in Sekhukhuneland). He was one of the first chiefs to accept Pretoria's offer of a position in Pretoria's newly declared Lebowa homeland government. His son Mokgome M. Matlala became Minister in the Department of Home Affairs, instilling strong tribal-based authority, which continues to today.

In 1962, the farm Krokodilheuvel (later Kolekotela) was occupied by members of the Mampana community. Before, they lived on white farms scattered in Sekhukhune and were brought together on this farm.

The nine farms from the next downstream farm Struisvogelkoppie (later Setlaboswana) up to Haakdoringsdraai (Tswaing) were followers of Chief Masemola, who had always resided in this area of paramount Chief Sekhukhune, one of the strongest contesters of the apartheid regime and supporter of the African National Congress (ANC). Families had been scattered on various white farms, but eventually they were consolidated. The central area, Veeplaas ('place of cattle') only got irrigation infrastructure in 1983.

The most troubling re-location was for Chief Masha, his followers and already existing inhabitants in the last downstream farms: Strydkraal and Mooiplaas. In the 1950s, Chief Masha and his followers were forcefully removed from Kalkfontein, near Lydenburgh in current Mpumalanga. Pretoria gave Chief Masha and part of his followers these farms as some economic and moral compensation. Chief Masha obtained a relatively important position in the Lebowa government. He interacted actively with the Lebowa Department of Agriculture and white engineering firms, which gave him the reputation of an entrepreneurial and progressive chief. In 1987 a center pivot was given to 'his community'. However, as a community member narrated, when it appeared difficult for 'the community' to manage, Chief Masha took the management over. He, in turn, leased the operation out to the first strategic partner in the area: a white farmer B. from Marble Hall, the nearest white town at some 40 km distance. His contract was to last to 2007. Other community members did not like farmer B.: 'He was shooting at our animals even if they were far, and without warning.' However, in that downstream area, the Nchabeleng and Ga-Nkoane communities of Apel cultivated the irrigated farm of Mooiplaas. They felt that Chief Masha and his people were forced upon them without consultation, and that this deprived them from part of their land in the irrigation scheme. This compounded increasing political contest between Nchabeleng's anti-apartheid movement and the Masha community. The struggle became violent and led to the abandonment of most of the Mooiplaas scheme. Lastly, in the 1980s, the people from Moutse in the former Kwa'Ndbele homeland settled on the trust farm Elandskraal on the left bank (Tapela, 2009).

As elsewhere in South Africa, up to the 1970s, the water infrastructure was mostly flood irrigation. In the upstream farms water was pumped out of the river, but in the middle, near Veeplaas, a weir was constructed in the Olifants River to feed a gravity canal that conveys water to the fields of the downstream farms till today. Gradually, canals were lined. A small dam, the Piet Gouws Dam, was constructed in the 1960s. The latter was also for domestic water for Chief Masemola's village. With great zeal and efficiency, the white engineers installed electricity and new equipment in 1983. Water pumped from the canals or river fed into piped sprinklers (which were still easy for farmers to move around and control), and

centre pivots (which required more centralized control). These upgrades now also included the grazing area of the Masemola community, Veeplaas, implicitly pacifying Chief Sekhukhune as well.

In 1987, the government of Lebowa finished a large new dam just upstream of Phetwane. The immediate purpose was to provide for domestic water supplies for communities downstream and for irrigation. However, with foresight, the planners targeted the municipal water needs of the province's capital of Polokwane at 100 km distance, as well as water provision to the increasing number of mines. An estimated 200 people have been displaced without compensation for this large dam covering 1 288 ha. Some of them lodged a land claim in 2012 (Tapela, 2009).

The water technologies of pumps and sprinklers required centralized management by managers who also arranged for inputs and markets. This was provided either by commercial agencies contracted by government or by government itself. The management dictated from the top-down: the crop to be sown (alternately wheat and maize, sometimes cotton, but hardly ever high-value vegetables although farmers were quite interested (Maloa and Nkosi, 1993); the dates of ploughing and other operations; the provision of paid mechanized ploughing services; the fertilizers and chemicals to be used; the day and hours when the sprinkler pipes had to be moved; the days for harvesting and central collection of the produce; and the payment days. The management insisted on collecting all produce and discouraged any local trade (which still occurred, though). They brought the harvest to the East Transvaal Cooperative (Oos Transvaal Kooperasie (OTK)) or North Transvaal Cooperative (Noord Transvaal Kooperasie (NTK)), which calculated the income. Costs for cultivation were subtracted from the income gained, to pay the net incomes. Indeed, farmers were not more than laborers on their own plots, bearing the risks of this high-input, expensive, and high-risk form of farming (Shah et al, 2002).

This farm management was a lucrative business. In 1996, with the consolidation of the nine new provinces, the corporations in the north were merged into the Agricultural and Rural Development Corporation (ARDC) (Matlala and Shaker, 2003). ARDC received both USD 7 million per year from Treasury and service charges from farmers. It employed a staff of 1 200 and had a salary bill of USD 2,2 million. The corporation cultivated and provided services for 120 000 ha of government land (Shah et al, 2002).

#### 7.4 Collapse and responses

Already from 1989 onwards, government investments to finance the white-dominated irrigation management agencies began to dwindle. There was even less political will of the new ANC government to keep subsidizing these agencies. The new officials started declaring the (white) publicly funded agencies as expensive and inefficient and not strict enough in

repayment of credits (which somewhat cushioned smallholders' risks) (Maloa and Nkosi, 1993). Government budgets reduced by more than 40 percent (Maloa and Nkosi, 1993). So the government drastically reduced funding of the ARDC, from USD 7 to 2 million (Matlala and Shaker, 2003). Farmers' complaints were discarded. They were told 'to stand on their own feet now'.

From the winter wheat crop of 1996 onwards, farmers had to take over all production costs, starting with the payment of electricity bills. However, credits and capital for the purchase of inputs and the organization of farmers in collectives to begin such collective action were lacking. A downward spiral ensued. Pumps broke down and were not repaired. Canals were not cleared. Lack of income from one crop prohibited the purchase of the costly inputs for the next crop. By 1999, only 30 percent of the scheme was cultivated (Small and Stimie, 1999). A farmer commented: 'It is ok for us to stand on our own feet, but this has been too sudden'.

Various responses emerged. Plot holders, especially women, continued irrigated cultivation and also tried to establish direct relationships with the Land Bank and market cooperatives, but failed. Along the canals, especially women continued or started informal gardens, whether the existing or self-made offtakes were seen as illegal or not, which succeeded. Food plot holders with small farm sizes of 0.12 ha started saving groups, which also succeeded (Machethe et al, 2004). However, the most marginalized, especially elder women, lost their basis of subsistence.

In one farm, Veeplaas, agri-business Lonrho attempted cotton outgrower arrangements with all plot holders. In Phetwane, the Department of Agriculture with the cotton cooperative tried the same. Both efforts failed. Highly mechanized cotton cultivation is high-risk: inputs were costly, so profitability mainly depended on very high production. However, the slightest glitches in the production process led to net losses and great resentment about lost food security (Tapela, 2009). As soon as LONRHO had moved out of Veeplaas, farmer B., who cultivated cotton for Chief Masha, arranged a private deal with the tribal authorities of Masemola for him to cultivate the now idle land and water infrastructure.

A more successful arrangement emerged in Elandskraal. Here, the smallholders agreed bilaterally with a commercial farmer trading as Arthur W. Creighton (AWC) to engage in a joint venture, with the explicit goals of skill transfers and consultation about the production process. The strategic partner would bring capital, inputs, cultivation skills, mechanized equipment and guaranteed markets to the table. The original plot holders would organize into a cooperative with a committee, and arrange for paid labor and security against vandalism. The net income would then be divided in pre-set proportions with a longer-term 50-50 division. The government, which still owned the land, stepped in to finance and install the preferred irrigation infrastructure of center pivots.

In 2004, instead of the participatory approaches envisaged in the RESIS program, the new leadership of the Limpopo Department of Agriculture took the arrangement in Elandskraal as the model for RESIS Recharge for wide upscaling, with the same strategic partner AWC. However, the department introduced a couple of changes (Tapela, 2009). First, the department became the third party in the contract, but in such a way that no party was accountable to the farmers. The strategic partner could refer complaining farmers to the department, but there was no way for the farmers to hold the department accountable. Second, the irrigation technology was top-down: new, very expensive 'floppy systems'. They required an even more sophisticated centralized management. Even years later, only three persons in the province were said to be able to manage floppy systems (Sithole, 2011). Moreover, there was only one manufacturer of floppy systems. This monopoly allowed bypassing the procurement procedures. This all remained hidden under claims of 'innovating the most modern home-grown technology' for 'most economically viable and efficient irrigation'. Third, a new partnership with a former extension worker, claimed to ensure broad-based black economic empowerment. This rendered the deals even more untransparent and contested. The only commitment by the strategic partner vis-à-vis communities was that he should train them in the areas of finance, quality control, marketing, management, operational, technical and business operation. Significantly, this list lacks agronomic training about crop varieties or crop water requirements, and vesting own sustainable access to input and capital suppliers and output markets. Black farmers were still not supposed to become competing producers. The consultancy firm that had operated in the Flag Boshielo scheme during the apartheid era was commissioned to make the irrigation designs.

Farmers, and even the strategic partner, were reluctant to accept this centralized technology package. Farmers preferred the irrigation systems they knew and were especially reluctant to give up their land both during the two to three years of design and construction and the production phase. However, as this was still state land, their bargaining power around this precious, well-watered resource was limited. They also wanted to grow at least some maize for food security. However, food security was depicted as backward and became the main excuse for the department to simply exclude people who were concerned about food security. In RESIS Recharge, the choice became this top-down package or nothing. In these negotiations, smallholders and even non-farming youth in search of money were accepted in only five new schemes in Flag Boshielo. These were the four upstream farms (each between 52 and 243 ha, starting in 2008-2009) and the latest in 2012: Strydkraal downstream (257 ha, and with center pivots again).

All contracts with AWC failed and ended, in spite of significant dividends from the net income shared between smallholders and the strategic partner and some job creation (in the highly mechanized mode of cultivation). Lack of transparency about the farm budget and exclusion

from the production process and lack of any skills transfer became the main bone of contention. Especially when the strategic partner claimed losses, suspicion *vis-à-vis* the strategic partner and also the cooperative's committees arose. In Strydkraal, this lack of transparency incited some of the younger male members to challenge the committee and the chief to the point of chasing out both the committee and the strategic partner. Commercial farmer B. was invited to take over from AWC.

The committee of Setlaboswana went to the buyer in Gauteng to check the number of trucks leaving the field and their loads. This conflict ended in a court case. Neighbouring schemes of Kolekotela and Mogalatsane also ended the contract. These three farms have remained idle ever since, and equipment has been vandalized. Phetwane also ended the contract with AWC, but continued to operate thanks to highly subsidized support by the department. However, profits remain low and only pay the laborers. The official who headed RESIS Recharge was promoted to central government in Pretoria. After all, he managed to spend the large amounts of funding available for smallholder agriculture, which remains the Achilles heel of perverse incentives in any bureaucracy.

### 7.5 Investments for self-supply

In contrast to the wasteful expenditures in this Public Private Partnership (PPP), many smallholders across the Flag Boshielo scheme mobilized their own investments for water infrastructure, also to compensate for the losses occurred in their schemes. In Elandskraal, for example, people irrigated 2 ha plots outside the formal boundaries of the scheme. These were highly productive. Nevertheless, that water supply was cut off (Mapedza, field notes).

Rivers, wetlands and canals were used for cropping. For example, a canal from the Piet Gouws Dam was 'redesigned' by former farmers at Veeplaas through punctures leading water through long furrows to individuals' fields, some of which were as large as 5 ha (Tapela, 2009). Farmers also invested in irrigation in risky areas. In Mooiplaas, a wealthier relative of Chief Masha living in Johannesburg started to invest in an area adjacent to the river and prone to damage of flooding. That land was seen as too risky for the Department to develop. The various water sources also provided water for livestock, brick making, and small-scale enterprise. Moreover, with dwindling employment opportunities and poverty, men and women took up fisheries in the river and dam reservoir. However, government officials punished poor women and men with very small nets for fishing without a licence.

Last but not least, many people, especially elder women, used water at their homesteads not only for drinking and other domestic uses but also for cultivation, livestock and small-scale enterprise. This water came partly from the formal piped water supplies by the Lepelle Water Board. However, the Board's tariffs were steep. People even paid for water below the 6 000 litres per household per day, which is the cut-off point for South Africa's Free Basic Water



Policy (Tapela, 2009). Partly as a compensation for the long delays in the construction of the formal water supply scheme, quite some connections had already been made illegally by private plumbers (Tapela, 2009). However, the realization of the longer-term high tariffs of the water supplied by the Lepelle Water Board discouraged the productive uses of high volumes of water. Where possible, water from communal boreholes of the apartheid era was used, for free. The boreholes also provided water to the poorest households who were not connected at all. Without access to a borehole, these households either asked neighbours for permission to use their water supplies, or they went to the canals or the crocodile-infested Olifants River (Tapela, 2009).

In Strydkraal, irrigation water was swiftly supplied for 253 ha. Yet, at the same time, the municipality failed to provide any water to residential areas, neither from pre-1994 nor from post-1994 boreholes, reservoirs, and piped gravity schemes. Private water vendors with donkey carts or cars sold water. A drum of 200 litres cost USD 2 or USD 3. Some women still used and re-used this very expensive water to irrigate the few vegetables in their homesteads. Others carried dirty water with buckets and wheelbarrows from nearby gravity canals or the distant river.

All this initiative went unnoticed, unless government declared as illegal and tried to prohibit, typically in vain.

## 7.6 Other case studies: four smaller schemes in Limpopo Province

The source for the following case studies is a field report by Janani Jyani (2012).

Four other irrigation schemes in Limpopo Province shed further light on the pre-independence political goals of smallholder irrigation support and post-independence RESIS Recharge. This ranged from full rejection to success in the Zava, Metz, Silwana and Makuleke schemes.

The **Zava** scheme is located in Greater Giyani Municipality in Mopani District. It was established in 1986 with support from Drought Relief Funds, including the provision of an extension worker and a technician. The 15 ha scheme is for 26 women. The women were involved in the choice of the irrigation system. Water from the Greater Lethaba River is pumped with an electric centrifugal pump (which is protected in a pump house), and conveyed to a concrete storage tank, then to stand pipes, and from there to drag hose pipes. The farmers are responsible for everything: the payment of electricity, maintenance of the irrigation infrastructure and the fence, purchase of inputs (collectively in bulk), marketing and selling their produce. They learned to plant vegetables in September so they can fetch premium green-mealies prices in November/December. Then they re-plant for the second maize crop.

Under the RESIS programme, the government proposed to work with a strategic partner but the women did not want that. No other assistance was given till today, neither by government nor any NGO. The women felt they especially lacked assistance for the upkeep of the irrigation infrastructure and fence. After the damage of the floods in 2011, there was no support and the farmers had to pay USD 1 800 to get the pumps and electric motor repaired. Other problems mentioned were a leaking concrete storage tank, which meant they have to pump directly to the fields and incur high electricity costs; the regular breaking of the coupling bolts of the centrifugal pump (almost twice per month); the laboriousness of dragging hoses now that the women were old; and the collapse of the old fence around the scheme so that livestock easily entered and damaged the crops. The success of the scheme in spite of this, was attributed by the women to (1) the determination of each farmer, (2) the reliable water source, (3) income and other benefits the farmers realize from the scheme, (4) cooperation of farmers in dealing with scheme's problems such as electricity bills payments and maintenance costs, and (5) working together as a unit.

The **Metz** irrigation scheme is located in Maruleng Municipality in Mopani district. It was constructed in 1958 by the Bantu Investment Corporation to compensate for the forced removals of the farmers from their native area of Mmamathola. Some 204 ha are irrigable, and water is supplied from a dam. Flood irrigation is used for an orchard of mainly mango trees. The 129 smallholders who volunteered to take up irrigation each have a plot of between 1.2 and 1.6 ha. Some training was given. A water bailiff paid by government operated and maintained the water supplies. When RESIS Recharge came to Metz in 2007, some choice was offered to the farmers on which irrigation technology they preferred. They opted for floppies, but only in the open areas without mango trees. However, the installing contractor also installed floppies in the orchard. This infuriated the farmers and they rejected this and the scheme collapsed. Then the government withdrew its support for inputs. Water supply to the scheme is uncertain because people have settled upstream along the supply canal and use the canal as well. This reduces water that reaches the balancing dam.

The **Silwana** irrigation scheme is located in the Ba-Phalaborwa municipality in Mopani District. It was established in 1982 by the previous government's investment corporation and managed as a government enterprise, operated by government officers. The scheme of 76 ha took water from the Greater Letaba River and from four newly drilled boreholes. It irrigated 66 ha of orchards with sprinklers. In 1999, after interviews with possible candidates, the scheme was handed over to six farm workers (four women and two men). They formed a cooperative and cultivated the farm as a whole. In 2004, under the earlier RESIS program, the government consulted with the farmers about the technical design and replaced the sprinklers by micro-jet for 33 ha citrus and 33 ha mango trees. A floating lift pump and a booster pump provided water. An additional 7 ha was opened up for drip irrigation for

horticulture, using water from boreholes. The farmers were also trained in the use of the equipment.

However, the government also brought a strategic partner. For six years, the strategic partner gave nothing to the farmers. The farmers took the case to court and in 2010 the strategic partner was ordered to leave. However, during the court proceedings, the citrus trees died off. The farmers started cultivating tomato and pepper in 2010. Unfortunately, the farmers failed to get timely transport, and produce was rotting. The Silwana farmers are further supported by the Limpopo Department of Agriculture for extension services, part of the inputs costs, and irrigation infrastructure maintenance. Extension officers visit and advise the farmers almost every week.

We conclude the case studies in this South Africa country report with a still existing joint venture with AWC: the **Makuleke** smallholder irrigation scheme is located in Thulamela Municipality in Vhembe District. The scheme of 218 ha was constructed in 1986 by the development corporation to accommodate the community that had been displaced by the Kruger National Park. A total of 43 farmers received plots of 5 ha each. In addition, 273 women received food plots. The scheme expanded to 236 ha. In 2002, the earlier RESIS program introduced a cotton outgrower arrangement with Nordelike Sentral Katoen (NSK). This included the installation of 19 centre pivots. A dam and unlined canal supplied water to a balancing dam from which four centrifugal pumps bring water to the pivots. Farmers were involved and trained in the use of center pivots. However, by the end of the contract in 2004, there had only been losses. The Limpopo Department of Agriculture settled the farmers' outstanding debts.

In 2007, the farmers engaged in a three-year partnership with AWC, which has been extended. However, as many as 273 women lost their access to their small food plots. The 43 farmers received significant dividends up to USD 2 400 per year. Nevertheless, farmers expressed the same complaints as above: lack of involvement in the production processes and expenditure records, and lack of skill transfers. Government failed to provide direct support to the farmers as the strategic partner was meant to do that.

## 8. Conclusions and recommendations

Recapping the questions, this country study for South Africa found the following answers.

### 8.1 Hydrological hazards

What are the precise hydrological hazards of climate variability and change, and what is the meaning of 'water scarcity' for agriculture in South Africa?

South Africa faces high and unpredictable variability in rainfall and temperatures, and significant parts of South Africa are dry, especially in the south west. High assurance supplies of water for municipal uses, mines, industrial uses and coal-fired power plants are needed on the Highveld of Gauteng, where water sources are scarce. However, over a century of sophisticated investments by the colonial government in infrastructure, including large inter-basin and international water transfers, has mitigated these hazards – for the settlers and their economic interests. This has led to major inequalities: in rural areas, 95 percent of water resources are used by 1.2 percent of the population. The most cost-effective sites for dams and other infrastructure have been taken. So most naturally available water resources are committed, as endorsed by the new government’s legal recognition of existing lawful uses. An increasing number of South Africa’s basins are reaching physical water scarcity in the sense that new storage development implies that others have to give up water. The only way to ensure a more equitable distribution of water, especially for the poor in former homelands, is to redistribute water. However, while distributive land reform continues to attract much attention from the South African government, civil society and farmer organizations, distributive water reform is hardly mentioned.

## 8.2 Lessons from past and present investments

What lessons can be learnt from past and current investments in agwater management in South Africa, in particular from their strengths and weaknesses in sustainably contributing to poverty alleviation, food security and agricultural and economic growth?

How can the South African government, NGOs and donors build on these strengths and overcome the weaknesses?

### 8.2.1 Irrigation scheme investments by government, donors and NGOs

South Africa has shown the pivotal role of governments in realizing and catalysing investments in water infrastructure for irrigation. These investments were the backbone of the colonial economy. State investments in white agriculture and irrigation rendered agriculture the engine of growth of this economy. Today’s large-scale agriculture and its agri-business of forward and backward linkages continue to shape consumer markets. Potentially competing producers keep being discouraged.

Political-economic objectives also underpinned government’s investments in smallholder irrigation in former homelands. These investments: *created* dependence through increasingly centralized irrigation technologies that are only profitable under the stringent conditions that the farm managers could achieve with obedient plot holders; improved household food security of the plot holders and national food security, also to reduce migration to urban centres; strengthened political stronghold by divide-and-rule among chiefs and between men and women; and created jobs for experienced managers.

This legacy appeared hard to change. The new government hoped that a strategic partner could replace the public farm managers at no cost to the government, other than providing the strategic partner with land and water infrastructure. In return for that, the strategic partner had to pay a share, mostly half, of the net income as a sort of lease to the organized plot holders. However, it did not work out in most cases. Plot holders preferred to keep control over land and production processes; they lacked communication and accountability about the large-scale farm enterprise's finances, especially when losses were incurred; and they did not receive the promised transfer of skills. These were the main reasons for the smallholders to end the agreement, or not even to enter into them. Major tensions between committees and member plot holders and, in some cases, between cooperatives and excluded non-members erupted in the process.

More successful government support was demand-driven participatory financial and technical assistance in the installation or hand-over of irrigation infrastructure and continued training and assistance for O&M and replacement, technical and agronomic skills training, organization of irrigator groups for bulk purchase of inputs and sales, and, last but not least, assistance for marketing.

#### 8.2.2 Investments by individuals or groups for self-supply

Unlike other SADC countries South Africa has a blind spot for investments in irrigation by individuals or groups for self-supply. The only exception is the promotion of rainwater harvesting. This blind spot for 'independent' farmers is partly because such farming is likely to be less developed than elsewhere. It has been discouraged for a very long time, and has shaped the (now more racially mixed) legacy of a dual economy. Another reason is that the investments that do exist have hardly been studied and recognized. Yet, recognizing and building on a bottom-up approach, and supporting these investments, would open up a new and more sustainable domain of spending of the country's available funding.

#### 8.2.3 Investments by agri-business

Large-scale farmers continue to invest in irrigation, also illegally as the new investors intercept water from the Lesotho Highland Water Scheme in the Vaal basin.

A major contribution of agri-business to poverty alleviation is employment creation. However, since the 1970s many jobs were lost as a result of further mechanization and as farmers' escape routes from improved labor laws. However, the employment rates in agriculture have now stabilized. Cheaper foreign workers take their places. Also, the much advocated skills transfer to emerging farmers has hardly been implemented. Food prices, also for poor net food buyers, have rocketed.

There is increasing political pressure to further remove the privileges that large-scale farmers used to enjoy, for example in the pricing of bulk water supplies, or their abundant use of scarce water resources. Farm killings added to the pressure. As a response, the South African agri-business moved out and set up new branches in Mozambique, Zambia, Nigeria, etc. This renders the question on how agri-business can contribute to poverty alleviation and food security even more of a regional question.

The main lessons that other countries can learn from South Africa is how the systematic exclusion of African smallholders from government support and systematic targeting of support to a specific minority denied African smallholders the ability to become the engine of national growth, and has resulted in structural unemployment and poverty of an increasing number of (young) citizens.

## 8.2 Cross-sectoral synergies

What are the untapped synergies between the public sector agencies with mandates in land and agriculture and those with mandates in water management, so that both sectors can achieve their goals more effectively?

Ever since 1994, the land sector has aimed at agrarian reform to redress South Africa's inequalities in land resources and land productivity and growing unemployment. This agrarian reform included restitution, redistribution, tenure reform, and improvement of productivity. In contrast, the water sector has still hardly even addressed major intra-sectoral differences like those in agriculture. More collaboration would enable the pro-active design of a land-water strategy that could accelerate agrarian reform.

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