

Running on Empty

**What Business, Government and Citizens must do to
confront South Africa's water crisis**



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Summary

South Africa, one of the driest countries in the world, is on the cusp of a major water crisis that poses a serious and immediate risk to the economy and to social stability. Against this backdrop, an urgent collective focus on water efficiency involving all parts of society is the only way to address this risk in a timely manner.

While water scarcity has been brought into sharp focus by the 2015 drought, the challenge is far broader in scope than the current emergency. Because of the central role water occupies in our lives, managing water scarcity is not just one of many peripheral issues South Africa faces, but one that, with increasing pressures from climate change, population growth and the future demands of economic development, could define our country's progress. Lack of action could lead to social conflicts, cause further damage to already marginalised communities and severely limit socioeconomic development. While the poor face the greatest immediate risk, this challenge ultimately threatens everyone.

We need a paradigm shift in the way we value and manage water. Instead of placing the prime focus on building new dams and infrastructure that will take too long to help solve the immediate crisis, South Africa must refocus its response from securing supply to investing in managing demand more effectively. The most immediate requirement is to massively ramp up water efficiency measures at all levels, which could generate significant water savings and result in a more equitable distribution of water. These actions must involve all parts of society, but there is a particularly important role for its most powerful and resourceful members, namely the South African business community which has largely been invisible in the debate, despite the significant, direct risk that water scarcity represents for the bottom line of companies operating across the nation.

Although South Africa has made significant progress in ensuring that more citizens have access to fresh water, this trend is rapidly reversing due to crumbling infrastructure and extreme weather events. Severe drought is already having considerable economic impacts and is especially impacting poor rural communities, women and girls. The government has declared four out of nine South African provinces disaster areas, while 6,500 rural communities face acute water shortages. Severe water pollution in many areas exacerbates the pressure on water sources, as do high levels of water loss and wastage. More than 25% of water never reaches the final consumer because of faulty infrastructure, while 6.4% of water is stolen by unauthorised users. Thirty percent of treatment facilities are in a critical state, implying that millions of litres of untreated or inadequately treated sewage are illegally discharged into rivers and streams each day. As a semi-arid country, South Africa cannot afford such pollution and wastage of its precious water supplies.

The country already imports nearly a quarter of its water from Lesotho through a water transfer scheme, primarily to serve the Gauteng region. There will be a 17% gap between supply and demand in 2030 and several South African Water Management Areas will not have enough water to meet their water demand. Those likely to face the biggest gaps are the ones supplying the largest cities – Johannesburg, Cape Town, Durban and Pretoria. Cape Town, which falls within the Berg Water Management Area, will need to close a gap of about 28% to meet future demand. The Institute for Security Studies based in Pretoria noted in 2014, that government's current plan is inadequate in addressing the scale of the problem. While a key demand driver is the increasing size of the country's urban population, projections estimate that household demand will equal 3.6 billion m³ by 2030, with the wealthiest fifth of the population accounting for half of all withdrawals. Like most basic rights and social services in South Africa, water access is fundamentally affected by systemic inequalities, often dictated and perpetuated by the Government and corporations.

In 2015, global investment group Nomura International reduced its 2016 growth forecast for South Africa by 3% because of water restrictions limiting output. Longer-term modelling indicates that further decreases in the quality and therefore usability of water in the country (even by 1%) could lead to the loss of an estimated

200,000 jobs, a drop of 5.7% in disposable income per person (the equivalent of R16 billion per household), and an increase of 5% in government spending and debt.

Despite the gloomy outlook, significant and almost immediate savings can be made by investing in water efficiency at all levels. Furthermore, investing in water also offers economic opportunities, and many good initiatives are already underway. In agriculture, which uses 60% of the country’s water, 30-40% of water could be saved just by ensuring that irrigation systems are more efficient. The domestic and municipal sectors – currently using 27% of South African water – can reduce their consumption by at least 12–30% by addressing physical leaks and increasing household water efficiency. The information on potential savings is much less clear for industry, which uses 11% of South Africa’s water, and the rest of the business community, which consumption represents around a third of municipal water. However, our calculations show that, if industry reduced its water usage by 10%, 3.1 million households (about 13.7 million people) would be able to access a basic supply of 6,000 litres a month.

Potential Savings

Agriculture could save 30—40% water by investing in more efficient irrigation

Municipal and domestic users could save 12—30% by stopping leaks and increasing household water efficiency

By improving efficiency in industrial use of water by 10%, 13.7 million people can get basic water supply

Given that the business community and commercial-scale farmers have the most resources and face significant economic risk from water scarcity and pollution, they should immediately step up their engagement and practical response to the looming crisis. They can start doing this by disclosing their own water use; setting transparent targets and improving their own operations; and working with their supply chains to ensure that they use as little water as possible. The business community could begin investing in products and technologies that save water. They can also offer these to consumers and inform them about the benefits. Retailers, for example, should take the lead by only offering water-efficient products, such as water-efficient taps and detergents. Finally, the business community should work together with national and local authorities to improve infrastructure, including wastewater treatment facilities, and maintenance to prevent leakages. These types of water efficiency projects already exist and offer significant benefits in helping to ensure the supply of sufficient and high-quality water to all South Africans. Drastic behavioural change on the part of businesses and consumers is therefore required to bring the situation back under control.

Introduction

This report explores the issue of water scarcity in South Africa, within the context of the imminent threat that it already poses to the economic and political security of small and larger economies around the world. Climate change induced drought in Syria, for example, is widely accepted as being one of the drivers of the ongoing, 5-year war, has led to the loss of too many lives and unprecedented numbers of Syrian refugees migrating to Europe. This, in turn, is having a significant impact on European Union Member States, triggering national political upheaval and leading to frictions within the Union. In Brazil, a severe and long-term water crisis in the country’s largest city, Sao Paulo, threatens the entire city system, which cannot supply enough water to keep up with a rapidly increasing urban population. Climate change and deforestation have exacerbated this crisis by contributing to shifting rainfall volumes and locations. The president of Brazil’s Water Authority told lawmakers: “If it doesn’t rain, we run the risk that the region will have a collapse like we’ve never seen before.”¹

South Africans face similar risks. The current severe drought is already directly impacting the economy, as detailed in this report. The indirect consequences, however, pose the most significant risk to both economic and social stability, triggering widespread anger and protest. The resultant economic crisis could likely lead to cascading political crises that would impede much-needed economic and social development for decades to come.

While government is of course ultimately responsible for delivering water infrastructure, it cannot on its own implement the solutions that are needed right now. The responsibility for dealing with this crisis must therefore be a shared one.

Today’s challenge affects individuals, families, communities and businesses and therefore demands a collaborative response based on a collective understanding of the urgency and immediacy of the risk. The pathways to action and the benefits they offer are outlined in this report. Our immediate action will buy time for the envisioning and implementation of longer-term solutions. We have the motivation, the required skill set, and the capacity to drive the mind-shift and accompanying shift in behaviour. We need to act now.

In Diepsloot, Johannesburg residents in the township await feedback from the municipality about pollution, spilt sewerage, burst pipes, leaks and a lack of infrastructure in the community.
Photo by: Hanyeol Lee, H. Lee Productions



CHAPTER 1: The global water context

This chapter describes the state of the world's water resources, explores how a changing climate might affect global water resources, and makes the case for improved water demand management and efficiency measures as the best immediate response to the crisis.

1.1 The state of the world's water resources

The Earth's hydrosphere contains about 1.4 million cubic kilometres (km³) of water.² Not all of this is available or fit for crop production or human and animal consumption as most of it is too salty. Only 2.5% is freshwater and about 69% of this is 'locked up' in glaciers, ice caps and permanent snow cover. About 30% is stored in the ground and the rest is found in river systems, lakes and reservoirs.³

We can only access about 90,000km³ of water a year easily, less than 0.5% of the total freshwater available. UN Water, 2006

Various interrelated drivers influence the availability and quality of global freshwater systems. Long-term changes in the soil's capacity to store moisture, runoff volumes, and precipitation and hydrological patterns affect soils, wetland hydrology and geomorphology in regional systems.⁴ Chemical and biological changes, including long-term changes in nutrient and sediment flow to oceans and water quality, can lead to pollution of freshwater systems.⁵ Changes in water use and withdrawal patterns (currently increasing in the developing world and falling in industrialised countries) can also cause water-stress patterns to shift.⁶

1.1.1 Water needs

Each person needs between 50 and a 100 litres of water a day to stay healthy, and a further 400,000 litres of water a year through food⁷. Residents in some countries, such as the United States (US), consume more than eight times that amount for domestic use and four times as much for food production. Water consumption is thus unevenly distributed between and within countries.⁸ Demographic pressures, such as a growing population, and resource-intensive economic growth models further diminish the availability and quality of water resources. There is increasing competition between countries and between sectors within countries for water.

1.1.2 Water scarcity, water access, water-related diseases and rising water tensions

Water scarcity is understood as the "lack of enough water (quantity) or lack of access to safe water (quality)",⁹ while water stress refers to the "ability, or lack thereof, to meet human and ecological demands for water."¹⁰ The concept of water stress also encompasses environmental flows and accessibility of water. Countries are classified as water-stressed if they receive less than 1,700 cubic metres (m³) of rain a year, and as water-scarce if they receive less than 750m³ rainfall a year. An estimated 2.4 billion people, one-third of the world's population, currently live in water-scarce conditions and this figure will likely increase to two-thirds by 2025, with half of the world's population living in conditions of absolute water scarcity by 2050.¹¹ Some regions such as the Middle East and North Africa experience permanent water deficits.¹² Water sources are distributed unevenly across the Earth's surface and do not align necessarily with the location of dense human settlements. Current water demand exceeds available supply in nearly 80 countries. The US, parts of China, India, many African countries and scores of others are suffering the debilitating effects of water scarcity.¹³

Water conflicts have started to spill out onto the regional political landscape and this type of conflict is expected to intensify between countries as each races to secure the necessary water resources required to underpin economic growth,¹⁴ and even more intensively between sectors, such as agriculture, industry and consumers, within water-scarce countries.

Beyond the issue of scarcity, about 1 billion people lack access to clean water and about 2.5 billion lack access to adequate sanitation services. Most of these people live in sub-Saharan Africa and South and East Asia. A growing world population puts further pressure on already strained water and sanitation infrastructure. Some studies indicate that in some areas, up to 95% of urban sewage is discharged untreated into surface water bodies, particularly in developing countries; in the US, about 37% of lakes have been declared unfit for swimming for this reason.¹⁵ The infiltration of human waste, fertilisers, pesticides and soil sediments into water bodies poses a threat to human wellbeing and agricultural productivity, particularly in countries that do not have strict and enforceable water regulations.¹⁶ This increases the threat of water-borne and water-related diseases. About 3.4 million people, mostly children, die each year from consuming unsafe drinking water or from not having access to decent sanitation services. The US Center for Disease Control estimates that providing access to clean water and sanitation services and improving general hygiene practices could prevent 9% of global infections and 6% of all deaths.¹⁷

Women and water

Women and children bear the primary responsibility for water collection. Access to water is a very time-consuming activity for many women, especially in rural areas. Women and girls often spend up to 6 hours and have to walk an average of 3.7 miles a day just to collect water. In rural Africa collecting water takes 26% of women's time or 40 billion hours in total each year.

This is part of unpaid care work that prevents women from doing other activities, such as going to school, growing food, engaging in paid work, spending time with their families and having free time. Unpaid care work includes all those activities that go towards caring for a household such as cooking, cleaning, collecting water and firewood and caring for the ill, elderly and children when these activities are done by family members for no pay.

In rural areas women use water for both domestic and agricultural activities, while men use water primarily for their agricultural work. The need for water for domestic purposes increases when the need for care increases. For instance, research from Tanzania shows how women's demand for water increased as they cared for their family members living with HIV and AIDS. The right to water is enshrined in a number of international human rights treaties and government remains the primary duty bearer ensuring the fulfilment of this right. However, some governments are opting to privatise water making it more difficult for women living in poverty to access this resource. Climate change will also likely deteriorate water access, even in many areas, where water sources are currently available.

Improved access to water and water efficiency, i.e. products and technologies that reduce the necessary quantity of water, can significantly reduce women's workloads, time spent on unpaid care work and increase school attendance of girls by over 15%. The impact of women reclaiming time shouldn't be underestimated - women reinvest up to 90% of their income back into their families, improving their family's health and nutrition and ensuring that their children get a good education.

Sources: ActionAid, 2013, Water.org, 2013, UN Water, 2015

The role of water, firstly as a prerequisite for life on Earth and secondly as an economic resource, are often in conflict. The exploitation of water as a commodity has put aquatic ecosystems and the life they support at risk.¹⁸ The World Economic Forum declared the water crisis the biggest global risk to societal stability in 2015, above war and international terrorism. There is, however, no global solution possible; interventions must focus on the local and regional levels because of diverse causes of water loss. Significant investments in infrastructure, educational initiatives to change behaviour, and investment in water efficiency and treatment measures will be required.

1.2 How we use and lose water

We use about 69% of available freshwater to grow food, 22% for industrial purposes, 8% for domestic practices (cooking, cleaning, drinking), and 1% for recreational activities.¹⁹ Water is lost either physically through leakages or commercially through theft, fraud or inefficient uses and wasteful behaviours.

Poorly maintained or badly designed infrastructure is the primary culprit for the physical loss of water. More than 32 billion m³ of treated water is lost through leaks every year. While half of this was lost in developing countries, countries such as Bulgaria and Italy have shockingly high leakage rates – 50% and 42% respectively.²⁰ Countries in the Middle East, North Africa and the Mediterranean region have made it a priority to fix infrastructure and improve billing systems to decrease loss of water and of revenue.²¹ A growing and increasingly urbanising global population will intensify the pressure placed on water systems.²²

Commercial loss is referred to as non-revenue water, which is the difference between the amount of water in the distribution system and the amount billed to consumers. The World Bank places a conservative estimate of non-revenue water loss at 50 billion m³ with the allied cost to water utilities at US\$15 billion each year. This is more of an issue in developing countries, which often do not have adequate monitoring or national reporting systems for water utility performance,²³ and who can afford it the least. Both types of loss affect the financial viability of water services, which in turn reduces their capacity to fund necessary maintenance and expansion.

1.3 The influence of a changing climate on global water resources

It is increasingly apparent that humans are influencing the Earth's climate system, primarily through accelerating greenhouse gas emissions, which are currently at the highest levels in recorded history. This has led to changes in global, regional and local climate patterns with widespread effects on human and natural systems, including the water cycle.

1.3.1 Observed changes and the implications

Temperature, rainfall and evaporation rates are the main determinants of water availability. A changing climate is thought to be responsible for an increase in the frequency and/or intensity of ecosystem disturbances, such as flash floods, droughts, windstorms, fires and pest outbreaks.²⁴

Malta shifts focus to demand management

The Mediterranean island of Malta has one of the lowest rates of renewable water supply in the region and one of the top 10 highest population densities. It was one of the first countries to invest in desalinisation plants in an attempt to meet increasing demand. It was forced to shift its focus in the 1990s from water supply to water loss issues and adopted sophisticated technology to monitor and reduce leaks. The implementation phase of this project was so effective that Malta decommissioned its plants in 2015 and has reduced the level of water extraction from the island's aquifers to below 1960 levels.

Source: World Bank 2014a.

The proportion of land surface experiencing extreme drought at any one time will increase by 30-fold, the frequency of extreme drought events will increase by 2-fold, and the increase in mean drought duration by 6-fold by 2090.²⁵

Intergovernmental Panel on Climate Change [IPCC] 2014.

The average global surface temperature increase of 0.8°C relative to pre-industrial levels has already affected the hydrological cycle. The Intergovernmental Panel on Climate Change (IPCC) states that it is “likely” that human activities have affected the global water cycle since 1960.²⁷ Looking to the future, a temperature increase of up to 4°C will result in unprecedented heat extremes in the Middle East, North Africa, Latin America and the Caribbean, with consequences for human and ecosystem health.

As temperatures rise, water bodies heat up, which has consequences for the species that inhabit them as the concentration of nutrients changes and oxygen levels decrease in the deeper layers. Temperature increases play a critical role in regions dependent on glacial melt water in the dry season (parts of China, Pakistan and India) as snow is likely to melt earlier and be less abundant. In regions such as Mongolia and Xinjiang, China, earlier and increased snow melt is raising lake levels, but this is only useful if the surplus can be stored and distributed in the dryer months.²⁸ In other regions (Qinghai in China, Australia, Africa, North America and Europe) lake levels are decreasing because of drought, increasing temperatures and human activities.²⁹ In coastal regions, higher temperatures are likely to drive thermal expansion of ocean waters and contribute to rising sea levels.

Rainfall patterns are likely to continue shifting and projections indicate a decrease of up to 50% in some regions, while others (such as central and eastern Siberia and northwestern South America) will experience increases of up to 30%.³⁰ This could be beneficial, but could also lead to flooding and loss of property and life if infrastructure is inadequate for capturing and storing extra water.³¹ The same applies to increased annual river runoff.³² Increased water flow can also contribute to soil erosion and leaching of nutrients from the soil, as well as carrying potential pathogens and pollutants (fertilisers, pesticides, etc.) to water courses,³³ which can increase algal blooms and the bacterial and fungal content of water bodies.³⁴ This has implications for treatment and monitoring costs.³⁵

The IPCC predicts an increase in heavy precipitation events over the coming decades, which will likely increase flash flooding incidents and adversely affect water quality.³⁶ Extreme events could also affect the rate at which groundwater recharges. In some they could damage the soil’s ability to absorb water, while in other dryer areas it could increase groundwater reserves.³⁷ Water levels in aquifers seem to be decreasing as abstraction surpasses recharge rates, although this is not necessarily linked to climate change.³⁸

“We predict a 150% increase in future flood risk by 2050 ... between 500,000 and 640,000 people will be affected by river floods by 2050 ... the annual economic impact of flood damage ... is set to rise to between 20 and 40 billion EUR in 2050...”²⁶ Lorenzo Alfieri, Joint Research Centre (JRC)

The consequences of climate change will include economic and social impacts in terms of possible food shortages, more extreme weather events, more frequent political conflicts or social unrest, and greater numbers of environmental refugees. It will also drive an increase in water treatment costs. The agricultural sector (both commercial and small-scale) will be significantly affected, with negative implications for food security on local and national levels.³⁹

While models indicate that there might be more water available in the world, it will not necessarily fall where and when it is needed most⁴⁰ and this unpredictability could lead to significant natural disasters. The increase in demand for water for consumption and economic use will also play a significant role⁴¹ and will in many regions be an even more important driver of water stress than climate change.

Chapter 2: The great South African thirst – has it begun?

This chapter looks at the current state of South Africa’s water resources – including its water distribution and treatment infrastructure, the effects of the drought, and current and future drivers of demand, as well as the country’s capacity to cope with upcoming challenges.

South Africa is classified as the 30th driest country in the world⁴² with average rainfall of just 450 millimetres (mm) a year compared to the global average of 860mm.⁴³ Department of Water Affairs 2013; World Bank 2014

2.1 Overview of South Africa’s water resources

Nearly half of all precipitation (43%) falls on only 13% of the land. Only about 9% of rainfall ends up in rivers and wetlands, so little is converted into stream flow; there is also limited groundwater available. Most major urban centres and industrial developments are located far from the country’s watercourses and water has to be transported long distances to service people and businesses operating in these areas. The demand for water is increasing both as a result of the growing population (which has seen an increase of 13 million in the last two decades alone)⁴⁴ with increasingly middle-class lifestyles and expansion of the industries fuelling economic growth. South Africa has nine Water Management Areas. The Department of Water and Sanitation has set a water-use efficiency target for each one of these. The Government owns 29 irrigation schemes across the country. These are managed by water use associations and irrigation boards. In addition, there are another 300 local-level institutions that manage infrastructure and water sources, mainly in water-stressed catchments.

Most rains fall along the eastern and southern coastlines while inland some regions receive less rain than the driest countries on earth.⁴⁵ The country has few natural lakes and aquifers and depends on rivers, dams and underground sources for water. In addition, the mean annual runoff is already stored in dams and cannot,

In the spotlight: Water reporting in South African media

Given the seriousness of the water situation in South Africa, it should hardly come as a surprise that water-related issues received more than 31 000 mentions in print, broadcast, online, and social media coverage since January 2015.

Almost half (43%) of mentions were in print media, followed by Twitter (28%), and online (21%). However, broadcast media only attracted 8% of mentions during the period under review.

Coverage looked at the financial and organisational implications of water shortages and drought on food production and prices. Most of the reporting focused on the immediate consequences of drought and various relief initiatives such as Operation Hydrate, Save Water Now, and Project Thirst.

Public sector-related stories were closely linked to reactive insights such as what is being done in terms of water supply and alternative water management. Drought relief questions and clean drinking water also came to the fore, as well as the Blue Drop Report published by government.

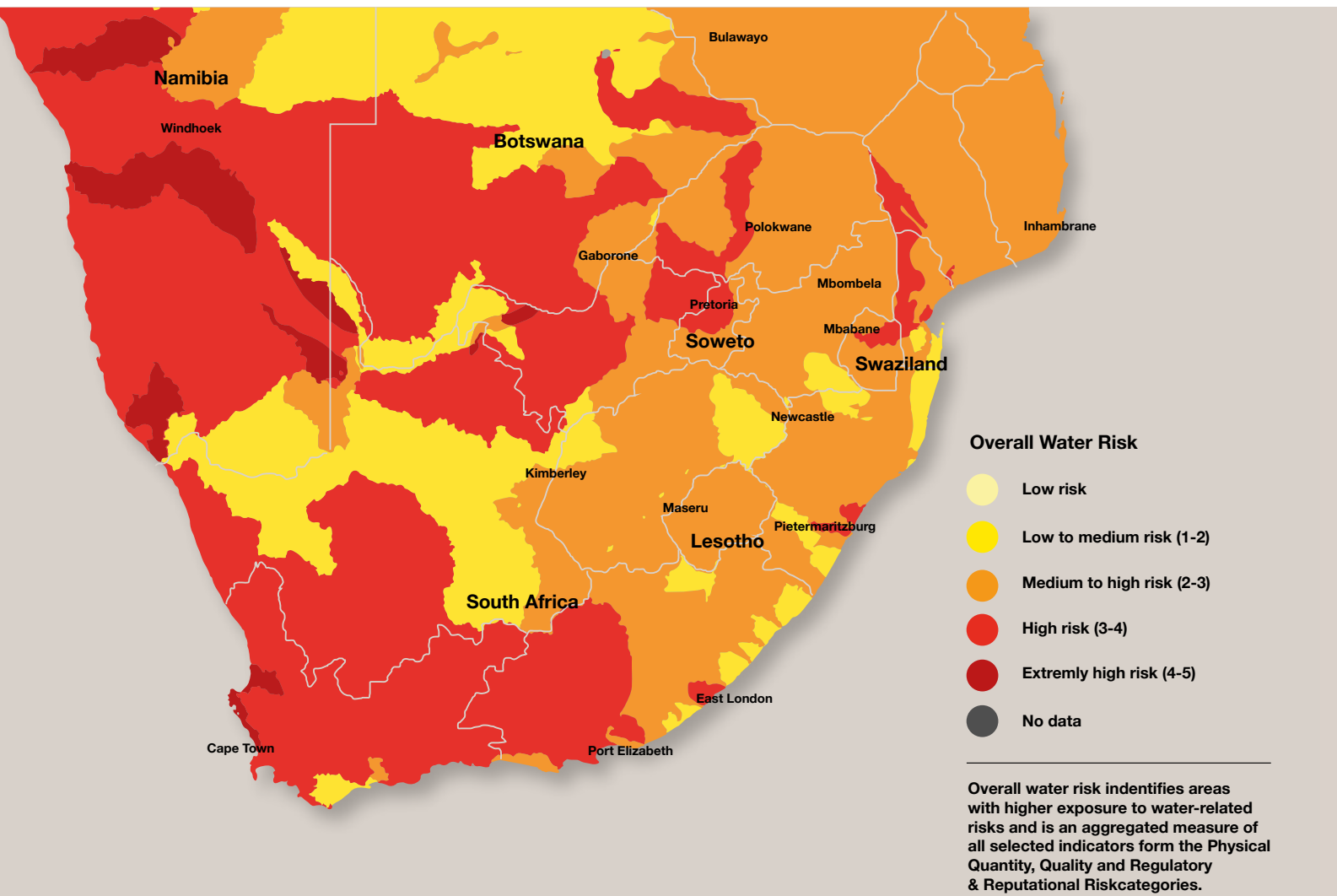
Overall, very little reporting has been done on the long-term solutions to the water crisis or what would happen if the situation becomes permanent.

Source: Media analysis by Professional Evaluation and Research, PEAR. 2016.

on its own, replenish stores. Of the 10.24 billion m³ of assured annual runoff, about 9.5 billion m³ of that is needed to maintain the natural reserve (rivers, dams, wetlands and estuaries) and 472 million m³ is needed each year to meet the domestic allocation of 25 litres of water per person per day.⁴⁶ Its major rivers, such as the Orange River, are shared with neighbouring countries and many run along the coast and into the sea, thus not reaching the driest parts of country.⁴⁷ In short, water is not distributed evenly across the country. It is also not distributed equitably between people, mirroring South Africa's high levels of economic inequality

Severe water pollution in many areas exacerbates the pressure on water sources, as do high levels of water loss and wastage. Climate change is causing rainfall patterns to change resulting in more intense and frequent weather events (droughts, floods, fires). The country is hovering alarmingly close to the water scarcity threshold⁴⁸ and it is likely that it will be reclassified from being 'water-stressed' to 'water-scarce' in coming years. The hot climate further exacerbates water shortages, as up to three times more water evaporates from dams and storage facilities than what falls as rain, making it difficult to replenish water 'stores'.⁴⁹ Further influential factors include rising electricity costs with implications for the costs of pumping water, rising purification costs, and the significant investment needed to refurbish and build new water infrastructure. Figure 1 indicates South Africa's rating according to the Water Risk Index.

Figure 1: South Africa's rating according to the Water Risk Index



The 2015-2016 drought

South Africa is currently experiencing its worst drought since 1982, which has, so far, affected 173 of 1,628 water-supply schemes that serve about 2.7 million households. Dam levels are at all-time lows and 2015 was declared the driest year on record. The government has declared four of South Africa's nine provinces disaster areas; 6,500 rural communities face severe water shortages. Gauteng, the country's commercial region, is under water restrictions (three-minute showers, limited watering of gardens, etc.) with no relief in sight as it accesses water from the Lesotho Water Transfer Scheme and will only be able to draw additional water when the next phase comes online in 2020. The Department of Water and Sanitation's 'Water Reconciliation All Town Study' has shown that water resources in 30% of South African towns are already in deficit, with water resource shortages expected in another 13% of towns in the next five years and in a further 12% in the next ten years. Record temperatures (32 of them in the summer of 2015/16) have added to the hardship South Africans are already experiencing; 11 people have died from heatstroke and wildfire outbreaks have increased. The last El Niño phenomenon, which is one of the strongest ever recorded, has warmed the Pacific Ocean by 3°C, intensifying drought conditions and exposing severe weaknesses and vulnerabilities in South Africa's water system.

Farmers have borne the brunt of the drought. Maize production has fallen to a third of expected levels with knock-on effects for the region and South Africa will need to import half of its domestic needs in 2016 to meet the shortfall in demand. Cattle farmers are battling to feed their herds; some have had to sell onto a flooded market at reduced costs. Small-scale farmers who do not have the capital, insurance security or lending power to safeguard their crops or livestock have been worst affected by the drought. An immediate result of the drought has been food price increases, which will affect the poor, who are already struggling.

Sources: Mg.co.za 2012; Africanews 2015; Engineeringnews.co.za 2015; Dailymail.co.uk 2015; Bloomberg.com 2016; Reuters.com 2016.



Water in South Africa: Where does it leak?

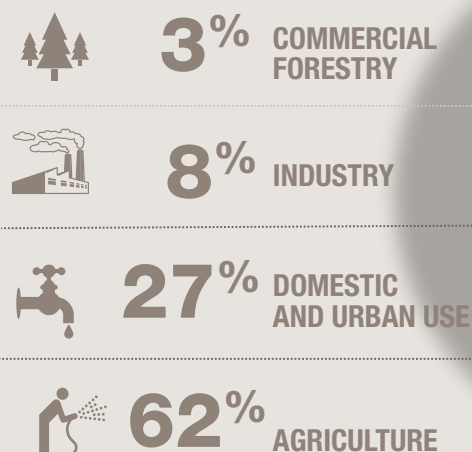
SOUTH AFRICA IS THE
30TH DRIEST
COUNTRY IN THE
WORLD

BUT IT
USES MORE

ON AVERAGE
235^L
WATER/DAY 

COMPARED TO THE
REST OF THE
WORLD

173^L
WATER/DAY 



 **4.3M**
Swimming Pools

36.8%
OF WATER IS
WASTED

= 7.2B
Rands / Year 

Unbilled Use

5% 

IS TAKEN BY REGISTERED USERS

Direct Stealing

 **6.4%**

STOLEN BY UNAUTHORISED USERS

Indirect Stealing

 **25.4%**

REAL LOSSES DUE TO INEFFICIENCIES

ADOPT WATER EFFICIENCY MEASURES NOW!

ActionAid's partner - Xhilo - has been working closely with the Ri Rothe Poultry and Farming Cooperative in Limpopo since 2009, providing infrastructural support and workshops on drought resilient farming practices. Photo: Katherine V Robinson



Drought tempers growth of crops and profit

The Ri Rothe Poultry and Farming Cooperative was established in 2009 and currently has six members. The cooperative sells vegetables and chickens to the local community and provides members with a small stipend and enough revenue to keep the business afloat. ActionAid South Africa and its local partner Xhilo provided training, as well as a water tank, chicken runs, and poultry feed to kickstart the project. It is the only cooperative poultry farm in the area registered with the Department of Trade and Industry. Representatives from the Department of Agriculture and the University of Limpopo have visited the farm to advise on how to scale up production. Members hope to grow the farm and enterprise so that they can tap into bigger markets, and realise more revenue; however, the current drought has tempered these aspirations by diminishing the volumes they can produce, and thus their revenue.

2.2 Running on empty?

Nearly 100% of available water in South Africa is already allocated⁵⁰ and former Minister of Water and Environmental Affairs Edna Molewa noted in 2013 already that "this means that my child and your child that is born tomorrow has 2% of water for use going into the future."⁵¹ In addition, an estimated 40% of wastewater treatment plants are in a critical state⁵² diminishing the country's ability to replenish water stocks. Outdated and inadequate water- and sewage-treatment infrastructure combined with an unskilled workforce have exacerbated the situation.⁵³ Of South Africa's 931 water systems spread throughout 153 municipalities, water services authorities, only 98 systems produced water of high enough quality to receive 'Blue Drop' certification in 2012.⁵⁴ Government introduced this certification scheme in 2008 to introduce incentive-based regulation of the management of drinking water quality and transparency on management performance.

Of South Africa’s 120 rivers, 82% are considered threatened, 44% critically endangered, 27% endangered, 11% vulnerable, and only 18% least threatened.⁵⁵ The figures below illustrate current water supply and demand in the country.

South Africa’s Water Services Authorities operates an infrastructure network comprising 824 wastewater collection and treatment systems. It handles 5,128.9 megalitres of water a day through 824 treatment facilities with a collective hydraulic design capacity of 6,509.7 megalitres a day. In short, there is only 22% available capacity overall for future demand; in reality, many plants have no surplus capacity and are running at full demand. According to a 2013 Green Drop Report, 30.1% of these systems are in a critical state implying that millions of litres of untreated or inadequately treated sewage are illegally discharged into rivers and streams each day.⁵⁶

2.3 Future demands on water

Estimated water usage in South Africa in 2013 was between 15.6 and 16 billion km³ a year⁵⁷ and future demand projections are 17.7 billion km³ by 2030.⁵⁸ According to the Water Resource Group, this will leave a gap of 17% between water supply and demand. At least six out of nineteen Water Management Areas will not have enough water to meet demand by 2030. Those likely to face the biggest gaps are the ones supplying the largest cities – Johannesburg, Cape Town, Durban and Pretoria. Cape Town, which falls within the Berg Water Management Area, will need to close a gap of about 28% to meet future demand. The Institute for Security Studies noted in 2014 that the Government’s current plan is not adequate to address the scale of the problem.⁵⁹ The country already imports nearly a quarter of its water from Lesotho through a water transfer scheme, primarily to serve the Gauteng region.⁶⁰

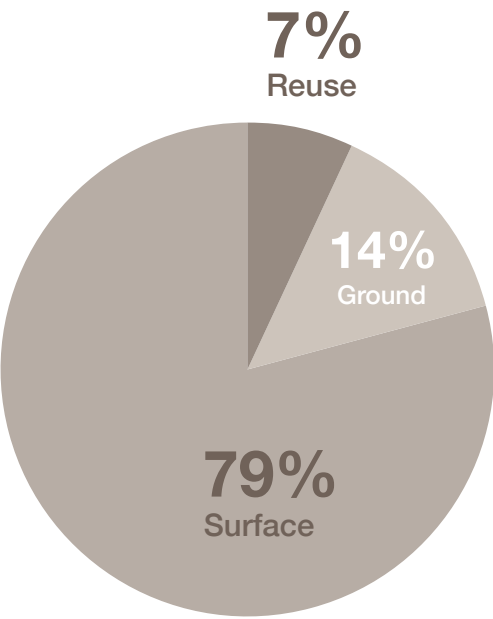


Figure 2: Current water supply: 14.6km³

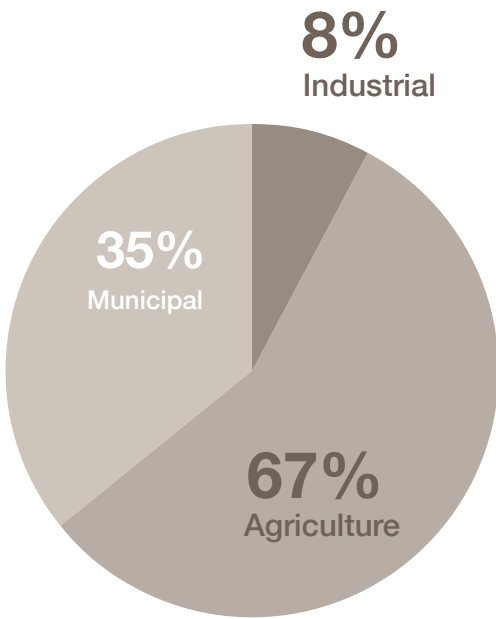
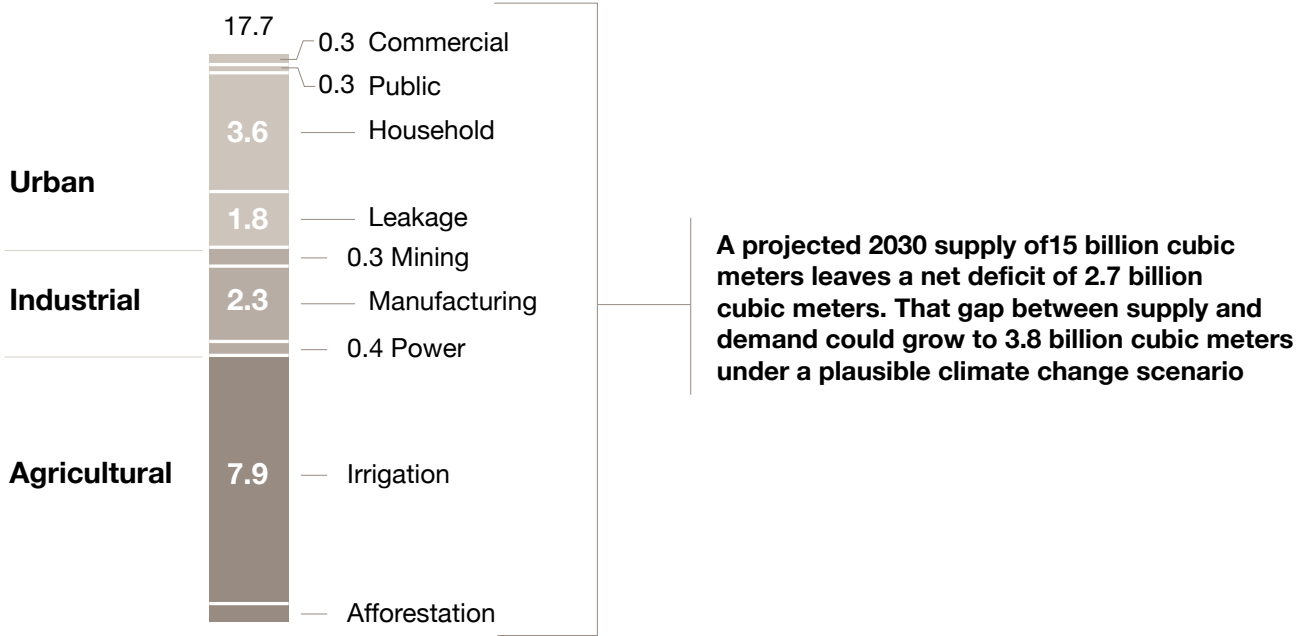


Figure 3: Current water demand: 15.6km³

Figure 4: Supply and demand gap by 2030 ⁶¹



2.3.1 The likely effects of a changing climate

Climate change effects could exacerbate the problem significantly. Increased rainfall variability and seasonality, overall warming trends, and more frequent extreme weather events (droughts and floods) will all lead to more surface water being lost. A small decrease in rainfall, and a corresponding increase in irrigation needs, could widen the supply–demand gap to at least 3.8 billion km³,⁶² pushing the country into crisis.

A 2015 report *Projections of rapidly rising surface temperatures over Africa under low mitigation* concluded that temperatures have been rising at a rate equivalent to more than twice the global rate across Africa for the past 50 years.⁶³ If this trend continues temperatures in the interior of South Africa will reach an average of 3°C hotter than pre-industrial levels.⁶⁴ The World Economic Forum notes that droughts will occur more frequently and with more severity this century.⁶⁵ Future predictions regarding rainfall variability and seasonality in South Africa are less certain, but models predict that rainfall will decrease and shift, as well as being of on average shorter duration, and thus affecting water retention levels in the soil.⁶⁶

2.3.2 Water-shedding and likely consequences

The drought has exposed the fragility of South Africa’s water system and engineers are warning that the Government might soon need to start mass water-shedding – cutting off supply in times of critical overuse or undersupply.⁶⁷ South Africans have become accustomed in recent years to load-shedding of electricity by the national energy supplier Eskom, but water-shedding will surely have far more drastic consequences for individuals, communities and industry. While electricity is generated and distributed throughout the country, water supply is more localised and involves many actors and stakeholders. The similarity between the crises of electricity and water rests on both being undervalued commodities used and distributed with poor infrastructure, and, in many cases, with no attention paid to long-term understanding of system strain, which can and has in many cases led to a collapse in service delivery.⁶⁸ As with load-shedding, water-shedding will have significant negative consequences for the economy. In November 2015 global investment bank Nomura International reduced its 2016 growth forecast for the country by 3% on the basis of water restrictions limiting output, which would compound negative inflation trends.⁶⁹



“Clouds in the sky are a false promise”

Alphious Rambuda was born in 1921 and is now 95-years-old. He has a pension grant but still works at the Ri Rothe Poultry and Farming Cooperative to support his family. After working in Johannesburg as a taxi driver for more than ten years, he came home to Tshiombo and began farming in his retirement.

The drought has hit the community hard, and their main challenge is the water shortage which is having a negative effect on the growth of vegetables. The water tank donated by AASA and Xihlobo has helped immensely with the irrigation of the vegetables, but there is just not enough rain to keep the tanks full.

Alphious says that the climate has deteriorated, that the droughts he experienced as a younger man were much less harsh, and hunger is worse than in the past. “The clouds in the sky are a false promise because they never bring rain. It’s like when you are starving and someone walks right past you with a full basket of food.”

Longer-term modelling indicates that further decreases in the quality and therefore usability of water in South Africa (even by 1%) could lead to the loss of an estimated 200,000 jobs, a drop of 5.7% in disposable income per person (the equivalent of R16 billion per household), and an increase of 5% in government spending and debt, as well as a 1% drop in GDP growth rates.⁷⁰

Timeslive.co.za 2010

The South African government has taken the growing and aspirational population and worsening water pollution into account in its long-term water scenarios,⁷¹ but implementation of mitigation and adaptation measures seems to be lagging behind the expressed urgency of the situation. It is clear that swift action is required to reduce water demand and increase supply if South Africa is to avoid entering a water crisis that could exacerbate existing tensions and conflicts in the country around service delivery and the slow pace of transformation.

CHAPTER 3: Competing sectoral demands for water

This chapter provides an overview of consumption patterns by sector – agricultural, domestic/municipal and industrial (including mining and energy generation). South Africa does not have accurate records of water use per sector, in particular figures for the irrigation sector are lacking because much water is not metered, and use is estimated on crop type and number of irrigated hectares.

3.1 Overview of water demand

The following graphic provides an indication of sectoral use of water in the country. These competing demands – for food production, for domestic use and for economic activity – provide the greatest challenge to finding equitable solutions to South Africa’s water crisis.

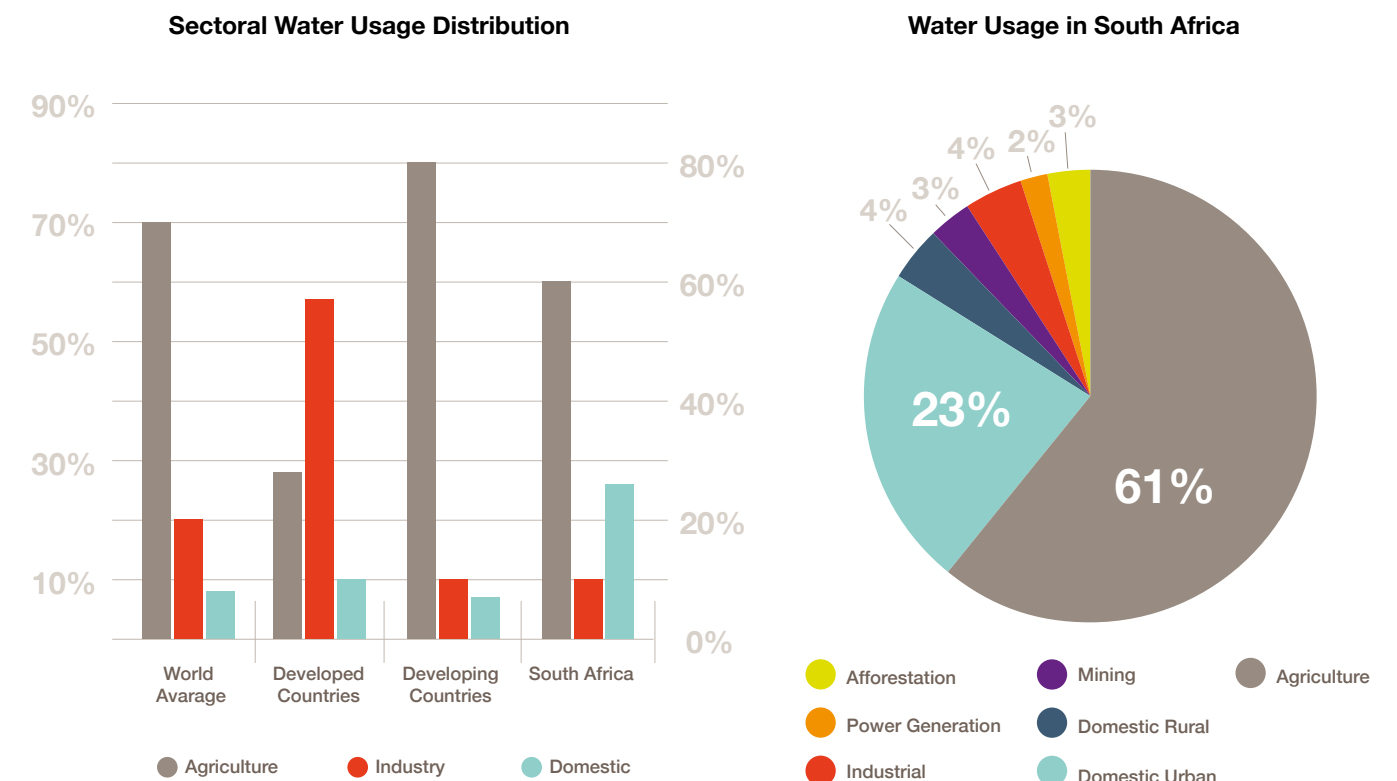


Figure 5: Sectoral use of water in South Africa, 2013

3.1.1 Agricultural users

The agricultural sector uses about 60% of water in South Africa to grow crops and sustain livestock.⁷² The sector contributes about 3% to the country’s gross domestic product (GDP), produces food for the country, employs nearly 638,000 people directly and an estimated 8.5 million indirectly,⁷³ throughout the value-chain.⁷⁴

The intensification of farming practices – mono-culture high-input models – has increased water abstraction and water pollution levels, destroying ecosystems, such as the wetlands necessary for natural drainage systems, and lowering oxygen levels in river water, which can result in the extinction of flora and fauna species, as well as contributing to the gradual salinisation of ground water in coastal areas.⁷⁵ The construction of dams and diversion of water courses for irrigation purposes has also diminished water availability in the bigger cycle.⁷⁶

More than half of freshwater (60%) is spent on irrigating 1.5% of South Africa's agricultural land⁷⁷ (about 1.6 million hectares).⁷⁸

Department of Water and Sanitation 2004; National Planning Commission 2012.

The bulk of water used by the agricultural sector is mainly allocated to commercial farmers, with small-scale and subsistence farmers mostly practicing rain-fed or hand-watered agriculture. Irrigation types are localised (12% of water), surface irrigation (33%), and sprinkler irrigation (55%).⁷⁹ Water is lost through evaporation, absorption by plants, runoff or infiltration into aquifers and pollution.⁸⁰ It is estimated that 35–45% of water is lost during irrigation, mostly because schemes are in a state of disrepair or have exceeded their economic lifespan.⁸¹ Other factors are runoff losses, inefficient irrigation techniques and leakages, wasteful field application methods and cultivation of thirsty crops, improper irrigation scheduling, and soil type and preparation.⁸²

As not all water distributed through conventional irrigation methods reaches the root systems of plants, about 35% of water returns to river systems by overland flow and collects nutrient-enriched seepage and residues of herbicides and pesticides, as well as other pollutants, along the way that are detrimental to the water quality of the receiving body.⁸³ Decreasing the amount of water used for irrigation is fraught with challenges. Although the Department of Water and Sanitation has limited the amount of water allocated to agriculture, demand for food and feed is expected to rise significantly.⁸⁴

Conversely, the *National Development Plan* (2012) makes provision for increasing the percentage of land under irrigation by 33% by 2030 as part of its job creation efforts.⁸⁵ And to support the emergence of black South African small-scale farmers, the department will need to ensure that they can access sufficient water. This requires trade-offs in allocation, investment into suitable, affordable technologies, and incentives for switching to more water-efficient farming systems.

3.1.2 Domestic/municipal users

Provision of clean drinking water for citizens is a priority for the South African Government and has been hailed as one of the its successes. In 1994 only 59% of the population had access to clean water; by 2012 that figure had risen to 90% despite a significant increase in population levels.⁸⁶ South Africa met its Millennium Development Goal commitment of halving the number of people without access to clean water two years ahead of the 2015 deadline;⁸⁷ it has not yet, however, met its commitment to halving the number of people who lack access to sanitation services. The Constitution states that all have the right to enjoy access to sufficient water and government provides a minimum amount of 25 litres of water a day to each person who qualifies for the Free Basic Water subsidy. The National Development Plan aims to ensure that all South Africans have access to clean, running water in their homes by 2030.⁸⁸

Domestic users account for about 27% of the country's water use – which breaks down to around 24% in urban areas and 3% in rural areas.⁸⁹ Water is used at the domestic level for drinking, cooking, cleaning, sanitation and washing clothes, and in some cases watering lawns or filling swimming pools. About 90% of the population have access to basic service provision, including water, but the average amount of water used differs significantly between low-income, medium-income and high-income households.⁹⁰ Important to note is that around a third of municipal water is used for commercial activities.⁹¹

A middle-income four-person household typically allocates water to gardening (25%), flushing the toilet (25%), bathing and showering (24%), washing clothes (13%), and drinking, cooking and cleaning (13%). A commercial hotel with 300 rooms typically uses its water in guestrooms (37%), the kitchen (21%), toilets (17%), laundry (12%), coldrooms (6%), and for its swimming pool (5%). A high school with 1,200 learners and a sports field typically uses its water in the toilets (48%), on irrigating the sports field (38%), maintaining the swimming pool (6%), and the balance in the classrooms.

Anah Maemu, says that her biggest challenge as a farmer is water, not only because of the drought but a lack of water management in the area.
Photo: Katherine V Robinson



Farmers say women get raped while collecting water

Anah Maemu started farming on her plot in Tshiombo Village in the Limpopo Province in South Africa in 1969. Anah, who is now 85-years-old, grows pumpkin, corn, tomatoes and sweet potato.

She began farming to ensure she could feed her family and that they could attend school though the selling of any excess produce. In 2016, the plot continues to feed her three children, along with her six grandchildren and four great grandchildren, who attend Tshiombo Primary School where they learn agro-ecology as part of the school's nutrition programme, initiated by ActionAid South Africa's partner— Xihlobo. Her grandchildren and great grandchildren apply their skills to Anah's plot, helping her with fertilising, watering and ploughing. "I want these children to become good farmers in the future," says Anah. She also added that Xihlobo has helped her by hosting workshops on how to better take care of crops.

Anah says that her biggest challenge is water, not only because of the drought but a lack of water management. She explained that the canal water is empty by morning because people up stream have already used all the water released by those controlling the dam water. "We spend our evenings walking to collect water, so we can irrigate crops in the morning. Many women get raped." Anah says that the community needs better water management so women can irrigate their crops without having to collect water late at night.

For these examples, the easiest way to reduce water use is to implement water-efficient technologies where possible, and reduce water usage for swimming pools and irrigation. In comparison, a low-income household has a dramatically different relationship with water. Those who do not have access to water resources spend a significant portion of their time physically collecting, treating and storing water. An estimated 4.2% of households still collect water from rivers, streams, springs, stagnant water pools, dams, and wells to meet basic needs. These households use up to 73% for toilet functions, 19% for general hygiene purposes, and an average of 8% for drinking, cleaning and cooking.

There are both physical and commercial losses of water within the domestic sector. Physically, water is lost through poorly maintained or inadequate infrastructure. About 31% of piped water does not reach consumers because of leaks in the network system.⁹² This is the greatest loss in middle- and high-income areas where households tend to pay for water connections – the urban municipal non-revenue water value is at 35.3%.⁹³

In most municipalities water is fed to the property via a metered connection and pressurised water pipes. The cost of leakages can be borne either by the municipality or the consumer depending on where the leak occurs. If it is on the property, the consumer will pay, both for the water lost and for fixing the leak.⁹⁴ All leaks represent a loss of precious water and of income – either for the municipality or the consumer.

Rural municipalities have a much higher non-revenue water count, going up to 72% in some cases⁹⁵ with medium-sized municipalities’ non-revenue water loss ranging from about 34% to 41%.⁹⁶ The loss at the smaller municipal level is primarily accrued through authorised, but unbilled consumption as the municipality works off estimated as opposed to actual water meter readings.⁹⁷ There is therefore no incentive for households to be efficient regarding their water use. These municipalities also have fewer resources available for cost recovery.⁹⁸ On average, 20% of water use is authorised, but not billed for.⁹⁹ Many municipalities have inadequate record-keeping systems record-keeping skills, and in some cases lack even basic meter readings.¹⁰⁰ Besides being unable to accurately monitor and invoice for the water they distribute, they are also unable to ascertain if there are leaks in the system.¹⁰¹

Despite gains being made in connecting more South African households to water services, intermittent supply and compromised quality sometimes render access meaningless.¹⁰² The following table indicates the average amounts of water lost across metropolises, cities and towns.

Municipal category	% Water Loss	Litres/capita/day
A (Metropolises)	29.2	280
B1(Secondary cities)	38.5	249
B2 (Large towns)	38.3	204
B3 (Small towns)	36.2	174
B4 (Mostly rural)	58	164
Total for 2011/2012	37.2	226

Table 1: The average amount of water loss across different municipalities in South Africa

The main factor that influences the high rate of non-revenue water is the low level of investment in upgrading and maintaining water-service infrastructure. The lost revenue for South Africa equates to R11 billion a year at the municipal level. Government has asked municipalities to prioritise the reduction of water losses; it is included as a key performance indicator for municipal performance.¹⁰⁴

Wind power plant Stock Photo: Royalty free



Energy and water nexus

Energy generation depends on water and is vulnerable to physical and technical constraints on water’s availability. A more water-constrained future, as the global population and economy grow and climate change effects are increasingly felt, will impact the energy sector’s reliability and costs. For this reason, it makes sense for South Africa to look at more water-friendly energy sources. Energy efficiency, wind and solar PV contribute to a low-carbon energy future without intensifying water demands. In addition to using less water at the site of electricity generation, these renewable technologies have little or no water use associated with the production of fuel inputs and minimal impact on water quality compared to alternatives that discharge large volumes of heated cooling water or contaminants into the environment.

In the World Energy Outlook’s 450 Scenario, which implies the adoption of climate-friendly technologies, water withdrawals rise by only 4% compared to 2010 use of water for energy — and even this is mostly due to water intensive biofuels (which in many cases have other negative environmental and social impacts). Coal and nuclear electricity are highly water intensive due to water-hungry cooling systems. Water withdrawals per unit of electricity generated are highest for fossil-steam (coal-, gas-, and oil-fired plants operating on a steam-cycle) and nuclear power plants with once-through cooling at 75,000–450,000 litres per megawatt-hour. Advanced and more expensive cooling systems can offset some of these additional water requirements, but they often come at the cost of reducing efficiency and hence, in the case of coal, increase CO2 emissions. Water is growing in importance as a criterion for assessing the physical, economic and environmental viability of energy projects.

Source: *International Energy Agency, 2012*

While a key demand driver is the increasing size of the country's urban population, projections estimate that household demand will equal 3.6 billion m³ by 2030, with the wealthiest fifth of the population accounting for half of all withdrawals.¹⁰⁵ This equates to an increase in municipal demand of 25% in a business-as-usual model.¹⁰⁶ However, as noted above regarding the future demand-supply gap, this water will simply not be available.

3.1.3 Industrial users – including mining and energy generation

The mining and industrial sector uses 16% of South Africa's water and the energy sector a further 2%.¹⁰⁷ The mining sector, which was the bedrock of South Africa's economy and historically the main culprit responsible for degrading water sources,¹⁰⁸ is expected to expand and it is likely to do so in water-scarce catchment areas.¹⁰⁹ Water is lost in this sector through leaks because of ill-maintained or inadequate water supply infrastructure, or through pollution of surrounding water bodies, such as in the case of acid mine drainage in the provinces of Gauteng and Mpumalanga.¹¹⁰ Water is also needed to process minerals, for hydrometallurgical and pyrometallurgical processes and to control dust on roads and waste dumps. While low-quality industrial and mine water can be used, high-quality potable water is needed in the administration buildings and camps.

In an annexure to a parliamentary question tabled in 2015, the Department of Mineral Resources noted that at least 104 mines out of a total of 1,712 operational mines were working without water-use licences in 2014. However, leading companies in the mining sector have anticipated the trend of water demand exceeding availability as well as the accompanying impact on the quality of existing water resources and have invested in large body of research to inform their pragmatic responses. These responses have included improved performance in water management through increased efficiency, technological innovations and sharing of good practice.

Power generation uses 2% of South Africa's water. This is a relatively high figure given the low number of power stations. Most were designed as wet-cooled and wet-ashing stations and so consume large quantities of water.¹¹¹ It must also be noted that this statistic does not include the water used during coal extraction, processing, pollution control and disposal of by-products. If these are included, the amount of water used to generate power increases to about 4.8%.¹¹² In efforts to remove the current constraints on power generation in the country, three stations have been recommissioned, unfortunately they are water-intensive plants. Medupi and Kusile are Eskom's flagship coal-fired power stations yet to come online, using dry cooling or hybrid cooling technologies, base load water consumption will grow from 332 giga litres in 2013 to 370 giga litres in 2035, representing more than a 10% increase.¹¹³ Eskom's current coal-fired stations are some of the most water-intensive in the world.¹¹⁴ According to a 2011 Greenpeace report *The True Cost of Coal in South Africa* every unit of electricity produced by Kusile will use 173 times more water than what the equivalent amount of energy produced by wind power would have used.¹¹⁵ There are also doubts as to whether Eskom's water-accounting framework for its coal-fired plants is detailed enough to accurately capture the utility's water use.¹¹⁶

The rising cost of water or increasing scarcity could thus affect the country's ability to generate energy, compounding the poor economic growth outlook for 2016. Some estimates indicate that substituting coal electricity with electricity generated from solar, wind, tidal or wave sources could save up to 3.32 litres per kilowatt-hour of generated energy.¹¹⁷

Warning sign posted along the Juksei River embankment, Johannesburg. Photo by: Hankyeol Lee, H. Lee Productions



Major companies view water scarcity as a threat

While it would seem that water scarcity poses a threat to all individuals, communities and businesses, some are at more risk than others. For example, 68% of 174 global Top 500 companies stated that water poses a substantive risk to their business. In 2014, 573 investors, representing US\$60 trillion in assets, used the Carbon Disclosure Project's (CDP) water programme, an increase in the number of companies participating of 318% from 2010. In South Africa, the CDP conducts similar annual surveys among the biggest South African companies on how they perceive and address water risk. However, response to its 2014 survey was low, with just over half of companies responding. According to the CDP, "this does not reflect the significance of water-related risks in the country, and might suggest that companies are overlooking the severity of these risks." Those that did respond reported exposure to significant water-related risks in their direct operations. Half had experienced water-related impacts in the reporting period. Most said they were undertaking a water-related risk assessment. More than a third said they expected higher operating costs in their operations, and 15% said they expected plant/production disruption leading to reduced output and 13% expected supply chain disruption. More than 60 companies listed on the Johannesburg Stock Exchange are classified as being within a water-intensive sector or within a sector sensitive to water issues. This would suggest that there is a strong business case for immediate action, including from major investors in the stock exchange.

Source: Carbon Disclosure Project, 2014.



CHAPTER 4: Keeping the taps on: Taking Action

This chapter sets out recommended actions for improving water efficiency measures in the agricultural, industrial and domestic/municipal sectors. These actions would enable South Africa to close its water demand-supply gap using cost-effective measures. Efficiency can be immediately implemented across all three main sectors bringing significant water savings and also a significant investment opportunity for designing and implementing water-efficient technologies.

4.1 Challenges and opportunities

The current challenges that face South Africa's water sector must be kept in mind when deciding on and implementing water efficiency measures or demand management programmes within the various sectors. Measures and programmes must also address socioeconomic goals, including the Government's commitment to eradicating poverty. Poverty manifests itself in myriad ways, including the inability to pay for water services. Water management tools need to support the building of a socially and environmentally just society and support the paramount need to balance economic growth (and consequent withdrawal of water for industrial and business use) and social equity. Any major shifts in water allocation, pricing and strategy must first consider the unintended consequence of further perpetuating divisions in an already unequal society.

The water-energy-food nexus must be borne in mind when making decisions on water-efficiency measures. Building, operating and maintaining new water infrastructure rests on a reliable energy supply, which is already in short supply in South Africa. Balancing the water needs of new human settlements, agricultural irrigation and industrial uses against gains in water volumes and quality must be carefully weighed. Interventions must therefore be based on inclusive and transparent public participation processes to avoid precipitating further social instability.¹¹⁸

However, while water scarcity presents itself as an immediate sustainability challenge, it also presents a significant investment opportunity for designing and implementing water-efficient technologies. South Africa does have a strong legislative framework regarding the environment, of which water is part, and it has some good infrastructure that will continue to deliver if well-maintained.

In addition, water-treatment technologies are increasingly available and more affordable; some sectors have begun setting water efficiency targets and highlighting best practices. The second *National Water Resource Strategy* has been developed in a consultative manner and, as such, has included aspects other than purely technical ones, and there is an increasing interest in public-private partnerships to deliver water, although these remain challenging endeavours. All initiatives aimed at improving water-efficiency and decreasing demand must align with existing legislation and not disrupt the development growth path outlined in South Africa's *National Development Plan* (2012).

It is possible for South Africa to close its demand-supply gap using cost-effective measures across its supply network and implement and regulate efficiencies in the agricultural and industrial sectors. Measures would result not only in a significant saving of water, but also appreciable cost savings. These measures would, however, need to be created and implemented within a local context to provide for regional-specific needs.¹¹⁹ For example, the focus in some water management regions would be on improving efficiency in agricultural water use, while in cities such as Johannesburg, Durban and Cape Town, it would be on improving efficiencies within the domestic and industrial sectors. The country's plan to double its power generation capacity by 2025 and the fact that its biggest demand centres are mostly geographically removed from supply points will place pressure on the country's water resources, particularly if conventional energy sources supply the bulk of this future power.

4.2 Water efficiency in the agricultural sector

Making agricultural irrigation systems more efficient could save between 30–40% of current water use. Department of Water and Sanitation 2014.

The agricultural sector could make a dramatic contribution to water saving efforts in South Africa. A focus on making irrigation systems more efficient, planting appropriate crops in terms of soil type and micro-climate, as well as reallocating water to higher-value users through intersectoral or intrasectoral transfers, and limiting the integrated harvested areas under a particular crop to reduce the amount of water that is transferred from the land to the atmosphere by evaporation from the soil and other surfaces and by transpiration from plants, called evapotranspiration, or diverting water to higher-value crops could all contribute significantly to saving water.¹²⁰ South Africa also has experience with successful projects that have led to substantial water savings. For example, the removal of alien vegetation from streams in the three Western Cape water catchments increased the flow of water by up to 12m³ a day.¹²¹ Some 3.3 million kilolitres of water is used by alien species – the equivalent of 7% of the country's runoff.¹²² Alien invasive plant species use up to twice the amount of water of indigenous plants in some areas.¹²³

A shift in thinking is required in the agricultural sector as to how to improve water productivity, broaden access to water for the poor and manage water resources in an integrated way that takes into account the need to preserve the natural reserve and enhance ecosystem health.

The following are recommended measures for the agricultural sector:

- Use Water Balance Approach Modelling to assess and understand the status and trends in water availability in a specific region over a specific period of time.¹²⁴
- Fix leaks in distribution pipes and reduce inefficient use of water through better control measures, land management and agronomic practices, including conservation farming. This can improve water efficiency levels by up to 40%.
- Implement more efficient irrigation practices, such as use of sprinkler (with a centre pivot, permanent sprinklers or flood-piped) or micro-irrigation, including drip irrigation, which has an efficiency rating of 95%.
- There are plenty of innovations in the irrigation market suitable for implementation in South African conditions, including precision irrigation, which can be operated using drums and drips, or treadle pumps.¹²⁵ Improving the efficiency of irrigation systems can generate water savings of up to 10%.
- Invest in irrigation timing mechanisms¹²⁶ and investigate alternative ways of irrigating, such as flood irrigation, which has been used successfully in the Eastern Cape.
- Invest in low-cost technologies, such as tanks for harvesting rain water and runoff, small storage dams and underground tanks to catch underground runoff.
- Pay attention to minimising seepage from irrigation canals, limiting large-scale percolation, and scheduling to avoid large evaporative losses.¹²⁷
- Remove alien invasive plant species and move towards agro-ecological cultivation systems.

Given that agriculture is the largest use of water in South Africa, it is imperative that the sector focuses on using water efficiently, particularly in irrigation systems. Only 1.5% of water is used to supply animals with water, however the consumption of virtual water through animal feed can be much more significant (see box on water footprint of food).¹²⁸ Beyond irrigation, farmers need to start adopting improved soil fertility management measures, reducing biomass loss and soil moisture evaporation and selecting carefully the genetic

ActionAid's agroecological approach to increasing water efficiency

ActionAid South Africa supports smallholder farmers in the provinces of Limpopo, Northern Cape, Eastern Cape and KwaZulu-Natal. This group farms in regions characterised by low, erratic and unreliable rainfall patterns that produce less than 450mm of rain a year. This poses a serious threat to farmers' water and food security and they find it difficult to make decisions that will enhance and strengthen sustainable food production.

ActionAid supports and empowers these farmers to become food secure and generate revenue through sales of surplus by promoting an agroecological approach to farming using water-efficient irrigation systems. The focus is on conserving water and using practices, such as mulching, intercropping, cover crops, micro-drip irrigation, as well as choosing drought-resilient crops. This approach will mitigate the effects of climate change and improve productivity. These practices improve soil structure by building up layers of organic matter thus allowing rain water to infiltrate the soil and the soil to retain the water. ActionAid also promotes the use of locally adapted seed varieties that produce higher yields in this context than genetically modified seeds that are not climate resistant or water efficient.



This approach has proven successful in improving household food security and income levels. Mr Ntshaube of Lunungwi Village in Venda notes: "ActionAid's agro-ecology approach to smallholder farming has greatly changed our thinking in managing the water crisis we have experienced for years ... I have witnessed farmers producing more than their needs and selling surpluses for the betterment of their livelihoods. This was not possible without ActionAid's intervention."

ActionAid believes that smallholder and subsistence farmers bear the brunt of water shortages and government-enforced restrictions, despite their negligible contribution to the problem, as with climate change and pollution issues. It believes that these farmers hold the key to building sustainable food and water systems. Government and corporate agribusiness need to move away from the current profit-driven, mono-cropping agricultural model to stop the decline into further inequality and poverty.

Source: Edmore Mangoti— ActionAid South Africa's Land and Food Rights Coordinator

Mavis Ramaofisi who teaches agro-ecology as part of the Tshiombo Primary School nutrition programme, also works with other women farmers to ensure that excess produce from the food gardens not only feeds the school children but also local families and crèche's in need of food.
Photo: Katherine V Robinson

material they use for planting to reduce their susceptibility and vulnerability to drought.¹²⁹ Resource-conserving farming approaches, including rainwater harvesting, conservation agriculture and integration of livestock and aquaculture into the farming system, have led to radical crop increases and gains in water efficiencies in developing countries.¹³⁰ This implies the need to focus on improving water productivity, as well as water efficiency.¹³¹

A focus on irrigation systems, while necessary, does not, however, speak to the water needs of small-scale and emerging farmers in South Africa. While the release of water savings to this sector might help ease the water constraints it faces, they will also need to adopt innovative solutions and invest in low-cost technologies to harvest rainwater, access shallow groundwater aquifers, develop wetlands for agriculture, and recycle liquid and solid wastes and nutrients from urban areas. Government will possibly need to subsidise the small-scale farming sector to enable them to access water affordably, efficiently and sustainably. The sector would also benefit from educational programmes aimed at creating a sense of ownership over local water resources in efforts to preserve their integrity and quality. These types of programmes have typically focused on providing information on fertiliser application rates, land-use modifications and capturing and storing water.¹³² The private operation system uses low-cost technologies and the state provides infrastructural support (including access to inputs and markets) and has proven effective in some African countries, including those in the Sahel region.¹³³

Government has an important role to play in setting a facilitating framework for improving water efficiency and productivity in the sector. The *National Water Act* (1998) mandates the Department of Water and Sanitation to register all water users, except those receiving water from a local authority or a bulk water supplier. The department allocates water to users based on their needs. The Act requires irrigation schemes to develop water management plans that establish current water use and set targets and make plans for improving water efficiency. The department has made enforcement of the principle of universal water measurement for irrigation a priority action.

The second edition of the *National Water Resources Strategy* focuses on developing the necessary regulatory support and incentive framework to improve irrigation efficiency. The intent is to release water savings to emerging farmers and to reduce water losses by up to 40% by applying specific actions and producing best practice guidelines.¹³⁴ The department notes that new entrants will need to develop and submit appropriate irrigation infrastructure and operating plans prior to claiming water allocations.¹³⁵

4.3 Water efficiency in the industrial, mining and energy sector

If the natural resource intensive industry reduced its water usage by 10%, 624,000 households (about 2.7 million people) would gain access to 30 kilolitres a day or 3.1 million households (about 13.7 million people) would access a basic supply of 6 kilolitres a day.

Calculated for this report by Pegasys Institute 2016

Our research has shown that it is difficult to establish a comprehensive overview of the commercial and industrial consumption of water in South Africa. Industry uses around 11% of water, but also around one-third of municipal water; 27% of South Africa's water is used for commercial activities. In addition, there are significant variations in demand and supply and basins characterised by industrial centres have the largest gaps. For example, the Waterberg catchment area has 40% of South Africa's coal resources, but insufficient water to mine and process them. The Upper Vaal Water Management Area is likely to exceed its supply by 33% in 2030 due to industrial demand and the Olifants catchment area will experience an even higher gap.¹³⁶

There are few quantifiable targets in South Africa for this sector as they are individually set on a voluntary basis. Most existing targets are intensity targets that range from 0% – retaining water intensity at its current

levels – to a 30% reduction in water intensity, or they focus on improving water accounting or improving the volume of water that is recycled.¹³⁷ There are very few targets set that relate to water quality. Individual companies and sectors should set measurable water use and efficiency targets against international best practice guidelines.¹³⁸

Although some companies do report seeing water-related opportunities that potentially could generate substantive changes in their businesses and create a space for innovative product development, most only see opportunities to mitigate risk, primarily through cost-saving measures (improving efficiency and recycling), and accruing reputational benefits.¹³⁹

Industry can lead South Africa's drive to become more water-efficient by focusing on two fronts: reducing own consumption and encouraging others to do the same, and tackling pollution to improve the quality of water systems. Increasing water scarcity and thus increasing prices will impact negatively on industry; it is imperative that this sector acts to preserve water where it can.

The following are recommended measures for the industrial sector:

- Conduct water audits of primary and secondary operations as a key efficiency tool to identify areas for improvement and significant reduction in water usage as the first step to setting targets and developing strategies.
- Begin or, as in many cases, continue to invest in research and development that supports water efficiency and good water practices. This bears fruit in terms of reduced financial losses as the water price increases, but is also a reputation-enhancing measure.¹⁴⁰
- Use the Water Footprint Network assessment to understand how water is used within operations, where water is sourced from, how much is used, what the return flows are, and the quality thereof. This allows for benchmarking against international best practice guidelines.¹⁴¹ It also allows companies to quantify environmental impact and identify strategies to reduce that impact.¹⁴²
- Investigate non-potable use of partially treated effluent as described in the Water for Growth and Development Framework; improve the efficiency of effluent treatment plants using reverse osmosis technologies; retrofit with more efficient parts where possible.¹⁴³
- Get involved with innovative public and private sector partnerships and projects that aim to set standards and guidelines for different sectors to close the projected water gap.
- Focus on lowering pollution levels in wastewater and halting any discharge of waste into water bodies. Cleaning contaminated water must be a priority.
- Energy generation companies—in South Africa's case Eskom—should explore less water-intensive ways of generating energy. Eskom should also explore the merits of transitioning to decentralised, local electricity production and distribution centres. This would offer additional social and economic benefits to local communities.
- Participate in debates and engage with stakeholders on water issues (at all levels) to benefit from and add to the growing body of knowledge on the subject.¹⁴

Durban: Water recycling in the food sector

Durban, located on South Africa's east coast, is one of the country's fastest growing cities and its second largest industrial centre. Situated in a water-stressed region, it is expected to become dependent on desalinisation in the coming years. The industrial sector places considerable pressure on Durban's water resources. In 2012 Unilever, a global consumer goods firm, opened a US\$72 million factory in Durban, the company's second largest dry food goods factory. The factory uses rainwater harvesting and condensate recovery to reduce its use of municipal water, which meets about 20% of its on-site water demand. It also recycles most of the process water and greywater produced in the factory, which meets about 80% of demand, as well as operating a central water treatment plant that uses biological treatment methods and reverse osmosis processes that apply a semipermeable membrane to remove larger particles from drinking water. These practices have also reduced runoff from the site, thereby reducing the risk of flooding for local communities. The need to use municipal supply has almost been eliminated (in normal circumstances) freeing up 12,000m³ of potable water a year, enough to meet the needs of 200 families. Up to 65,000 tons of dry goods are produced every year with minimal dependence on water. This initiative is implemented as part of the company's sustainability policy, and does not provide a direct financial return.

Source: Water Resources Group 2030, 2013

4.4 Water efficiency in the domestic/municipal sector

The domestic and municipal sectors can reduce their consumption by 12–30% by addressing physical losses (leaks) and increasing household water efficiency.¹⁴⁵ Seago & McKenzie 2012

4.4.1 Actions on the national level

Government has set a target to halve the current non-revenue water loss of 39% by 2020; however, it is unlikely this target will be achieved. While municipalities also have targets, government is encouraging them to put concrete measures in place given the general lack of performance. Most of the Department of Water and Sanitation's budget is spent on developing water infrastructure each year.

A recent Government report recommends that the state will spend almost R300 billion over the next four years to build the infrastructure needed to avoid a full-scale water crisis – this is more than 100 times the budget allocated to water management in 2013.

Water-focused projects in the industrial sector

Anglo American's Australian-based Rain Immunisation Project aims to decrease the amount of production time lost due to high variability in precipitation. The company has improved its flood protection infrastructure; built road crossings and put road-sheeting on semi-permanent roads; upgraded underground mines; built extensive pump and piping networks; and improved storage and dewatering capacity. The project has built the basis needed to generate wet weather plans, as well as plans for drought scenarios.

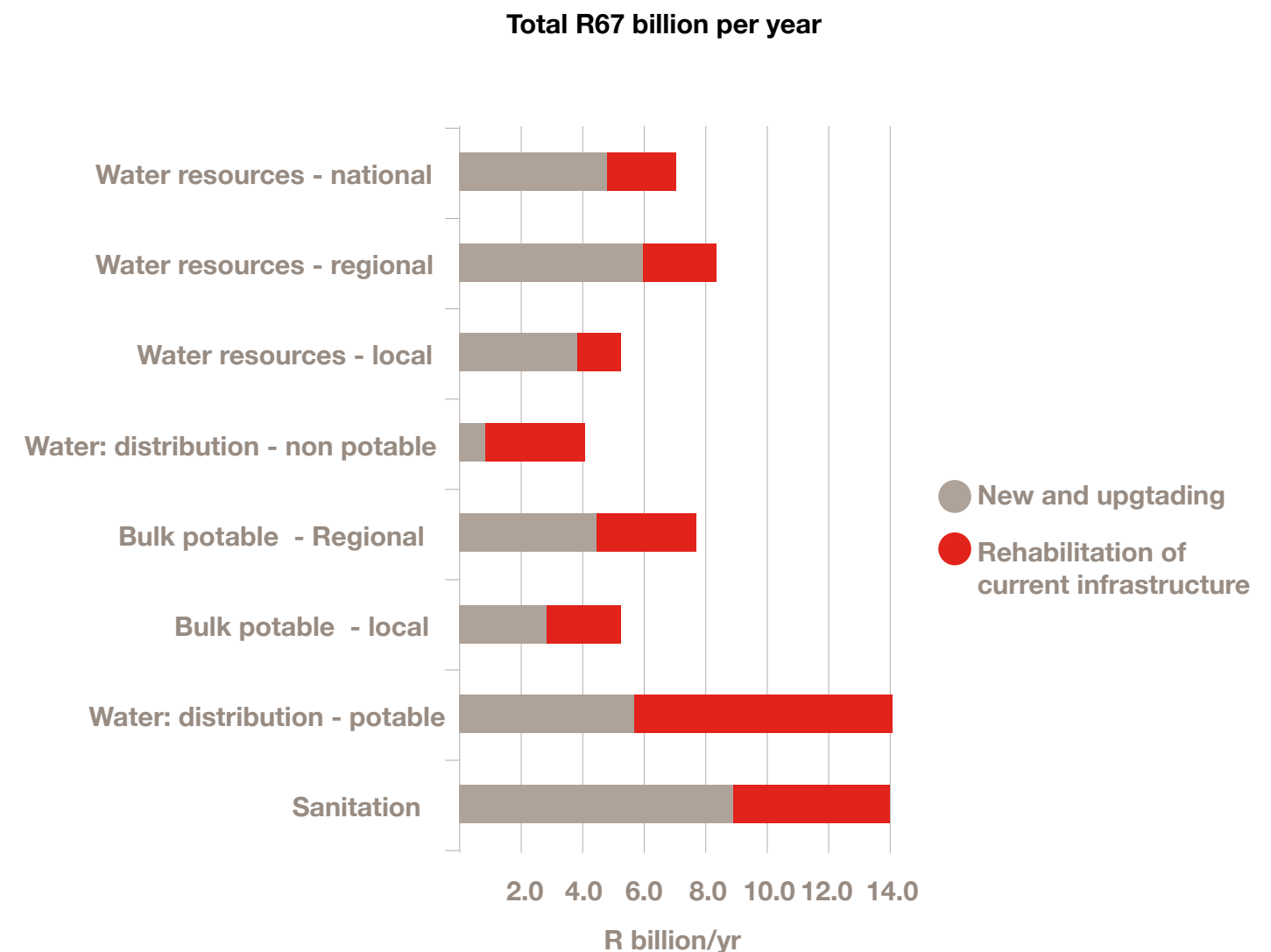
In South Africa's Rustenburg area, Anglo American Platinum has collaborated with the municipality to reduce its water usage. It has signed an agreement to use 15 megaliters a day of treated effluent in its operations, and commissioned a R15 million water treatment plant to improve the quality of treated sewerage water. This collaboration has resulted in the saving of significant amounts of potable water.

Source: Carbon Disclosure Project, 2012.

This shows the ability of large scale enterprise to undertake water efficiency measures. However this case study is by no means representative of the broader impact of commercial mining on water and communities at large. It is not enough for mining companies to take a retrospective and curative approach to water use, but instead they need to increase these efforts tenfold to prevent misuse, pollution and wastage of water. Furthermore, mining companies must align these efforts with broader community engagements to ensure that they are positively impacting the water security and livelihoods of mining affected communities.

The following figure illustrates the required annual spend on infrastructural elements.

Figure 6: Required annual capital spending on water infrastructure



Water use efficiency in these sectors will therefore have significant impacts on the investment requirements for new infrastructure, as would water use efficiency in irrigation and the transfer of any water savings to these sectors. A conservative estimate is that 20% of the new infrastructure spend directly serves industry, manufacturing and electricity generation needs, amounting to R7.6 billion a year. However, because little of the new spend will be on irrigation, in reality it is likely that a higher percentage would be spent on serving the water needs of industry. Having said this, even under a conservative scenario, the possible financial and economic benefits of postponing new infrastructure development even for one year, as a result of improved water use efficiency and water conservation in the industrial sector, are significant. Five scenarios are outlined in the graph below.

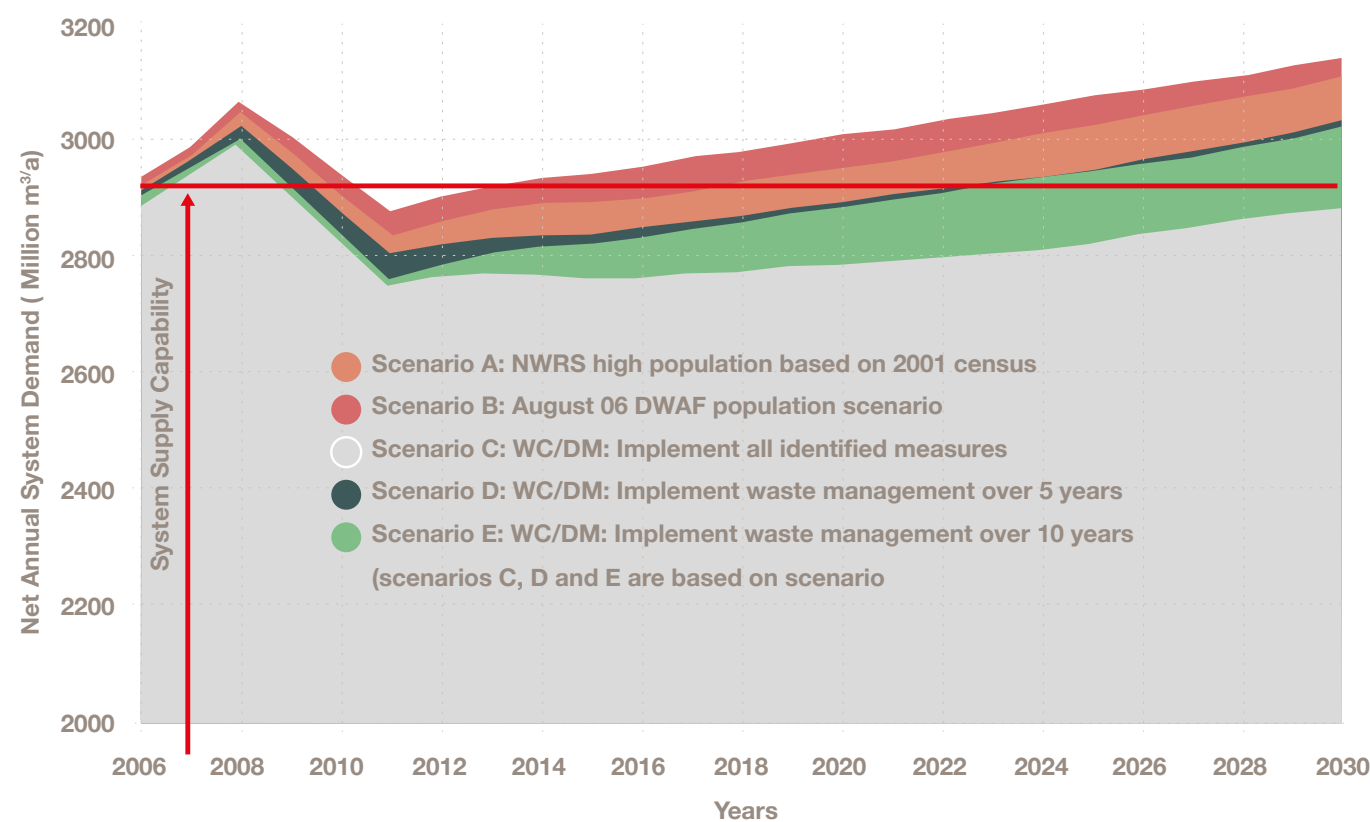


Figure 7: Impacts of five water conservation scenarios

In August 2015 the Government initiated the 'War on Leaks' project, which is run by Rand Water. The project will train 15,000 unemployed youth as artisans and plumbers to fix leaking taps and pipes in their local communities.¹⁴⁷ Incentives such as those offered under the Government's solar water geyser subsidy system have proven successful in reducing energy usage, and could be adapted to bring about water savings.

South Africans consume an average of 235 litres of water a day, which is significantly higher than the global average of 173 litres.¹⁴⁸ There is therefore much scope to raise awareness of wasteful consumption, which would provide space for the necessary buy-in to more advanced technical measures and institutional changes regarding water. Suggested policy changes include providing incentive grants, improving water efficiency labelling and charging for water through segmented tariffs (flat, metered or block rates).¹⁴⁹

Higher water prices (through stepped tariffs) have helped reduce consumption, as have community-based social marketing of technologies to monitor water use.¹⁵⁰ Using tax incentives to curb water use and reward water efficiency is another option.¹⁵¹ The Department of Water and Sanitation has developed guidelines for municipalities regarding water use and management.¹⁵² The strategy emphasises the need for water issues,

particularly water efficiency, to shape all decisions regarding water allocations and water-use applications regardless of sector.¹⁵³ It further notes that compliance, monitoring and enforcement need to be supported; this will require enhanced institutional capacity.¹⁵⁴ Overall targets per catchment has been set in stressed catchments (such as Upper Vaal) but delay in setting of water use reduction targets per water user, seems to indicate an apparent disconnect between the urgency of the crisis and the official response.

It is recommended that national Government:

- Develop an appropriate policy to address natural disasters, such as floods and droughts, in a cohesive and interdepartmental manner.
- Set water efficiency targets for all water users in stressed catchments.
- Provide incentives for good performance and penalties for malpractice.
- Develop a regulatory framework to monitor and enforce compliance.
- Roll out further grant incentives schemes for water efficiency measures.
- Start visibly enforcing the 'polluter pays' principle as regards illegal consumption and water contamination using the Blue Scorpions, Green Scorpions and the Compliance, Monitoring and Enforcement Task Team.
- Seriously investigate and consider investing in large-scale desalinisation plants.

Government faces tougher choices

Government will need to make tough choices regarding water allocation. It would do well to look to the example of Singapore, one of the most water-stressed countries in the world with no freshwater lakes or aquifers. The country has become a world leader in managing its scarce water reserves using a sober, but ambitious plan to reshape its economic model and move away from industries that use a lot of water, instead investing in those that help conserve it.

4.4.2 Actions at the municipal level

If per capita municipal consumption was lowered to the world average by 2035, the demand-supply gap would be reduced by almost half.¹⁵⁶

Institute for Security Studies 2014

Municipalities can contribute significantly to saving water by implementing the measures outlined below, particularly as they are also often responsible for managing industrial water provision from their systems, including proper metering and billing and specifying and monitoring quality and volume of industrial effluent disposed of in domestic waste water (sewage) disposal systems. Government has made municipal infrastructure grants available to smaller, rural municipalities to, for example, obtain basic meter-reading equipment to decrease the levels of unbilled, authorised consumption. Implementing accurate metering and billing will not only reduce financial losses, but also help with intermittent supply.¹⁵⁷

The amount of water lost through leaking pipes, theft and bad billing in one year in Johannesburg alone would fill 87,743 Olympic-sized swimming pools.¹⁴⁶ Waterwise 2015

The following measures are recommended for municipalities:¹⁵⁸

- Repair all visible and reported leaks in water connection network and distribution systems, replacing pipes where necessary and rehabilitating the pipe network. Reticulation networks have an average lifespan of 50 years.
- Install leak detection and repair systems. This could provide savings of 15% on total demand and reduce water not accounted for to 11%.
- Implement technically correct operating and maintenance measures. This could include protecting corrosion of a metal surface by applying cathodic protection techniques of pipelines, meter and pressure management programmes, and unauthorised connection programmes. Ensure correct zoning of water processes are followed.
- Introduce a programme to reduce plumbing leaks in households. An estimated 20% of water is lost through these leaks, including from taps, toilets and hot-water geysers.¹⁵⁹ Programmes can include:
 - Sponsored leak repair initiatives, particularly for council houses.
 - Communication and educational campaigns.
 - Credit-control measures to ensure payment for services.
- Retrofit existing plumbing fittings with more efficient ones within municipal buildings and serviced location,¹⁶⁰ and in schools.
- Provide grant incentive schemes for retrofitting and also to consumers who replace lawns with water friendly alternative like native shrubs and reduce garden watering. This should be supported by communication and educational initiatives and could be enforced through regulations and by-law amendments.
- Research new technologies that would reduce consumer water use, such as soil moisture monitors that link to automatic garden irrigation systems.¹⁶¹
- Select appropriate service levels for different communities to reduce new demand enforcing the use of efficient plumbing fittings, reticulation design practices and installation of pre-payment meters. Incentives should be offered to housing developers using the aforementioned items.¹⁶²

4.4.3 Actions by households

Switching to low-flow aerated taps (about R220 per tap) will save 9 litres of water a minute. Changing to efficient showerheads (between R400 and R1,000) saves 23 litres of water a minute. Changing to a dual flush toilet (about R1,500) saves 5 litres a flush.¹⁶³ Price 2010

If average household water consumption was cut by 20% today it would contribute significantly to building the 10-year water reserve needed to avoid future water cuts.¹⁶⁴ Water leaks cost the Government approximately R7.2 billion in 2015. Consumers could also contribute to saving water by switching their buying preferences to food and beverages with low levels of embedded water.

The following measures are recommended for household consumers:

- Complete a water audit to find out what devices and activities use the most water.
- Report all leaks to the relevant water service provider immediately.
- Replace existing plumbing fittings with more efficient ones, including fitting dual-flush or interruptible toilets, user-activated urinals, low-flow shower heads, thermostatically controlled mixer taps, and tap controllers and aerators.¹⁶⁵ This could reduce household and commercial

water consumption by an estimated 40%.¹⁶⁶

- Insulate all geysers and water pipes.
- Reduce water used in the garden by sweeping instead of spraying paved areas, irrigating early in the morning or late in the evening to reduce evaporation, irrigating less often but for longer periods, planting indigenous plants, using a trigger gun on a hose pipe to control flow and avoiding over fertilising of lawns as they will need more water. Install water-efficient irrigation systems.¹⁶⁷ Introduce water-wise plants and start mulching. Design water features to move gutter water or runoff into ponds.
- Investigate grey water recycling systems and rainwater harvesting options. This can reduce water usage by 50% for gardens.¹⁶⁸ Greywater recycling systems cost between R1,000 and R4,500 for a simple system and advanced recycling systems, which can cost up to R45,000, can recycle up to 10,000 litres of water a day.¹⁶⁹
- Keep swimming pools covered when not in use to reduce evaporation and do not over fill them. Check and fix pool leaks and design, if possible, pools with smaller surface areas.
- Load the washing machine to full capacity to avoid wasting water and wash with cold water. The average machine uses 11 litres to wash 1 kilogramme of cotton. Find more efficient brands of washing powder that require less water. Choose the most efficient cycle for washing.
- Load the dishwasher to full capacity and scrape off excess food instead of rinsing. A dishwasher uses between 10 and 21 litres a cycle. Time sensors can be used to shut down industrial machines when not in use.
- Do not pour toxic paint, solvents, chemicals, poisons or pesticides into storm-water, sewer drains or rubbish bins. Dispose of pollutants at hazardous waste sites.
- Change behaviour patterns: Turn off the tap when brushing teeth, wash vegetables in a bowl and not under running water, do not use hot water to defrost food, take shorter showers and bathe less or in less water.
- Get informed about the water footprint of the products you buy, from food consumption to clothes and energy sources.

Johannesburg: Water pre-payment system

Johannesburg Water implemented a pre-payment system in Soweto in 2004, a suburb comprising about 360,000 households in Gauteng to much debate and criticism. Residents opposed installation of meters on the grounds that most were unemployed and would not be able to afford buying water while others complained about the free monthly allocation of 6 kilolitres of water being inadequate.

Representatives went door-to-door promoting the system and the resultant uptake led to a significant decrease in household usage from more than 50 kilolitres a month to less than 12 kilolitres resulting in an 80% saving of water typically consumed under 'uncontrolled' conditions. The water authority has seen both financial and resource benefits from this initiative.

Source: Singh & Xaba 2008.

While municipal initiatives to save costs and water are always welcome, we need to be cognisant of communities' very real grievances, particularly those living in poverty or facing economic difficulties that intersect with other inequalities. It is critical that government and municipalities do not impose and implement initiatives without engaging community members first, so they can inform all strategies that affect them directly.

Ekurhuleni: Metering of non-revenue water

Ekurhuleni Metropolitan Municipality in Gauteng province provides about 314 million m3 of water to 800,000 households each year. The municipality did not prioritise metering of top consumers in the region and many meters were broken or not reliable. Non-revenue water was estimated to account for about 50% of all water supplied. In 2010 the municipality launched a campaign to replace meters and consolidate multiple connections into single metered supplies, in particular to be able to measure the water use of the top 500 consumers. Other components of the project included conducting a full water audit and testing to identify illegal connections and find and fix leaks, as well as testing the capacity of fire hydrants. In 2012, the project won the Government’s 2012 Water Conservation Award. It is being extended to a further 25,000 bulk users- individuals or entities who extract directly from sourcein the region. The municipality ran an extensive and highly effective educational campaign to raise awareness about the benefits of the project: even though about 75% of users faced increased water bills, they offered no resistance to the project and were broadly supportive of its goals.

The project cost close to R38 million but generated additional revenue of approximately R82 million (based on current Rand to US dollar exchange rate) for the municipality in the first year. It also lowered non-revenue water levels significantly. In the first year, an additional 5.8 million m3 of water was billed for. In addition, the project created 20 full-time jobs and a further 4,660 man-days of employment over two years. An important output has been the comparative audit pre- and post-implementation allowing the tangible benefits to become visible and creating support for the extension of the project, the second phase of which will span 2014 to 2024.

Source: Water Resources Group 2030, 2013

Water footprint of our food

The food we eat makes up more than two-thirds of an individual’s water footprint, mostly because of all the water that was necessary to produce that food. Diets that contain a lot of meat and processed food are also heavy on the use of water. Rearing livestock significantly contributes to humanity’s water footprint, water pollution and water scarcity. The water footprint of any animal product is larger than the water footprint of a crop alternative with equivalent nutritional value. For example, the average water footprint per calorie for beef is 20 times larger than for cereals and starchy roots. In absolute terms, one steak (300 g of beef) needs 4,650 litres of water to be produced, while 300 g of corn take 270 litres of water and 300 g of potatoes only 75 litres of water. By reducing meat consumption and eating more vegetables, grains and beans, people can help to save water and CO₂ emissions, as livestock is also responsible for 18% of anthropogenic greenhouse gas emissions (in terms of CO₂-equivalent). Studies have shown that reducing meat consumption to levels that are recommended by the World Health Organisation (WHO) would lead to a 36% reduction in water footprint in developed countries and a 15% reduction in the developing world.

Source: Hoekstra, 2014 & Raureif, 2010-12



Cows Stock Photo: Royalty free

Homeowners in Siyandhani Village use downpipes on the side of the house to collect rain water, Siyandhani Village is close to the the town of Giyani in Limpopo Province. The province was declared a disaster area in 2015 due to ongoing droughts. Photo: Tim Moolman, Tim Moolman photography



Installing rainwater harvesting systems

In the small town of Kleinmond, in the Western Cape domestic-scale rainwater harvesting systems were implemented alongside the municipal water distribution system. The collected water serves as either a primary source or as a supplementary source of water that can be used, if clean, for drinking and laundry. Non-potable water can still be used for irrigating gardens, cleaning, and flushing toilets. These systems can save 30–50% of water normally drawn from the distribution network and up to 80% in businesses or commercial buildings. Rainwater harvesting is the most widespread water management strategy in South Africa, but is yet to reach its full potential and commercial and institutional acceptance.

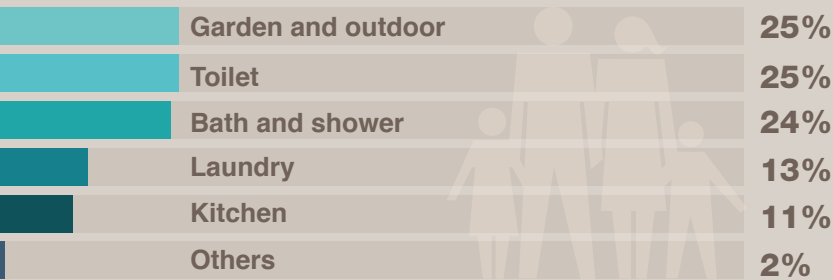
There is a cost to installation, which could act as a deterrent, and the tanks might be viewed as being unsightly. It is more commonly used in rural areas, where it is viewed as a reliable source of water. The Government has developed an incentive to implement rainwater harvesting to reduce overall demand on the system. This water source is capable of providing at least 50% of allocated system demand when used appropriately, such as for flushing toilets, and could supply 62% of household’s irrigation requirements. It also reduces stormwater discharge.

Source: Turton & Du Plessis, 2016

What can you do to save water?

12-30% water can be saved through repairing of leakages by municipalities and increased water efficiency in households

Typical water use for a middle income four person household with garden includes



A South African uses **235 l/water/day**, while an average world citizen uses **173 l/water/day**

Municipal Category	% Water Loss	Litres/capita/day
A (Metropolis)	29.2	280
B1(Secondary Cities)	38.5	249
B2 (Large Towns)	38.3	204
B3 (Small Towns)	36.2	174
B4 (Mostly Rural)	58	164
Total for 2011/2012	37.2	226

Levels of water losses in South Africa (Water, 2014).



Repair Leaks: 20% estimated water is wasted through plumbing leaks

Reduce water losses by 50%



Grey water recycling (reuse of waste water from hand-washing and showers to irrigate the garden)



Rainwater harvesting (rain water collected from roofs or commercial properties can be used for toilet flushing, laundry, garden irrigation and sometimes as additional source of potable water) 30-80% of water can be saved, depending on the size of the collection tank



Only irrigate the garden early morning and evening to avoid evaporation



Use indigenous plants that do not need a lot of water



Use water efficient detergents and washing powders



Eat water-friendly diet



Do not leave the tap running, when you wash vegetables or dishes



Only use washing machine and dishwasher when fully loaded and use savings programme

Reduce water losses by 40%



Replace with low flow taps uses 6 l/min instead of 15 l/min



Replace with efficient showerheads uses 7 l/min instead of 20 l/min



Replace with dual flush toilet uses 6 l/flush instead of 11 l/flush



Close the tap, when you brush your teeth (6 litres of water/minute are lost)

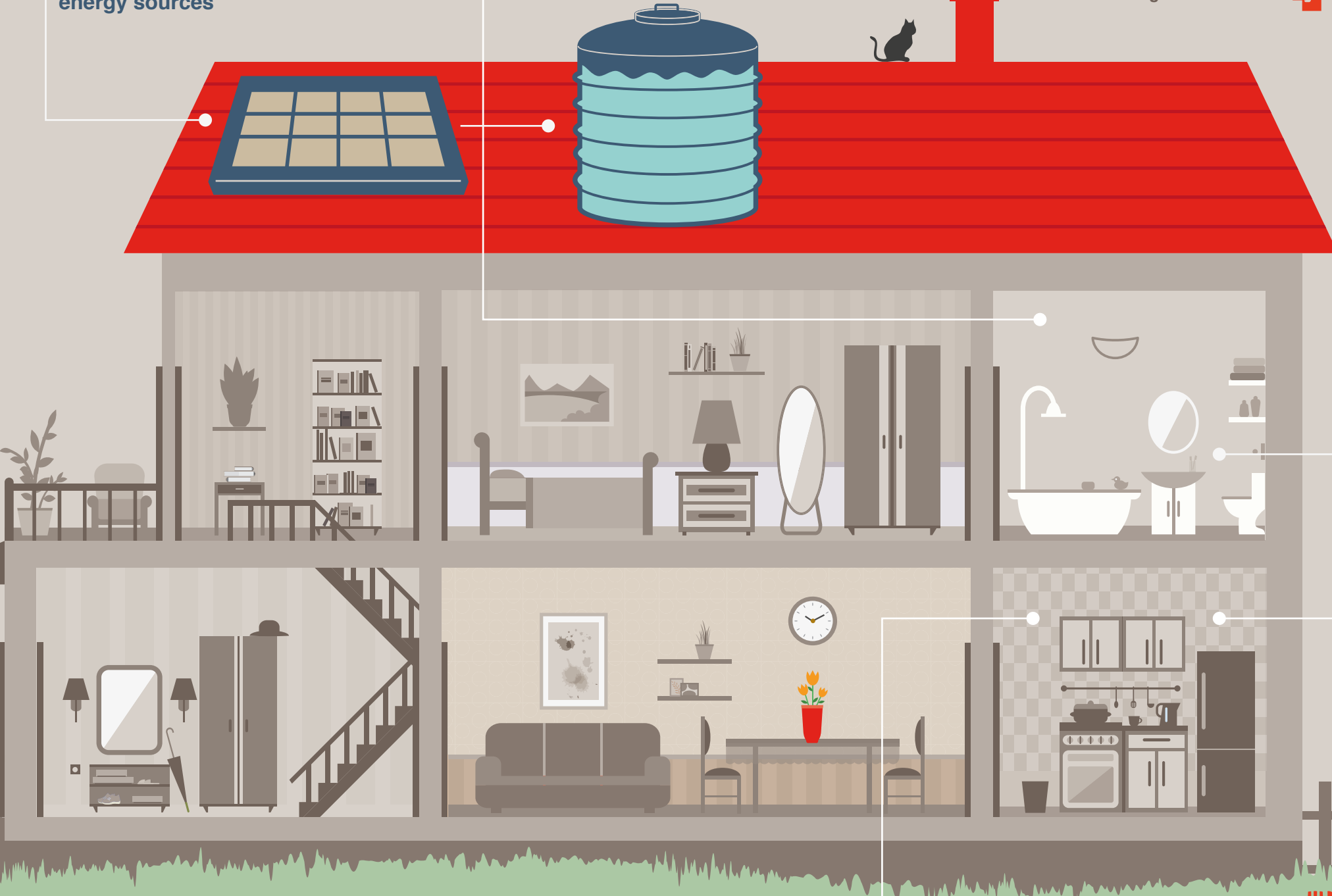


Do not dispose rubbish and medicine or chemicals in the toilet



Take shower instead of bath (66% water saving) & reduce the length of shower

Choose water-friendly energy sources





CHAPTER 5: Moving forward

5.1 Conclusion

South Africa is at the beginning of a major water crisis, both in terms of supply and quality of water. It will need to act urgently to limit demand for water and find ways of increasing supply to achieve its commitment to provide access to clean water for all, grow the economy, and ensure that sufficient quantity and quality is available to preserve ecosystems. Failure to take swift action will see a deepening of social tensions surrounding water, which could lead to social unrest. The country is already categorised as high risk for civil unrest given the thousands of service delivery and other protests that occurred in 2015,¹⁷⁰ and which sometimes spilt over into wider conflict. Water scarcity poses a real and significant future threat to individuals, households, communities and businesses, and to our way of life. Closing the gap between future demand and supply of water is a challenge that requires a collective and inclusive approach to finding and implementing solutions. Some tough choices will be required regarding how and in which quantities to allocate water to different parts of society alongside significant investment in building and maintaining infrastructure. The Government cannot do this on its own. But there is one significant opportunity that would provide immediate benefits and in which individuals, business and government can participate: an immediate and massive ramping up of water efficiency across all sectors of society.

The participation and investment by powerful players in the progressive business sector is crucial. Our report illustrates that there is plenty of opportunity for these players to take responsibility for their water use and lead the way. Despite the fact that many companies perceive water as a significant risk to their own operations, most of them are not taking measures and are not engaging to the extent needed. They are the missing link, but also the key to rapid action. If the business community increased the efficiency of its operations, enough water would be freed up to supply 2.7 million people with their basic water needs.

The business community can, however, do much more than this. It can disclose its water use, set transparent targets and move its operations and supply chains to water-efficient models. It can also invest in products and technologies that save water, offer these to consumers and educate the public about the associated benefits.

Finally, the business community can and should work with national and local authorities to improve water infrastructure, including wastewater treatment plants, and prevent leakages.

The Government is committed to improving water efficiency and to providing access to water for all as part of its goal of eradicating poverty and growing the economy in an inclusive way that does not compromise the necessary natural reserve (an imperative for building South Africa's resilience to climate change). Water savings will be used to support inclusive economic growth. It cannot, however, do this on its own. It needs other powerful stakeholders to assume responsibility and take action.

5.2 Recommendations for action

This section outlines high-level strategic issues and actions that would likely result in significant water and associated cost savings. More specific actions for each sector were outlined in the previous chapter.

All plans to reduce demand and increase supply must take into account the need to redress social and economic injustice in South Africa. Measures must therefore be designed to have multiple benefits. They must enhance social and ecological resilience, promote inclusive economic growth, and benefit the marginalised.

The business sector can help South Africa by:

- Improving their own business operations to use as little water as possible.
- Investing in and providing water-efficient products and technologies. For example, Eskom should look

to low-water intensive renewable energy options. Big retailers of consumer goods could start by only selling water-efficient products. Retailers such as Woolworths have already benefitted from choosing to source in a more sustainable way by attracting consumers who are keen to live and eat in a more ethical way.

- Investing in municipal infrastructure in partnership with government to conduct audits and support water-saving programmes.
- Working with small and medium enterprises that have solutions to water shortages and that can provide the necessary services, such as water audits.
- Taking a leadership role with the Government and joining forces to implement the necessary changes to ensure a sustainable supply of water for people, the economy and the ecosystems.

Government can help South Africa by:

- Creating a regulatory framework that incentivises good water behaviour and penalises bad behaviour. It must also ensure that all of its policies and plans align with the promise to secure safe access to water for all. Finally, it should set binding targets for commercial players to reduce their water use. The polluter pays principle must be enforced.
- Finding and repairing all leaks within the municipal reticulation system. Ensure that its metering and billing systems are in working order and work to reduce the levels of non-revenue water in the country.
- Spearheading an educational initiative to raise awareness of water as a valuable and scarce resource in efforts to change consumer and business behaviour patterns.

The domestic and municipal sectors can reduce their consumption by 12–30% by addressing physical losses (leaks) and increasing household water efficiency.¹⁷¹

Seago & McKenzie 2012

The agricultural sector can help South Africa by:

- Urgently investing in efficient irrigation equipment and looking at innovative ways to access water. This sector in particular needs to shift in a transformative way to open up access to water, land and markets for small-scale and emerging farmers. In part, water scarcity has been brought about by the country's reliance on large-scale commercial farming operations that practice monoculture and high-external input (fertilisers, pesticides, water) farming. It is not just water withdrawal that needs to be reduced, but also water pollution through leaching and runoff of contaminated water.

Making agricultural irrigation systems more efficient could save between 30–40% of current water use.

Department of Water and Sanitation 2014

The industrial sector can help South Africa by:

- Immediately investing in enhancing water-efficient technologies and solutions across its supply chains.
- Prioritising, reducing or eliminating water pollution from its activities. There is considerable scope for industry to take the initiative in helping to set sector standards and best practice guidelines to minimise its impact on water sources.
- Putting in place concrete targets and establishing transparent measurables to track progress towards these.

If industry reduced its water usage by 10%, 624,000 households (about 2.7 million people) would gain access to 30 kilolitres a day or 3.1 million households (about 13.7 million people) would access a basic supply of 6 kilolitres a day. Pegasys Institute 2016

South Africans can help by:

- Taking control over their domestic consumption of water by changing the way they use and view water and adopting water-saving technologies, such as efficient taps and double flush toilets, and using products, such as efficient detergents.
- Only buying products with low water footprints to minimise the impact on water consumption and quality levels.

Switching to low-flow aerated taps (about R220 per tap) will save 9 litres of water a minute. Changing to efficient showerheads (between R400 and R1 000) saves 23 litres of water a minute. Changing to a dual flush toilet (about R1 500) saves 5 litres a flush.¹⁷² Price 2010

We cannot survive without water. We cannot dream of a better future without water. We cannot create jobs or grow the economy without water. There is no time for delay. We must act now.

The list of references

1. Bloomberg.com. 2014. Sao Paulo warned to brace for more dramatic water shortages. [Online] Available: <http://www.bloomberg.com/news/articles/2014-10-21/sao-paulo-warned-to-brace-for-more-dramatic-water-shortages>. Accessed: 29 January 2016.
2. Kibona, D., Kidulile, G. & Rwabukambara, F. 2009. Environment, climate warming and water management. *Transit. Stud. Rev.*, 16: 484-500; Cassardo, C. & Jones, J.A.A. 2011. Managing water in a changing world. *Water*, 3: 618-628; Lui, J., Dorjderem, A., Fu, J., Lei, X., Lui, H., Macer, D., Qiao, Q., Sun, A., Tachiyama, K., Yu, L. and Zheng, Y. 2011. *Water Ethics and Water Resource Management*. Ethics and Climate Change in Asia and the Pacific (ECCAP) Project, Working Group 14 Report. Bangkok: UNESCO.
3. Kibona, D., Kidulile, G. & Rwabukambara, F. 2009. Environment, climate warming and water management. *Transit. Stud. Rev.*, 16: 484-500; Cassardo, C. & Jones, J.A.A. 2011. Managing water in a changing world. *Water*, 3: 618-628; Lui, J., Dorjderem, A., Fu, J., Lei, X., Lui, H., Macer, D., Qiao, Q., Sun, A., Tachiyama, K., Yu, L. and Zheng, Y. 2011. *Water Ethics and Water Resource Management*. Ethics and Climate Change in Asia and the Pacific (ECCAP) Project, Working Group 14 Report. Bangkok: UNESCO.
4. Alcamo, J.M., Vorosmarty, C.J., Naiman, R.J., Lettenmaier, D.P. & Pahl-Wostl, C. 2008. A grand challenge for freshwater research: understanding the global water system. *Environmental Research Letters*, 3: 1-6.
5. Alcamo, J.M., Vorosmarty, C.J., Naiman, R.J., Lettenmaier, D.P. & Pahl-Wostl, C. 2008. A grand challenge for freshwater research: understanding the global water system. *Environmental Research Letters*, 3: 1-6.
6. Alcamo, J.M., Vorosmarty, C.J., Naiman, R.J., Lettenmaier, D.P. & Pahl-Wostl, C. 2008. A grand challenge for freshwater research: understanding the global water system. *Environmental Research Letters*, 3: 1-6.
7. United Nations 2005-2015: UN-Water Decade Programme on Advocacy and Communication and Water Supply and Sanitation Collaborative Council, Media briefing. [online] Available: http://www.un.org/waterforlifedecade/pdf/human_right_to_water_and_sanitation_media_brief.pdf
8. Kibona, D., Kidulile, G. & Rwabukambara, F. 2009. Environment, climate warming and water management. *Transit. Stud. Rev.*, 16: 484-500; Pimentel, D., Whitecraft, M., Scott, Z.R., Zhao, L., Satkiewicz, P., Scott, T.J., Phillips, J., Szimák, D., Singh, G., Gonzalez, D.O. & Moe, T.L. 2010. Will limited land, water, and energy control human population numbers in the future? *Human Ecology*, 38: 599-611; Cassardo, C. & Jones, J.A.A. 2011. Managing water in a changing world. *Water*, 3: 618-628. Thewaterproject.org. 2016. *What is water scarcity?* [Online] Available: https://thewaterproject.org/water_scarcity. Accessed: 3 March 2016.
9. Thewaterproject.org. 2016. *What is water scarcity?* [Online] Available: https://thewaterproject.org/water_scarcity. Accessed: 3 March 2016.
10. Pacinst.org. 2014. *Defining water scarcity, water stress, and water risk: It's not just semantics*. [Online] Available: <http://pacinst.org/water-definitions/>. Accessed: 3 March 2016. Water scarcity
11. Curry, E. 2010. Water scarcity and the recognition of the human right to safe freshwater. *Northwestern Journal of International Human Rights*, 9: 103-121; Ribolzi, O., Cuny, J., Sengsoulichanh, P., Mousque's, C., Soulleuth, B., Pierret, A., Huon, S. and Sengtaeuanghoung, O. 2011. Land use and water quality along a Mekong tributary in Northern Lao P.D.R. *Environmental Management*, 47: 291-302.
12. Cassardo, C. & Jones, J.A.A. 2011. Managing water in a changing world. *Water*, 3: 618-628.
13. Rosegrant, M.W., Ringler, C. & Zhu, T. 2009. Water for agriculture: maintaining food security under growing scarcity. *Annual Review of Environmental Resources*, 34,:205-222; Kumm, M., Ward, P.J., de Moel, H. and Varis, O. 2010. Is physical water scarcity a new phenomenon? Global assessment of water shortage over the last two millennia. *Environmental Research Letters*, 5: 1-10; Pimentel, D., Whitecraft, M., Scott, Z.R., Zhao, L., Satkiewicz, P., Scott, T.J., Phillips, J., Szimák, D., Singh, G., Gonzalez, D.O. & Moe, T.L. 2010. Will limited land, water, and energy control human population numbers in the future? *Human Ecology*, 38: 599-611.
14. O'Brien, K.I. and Leichenko, R.L. 2003. Winners and losers in the context of global change. *Annals of the Association of American Geographers*, 93: 89-103; Cassardo, C. & Jones, J.A.A. 2011. Managing water in a changing world. *Water*, 3: 618-628.
15. United Nations [UN]. 2003. *The United Nations Development Report: Water for People, Water for Life*. Paris: UN; Cassardo, C. & Jones, J.A.A. 2011. Managing water in a changing world. *Water*, 3: 618-628; Ribolzi, O., Cuny, J., Sengsoulichanh, P., Mousque's, C., Soulleuth, B., Pierret, A., Huon, S. and Sengtaeuanghoung, O. 2011. Land use and water quality along a Mekong tributary in Northern Lao P.D.R. *Environmental Management*, 47: 291-302.
16. United Nations [UN]. 2003. *The United Nations Development Report: Water for People, Water for Life*. Paris: UN; Cassardo, C. & Jones, J.A.A. 2011. Managing water in a changing world. *Water*, 3: 618-628.
17. Centre for Disease, Control and Prevention [CDC]. 2015. *Global WASH Facts*. [Online] Available: http://www.cdc.gov/healthywater/global/wash_statistics.html. Accessed: 23 January 2016.
18. Pimentel, D., Whitecraft, M., Scott, Z.R., Zhao, L., Satkiewicz, P., Scott, T.J., Phillips, J., Szimák, D., Singh, G., Gonzalez, D.O. & Moe, T.L. 2010. Will limited land, water, and energy control human population numbers in the future? *Human Ecology*, 38: 599-611
19. Kibona, D., Kidulile, G. & Rwabukambara, F. 2009. Environment, climate warming and water management. *Transit. Stud. Rev.*, 16: 484-500; Rosegrant, M.W., Ringler, C. & Zhu, T. 2009. Water for agriculture: maintaining food security under growing scarcity. *Annual Review of Environmental Resources*, 34,:205-222; Cassardo, C. & Jones, J.A.A. 2011. Managing water in a changing world. *Water*, 3: 618-628.
20. Babic, B., Dukic, A. & Stanic, M. 2014. Managing water pressure for water savings in developing countries. *Water S.A.*, 40:221.
21. The World Bank. 2014a. *Making every drop count: Reducing water loss in the Middle East and North Africa Region*. [Online] Available: <http://www.worldbank.org/en/news/feature/2014/09/02/making-every-drop-count-reducing-water-loss-in-the-middle-east-and-north-africa-region>. Accessed: 25 January 2016.
22. Sikdar, S.K. 2007. Water, water everywhere, not a drop to drink. *Clean Technology and Environmental Policy*, 9:1-2; Ribolzi, O., Cuny, J., Sengsoulichanh, P., Mousque's, C., Soulleuth, B., Pierret, A., Huon, S. & Sengtaeuanghoung, O. 2011. Land use and water quality along a Mekong tributary in Northern Lao P.D.R. *Environmental Management*, 47: 291-302.
23. Kingdom, B., Liemberger, R. & Marin, P. 2006. The challenge of reducing Non Revenue Water in Developing Countries. How the Private Sector Can Help: A look at performance-based service contracting. Water Supply and Sanitation Sector Board Discussion Paper Series. Paper No. 8, December 2006.
24. Intergovernmental Panel on Climate Change [IPCC]. 2014. *Special Report on Emission Scenarios*. Report for Working Group of the IPCC.
25. IPCC. 2014. *Special Report on Emission Scenarios*. Report for Working Group of the IPCC.
26. European Geosciences Union. 2015. *Floods and droughts set to increase due to climate change*. [Online] Available: <http://blogs.egu.eu/geolog/2015/04/29/floods-and-droughts-set-to-increase-due-to-climate-change/>. Accessed 3 March 2016.
27. IPCC. 2014. *Special Report on Emission Scenarios*. Report for Working Group of the IPCC.
28. IPCC. 2014. *Special Report on Emission Scenarios*. Report for Working Group of the IPCC.
29. IPCC. 2014. *Special Report on Emission Scenarios*. Report for Working Group of the IPCC.
30. IPCC. 2014. *Special Report on Emission Scenarios*. Report for Working Group of the IPCC.
31. IPCC. 2014. *Special Report on Emission Scenarios*. Report for Working Group of the IPCC.

32. IPCC. 2014. *Special Report on Emission Scenarios*. Report for Working Group of the IPCC.
33. Miller, K. and Yates, D. 2006. *Climate change and water resources: A Primer for Municipal Water Providers*. AWWA Research Foundation and American Water Works Association. IWA Publishing.
34. IPCC. 2014. *Special Report on Emission Scenarios*. Report for Working Group of the IPCC.
35. Miller, K. and Yates, D. 2006. *Climate change and water resources: A Primer for Municipal Water Providers*. AWWA Research Foundation and American Water Works Association. IWA Publishing.
36. Mimura, N., Nurse, L., McLean, R.F. et al. 2007. Small islands. In: Parry, M.L., Canziani, O.F., Palutikof, J.P., van der Linden, P.J. and Hanson, C.E. (eds) *Climate change 2007: impacts, adaptation and vulnerability*. Contribution of working group II to The Fourth Assessment Report of the IPCC. Cambridge, UK: Cambridge University Press, pp. 687–716 IPCC. 2014. *Special Report on Emission Scenarios*. Report for Working Group of the IPCC.
37. IPCC. 2014. *Special Report on Emission Scenarios*. Report for Working Group of the IPCC.
38. Doll, P., Kaspar, F. & Lehner, B. 2003. A global hydrological model for deriving water availability indicators: model tuning and validation. *J. Hydrology*, 270: 105-134; IPCC. 2014. *Special Report on Emission Scenarios*. Report for Working Group of the IPCC.
39. The World Bank. 2014b. *Turn Down the Heat: Confronting the New Climate Normal*. Washington, DC: World Bank.
40. Arnell, N. 2004. Climate change and global water resources. SRES emissions and socio-economic scenarios. *Global Environ. Change*, 14:31-52.
41. Alcamo, J., Florke, M. and Marker, M. 2007. Future long-term changes in global water resources driven by sosio-economic and climatic changes. *Hydrological Sciences Journal*, 52: 247-275.
42. Department of Water Affairs. 2013. *National Water Resource Strategy 2013*. Pretoria: Government Printers.
43. WorldDatabank. 2014. Indicators. [Online] Available: [http:// data.worldbank.org/indicator/AG.LND.PRCP. MM](http://data.worldbank.org/indicator/AG.LND.PRCP.MM). Accessed: 18 January 2016.
44. World Health Organization. 2010. *Progress on Sanitation and Drinking Water 2010 Update*. [Online] Available: www.wssinfo.org. Accessed: 28 January 2016.
45. Food and Agriculture Organization. 2015. Aquastat country profiles (South Africa). [Online] Available: www.fao.org/nr/ water/aquastat/ countries_regions/south_africa/ index.stm. Accessed: 30 January 2016.
46. The New Partnership for Africa's Development [NEPAD]. 2013. *Strategic overview for the water sector in South Africa*. [Online] Available: <http://nepadwatercoe.org/wp-content/uploads/Strategic-Overview-of-the-Water-Sector-in-South-Africa-2013.pdf>. Accessed: 13 January 2016.
47. Department of Water Affairs. 2013. *National Water Resource Strategy 2013*. Pretoria: Government Printers.
48. Food and Agriculture Organization. 2008. *Coping with water scarcity: An action framework for agriculture and food security*. Paris: United Nations.
49. Institute for Security Studies. 2014. *Parched prospects: The emerging water crisis in South Africa*. [Online] Available: [www.issafrica.org/ publications/papers/parched-prospects-the-emerging-water-crisis-in-south-africa](http://www.issafrica.org/publications/papers/parched-prospects-the-emerging-water-crisis-in-south-africa). Accessed: 29 January 2016.
- 50.
51. Water Research Commission. 2008. *Water Research Commission Report No. TT 381/08*. Pretoria: Water Research Commission.
52. Department of Water Affairs. 2013. *National Water Resource Strategy 2013*. Pretoria: Government Printers.
53. CSIR. 2010. *A CSIR Perspective on water in South Africa*. Report No. CSIR/NRE/PW/IR/2011/0012/A. Pretoria: CSIR; Department of Water and Sanitation [DWS]. N.d. Blue Drop. [Online] Available: https://www.dwa.gov.za/dir_ws/DWQR/. Accessed 29 January 2016.
54. DWS. N.d. Blue Drop. [Online] Available: https://www.dwa.gov.za/dir_ws/DWQR/. Accessed 29 January 2016.
55. South African Biodiversity Institute [SANBI]. 2007. *NSBA River Ecosystem Status*. [Online] Available: <http://bgis.sanbi.org/nsba/riverStatus.asp>. Accessed: 26 January 2016.
56. Mema, V. 2010. *Impact of poorly maintained wastewater and sewage treatment plants: lessons from South Africa*. Pretoria: Council for Scientific and Industrial Research (CSIR); Green Drop Strategy. 2013. *Green Drop Report: Executive Summary*. [Online] Available: [https:// www.dwa.gov.za/dir_ws/gds/Docs/DocsDefault.aspx](https://www.dwa.gov.za/dir_ws/gds/Docs/DocsDefault.aspx). Accessed: 26 January 2016.
57. Department of Water Affairs. 2013. *Strategic overview of the water sector in South Africa*. Pretoria: Department of Water Affairs.
58. Members include McKinsey & Company, the World Bank Group, and a consortium of business partners: The Barilla Group, The Coca Cola Company, Nestlé SA, New Holland Agriculture, SAB Miller PLC, Standard Chartered and Syngenta AG.
59. Institute for Security Studies. 2014. *Parched prospects: The emerging water crisis in South Africa*. [Online] Available: [www.issafrica.org/ publications/papers/parched-prospects-the-emerging-water-crisis-in-south-africa](http://www.issafrica.org/publications/papers/parched-prospects-the-emerging-water-crisis-in-south-africa). Accessed: 29 January 2016.
60. McKinsey.com. n.d. Confronting South Africa's water challenge. [Online] Available: [http://www.mckinsey.com/business-functions/ sustainability-and-resource-productivity/our-insights/confronting-south-africas-water-challenge](http://www.mckinsey.com/business-functions/sustainability-and-resource-productivity/our-insights/confronting-south-africas-water-challenge). Accessed: 3 March 2016.
61. McKinsey.com. n.d. Confronting South Africa's water challenge. [Online] Available: [http://www.mckinsey.com/business-functions/ sustainability-and-resource-productivity/our-insights/confronting-south-africas-water-challenge](http://www.mckinsey.com/business-functions/sustainability-and-resource-productivity/our-insights/confronting-south-africas-water-challenge). Accessed: 3 March 2016.
62. McKinsey.com. n.d. Confronting South Africa's water challenge. [Online] Available: [http://www.mckinsey.com/business-functions/ sustainability-and-resource-productivity/our-insights/confronting-south-africas-water-challenge](http://www.mckinsey.com/business-functions/sustainability-and-resource-productivity/our-insights/confronting-south-africas-water-challenge). Accessed: 3 March 2016.
63. Council for Scientific and Industrial Research & NASA. 2015. Projections of rapidly rising surface temperatures over Africa under low mitigation. [Online] Available: <http://ntrs.nasa.gov/search.jsp?R=20150019762>. Accessed: 27 January 2016.
64. CSIR & NASA. 2015. Projections of rapidly rising surface temperatures over Africa under low mitigation. [Online] Available: <http://ntrs.nasa.gov/search.jsp?R=20150019762>. Accessed: 27 January 2016.
65. Water Resource Group 2030. 2012. Briefing report prepared for the World Economic Forum Annual Meeting 2012. [Online] Available: http://www.cpc.ncep.noaa.gov/products/analysis_monitoring/lanina/enso_evolution-status-fcsts-web.pdf. Accessed: 15 January 2016.
66. Water Resource Group 2030. 2012. Briefing report prepared for the World Economic Forum Annual Meeting 2012. [Online] Available: http://www.cpc.ncep.noaa.gov/products/analysis_monitoring/lanina/enso_evolution-status-fcsts-web.pdf. Accessed: 15 January 2016.
67. World Wildlife Fund. 2011. Business Water Risk Report. [Online] Available: http://awsassets.wwf.org.za/downloads/wwf_business_water_risk_report_lr.pdf. Accessed 3 March 2016. BusinessDayLive.co.za. 2015. SA's Water Crisis is already here warn engineers. [Online] Available: <http://www.bdlive.co.za/national/2015/07/27/sas-water-crisis-is-already-here-warn-engineers>. Accessed: 29 January 2016.
68. See various articles: <http://ewn.co.za/2015/07/24/Water-shedding-to-become-reality-for-SA>; <http://www.news24.com/SouthAfrica/News/four-things-you-should-know-about-water-shedding-20151119>; <http://www.timeslive.co.za/thetimes/2014/04/14/brace-yourself-for-water-shedding>.
69. Bloomberg.com. 2015. Water is the new Eskom for South Africa's economy. [Online] Available: <http://www.bloomberg.com/news/articles/2015-11-03/water-is-the-new-eskom-for-south-africa-s-economy-nomura-says>. Accessed: 29 January 2016.
70. Timeslive.co.za. 2010. Study shows consequence of SA water crisis. [Online] Available: <http://www.timeslive.co.za/local/2010/11/15/study-shows-consequences-of-sa-water-crisis>. Accessed: 29 January 2016.
71. Department of Environmental Affairs. 2013. *Long-Term Adaptation Scenarios Flagship Research Programme (LTAS) for South Africa. Cli-*
mate Change Implications for the Water Sector in South Africa. Pretoria: Government Printer.
72. The New Partnership for Africa's Development [NEPAD]. 2013. *Strategic overview for the water sector in South Africa*. [Online] Available: <http://nepadwatercoe.org/wp-content/uploads/Strategic-Overview-of-the-Water-Sector-in-South-Africa-2013.pdf>. Accessed: 13 January 2016; DWS. 2014. *National Water Resource Strategy*. Second Edition. Pretoria: Government Printer; OSEC, 2011; Oberholster, P.J. & Botha, A.M. 2014. *Importance of water quality to the food industry in South Africa. Understanding the Food Energy Water Nexus*. World Wildlife Fund: South Africa.
73. SouthAfrica.info. n.d. Business. [Online] Available: <http://www.southafrica.info/business/economy/sectors/agricultural-sector.htm#.Vtgrx-fl9670#ixzz41qFe72lr>. Accessed: 29 January 2016.
74. NEPAD. 2013. *Strategic overview for the water sector in South Africa*. [Online] Available: <http://nepadwatercoe.org/wp-content/uploads/Strategic-Overview-of-the-Water-Sector-in-South-Africa-2013.pdf>. Accessed: 13 January 2016; DWS. 2014. *National Water Resource Strategy*. Second Edition. Pretoria: Government Printer; OSEC, 2011; Oberholster, P.J. & Botha, A.M. 2014. *Importance of water quality to the food industry in South Africa. Understanding the Food Energy Water Nexus*. World Wildlife Fund: South Africa.
75. CSIR. 2010. *A CSIR Perspective on water in South Africa*. Report No. CSIR/NRE/PW/IR/2011/0012/A. Pretoria: CSIR; NEPAD. 2013. *Strategic overview for the water sector in South Africa*. [Online] Available: <http://nepadwatercoe.org/wp-content/uploads/Strategic-Overview-of-the-Water-Sector-in-South-Africa-2013.pdf>. Accessed: 13 January 2016; Government Communication and Information System. 2015. *Agriculture*. [Online] Available: from: [http://www.gcis.gov.za/sites/www.gcis.gov.za/files/docs/resourcecentre/ Agriculture2015.pdf](http://www.gcis.gov.za/sites/www.gcis.gov.za/files/docs/resourcecentre/Agriculture2015.pdf). Accessed: 26 January 2016.
76. CSIR. 2010. *A CSIR Perspective on water in South Africa*. Report No. CSIR/NRE/PW/IR/2011/0012/A. Pretoria: CSIR; NEPAD. 2013. *Strategic overview for the water sector in South Africa*. [Online] Available: <http://nepadwatercoe.org/wp-content/uploads/Strategic-Overview-of-the-Water-Sector-in-South-Africa-2013.pdf>. Accessed: 13 January 2016; GCIS, (2015)
77. DWS. 2004a. *Water Conservation and Water Demand Management Strategy for the Agriculture Sector*. Pretoria: Government Printer.
78. National Planning Commission. 2012. *National Development Plan 2030*. Pretoria: National Planning Commission; Department of Water Affairs. 2013. *National Water Resource Strategy 2013*. Pretoria: Government Printers.
79. CSIR. 2010. *A CSIR Perspective on water in South Africa*. Report No. CSIR/NRE/PW/IR/2011/0012/A. Pretoria: CSIR; NEPAD. 2013. *Strategic overview for the water sector in South Africa*. [Online] Available: <http://nepadwatercoe.org/wp-content/uploads/Strategic-Overview-of-the-Water-Sector-in-South-Africa-2013.pdf>. Accessed: 13 January 2016).
80. CSIR. 2010. *A CSIR Perspective on water in South Africa*. Report No. CSIR/NRE/PW/IR/2011/0012/A. Pretoria: CSIR; NEPAD. 2013. *Strategic overview for the water sector in South Africa*. [Online] Available: <http://nepadwatercoe.org/wp-content/uploads/Strategic-Overview-of-the-Water-Sector-in-South-Africa-2013.pdf>. Accessed: 13 January 2016; Government Communication and Information System. 2015. *Agriculture*. [Online] Available: from: [http://www.gcis.gov.za/sites/www.gcis.gov.za/files/docs/resourcecentre/ Agriculture2015.pdf](http://www.gcis.gov.za/sites/www.gcis.gov.za/files/docs/resourcecentre/Agriculture2015.pdf). Accessed: 26 January 2016.
81. Colvin, C. 2015. *Curbing water loss in agriculture: Q&A with Christine Colvin*. [Online] Available: [http://www.bizcommunity.com/ Article/196/643/135179.html](http://www.bizcommunity.com/Article/196/643/135179.html). Accessed: 18 January 2016.
82. Colvin, C. 2015. *Curbing water loss in agriculture: Q&A with Christine Colvin*. [Online] Available: [http://www.bizcommunity.com/ Article/196/643/135179.html](http://www.bizcommunity.com/Article/196/643/135179.html). Accessed: 18 January 2016.
83. World Wildlife Fund. 2004. *Agriculture: Facts and Trends in South Africa*. [Online] Available: http://awsassets.wwf.org.za/downloads/facts_brochure_mockup_04_b.pdf. Accessed: 16 February 2016; CSIR. 2010. *A CSIR Perspective on water in South Africa*. Report No. CSIR/NRE/PW/IR/2011/0012/A. Pretoria: CSIR; NEPAD. 2013. *Strategic overview for the water sector in South Africa*. [Online] Available: [http:// nepadwatercoe.org/wp-content/uploads/Strategic-Overview-of-the-Water-Sector-in-South-Africa-2013.pdf](http://nepadwatercoe.org/wp-content/uploads/Strategic-Overview-of-the-Water-Sector-in-South-Africa-2013.pdf). Accessed: 13 January 2016; Government Communication and Information System. 2015. *Agriculture*. [Online] Available: from: <http://www.gcis.gov.za/sites/www.gcis.gov.za/files/docs/resourcecentre/Agriculture2015.pdf>. Accessed: 26 January 2016.
84. Department of Water Affairs. 2013. *National Water Resource Strategy 2013*. Pretoria: Government Printers.
85. National Planning Commission. 2012. *National Development Plan 2030*. Pretoria: National Planning Commission; Department of Water Affairs. 2013. *National Water Resource Strategy 2013*. Pretoria: Government Printers.
86. African Ministers' Council on Water. 2015. *Beyond Water Supply and Sanitation in South Africa: Turning Finance into Services for 2015 and Beyond*. [Online] Available: <http://www.wsp.org/sites/wsp.org/files/publications/CSO-SouthAfrica.pdf>. Accessed: 29 January 2016.
87. Statsa.gov.za. 2013. *MDG*. [Online] Available: http://www.statssa.gov.za/wp-content/uploads/2013/10/MDG_October-2013.pdf. Accessed: 28 January 2016.
88. South African Human Rights Commission. 2014. Water and sanitation, life and dignity: *Accountability to people who are poor*. [Online] Available: www.sahrc.org.za/home/index.php?ipkConte ntID=15&ipkMenuID=19. Accessed: 17 March 2014.
89. CSIR. 2010. *A CSIR Perspective on water in South Africa*. Report No. CSIR/NRE/PW/IR/2011/0012/A. Pretoria: CSIR.
90. CSIR. 2010. *A CSIR Perspective on water in South Africa*. Report No. CSIR/NRE/PW/IR/2011/0012/A. Pretoria: CSIR.
91. Water Situation in South Africa, Water Use Per Sector: Pegasys Institute. 2016. Report commissioned for Changing Markets 2016. Available on request.
92. Hay, E.R., Riemann, K., van Zyl, G. & Thompson, I. 2012. Ensuring water supply for all towns and villages in the Eastern Cape and Western Cape Provinces of South Africa. *Water S.A.*, 38:437–444; KPMG. 2014. *SA needs to curb water wastage*. KPMG South Africa Blog. [Online] Available: <http://www.sablog.kpmg.co.za/2014/04/saneedscurbwaterwastage/>. Accessed: 20 January 2016; Mckenzie, R.S. 2014. *Guidelines for reducing water losses in South African municipalities*. Water Research Commission.
93. KPMG. 2014. *SA needs to curb water wastage*. KPMG South Africa Blog. [Online] Available: <http://www.sablog.kpmg.co.za/2014/04/saneedscurbwaterwastage/>. Accessed: 20 January 2016.
94. DWS. 2014. *National Water Resource Strategy*. Second Edition. Pretoria: Government Printer; Mckenzie, R.S. 2014. *Guidelines for reducing water losses in South African municipalities*. Water Research Commission.
95. KPMG. 2014. *SA needs to curb water wastage*. KPMG South Africa Blog. [Online] Available: <http://www.sablog.kpmg.co.za/2014/04/saneedscurbwaterwastage/>. Accessed: 20 January 2016.
96. DWS. 2004b. *Water Conservation and Water Demand Management Strategy for the Water Services Sector*. Pretoria: Government Printer; Jacobs, (2008)
97. KPMG. 2014. *SA needs to curb water wastage*. KPMG South Africa Blog. [Online] Available: <http://www.sablog.kpmg.co.za/2014/04/saneedscurbwaterwastage/>. Accessed: 20 January 2016.
98. KPMG. 2014. *SA needs to curb water wastage*. KPMG South Africa Blog. [Online] Available: <http://www.sablog.kpmg.co.za/2014/04/saneedscurbwaterwastage/>. Accessed: 20 January 2016.
99. Wegelin, W.A., Mckenzie, R.S., Herbst, P. & Wensley, A. 2011. Benchmarking and tracking water losses in all municipalities of South Africa. IMESA Report. [Online] Available: <http://www.imesa.org.za/images/conf2010papers/14.pdf>. Accessed: 12 January 2016.
100. NEPAD. 2013. *Strategic overview for the water sector in South Africa*. [Online] Available: [50](http://nepadwatercoe.org/wp-content/uploads/
</div>
<div data-bbox=)

101. Strategic-Overview-of-the-Water-Sector-in-South-Africa-2013.pdf. Accessed: 13 January 2016.
102. NEPAD. 2013. *Strategic overview for the water sector in South Africa*. [Online] Available: <http://nepadwatercoe.org/wp-content/uploads/Strategic-Overview-of-the-Water-Sector-in-South-Africa-2013.pdf>. Accessed: 13 January 2016.
103. Blaine, S. 2013. *Nearly 40% of municipal water lost en route to customers*. [Online] Available: <http://www.bdlive.co.za/national/science/2013/03/20/nearly40ofmunicipalwaterlostenroutetocustomers>. Accessed: 20 January 2016.
104. Water, A. 2014. *Water Loss: Are we wasting our way into potential water crisis*. [Online] Available: <http://www.wrc.org.za/Lists/Knowledge%20Hub%20Items/Attachments/10982/10%20water%20leak%20p%2034-37.pdf>. Accessed: 4 February 2016.
105. DWS. 2014. *National Water Resource Strategy*. Second Edition. Pretoria: Government Printer.
106. McKinsey.com. n.d. Confronting South Africa's water challenge. [Online] Available: <http://www.mckinsey.com/business-functions/sustainability-and-resource-productivity/our-insights/confronting-south-africas-water-challenge>. Accessed: 3 March 2016.
107. Department of Water Affairs. 2013. *National Water Resource Strategy 2013*. Pretoria: Government Printers.
108. CSIR. 2010. *A CSIR Perspective on water in South Africa*. Report No. CSIR/NRE/PW/IR/2011/0012/A. Pretoria: CSIR.
109. CSIR. 2010. *A CSIR Perspective on water in South Africa*. Report No. CSIR/NRE/PW/IR/2011/0012/A. Pretoria: CSIR; NEPAD. 2013. *Strategic overview for the water sector in South Africa*. [Online] Available: <http://nepadwatercoe.org/wp-content/uploads/Strategic-Overview-of-the-Water-Sector-in-South-Africa-2013.pdf>. Accessed: 13 January 2016.
110. CSIR. 2010. *A CSIR Perspective on water in South Africa*. Report No. CSIR/NRE/PW/IR/2011/0012/A. Pretoria: CSIR; The New Partnership for Africa's Development [NEPAD]. 2013. *Strategic overview for the water sector in South Africa*. [Online] Available: <http://nepadwatercoe.org/wp-content/uploads/Strategic-Overview-of-the-Water-Sector-in-South-Africa-2013.pdf>. Accessed: 13 January 2016.
111. NEPAD. 2013. *Strategic overview for the water sector in South Africa*. [Online] Available: <http://nepadwatercoe.org/wp-content/uploads/Strategic-Overview-of-the-Water-Sector-in-South-Africa-2013.pdf>. Accessed: 13 January 2016; Oberholster, P.J. & Botha, A.M. 2014. *Importance of water quality to the food industry in South Africa. Understanding the Food Energy Water Nexus*. World Wildlife Fund: South Africa.
112. <http://www.greenpeace.org/africa/Global/africa/publications/coal/WaterHungryCoal.pdf>. Accessed: 15 February 2016.
113. <http://www.wrc.org.za/Knowledge%20Hub%20Documents/Research%20Reports/2383-1-14.pdf>
114. Greenpeace.org. n.d. Water hungry coal. [Online] Available: <http://www.greenpeace.org/africa/Global/africa/publications/coal/WaterHungryCoal.pdf>. Accessed: 15 February 2016.
115. Greenpeace.org. n.d. Water hungry coal. [Online] Available: <http://www.greenpeace.org/africa/Global/africa/publications/coal/WaterHungryCoal.pdf>. Accessed: 15 February 2016.
116. Greenpeace.org. n.d. Water hungry coal. [Online] Available: <http://www.greenpeace.org/africa/Global/africa/publications/coal/WaterHungryCoal.pdf>. Accessed: 15 February 2016.
117. Wassung, N. n.d. Water Scarcity and Electricity Generation in South Africa: Part 1. [Online] Available: <http://www.sustainabilityinstitute.net/research/research-publications?task=download&file=file&id=20227>. Accessed: 23 January 2016.
118. DWS. 2014. *National Water Resource Strategy*. Second Edition. Pretoria: Government Printer.
119. Seago, C.J. & Mckenzie, R.S. 2012. *An assessment of Non-Revenue Water in South Africa*. Report to the WRC. WRC Report No TT 300/07. Water Research Commission; DWS. 2014. *National Water Resource Strategy*. Second Edition. Pretoria: Government Printer; The World Bank. 2014a. *Making every drop count: Reducing water loss in the Middle East and North Africa Region*. [Online] Available: <http://www.worldbank.org/en/news/feature/2014/09/02/making-every-drop-count-reducing-water-loss-in-the-middle-east-and-north-africa-region>. Accessed: 25 January 2016.
120. DWS. 2004a. *Water Conservation and Water Demand Management Strategy for the Agriculture Sector*. Pretoria: Government Printer.
121. World Wildlife Fund. 2004. *Agriculture: Facts and Trends in South Africa*. [Online] Available: http://awsassets.wwf.org.za/downloads/facts_brochure_mockup_04_b.pdf. Accessed: 16 February 2016; DWS. 2004a. *Water Conservation and Water Demand Management Strategy for the Agriculture Sector*. Pretoria: Government Printer; CSIR. 2010. *A CSIR Perspective on water in South Africa*. Report No. CSIR/NRE/PW/IR/2011/0012/A. Pretoria: CSIR.
122. Matchdeck.com. 2014. South Africa celebrates National Water Week. [Online] Available: <https://www.matchdeck.com/article/2351-south-africa-celebrates-national-water-week#/index>. Accessed: 3 March 2016.
123. World Wildlife Fund. 2004. *Agriculture: Facts and Trends in South Africa*. [Online] Available: http://awsassets.wwf.org.za/downloads/facts_brochure_mockup_04_b.pdf. Accessed: 16 February 2016.
124. Incencio, A., Sally, H. & Merrey, D.J. 2003. *Innovative approaches to agricultural water use for improving food security in sub-Saharan Africa*. Colombo, Sri Lanka: International Water Management Institute; Annandale, J.G., Stirzaker, R.J., Singels, A., van der Laan, M. & Laker, M.C. 2011. Irrigation scheduling research: South African Experiences and future prospects. *Water S.A.*, 37; Reinders, F.B. 2011. Irrigation methods for efficient water application: 40 years of South African research excellence. *Water S.A.*, 37:765–770.
125. DWS. 2004a. *Water Conservation and Water Demand Management Strategy for the Agriculture Sector*. Pretoria: Government Printer; DWS. 2014. *National Water Resource Strategy*. Second Edition. Pretoria: Government Printer.
126. DWS. 2004a. *Water Conservation and Water Demand Management Strategy for the Agriculture Sector*. Pretoria: Government Printer; DWS. 2014. *National Water Resource Strategy*. Second Edition. Pretoria: Government Printer.
127. Food and Agriculture Organization. 2005. *AQUASTAT on South Africa*. [Online] Available: http://www.fao.org/nr/water/aquastat/countries_regions/zaf/index.stm. Accessed: 18 January 2016.
128. DWS. 2004a. *Water Conservation and Water Demand Management Strategy for the Agriculture Sector*. Pretoria: Government Printer; DWS. 2014. *National Water Resource Strategy*. Second Edition. Pretoria: Government Printer.
129. DWS. 2004a. *Water Conservation and Water Demand Management Strategy for the Agriculture Sector*. Pretoria: Government Printer; DWS. 2014. *National Water Resource Strategy*. Second Edition. Pretoria: Government Printer.
130. Pretty, J.N. Brett, C. Gee, D. Hine, R.E., Mason, C.F., Morison, J.I.L., Raven, H., Rayment, M.D. & van der Bijl, G. 2005. An assessment of the total external costs of UK agriculture. *Agricultural Systems* 65(2):113-136.
131. DWS. 2004a. *Water Conservation and Water Demand Management Strategy for the Agriculture Sector*. Pretoria: Government Printer; DWS. 2014. *National Water Resource Strategy*. Second Edition. Pretoria: Government Printer.
132. Incencio, A., Sally, H. & Merrey, D.J. 2003. *Innovative approaches to agricultural water use for improving food security in sub-Saharan Africa*. Colombo, Sri Lanka: International Water Management Institute.
133. Incencio, A., Sally, H. & Merrey, D.J. 2003. *Innovative approaches to agricultural water use for improving food security in sub-Saharan Africa*. Colombo, Sri Lanka: International Water Management Institute.
134. DWS. 2004a. *Water Conservation and Water Demand Management Strategy for the Agriculture Sector*. Pretoria: Government Printer; Food and Agriculture Organization. 2012. *Coping with water scarcity: An action framework for agriculture and food security*. [Online] Available: <http://www.fao.org/docrep/016/i3015e/i3015e.pdf>. Accessed: 18 January 2015; DWS. 2014. *National Water Resource Strategy*. Second Edition. Pretoria: Government Printer; Colvin, C. 2015. *Curbing water loss in agriculture: Q&A with Christine Colvin*. [Online] Available: <http://www.bizcommunity.com/Article/196/643/135179.html>. Accessed: 18 January 2016.
135. DWS. 2004a. *Water Conservation and Water Demand Management Strategy for the Agriculture Sector*. Pretoria: Government Printer; Food and Agriculture Organization. 2012. *Coping with water scarcity: An action framework for agriculture and food security*. [Online] Available: <http://www.fao.org/docrep/016/i3015e/i3015e.pdf>. Accessed: 18 January 2015; DWS. 2014. *National Water Resource Strategy*. Second Edition. Pretoria: Government Printer;v Colvin, C. 2015. *Curbing water loss in agriculture: Q&A with Christine Colvin*. [Online] Available: <http://www.bizcommunity.com/Article/196/643/135179.html>. Accessed: 18 January 2016.
136. DWS. 2011. *Water Conservation and Water Demand Management Guideline for the Mining sector in South Africa*. Pretoria: Water Use Efficiency Directorate; Carbon Disclosure Project. 2012. CDP's water program: South Africa. Recognising the strategic value of water. Report 2012.
137. International Council on Mining and Metals. 2012. *Water Management in mining: A selection of case studies*. International Council on Mining and Metals; DWS. 2014. *National Water Resource Strategy*. Second Edition. Pretoria: Government Printer.
138. International Council on Mining and Metals. 2012. *Water Management in mining: A selection of case studies*. International Council on Mining and Metals; DWS. 2014. *National Water Resource Strategy*. Second Edition. Pretoria: Government Printer.
139. International Council on Mining and Metals. 2012. *Water Management in mining: A selection of case studies*. International Council on Mining and Metals; DWS. 2014. *National Water Resource Strategy*. Second Edition. Pretoria: Government Printer.
140. International Council on Mining and Metals. 2012. *Water Management in mining: A selection of case studies*. International Council on Mining and Metals; Carbon Disclosure Project. 2012. CDP's water program: South Africa. Recognising the strategic value of water. Report 2012; DWS. 2014. *National Water Resource Strategy*. Second Edition. Pretoria: Government Printer.
141. International Council on Mining and Metals. 2012. *Water Management in mining: A selection of case studies*. International Council on Mining and Metals; Carbon Disclosure Project. 2012. CDP's water program: South Africa. Recognising the strategic value of water. Report 2012; DWS. 2014. *National Water Resource Strategy*. Second Edition. Pretoria: Government Printer.
142. Haggard et al., 2014).
143. International Council on Mining and Metals. 2012. *Water Management in mining: A selection of case studies*. International Council on Mining and Metals; DWS. 2014. *National Water Resource Strategy*. Second Edition. Pretoria: Government Printer.
144. International Council on Mining and Metals. 2012. *Water Management in mining: A selection of case studies*. International Council on Mining and Metals; Xarbon Disclosure Project. 2012. CDP's water program: South Africa. Recognising the strategic value of water. Report 2012; DWS. 2014. *National Water Resource Strategy*. Second Edition. Pretoria: Government Printer.
145. Seago, C.J. & Mckenzie, R.S. 2012. *An assessment of Non-Revenue Water in South Africa*. Report to the WRC. WRC Report No TT 300/07. Water Research Commission.
146. Waterwise. 2015. Exports. [Online] Available: http://www.waterwise.co.za/export/sites/water-wise/downloads/main/2015_November_Water_Wise_newsletter_interactive.pdf. Accessed: 29 February 2016.
147. Gov.za. 2015. *President Jacob Zuma launches war on leaks campaign*, 28 August. [Online] Available: <http://www.gov.za/speeches/president-jacob-zuma-launches-war-leaks-campaign-28-aug-14-aug-2015-0000>. Accessed: 2 February 2016.
148. DWS. 2004b. *Water Conservation and Water Demand Management Strategy for the Water Services Sector*. Pretoria: Government Printer; Seago, C.J. & Mckenzie, R.S. 2012. *An assessment of Non-Revenue Water in South Africa*. Report to the WRC. WRC Report No TT 300/07. Water Research Commission.
149. Davies, A.R., Fahy, F. & Rau, H. 2014. *Challenging consumption: Pathways to more sustainable future*. Routledge, London.
150. Davies, A.R., Fahy, F. & Rau, H. 2014. *Challenging consumption: Pathways to more sustainable future*. Routledge, London.
151. Davies, A.R., Fahy, F. & Rau, H. 2014. *Challenging consumption: Pathways to more sustainable future*. Routledge, London.
152. DWS. 2014. *National Water Resource Strategy*. Second Edition. Pretoria: Government Printer.
153. DWS. 2014. *National Water Resource Strategy*. Second Edition. Pretoria: Government Printer.
154. DWS. 2014. *National Water Resource Strategy*. Second Edition. Pretoria: Government Printer.
155. DWS. 2014. *National Water Resource Strategy*. Second Edition. Pretoria: Government Printer.
156. Institute for Security Studies. 2014. *Parched prospects: The emerging water crisis in South Africa*. [Online] Available: www.issafrica.org/publications/papers/parched-prospects-the-emerging-water-crisis-in-south-africa. Accessed: 29 January 2016.
157. Wegelin, W.A., Mckenzie, R.S., Herbst, P. & Wensley, A. 2011. Benchmarking and tracking water losses in all municipalities of South Africa. IMESA Report. [Online] Available: <http://www.imesa.org.za/images/conf2010papers/14.pdf>. Accessed: 12 January 2016.
158. DWS. 2004b. *Water Conservation and Water Demand Management Strategy for the Water Services Sector*. Pretoria: Government Printer.
159. DWS. 2004b. *Water Conservation and Water Demand Management Strategy for the Water Services Sector*. Pretoria: Government Printer.
160. DWS. 2004b. *Water Conservation and Water Demand Management Strategy for the Water Services Sector*. Pretoria: Government Printer.
161. DWS. 2004b. *Water Conservation and Water Demand Management Strategy for the Water Services Sector*. Pretoria: Government Printer.
162. DWS. 2004b. *Water Conservation and Water Demand Management Strategy for the Water Services Sector*. Pretoria: Government Printer.
163. Price, G. 2010. *Water conservation guideline*. Durban: Municipal Environmental Planning & Climate Protection Department.
164. Businessdaylive.com. 2015. SA's water crisis is already here warns engineers. [Online] Available: <http://www.bdlive.co.za/national/2015/07/27/sas-water-crisis-is-already-here-warn-engineers>. Accessed: 28 January 2016.
165. DWS. 2004b. *Water Conservation and Water Demand Management Strategy for the Water Services Sector*. Pretoria: Government Printer.
166. DWS. 2004b. *Water Conservation and Water Demand Management Strategy for the Water Services Sector*. Pretoria: Government Printer.
167. Jacobs, H.E. 2008. Residential water information management. *South African Journal of Information Management*, 10:1–11; Price, G. 2010. *Water conservation guideline*. Durban: Municipal Environmental Planning & Climate Protection Department.
168. United States Environmental Protection Agency. 2016. *Outdoor water use in the United States*. [Online] Available: <http://www3.epa.gov/watersense/pubs/outdoor.html>. Accessed: 20 January 2016.
169. Price, G. 2010. *Water conservation guideline*. Durban: Municipal Environmental Planning & Climate Protection Department.
170. Maplecroft.com. 2014. Civil unrest rise in 20 countries over the last quarter. [Online] Available: <https://maplecroft.com/portfolio/new-analysis/2014/10/08/civil-unrest-rise-20-countries-over-last-quarter-hong-kong-liberia-see-biggest-increase-risk-maplecroft/>. Accessed: 25 January 2016.
171. Seago, C.J. & Mckenzie, R.S. 2012. *An assessment of Non-Revenue Water in South Africa*. Report to the WRC. WRC Report No TT 300/07. Water Research Commission.
172. Price, G. 2010. *Water conservation guideline*. Durban: Municipal Environmental Planning & Climate Protection Department.

BOX REFERENCES

Women and water: ActionAid. n.d. Making care visible. [Online] Available: http://www.actionaid.org/sites/files/actionaid/making_care_visible.pdf. Accessed: 7 March 2016; Water.org. n.d. Water-crisis: women & children facts. [Online] Available: <http://water.org/water-crisis/women-children-facts/>. Accessed: 7 March 2016; UN Water. 2016. World Water Day 2015. [Online] Available: http://www.unwater.org/fileadmin/user_upload/worldwaterday2015/docs/Water%20For%20Women.pdf. Accessed: 7 March 2016.

Californians ordered to cut water use by 25%: See: <http://www.circleofblue.org/waternews/2014/world/california-drought/#california-drought-coverage>; <http://www.theguardian.com/us-news/2015/apr/19/california-drought-protest-bottled-water>; <http://www.cuesa.org/article/10-ways-farmers-are-saving-water>.

Malta shifts focus to demand management: The World Bank. 2014a. Making every drop count: Reducing water loss in the Middle East and North Africa Region.

In the spotlight: Water reporting in South African media: Professional Evaluation and Research (PEAR) 2016. Water reporting in the South African media. Report available on request.

The 2015–2016 drought: See: <http://www.bloomberg.com/news/articles/2016-01-11/south-africa-may-need-about-1-2-billion-to-import-corn-needed>; <http://www.reuters.com/article/us-safrica-drought-idUSKCN0US14T20160114>; <http://www.engineeringnews.co.za/article/inside-governments-war-on-leaks-project-as-water-worries-rise-2015-11-20>; <http://www.news24.com/SouthAfrica/News/level-2-water-restrictions-imposed-in-joburg-20151109>; www.dailymail.co.uk/wires/ap/article-3392759/South-Africa-heat-wave-claims-11-lives-say-officials.html; http://www.cpc.ncep.noaa.gov/products/analysis_monitoring/lanina/enso_evolution-status-fcsts-web.pdf.

Major companies view water scarcity as a threat: Carbon Disclosure Project 2014. Global Water Report 2014. [Online] Available: <http://www.cdp.net/CDPResults/CDP-Global-Water-Report-2014.pdf>. Accessed 7 March 2016.

Durban: Water recycling in food sector Water Resources Group 2030 (2013) Managing Water Use in Scarce Environments – A catalogue of Case Studies, <https://www.waterscarcitysolutions.org>

Water-focused projects in the industrial sector: Carbon Disclosure Project. 2012. CDP’s water program: South Africa. Recognising the strategic value of water. Report 2012.

Energy and water nexus: International Energy Agency. 2012. Water for Energy. [Online] Available: http://www.worldenergyoutlook.org/media/weowebsite/2012/WEO_2012_Water_Excerpt.pdf.

Johannesburg: Water pre-payment system Singh, N. &Xaba, B. 2008. *Johannesburg water’s prepayment water system - appropriate technology in the implementation of project operation Gcin’amanzi in Soweto*. [Online] Available: http://www.esi-africa.com/wp-content/uploads/Nico_Singh_-_Progress,success_and_challenges_on_Operation_GCIN_amanzi_in_Soweto%5B1%5D..pdf. Accessed: 4 February 2016.

Ekurhuleni: Metering of non-revenue Water Resources Group 2030 (2013) Managing Water Use in Scarce Environments – A catalogue of Case Studies, <https://www.waterscarcitysolutions.org>

Water footprint of our food: Hoekstra, A.Y., Chapagain, A.K., Aldaya M.M. & Mekonnen, M.M. 2011. *The water footprint assessment manual: Setting the global standard*. [Online] Available: <http://www.waterfootprint.org/?page=files/WaterFootprintAssessmentManual> Accessed: 26 January 2016.

Installing rainwater harvesting systems: Dr. Turton, A. and Du Plessis, A., 2016, Research implemented for Changing Markets, Report available on request.

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