THE
# WATER WHEEL

ISSN: 0258-224

September/October 2017 Volume 16 No 5


## NATSURV - Towards water savings in the tannery industry

## NSTF-WRC Award winner

## Focus on electricity-water use in irrigation

WATER RESEARCH COMMISSION

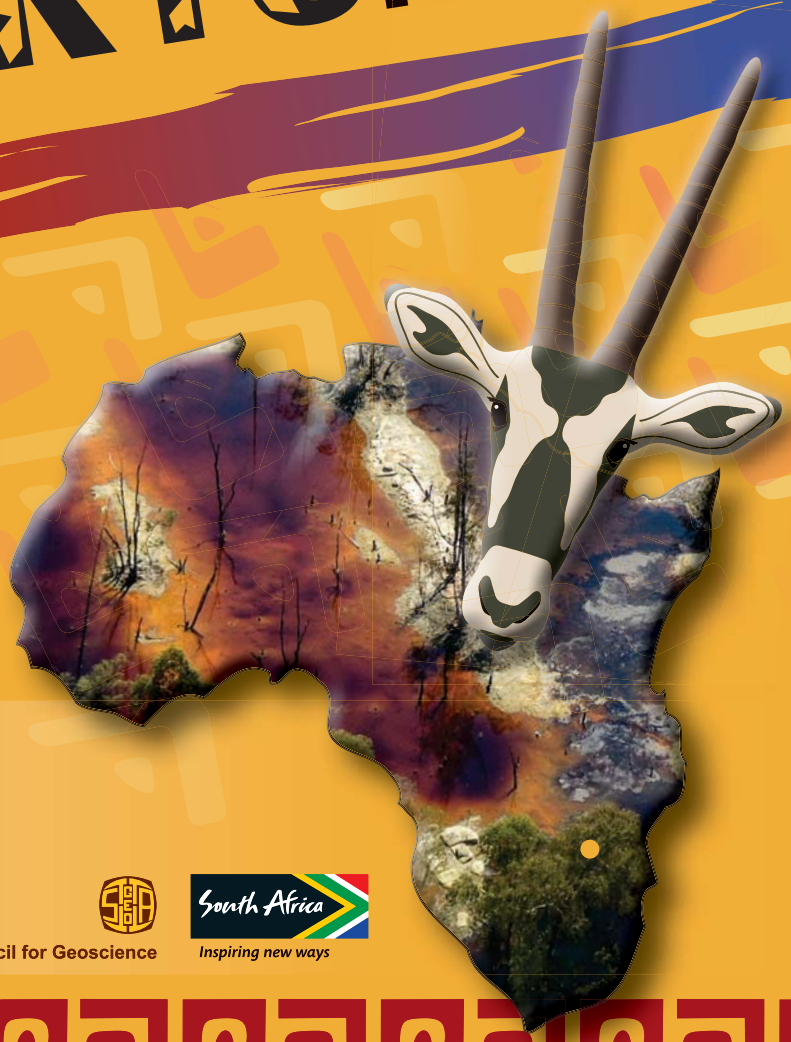
11th ICARD | IMWA 2018 Annual Conference
South Africa

# 11th ICARD | IMWA 2018 Conference

**International Conference on Acid Rock Drainage**
**International Mine Water Association**
**WISA Mine Water Division**

**10 – 14 September 2018**
**CSIR International Convention Centre**
**Pretoria, South Africa**

# RISK to OPPORTUNITY



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THE WATER WHEEL is a two-monthly magazine on water and water research published by the South African Water Research Commission (WRC), a statutory organisation established in 1971 by Act of Parliament.
Subscription is free. Material in this publication does not necessarily reflect the considered opinions of the members of the WRC, and may be copied with acknowledgement of source.

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# Contents



*The Water Research Commission has completed a new study on the water use and wastewater practices of tanneries. See story on page 14.*

# FLUID THOUGHTS

WRC CEO, Dhesigen Naidoo

## Women and water poverty

As we celebrate Women's Month in South Africa, we remember that the immense burden associated with not having access to safe water and clean sanitation is by and large firmly on the shoulders of women and the girl child.

It is estimated that in sub-Saharan Africa 75% of water carriers are women and girls. The average of two hours dedicated to fetching water from rivers and wells twice a day effectively robs these women of an economically productive life, and denies girls of the basic right to education and, by extension, the opportunity to escape the poverty trap.

This has the accumulative impact of sub-Saharan Africa losing 40 billion work hours of productivity a year. This is equivalent to the annual work hours of the whole of France. This is the level of production loss for the continent precipitated by insufficient access to water. Can you imagine the knock-on effect of these women achieving those 40 billion hours of productive earning work on their households, their communities and the prosperity prospects of this continent? This scenario while less stark replicates itself all through the developing world. Noble Laureate, Amartya Sen, said that the empowerment of women is not just a gender intervention, it is a development issue.

Especially if we can add the further burdens associated with personal safety for women of all ages risking the journey to river or well in the dark hours. Further, there is the health risks to women and their families associated with consuming water of unknown quality. The disease burdens of rural and peri-urban informal settlements stem firmly from polluted water sources and unhygienic sanitation. This is an untenable situation and one that affects more than 844 million people who do not have access to safe water today. This is more than 10% of the global population. Worse still, some 2.3 billion people do not have access to improved sanitation.

The World Health Organisation (WHO) further claims that, globally, at least 2 billion people use drinking source contaminated with faecal matter. These all illustrate the contribution of water to the overall character of a global feminised poverty scenario. Women and the girl child have, in fact, become very firmly the public face of water poverty.

This Women's Month the Water Research Commission (WRC) and the water and sanitation community of practice have been introduced to a remarkable group of remarkable women. These women – older and younger – are intent in re-writing the script so that the future will look very different.

On 22 August, the WRC and its partners, the Energy and Water Sector Education and Training Authority (EWSETA) and the Department of Water and Sanitation honoured a true Water Empowerment Pioneer who has inspired so many. Her name is Ma Pfarelo Rebecca Ramugondo from Limpopo. Already a Laureate of the Order of the Baobab, Ma Pfarelo, as she prefers to be called, decided that it was up to her and her fellow villagers to clean up their local river in Ha-Makhuvha. Inspired and encouraged by the enthusiasm of the women in her small group she established Tshikofokofo, a river cleanup campaign that is now active in 18 other surrounding villagers.

*EWSETA CEO, Errol Gradwell (left) and WRC CEO, Dhesigen Naidoo, with Ma Pfarelo Rebecca Ramugondo, who received an award for her outstanding contribution, commitment and support to communities struggling with water challenges.*

What was particularly important was who she addressing at the event. They are young women associated with the Women in Water Empowerment programme running out of the Ministry of Water and Sanitation championed by Minister, Nomvula Mokonyane, and managed by the WRC. These are young women entrepreneurs and students who are already changing lives around them for the better. They are building a network of

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women business leaders in the water and sanitation sector that will not only become a force that will lead the transformation of the sector, but also become a resource to empower women to get into the water sector as professional and encourage girls to study toward careers in water and sanitation. What is needed is partnership. Partnership from the private and public sector players to offer incubation opportunities to help develop this vital pillar of our development narrative through greater inclusivity and diversification.

Together we can redefine the future of the girl child in South Africa for a brighter more water secure country. What better time to start than Women's Month 2017.



# WATER DIARY

**International water**
**November 13-14**
The International Water Association (IWA) Development Congress & Exhibition will be held in Buenos Aires, Argentina. **Visit: http://www.iwa-network.org/news/save-the-date-iwa-water-and-development-congress-exhibition-2017/** for more information.

**Service delivery**
**November 26-29**
The Water Research Commission, together with the Water Institute of Southern Africa (WISA) is hosting the Second International Peri Urban conference, to be held at the Century City Conference Centre, in Cape Town. The theme of this conference is 'Shaping development and sustainability in peri-urban environments'. **Visit: www.wisa.org.za**

**Young water professionals**
**December 10-13**
The eighth International Young Water Professionals conference will take place in Cape Town under the theme 'Building leaders and making impact'. The conference brings together 450 water, environment and related young professionals from across the globe and showcases how the young water professionals are making impact across the sector as well as offering capacity development and training sessions to further skill our future water leaders to tackle the demands from the water sector. **Visit: http://iwaywpconference.org/**

**Water loss**
**May 7-9 2018**
The IWA Water Loss Specialist Group, together with the City of Cape Town, will host the biennial Water Loss Conference and Exhibit at the Century City Conference Centre in Cape Town. The conference will be one of the world's largest water loss conferences and is expected to attract over 500 participants from more than 50 countries. **Visit: https://www.eiseverywhere.com/ehome/251759&internal=1**

**Water resource management**
**June 24-27, 2018**
WISA is hosting its biennial conference at the Cape Town International Convention Centre.
**Visit: www.wisa2018.org.za**

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# NEWS

## South Africa – water can't be saved without change

Following all the rules to save water might be a great way of conserving the precious natural resource, but it won't work if it's done by some of the people some of the time.

A major shift in societal mindsets, behaviour and attitude is the only way to make sure that water saving efforts are effective and sustainable. This is according to Department of Water and Sanitation (DWS) Acting Deputy Director-General for Infrastructure, Leonardo Manus.

Manus was speaking at a roundtable discussion held jointly by DWS, GIBB and Sunlight. The roundtable served as a platform to discuss ways in which water saving and use can be more effective to aid future security efforts, and expand the pool of water resources in the country.

Participants at the roundtable said human behaviour change towards water remains a challenge that contributes to water scarcity in the country. They said that while new technologies are vital to increasing water supply, some social problems cannot be solved with technical solutions.

Manus said stakeholders have to become craftier in the way they see water use and management, as demand is escalating at a rate higher than supply. "Over time, cities have generated unnatural demand for water and, as more people move to the cities."

Along with economic growth, this results in a higher demand for water. "There is a definite need to relook at how we handle our water resources and, most importantly, how we use water."

*Source: SAnews.gov.za*

## Partnerships to boost SA's water security

South Africa has committed to work with all international agencies and governments to ensure water security.

The commitment was made during the 6th International Hydrology Programme (IHP) Africa National Committees meeting in Port Elizabeth, in the Eastern Cape, held earlier this year.

Water and Sanitation Deputy Director-General: Planning and Information, Deborah Mochotlhi, said delegates at the meeting must put their heads together to come up with implementable and effective international mechanisms to manage water security and protect water resources.

"These mechanisms will ensure that all the countries represented here today manage their water resources and also educate all water users about their role. Hydrologists play a critical in the water sector, as they measure the properties of bodies of water, such as water quality and streamflow, and they also analyse data on the environmental impacts of pollution, erosion, drought and other problems," she noted.

Mochotlhi said they are mindful of the global issues in relation to water challenges facing most parts of the world caused by the effects of climate change. South Africa, in particular, is still grappling with and recovering from the devastating drought effects.

"In recent months, the Western Cape province has been severely affected by these natural effects and, subsequently, the province was declared a disaster area due to serious water challenges. The Eastern Cape has also not been spared, with Nelson Mandela Bay, Buffalo City and Mnquma municipalities being hard hit by serious water challenges."

*Source: SAnews.gov.za*

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## New weather station opened in Johannesburg

On 14 July, the first weather station in Johannesburg, that is part of the Trans-African Hydro-Meteorological Observatory (TAHMO), was opened in Braamfontein.

The TAHMO aims to develop a vast network of weather stations across Africa. Current and historic weather data is important for agricultural, climate monitoring, and many hydro-meteorological applications.

A total of 10 stations, sponsored by IBM, will be opened up in the coming few months, mainly at fire stations throughout Johannesburg, supported by the City of Johannesburg. This first station was opened at the Maths Centre, where it will also be used to teach Maths, Science and Technology teachers in South Africa, how to use it in their lessons, to not only improve climate awareness but also practical physics and geography knowledge.

The TAHMO weather stations serve the funders of these stations with data, the national meteorological departments (in this case the South African Weather Service), the research community, and potentially interested parties in improved weather data.

The sales of data for commercial applications will help to sustain the network and add to the roll out. These 10 stations serve as the proof-of-concept for South Africa and the application in African cities. For more information, Email marieke@aqualinks.co.za

## South Africa faces a decline of cormorants

South Africa is facing a serious decline in its number of cormorants, according to the Department of Environmental Affairs.

Five species of cormorants are known to breed in South Africa, of which three are marine species and endemic to the Benguela ecosystem of southern Africa. The global population of two species of cormorants, the Cape cormorant (Phalacrocorax Capensis) and the Bank cormorant (Phalacrocorax Neglectus), has dropped by nearly 50% since the 1970s and are now regarded by the International Union for the Conservation of Nature (IUCN) as endangered. The latter two species compete with fisheries for prey, which could be one of the reasons for its decrease in numbers.

The Cape cormorant breeds at 53 localities between the Orange River and the Eastern part of the Eastern Cape. The majority of the decline occurred after the early 1990s off the northwestern coast of South Africa, between the Orange River estuary and Dassen Island. This is thought to have resulted from displacement of the main prey of Cape cormorants (anchovy and sardine) to the southeast coast.

The Bank cormorant breeds at 37 localities in the Northern and Western Cape provines and West of Cape Agulhas. Extinction of the colony at Lambert's Bay and large decreases between Saldanha Bay and Dassen Island coincided with a shift to the southeast of rock lobster, an important prey item in South Africa.

Some of the conservation measures taken include the protection of the birds' breeding habitats from disturbances and the establishment of elevated breeding platforms in colonies, such as Vondeling Island.

*Source: DEA*

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# GLOBAL

## Mass drownings fuel the Mara River ecosystem

Each year, more than a million wildebeest migrate through Africa's Serengeti Mara Ecosystem. While crossing the Kenyan reach of the Mara River, thousands perish. A new study, published in the Proceedings of the National Academy of Sciences, is the first to reveal how wildebeest drownings impact the ecology of the iconic river.

Amanda Subalusky, a postdoctoral associate at the Cary Institute of Ecosystem Studies, is the paper's lead author. She conducted the work while a graduate student at Yale University. Subalusky explains: "The Mara River intersects one of the largest overland migrations in the world. During peak migration, the wildebeest cross the Mara River multiple times, sometimes resulting in drownings of hundreds or thousands of wildebeest. Our study is the first to quantify these mass drownings and study how they impact river life."

The research team conducted five years of field surveys and analysed a decade of historical reports from the Mara Conservancy to determine the rate and frequency of wildebeest drownings in the Mara River's Kenyan reach. On average, 6 200 wildebeest – representing 1 100 tons of biomass – succumb each year during migration, with mass drownings occurring in 13 of the last 15 years (2001-2015).

Co-author, Emma Rosi, an aquatic ecologist at the Cary Institute, notes: "To put this in perspective, it's the equivalent of adding ten blue whale carcasses to the moderately-sized Mara River each year. This dramatic subsidy delivers terrestrial nitrogen, phosphorous and carbon to the river's food web. First, fist and scavengers feast on soft tissues, then wildebeest bones slowly release nutrients into the system – feeding algae and influencing the food web on decadal scales."

To reveal the fat of wildebeest carcasses, the researchers modelled in-stream consumption by fish and Nile crocodiles, scavenging by birds, nutrient uptake, and downstream transport. Stable isotope analyses of common fishes, camera monitoring of scavengers, and stable isotope analyses of biofilm on wildebeest bones all informed the fate of wildebeest nutrient inputs.

When wildebeest carcasses were present, they comprised up to 50% of the diet of common fish. The most frequent terrestrial scavengers on carcasses were Marabou storks, white-backed vultures, Rüppell's vultures and hooded vultuers, consuming 6-9% of soft tissue. Biofilms on wildebeest bones had a distinct isotopic signature, and made up to 24% of the diest of three common fish species months after drowning events. Due to low metabolic rates, Nile crocodiles were estimated to eat just 2% of total carcass inputs.

Co-author, David Post, an aquatic ecologist at Yale University commented: "The Mara River is one of the last places on Earth left to study how the drowning of large migratory animals influences aquatic ecosystems. Many migratory herds, such as bison, quagga, and springbok have been driven to extinction or remnant populations."

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# OPINION

## How Africa can prepare against the next El Niño

Governments and other key actors in food security need to prepare against the next El Niño, writes Dr Esther Ngumbi, a postdoctoral researcher at the Department of Entomology and Plant Pathology at Auburn University, Atlanta.

After a long dry spell coupled with drought, the rains have finally arrived in many African countries, including Kenya and South Africa, and the 2017 planting season is underway. But this joy may be short-lived. The United Nations World Meteorological Organisation released an update that projects a 50-60% chance of an El Niño forming in mid- to late 2017.

Depending on the regions and hemisphere, El Niño events can bring either drought or floods. Either way, these conditions trigger food insecurity, increase malnutrition and enhance vulnerability to infectious diseases. But this is not new. The last El Niño event, which occurred in 2015/16, caused the worst drought in decades and failed harvests in parts of Africa, Asia and the Pacific. As a result, millions of citizens across Africa and Asia experienced food insecurity.

Such warnings must be taken seriously and measures need to be taken to ensure that citizens in the countries that may be affected are cushioned. After all, we know that failure to act would lead to dire consequences as seen in the 2015/16 events.

**Efforts against 2016 El Niño**

Several countries have successfully implement El Niño preparedness plans. Faced with the 2016 event, the state of California, in the United States, prepared in advance and created a thoughtful plan of action that was communicated to citizens across the state. African countries such as Ethiopia, Kenya and Uganda have, in the past, also made efforts to prepare for El Niño related events, even though these were not always successful.

Anticipating the 2016 event, the government of Ethiopia prepared and rolled out plans for its citizens, including allocating almost US$30-million to pre-empt the influence and consequences of the phenomenon in the country. In addition, it communicated to its citizens the anticipated effects and implemented other actions to alleviate the aftermath effects. And in Nairobi and Narok (Kenya), government officials briefed citizens of the upcoming El Niño in public forums and urged citizens to prepare.

**Preparing against predicted El Niño**

First and foremost, governments and key actors in aiding food security must act and prepare with a sense of urgency. They should come up with detailed, well-thought out preparedness measures and national contingency plans of action.

These include deciding on triggers and a timeline for action, decision points, communication channels as well as the registration of its citizens that may need help. Preparing in advance and setting up concrete national plans will strengthen resilience, safeguard livelihoods and avert disaster.

Preparedness must be backed with interventions that help citizens to make the most of the current rain season before the predicted El Niño strikes.

These interventions include ensuring that farmers have all the agricultural inputs such as drought tolerant seed varieties, including sorghum, millet and cowpeas that are needed for the planting seasons. Governments, through their agricultural extension officers, must educate farmers on the need to plant these varieties.

All these interventions would allow farmers to increase their crop production and yields while diversifying and adapting their farming practices to make the most out of the current season.

**Long-term and communication interventions needed**

Equally important are long-term interventions. These include investing in irrigation and water-supply facilities as well as rehabilitating water catchment and implementing rainwater harvesting to ensure that countries are able to grow crops during the drought season.

Most importantly, governments should develop strong and reliable communication channels that enhance the dissemination and sharing of information and data about all the available interventions from communities to national and regional levels.

Finally, countries should strive to learn to assess impact in order to know what works best. This would allow countries to keep improving their disaster preparedness coping strategies.

*Source: Scidev.net*

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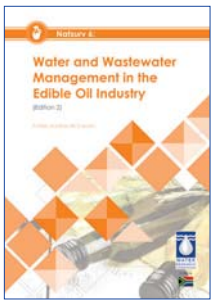
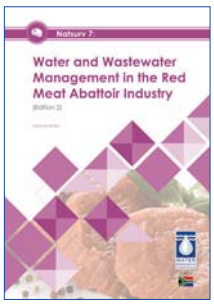
# NEW WRC REPORTS




*Natsurv 6 – Water and wastewater management in the edible oil industry (Edition 2)*

Manufacturing and processing industry consume significant quantities of energy and water. In addition, unwanted liquid, solid and gaseous waste is generated along with the intended products. Novel, more sustainable methods are constantly being sought to reduce qualitative and quantitative industrial pollutant loads and reuse water and waste. This new survey serves to update the content of the original national survey of the edible oil industry, completed in 1989. The report includes information stemming from an audit of the industry from both a local and global perspective.

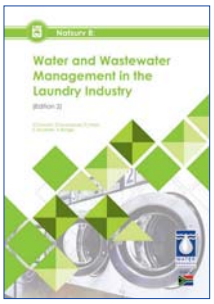
**Report No. TT 702/16**




*Natsurv 7 – Water and wastewater management in the red meat abattoir industry (Edition 2)*

Internationally, red meat abattoirs are known to be high volume water consumers. Similarly they are also serious polluters of wastewater. The increasing demand of domestic water consumers, and the limited supply of water in a semi-arid South Africa focuses the attention on high volume industrial consumers to assist in reducing water consumption. During the first survey (published in 1988) there were 25 registered abattoirs throughout South Africa. The deregulation of the South African meat industry in the 1980s brought about the demise of many large abattoirs. The markets opened up and smaller abattoirs proliferated. Management staff of smaller abattoirs are quite often not seriously concerned with water consumption and wastewater quality, as they focus on the quality of meat, which is their core business. Water consumed per slaughter unit (SU) were found to increase inversely to the abattoir slaughter capacity. Average consumption for large abattoirs is 0.91 kl/SU increasing to 2.04 kl/SU for small abattoirs. Wastewater qualities similarly have average chemical oxygen demand (COD) values of 1 217 mg/ℓ for large abattoirs and values as high as 5 025 mg/ℓ in small abattoirs.

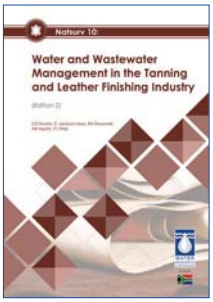
**Report No. TT 701/16**




*Natsurv 8 – Water and wastewater management in the laundry industry (Edition 2)*

This Natsurv provides an overview of the laundry industry and its changes since the 1980s. The study critically evaluated and documented the generic laundry process in terms of current practice, best practice and cleaner production. The specific water consumption rate was determined and best practice technology put forward. The local electricity, water and effluent prices and bylaws within which this industry functions were also described and evaluated to judge if the trends and indicators are in line with water conservation demand management and environmental practices.

**Report No. TT 703/16**




*Water and wastewater management in the tanning and leather finishing industry: Natsurv 10 (Edition 2)*

The main aims of the revision of this NATSURV were to provide a detailed overview of the tanning and leather finishing industry in South Africa, and its changes since 1980; to determine the water consumption and specific water consumption in the industry; determine wastewater generation and typical pollutant loads; and provide recommendations on best practices for the tanning industry.

**Report No. TT 713/17**

*Water resource protection: Research report. A review of the state-of-the-art and research and development needs for South Africa*

Water plays a significant role in the economies of the agricultural, business and industrial sectors. Expanding populations, economies and climate change have put pressure on the quality and availability of water resources in South Africa. Water resource protection therefore becomes increasingly important for sustainable supply management. Hence, a review of the state-of-the-art of resource protection in South Africa has been undertaken. Gaps in scientific understanding and implementation regarding water resource protection have been identified through literature review and discussions with stakeholders and experts. Aiming to improve the water resource protection in South Africa, a research strategy has been

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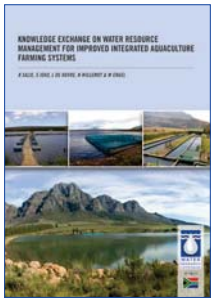
developed to tackle the most relevant of the identified gaps.
**Report No. 2532/1/17**

*Water use and crop parameters of pastures for livestock grazing management*

Cultivated pastures form the base of feed for many livestock production enterprises in South Africa, comprising more than a sixth of the country's total irrigated land, making it one of South Africa's highest value crops. To ensure sustainable pasture production to produce sufficient pasture to supply the protein demand more efficiently for a growing population, innovations will be required to increase the efficiency of water and nitrogen use in such pasture production systems in the livestock industry. The main objective of this research project was to address the existing challenges in the production of pastures for livestock grazing management and to find answers to the knowledge gaps identified in literature.
**Report No. 2173/1/16**




*Knowledge exchange on water resource management for improved integrated aquaculture farming systems*

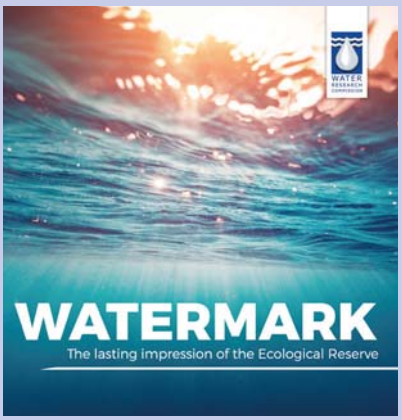
For four years the project team investigated and gathered information on aquaculture-agriculture systems, which are associated with farm/irrigation dams. Limited attention was paid to the adoption of this information and its implementation. The study for this project focused on the process of knowledge exchange to improve existing water resource management principles and practices, as well as creating a better opportunity for sustainability to both aquaculture and agriculture.
**Report No. TT 718/18 (main report) and TT 719/17 (training manual for small-scale rainbow trout farmers)**

*Nanotechnology for the treatment of industrial-scale effluents – particularly the removal or organic contaminants from textile effluents using nano-TiO2*

Suitable water quality is essential for life and industrial productivity. The aim of this project was to assess the application of one of the emerging nanotechnologies for water treatment, namely nanofiltration and nanophotocatalytic treatment of the nanofilter retentate.
**Report No. 2386/1/16**

*Principled, pragmatic revitalisation of catchment management forums in South Africa*

There are many views on catchment management forums (CMFs). They are seen as places for enthusiastic participation, communities of practice in the making, and crucial to the devolution of water management to local stakeholders. They are also seen as exhausted, toothless, talk shops, unrepresentative, undemocratic, haunts of the privileged, ignored by officials and a waste of time. This research project was designed to accompany the Department of Water and Sanitation revitalisation of catchment management forums, which is taking pace as part of the rollout of catchment management agencies, currently in progress.
**Report No. TT 682/16**




*Watermark – The lasting impression of the Ecological Reserve]*
The second, updated version of ***Watermark** – **The lasting impression of the Ecological Reserve*** **Report No. (SP 99/16)** has been published by the WRC. The publication explores the rationale behind the Ecological Reserve and illustrates how it will help to ensure the adequate supply of water in the years to come. The concept of the Reserve encapsulates a three-pronged sustainability approach: social, economic and environmental. Each of these three leg is taken into consideration when decisions are made regarding South Africa's water resources.

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# SECTOR MOURNS LOSS OF AQUATIC SCIENCE PIONEER

In August, the aquatic science fraternity mourned the death of stalwart environmentalist and researcher, Dr Mark Chutter. He was 84.

Considered a pioneer of aquatic science in South Africa, Dr Chutter leaves behind a stellar career infused with highlights that provided clear direction to the aquatic science sector and contributed tremendously to its advancement in South Africa.

Dr Chutter's first love was studying rivers, and he had a meticulous eye for recognising fine detail in aquatic species. This was undoubtedly aided by his earlier systematic research on dragonflies when he described one species and the nymph stage of several species. Dr Chutter completed his MSc in Zoology in 1960, followed by a PhD in River Ecology in 1967.

He joined the hydrobiologica laboratory at the National Institute of Water Resources at the CSIR in the early sixties. The institute was responsible for some of the first comprehensive river studies in South Africa. Former colleague, Prof Brian Allanson, relates how Dr Chutter developed an interest in the structure and ecology of river invertebrate fauna which was to grow into a major study of the Vaal River system. "This essential study of a river of immense importance to the growth of the Witwatersrand was chosen for his doctoral study at Rhodes University. By this time, Mark and his family lived in Grahamstown and we greatly benefited from his many talents." During his Vaal River studies Dr Chutter identified the previously undescribed livestock pest species, ***Simulium chutteri***, which was named after him.

Certainly the most significant of Dr Chutter's contributions to enumeration of the freshwater invertebrate fauna of South Africa's rivers was his development to a scoring system in which the sensitivity of river fauna could be described numerically. The basic tenants of this system were later developed into the South African Scoring (SASS) system, which today is widely used in the assessment of river health not only in South Africa, but also in other African countries.

Dr Chutter's other contributions were the management of an integrated research project involving 11 scientists and 8 technicians studying the eutrophication of Hartbeespoort Dam, evaluating water chemistry processes and assessing the impact this had on the biota. The aim was to devise a method to control the level of phosphorous entering the dam and develop an accepted standard for water quality.

After retiring from the CSIR, Mark continued consulting and providing expert evaluations of water development projects throughout southern Africa. Rob Palmer, who worked with Dr Chutter as part of AfriDev Consultants (Pty) Ltd, relates the following memory: "My first task at AfriDev was to market the company, and not knowing anything about marketing, I understood this to mean meeting people in their offices and chatting to them over a cup of coffee. One of the first marketing meetings I arranged was with a friend of mine at a large company, and Mark offered to join me. When we arrived, my friend was waiting for us at the entrance, but instead of taking us to her office, she surprised us by escorting us to a lecture hall that was filled with a crowd that was waiting expectantly for our presentation! Mark handled the situation with characteristic calmness, and although we did not get much work out of the company, my respect for Mark ratcheted up several notches. Another memorable incident took place hours before a major tender deadline, after I had stayed up all night in his office trying to find an error in the cost calculations. Mark looked at my spreadsheets and mentally added several pages of numbers while having breakfast, and spotted the error immediately! His aptitude for mental arithmetic was impressive to say the least. I cherish the time I spent with Mark, and remember and respect him for his intellect, reliability and gentle humour."

In 1990, Dr Chutter was awarded the Gold Medal from the Southern African Society of Aquatic Scientists in recognition of his scholarship and profound contribution to the hydrobiology of South Africa.

He is also remembered by Dr Ferdy De Moor: "Mark loved to play squash and tennis, and I remember weekend afternoons playing social tennis with him and other members of the NIWR staff at the CSIR courts. He also enjoyed playing bridge, and this was a daily event over lunch at the CSIR canteen."

"Mark always had a sharp mind for detail and always shared his opinions freely. He was always down to earth and friendly, and was always prepared to listen and discuss problems. He will be missed, but his contributions to water science in South Africa will be remembered and perpetuated through the continued and ever expanding practical use of his work."

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# THE WATER WHEEL

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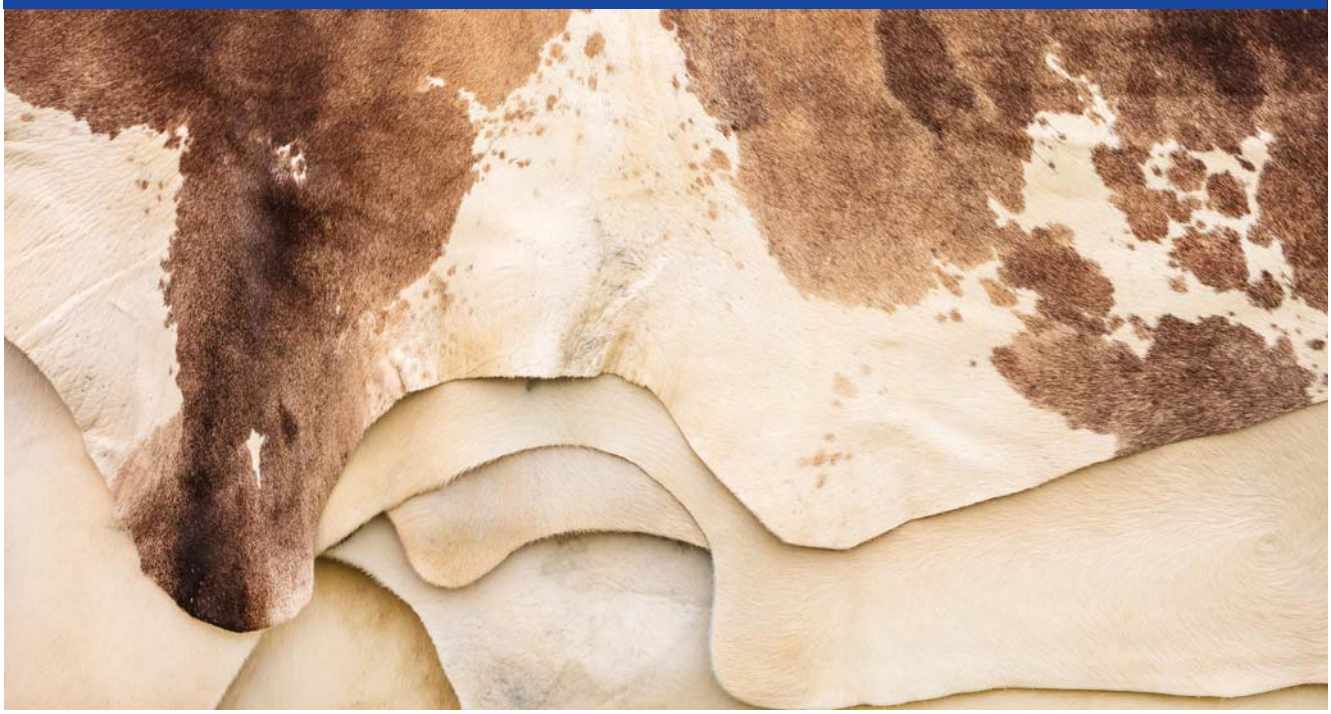
# INDUSTRIAL WATER USE

## National survey highlights how tanneries have stepped up their water game

*The latest in the Water Research Commission (WRC) National Survey (NATSURV) series of reports on industrial water and wastewater management focuses on the tanning and leather-finishing industry. Article by Sue Matthews*



The WRC's association with the tanning and leather-finishing industry dates back to 1977, when it began funding surveys and treatment trials on tannery wastewaters. This was at a time when the tanneries were struggling to meet increasingly stringent standards for discharging effluent into natural watercourses or municipal sewers. Most had been built alongside rivers and streams, from which they could abstract the water they required in large quantities and – prior to the promulgation of South Africa's first Water Act in 1956 – return it as highly polluted, untreated effluent.

The research was conducted by the now defunct Leather Industries Research Institute in Grahamstown, initially in collaboration with Binnie & Partners, which merged with Steffan Robertson and Kirsten (SRK) in 1988. Recommendations emanating from the research were published as a WRC 'technology transfer' report entitled *Guide to Wastewater Management in the Tanning and Fellmongering Industries* (**WRC Report No. TT 27/87**), and SRK was subsequently commissioned to undertake the first national survey of the sector's water and wastewater management in 1989, published as NATSURV 10 (**WRC Report No. TT 44/90**).

This exercise has recently been repeated by a small project team led by consulting water utilisation engineer, Chris Swartz. The second edition of NATSURV 10 outlines the changes that have taken place in the tanning and leather-finishing industry over the intervening 28 years, provides information on water consumption and wastewater generation – including typical pollution loads – and gives recommendations on best practices. Tanning has always been a water- and waste-intensive process, but apart from its socio-economic importance in terms of employment, domestic revenue and foreign exchange, it serves a vital function for abattoirs, as pointed out in the report.

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"Tanneries play an important role in processing a byproduct or waste from the meat industry, namely the hides and skins," the report states. "Without the tanning industry, these hides and skins would have to be disposed in landfill sites or incinerated. Tanneries therefore solve one pollution problem, but create many others during the processing of hides or skins into leather or partially processed forms of leather."

The term 'hide' refers specifically to the skin of large animals such as cows, oxen and large game, while 'skin' is used for sheep and goats, as well as small game, ostriches, crocodiles and other reptiles destined for so-called 'exotic leather' products. The tanning process can be divided into three main stages:

- Wet blue or fellmongery processing, which converts raw hides and skins into a tanned product known as 'wet blue' or raw sheepskins into pickled sheepskins, respectively.
- Dyehouse operations, which include splitting and shaving skins or hides to a defined thickness, neutralising, retanning, dyeing and fatliquoring.
- Leather finishing, which involves applying a film to the leather surface to give the leather protection and durability for its intended purpose.

The project team found that while the number of operators in the tanning and leather-finishing industry had grown from 20 to 35 since the first survey in 1989, there are actually fewer tanneries today. This is because there has been an increase in the number of facilities that purchase pickled sheepskins or wet blue for further processing, rather than doing the tanning themselves. At the same time, misfortunes in the ostrich and automotive leather sectors have resulted in the closure of a number of wet blue tanneries, although some new ones linked to feedlots have been established.

**NATSURV Reports then and now**

In 1984 the Water Research Commission, in collaboration with the Department of Water Affairs (now the Department of Water and Sanitation), initiated a programme of national surveys (NATSURVs) to determine the water requirements of particular industries, assess their wastewater quality and quantity, and identify research needs to assist them in improving water and wastewater management. The surveys culminated in the publication between 1987 and 1993 of reports on water and wastewater management for the malt-brewing, metal finishing, soft drink, dairy, sorghum malt and beer, edible oil, red meat, laundry, poultry, tanning and leather finishing, sugar, pulp and paper, textile, fruit and vegetable, and pelagic fishing industries. In 2005, two additional reports were produced for the oil refining and power generating industries. In 2013 a process began to update the NATSURV reports and include recommendations on best practices. As of August 2017, nine of these 'second editions' have been published, together with a new report on the iron and steel industry.

The project team visited 10 tanneries and leather finishers of different size, type and location to gather information. Water consumption data was used to calculate the specific water intake (SWI) – the water intake for a particular period divided by the quantity of hides produced for the same period – which ranged between 170 and 550 litres per hide for the full tanning process encompassing all three stages. This represents a significant improvement from the 320 to 744 litres per hide recorded in the first NATSURV in 1989, but the project team has proposed a target encouraging 'full-house' tanneries to further reduce water consumption and limit SWI to 500 litres per hide.

"Retanning and leather-finishing tanneries consume less water than full-house tanneries because the downstream processes are less water intensive," note the project team. "They also produce less polluted and smaller volumes of wastewater than full-house tanneries."

Considering the various steps and array of chemicals used in wet blue processing, it is not difficult to see why. Traditionally, raw hides have been cured with salt at the abattoir so that they do not start decomposing before their arrival at the tannery. The first step is therefore to soak the hides in water to wash out the salt, as well as dirt and blood. This highly saline water is then drained off and replaced with fresh water dosed with lime and sodium sulphide, which removes hair and epidermis, and opens up the collagen fibres to allow penetration of the tanning agents. This is followed by fleshing, which entails scraping off the fatty tissue on the inside of the hides, and then deliming and bating. Ammonium sulphate is typically used to remove lime and lower the pH for the bating enzymes, which break down proteins and soften the hide.

Next is the pickling step, in which sulphuric acid is added to lower the pH for better penetration of the tanning agents, together with enough salt to prevent damage to the hides from acid swelling. This is the final step in fellmongery processing to produce pickled sheepskins, but tanning requires immersion in a solution containing the tanning agent, with subsequent addition of a weak alkali – usually magnesium oxide or sodium bicarbonate – to raise the pH and ensure the tanning agent binds to the hide. The tanning agent most commonly used in industrial tanneries is chromium, which imparts the characteristic pale blue colour of wet blue. Where alternative tanning agents such as glutaraldehyde, aluminium and zirconium are used instead, the tanned hide is known as wet white because it remains an off-white colour.

*"Retanning and leather-finishing tanneries consume less water than full-house tanneries because the downstream processes are less water intensive. They also produce less polluted and smaller volumes of wastewater than full-house tanneries."*

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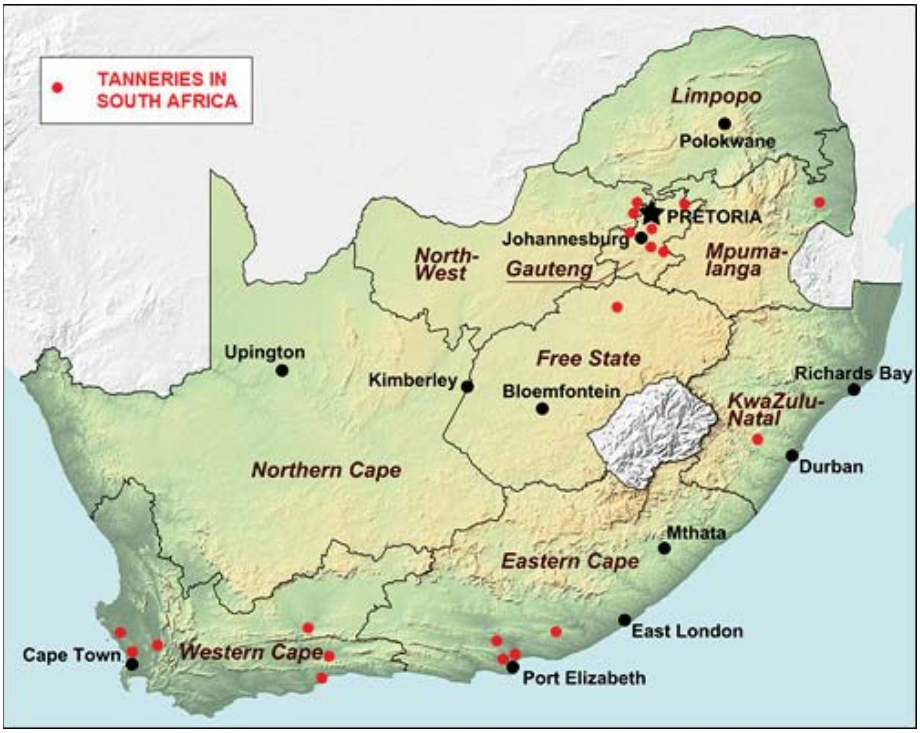


*Tanneries in South Africa*

Further processing at the dyehouse and leather-finishing stages involves a suite of chemicals too, including those in surfactants, degreasers, dyes, polymers, oils, resins and lacquers. Not surprisingly, then, the combined effluent from all these processes contains high organic loads, high concentrations of dissolved and suspended solids, as well as varying levels of sulphates, sulphides, chlorides and chromium.

Municipalities place restrictions on industrial effluent accepted into their wastewater treatment works, so that they are able to meet the final discharge limits set by the Department of Water and Sanitation. Large volumes of highly polluted industrial effluent could potentially disrupt the biological processes necessary for sewage treatment, or simply exceed the capacity of the wastewater treatment works to reduce particular parameters to within the final discharge limit. The project team found that such restrictions vary considerably between municipalities though. For example, Mossel Bay Municipality requires that the chemical oxygen demand (COD) of inflowing industrial effluent does not exceed 3000 mg/L, while Nelson Mandela Bay Municipality in Port Elizabeth has set the limit at 10 000 mg/L. The limit for sulphates ranges between 250 mg/L set by Oudtshoorn Municipality and 1800 mg/L required by Gauteng's City of Tshwane and City of Ekurhuleni, which both have a chlorides limit of only 100 mg/L, compared to 1500 mg/L at City of Cape Town. And the maximum permissible concentration of chromium varies between 5 and 20 mg/L depending on the municipality.

In an effort to adhere to such restrictions and avoid incurring penalty fees, tanneries treat their effluent prior to discharge to the WWTW. This begins with a pretreatment step, comprising mechanical screening and preliminary settling to remove much of the solids. Primary treatment via physico-chemical processes follows, in which fats are separated out and chemical coagulants and/or flocculants added to facilitate sedimentation of suspended solids in primary settling tanks. This is generally all that is done by operators that purchase wet blue for retanning and leather-finishing, but full-house tanneries also include a secondary treatment step, which involves biological treatment by micro-organisms to further reduce the biological oxygen demand (BOD). The larger tanneries use conventional activated sludge (CAS) systems, operated as completely mixed systems with extended aeration, while smaller ones rely on ponding systems. The treated wastewater is then diverted to the municipal wastewater treatment works, and the sludge – made up of solid matter separated out during the treatment process – is dried in the sun for a few days before disposal at landfills.

*"The tanneries were really good about providing information – even sitting round the same table and comparing notes – so that as an industry they can improve on their effluent quality."*

The project team note that tanneries have made considerable improvements in wastewater management since the first NATSURV. Many have heeded recommendations to segregate the waste streams of beamhouse processes – the initial soaking, liming, unhairing and fleshing – from those of the tanyard so that the effluents can be treated separately. This is important because most of the organic load originates from beamhouse processes, whereas tanyard effluent contains high concentrations of inorganics, including chromium. Chromium is precipitated during primary treatment, but this is inhibited to some degree by organic matter, fats and suspended solids,

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which compromises the ability to meet wastewater discharge limits for chromium, and reduces the efficiency of chromium recovery from the sludge for reuse, where this is done.

Furthermore, since the unhairing step uses lime and sodium sulphide, its effluent is very alkaline and contains high concentrations of sulphur compounds. It is preferable to keep this effluent separate from the acidic effluent emanating from the pickling and tanning steps, because hydrogen sulphide will be released if the pH falls below 9.5. This gas not only creates odour problems, but is also toxic and corrosive. Anaerobic or anoxic conditions in wastewater streams likewise result in hydrogen sulphide formation because they create a favourable environment for sulphate-reducing bacteria.

Apart from segregating wastewater streams to improve the quality of the final effluent, many of the larger wet blue tanneries have stopped processing salt-cured hides because the soak water contributes hugely to effluent salinity. Instead they use 'green' hides, fresh from the abattoir – providing it is close by – or chilled hides, cooled rapidly with ice, cold water or blast chillers and transported in refrigerated containers.

"Chilling reduces salt by about 60% in effluent, reduces the water requirement for processing and hence also reduces the wastewater requiring treatment," note the project team. In fact, this kind of relationship applies to all tanning and leather-finishing processes.

"Water use, wastewater generation and cleaner production technologies are inextricably linked, and should be considered holistically by industries seeking to become more sustainable. Reduced water consumption translates into reduced wastewater generation; reduced chemical usage or less toxic chemicals improves wastewater quality."

*The specific water intake of the tanneries surveyed ranged between 170 and 500 litres per hide for the full tanning process – a considerable improvement over the previous survey.*

The final chapter of the report includes various ways of conserving water in the different processing steps and substituting chemicals for those that have less impact on the environment. Of course, plant-derived tannins preceded chromium as tanning agents and are still used today, but the effluent produced from so-called vegetable tanning is dark and turbid, and contains a higher load of poorly biodegradeable COD than chrome-tanning effluent.

In fact, it is interesting to consider that the historical legacy of vegetable tanning in South Africa negatively impacts our water resources on a far wider scale than chrome tanning ever has. The black wattle, ***Acacia mearnsii***, was introduced to this country from Australia in the 1860s and was initially planted for firewood, shade and shelter, but the first plantations were established about 20 years later, after its bark was recognised to be a particularly good source of tannin for leather production. Demand for leather goods during the two World Wars resulted in rapid expansion of the area under plantation, peaking at about 300 000 hectares in the early 1960s. Today, black wattle plantations cover some 110 000 hectares and commercial emphasis has shifted from bark to timber, but the species has proven to be an aggressive invader. The National Invasive Alien Plant Survey, published in 2010, indicates that the area covered by invasive populations of black wattle is just under 475 000 condensed hectares – if density estimates are adjusted to the 100% cover equivalent – making it the plant species with the most extensive invasions. According to a recent paper by Le Maitre et al. (2016) in the WRC's journal, ***Water SA***, this implies that black wattle accounts for a third of the estimated 1 444 $m^3$/yr reduction in water flows due to invasive alien plants!

The findings and recommendations of the NATSURV report have already been shared at three stakeholder workshops in Gauteng, KwaZulu-Natal and the Western Cape, and will also be presented at upcoming leather industry conferences. Dr Jo Burgess, the WRC Research Manager overseeing the NATSURV reports, says that this was one of the easier surveys in terms of getting data from the industrial stakeholders.

"The tanneries were really good about providing information – even sitting round the same table and comparing notes – so that as an industry they can improve on their effluent quality," she remarks. "This highlights the point that the better the participation from the industry, the more value the NATSURV will be to that industry in providing them with information they can use to their own advantage."


To order the report, ***Water and wastewater management in the tanning and leather finishing industry: NATSURV 10*** (2nd edition) (**WRC Report No. TT 713/17**), contact Publications at tel: (012) 761 9300; email: orders@wrc.org.za or visit: www.wrc.org.za to download a free copy.

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# IRRIGATION SECTOR

## Study highlights economic trade-offs in irrigation design

*Water and electricity are precious commodities on farms, given their impact on profitability and food production. Jorisna Bonthuys looks at Water Research Commission (WRC) research that aims to optimise these key assets for those producers who are dependent on irrigation for their livelihoods.*

The recent drought and growing conflict amongst users given water scarcity have put the need for efficient water-use in the agriculture sector firmly in the spotlight again.

To optimise water-use and remain economically sustainable producers are increasingly looking at ways to do more with less water. In future, farmers will need to produce higher yields through beneficial water use, especially given rising input costs and more erratic weather patterns emerging. Water use issues are compounded by the fact that demand outstrips supply in many parts of the country. Besides the growing demand for water for socio-economic growth, other factors, such as ageing water-supply infrastructure and variable rainfall, are adding to emerging water pressures in South Africa.

Between 1991 and 2008 the WRC invested in several research and technology exchange projects to develop models for calculating irrigation costs and testing application in practice, reports Dr Gerhard Backeberg, WRC Executive Manager: Water Utilisation in Agriculture. "With increasing electricity tariffs and changing rate structures, requests were received from representatives of the irrigation industry that norms and standards for irrigation design should be revised. This led to a new research and development project, which ran between 2013 and 2017."

Many farmers are struggling to absorb operating costs caused by rising energy tariffs, reports Prof Bennie Grové from the University of the Free State's Department of Agricultural

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Economics. **"In future, rising electricity costs will become a significant part of operating costs on farms," he points out. "As a result, producers have to focus on the economic trade-off between investment costs and operating expenses when deciding on an irrigation system's design and management."**

Prof Grové was involved in research funded by the WRC to optimise the use of water and electricity in the agricultural sector. This is part of efforts to improve on-farm water management through better design and planning. Marcill Venter, who completed her MSc Agric (Agricultural Economics) on this subject, as well as Isobel van der Stoep, from the South African Irrigation Institute, contributed to this technical study.

**The researchers focused on three areas to manage rising costs, namely technology (design), farm management and electricity tariff choices.** Their work was synthesised in a WRC published report titled, ***The optimisation of electricity and water use for sustainable management of irrigation farming systems*** (**WRC Report No. TT 717/17**). The main aim of this research was to develop a model that would integrate irrigation system design aspects (including pipe diameter selection), electricity tariff choices and water planning to help support more efficient energy management.

Increasingly, farm profitability is coming under pressure due to the cost of pumping irrigation water, says Grové. This is because h**igher electricity tariffs create serious problems for many farmers since irrigation depends on electricity to pump water.**

**The cost of applying irrigation water on farms must be balanced with expected economic benefits, he notes.** "The old paradigm of applying irrigation water to sustain maximum production will be replaced with the new paradigm where water use is optimised to increase profitability."

*"The old paradigm of applying irrigation water to sustain maximum production will be replaced with the new paradigm where water use is optimised to increase profitability."*

**Rising input costs**

Previously, Eskom was one of the cheapest electricity suppliers in the world. Many irrigation designers took this situation as a given, Grové points out. This was because they were able to reduce investment costs by decreasing mainline pipe diameters with resulting larger kilowatt requirements.

The average tariff of electricity has, however, increased significantly in the last two decades. From 1998 until 2007 the increase in the average tariff was moving along with the inflation rate. In the year 2008, the tariff increased rapidly to maintain Eskom's sustainability and to cover expenses associated with the expansion of infrastructure. Indications are that further electricity price hikes are inevitable over the coming years as South Africa weans itself off its current fossil fuel intensive energy budget. This could have a significant impact on the cash flow, profitability and sustainability of irrigation farmers.

For some producers, the cost of increased electricity tariffs is even higher than for others because they have invested so heavily in outdated and energy-inefficient irrigation systems. Luckily, potential energy savings can be achieved by adopting new technologies (including variable speed drives and high-efficiency motors) while taking cognisance of the trade-offs between investment and operating cost, the report shows. **Says Grové, "The question is not whether irrigation farmers should adopt practices to improve energy and water management. Rather, the problem is how to evaluate the linkages between irrigation management, system design and the choice of electricity tariffs to improve energy and water management. Together these factors will determine the extent of water and energy savings in irrigated agriculture."**

**Consider lifecycle costs**

**Currently, the South African Irrigation Institute (SABI) is responsible for local irrigation design norms. These include details about irrigation requirements, system efficiency and even irrigation hours per week. But higher electricity tariffs have now made it necessary to rethink some of these norms given that they are not applicable anymore, the researchers say.**

**Rethinking these design norms can have a huge impact on local irrigation practices, Grové points out. About 80% of registered irrigation systems in South Africa are pressurised types of irrigation systems (centre pivots, sprinkler, drip and micro sprinkler systems). The majority of these are powered by centrifugal pumps driven by electrical motors. Any practices that will reduce the power demand of such systems will, therefore, have widespread application in the irrigation sector.**

**A trade-off exists between reducing investment costs and increasing operation costs through higher electricity costs, the researchers say.** Following a comprehensive literature review, a conceptual framework was developed of factors influencing the lifecycle costs of alternative electricity management interventions. Emphasis was placed on using lifecycle costing as it incorporates not only the cost of acquiring new technology but also operational costs, maintenance costs and the cost of disposing the product.

The conceptual framework takes cognisance of the irrigation system design process and the three focus areas that should be targeted to manage electricity costs. The design process includes the design of the power supply, water distribution network and the determination of the irrigation water demand and design of the infield irrigation system. Capital investments that influence the kilowatt requirement, management (operation and maintenance) of the irrigation system and choice of electricity tariff was identified as focus areas that should be investigated in order to reduce electricity costs.

The framework emphasises the linkages between irrigation system design and irrigation water and electricity cost management. Specifically, a trade-off exists between reducing

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investment costs and increasing operating costs through higher electricity costs.

The next step was to develop a mathematical model to calculate the lifecycle costs of this kind of investment over a period of twenty years. This so-called Soil Water Irrigation Planning and Energy Management (SWIP-E) programming model considers alternative management interventions. Decisions that influence electricity costs included the type of electricity tariff structure used, when irrigation happens throughout the day, the design capacity of the system and other factors like main pipeline size and operation and maintenance.

The model has the unique characteristic that it determines irrigation pumping hours through a daily soil water budget while considering the time-of-use electricity tariff structure. It also considers changes in kilowatt requirements resulting from mainline design changes.

The costing framework was tested on in the Douglas region and in Limpopo, using Eskom's Landrate and Ruraflex tariff structures (both aimed at rural agricultural users). The researchers considered the electricity use of centre pilot sizes of 30 ha and 47,7 ha, as well as static systems like micro irrigation and sprinkler irrigation systems.

Smaller irrigation system delivery capacities proved to be the most profitable for all the systems and electricity tariff structures investigated, as higher flow rates increased the energy demand. The implication of using the current 1,5% norm is that thinner pipe diameters would be used which decrease investment cost but at the same time increase operating cost (electricity costs).

Says Grové, "This means that increasing electricity costs will have a significant effect on the profitability of irrigation systems if thinner pipes are used."

Large pipe diameters reduce friction loss and therefore total pressure with lower kilowatt requirements while increases in flow rate will cause an increase in kilowatt requirements. This increase in kW demand had a greater impact on the energy cost than the decrease in irrigation hours resulting from high system capacities. "Also, electricity tariffs have a significant impact on break-even percentage friction, Grové points out. "Furthermore, the break-even point is much lower than the norm of 1.5%."

The results show that variable electricity costs increase as flow rate increases if the optimal pipe diameter stays the same. "Failure to consider electricity tariffs when designing irrigation mainlines may result in suboptimal designs which will increase electricity costs," he says.

The researchers recommend that the SABI design norm for the maximum allowable friction losses in main pipelines must be reduced from the current 1.5% to 0.7%. This would ensure that there is a better balance between investment and operating costs, Grové indicates. Lowering the norm will also decrease operating costs while increasing the investment costs.

The model provides a basis to evaluate the profitability of new technology such as variable speed drives, energy efficient pumps and motors as well as modification of existing irrigation system designs.

The choice of tariff-structure also has a direct impact on

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electricity use and profitability, the research shows. The timing of irrigation is of utmost importance since it has a direct effect on electricity costs and crop yield. Time-of-use electricity tariff-structures enable producers to schedule irrigation outside of peak periods to reduce electricity costs.

According to the researchers it is more profitable to use Ruraflex than Landrate, irrespective of the irrigation system size used. Says Grové, "The total annual fixed cost charge for Landrate is consistently higher than the annual fixed cost charge of Ruraflex, and savings can be achieved through careful planning of electricity supply points' sizes and locations."

Making irrigation system investment decisions on investment cost alone is flawed, he believes. "This is because the variable electricity costs may outweigh the capital costs when considering the life cycle of the investment. Investors in irrigation systems should ask their suppliers to provide an estimate of variable electricity costs together with the investment costs."

Management of irrigation systems also remains key to reduce costs while improving efficiency. These systems should, for instance, operate at the correct pressure. Pressures higher than the minimum requirements increase the power demand and thereby increase electricity costs, while those below the design requirements will mean more irrigation.

Furthermore, irrigation systems need to be maintained properly to make sure that water is applied at an acceptable uniformity. Lower uniformities necessitates more irrigation to ensure that the whole field receives enough water to maintain high crop yields. More irrigation hours increase electricity costs that again affects farm profitability.

Irrigation designers should also apply economic principles when designing mainline designs, the researchers point out. This will increase the overall profitability of the investment compared to applying the friction percentage design norm. Using economic principles will also differentiate between electricity tariff structures when designing an irrigation system.

The report shows significant opportunities exist for farmers to reduce electricity cost through irrigation system design, renewable energy resources and adopting new technology, Grové points out. "Careful consideration of the economics is necessary since smaller delivery capacities need much more intensive management because longer irrigation hours are needed to avoid a decrease in crop yield. Designers should include both the investment costs and an estimate of the operating costs of the irrigation system design to allow farmers to make informed decisions. However, cognisance also needs to be taken of the trade-off between investment and operating costs if new technology is adopted."

The SWIP-E model now informs other ongoing research efforts, including a SABI project to rethink the norms applied in irrigation system management across the country.

To access the report, ***The optimisation of electricity and water use for sustainable management of irrigation farming systems*** (**WRC Report No. TT 717/17**), contact Publications at Tel: (012) 761-9300; Email: orders@wrc.org.za or Visit: www.wrg.org.za to download a free copy of the report.

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Food and Agriculture Organization of the United Nations

## WHAT IS FOOD WASTE?

Food waste is all the food wasted even though it would have been good to eat: if something goes off in your fridge because you haven't eaten it in time; if you have put too much on your plate and throw away your leftovers instead of eating them later... THIS IS FOOD WASTE.

every year around the globe

**1.3 BILLION TONNES OF**

# FOOD

is

**lost** or **wasted**

that is

**1/3** OF ALL FOOD PRODUCED FOR HUMAN CONSUMPTION

## WE NEED TO STOP WASTING FOOD BECAUSE:

- Wasting food means wasting money, labour and resources such as energy, land and water that go into producing the food.
- Wasting food increases greenhouse gas emissions and contributes to climate change.


**SAVE FOOD**
**Global Initiative on Food Loss and Waste Reduction**



**Food and Agriculture Organization of the United Nations (FAO)**
Viale delle Terme di Caracalla
00153 Rome, Italy

www.fao.org/save-food
Save-Food@fao.org

INTERNATIONAL FOOD WASTE COALITION

# DO GOOD SAVE F

nine easy tips to red


## 1. ASK FOR SMALLER POR

Make sure you start you small portion on your pl go back for more if you'

## 2. LOVE YOUR LEFTOVERS

Instead of scraping leftovers into the bin, use them as ingredients for tomorrow's meal, or simply reheat them as the same meal again. Remember, if you want to use leftovers, it's very important to store them in the fridge or freezer within two hours of preparing your meal.

## 3. SHOP SMART

We often buy more food before it goes off. To av try to plan ahead, make don't go shopping on an

## 4. BUY "UGLY" FRUITS AND VEGETABLES

Many shops and farmers' markets offer irregularly shaped fruit and vegetable, which are just as good to eat as regularly shaped and coloured ones. Buy "ugly" fruits and vegetables to show that you do not want any food wasted!

**Together, we can fi**

uce food waste.

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## 5. CHECK YOUR FRIDGE

To make sure that food is properly stored and kept fresher for longer in your fridge, set it to the right temperature (between 1 and 5 °C), store products in the right places in the fridge and follow the instructions on the packaging or the fridge manual. Don't pack the fridge too full: you will use less energy and you'll be less likely to forget to use the food you bought.

## 6. PRACTICE FIFO: FIRST IN, FIRST OUT!

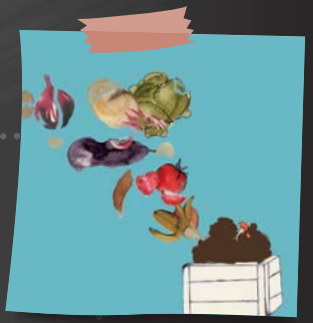
When you put your shopping away, rotate the food in your fridge and cupboard so that the older food comes forward and the most recent shopping – which will keep the longest – goes to the back. But keep an eye on the use-by and best-before dates – some new food may need to be eaten quickly.


## 7. UNDERSTAND DATES ON YOUR FOOD

After the "use-by" date has passed, food is not safe to eat anymore. "Best-before" dates, on the other hand, only show when the food is at its best quality in terms of smell, texture, and taste. If well stored, most of non-perishable food is still edible after the "best before" date!

## 8. TURN WASTE INTO COMPOST

If you do end up wasting some of your food, recover it by turning it into garden food: instead of throwing it in your regular bin and contributing to the greenhouse gas emissions connected to the transport and disposal of waste, why not set up a compost bin for food waste and fruit and vegetable peelings?




## 9. SHARING IS CARING: GIVE TO HELP

Give your surplus to help those who need it. When hygiene and sanitary conditions and traceability requirements are ensured, it's easy to give your surplus food to those in need. Learn about existing initiatives in your cafeterias, your stores, your city... to give a boost to food aid associations and reduce waste.

ight food waste. **So, Do Good – Save Food!**

# WATER SECTOR PERSONALITY

## Prof Bhekie Mamba: Dedicated to refining water treatment technologies that can save lives

*The Water Research Commission (WRC) has joined forces with the National Science and Technology Forum (NSTF) to recognise excellence, leadership and impact in the field of sustainable water management, knowledge generation and solutions. To celebrate the excellent work being done in water research and innovation in South Africa, the inaugural NSTF-WRC Award 2016/17 was bestowed upon Prof Bhekie Mamba, the Executive Dean of the College of Science, Engineering and Technology and at the University of South Africa (UNISA). Kim Trollip find out more about his achievements.*

*Courtesy NSTF*

*Prof Bhekie Mamba receiving the NSTF-WRC Award from Science and Technology Minister, Naledi Pandor, and WRC CEO, Dhesigen Naidoo.*

Prof Mamba, who is also the Director of UNISA's Nanotechnology and Water Sustainability Unit, researches nanotechnology-based systems for sustainably providing safe and clean water to disadvantaged communities. He is responsible for significant scientific and technological contributions and achievements in the fabrication of advanced nanostructured materials and systems for water treatment. Innovations include the Silver Impregnated Porous Pot filter for treating wastewater at household level.

Early on in his illustrious career, Prof Mamba identified the uncertainty around water quality as a critical research question of our time – one that affects the country and humankind as a whole. "In addition, the challenges around the contamination of water, cause untold ill health and in some unfortunate cases, mortality. Hence I began my pursuit of research funding to provide solutions in this important field."

As the Dean of the College of Science, Engineering and Technology of the largest university on the African continent, Prof Mamba is particularly passionate about providing water treatment solutions that can be applied in both urban and rural areas.

Another of Prof Mamba's passions is the responsiveness of the postgraduate students who have worked on various projects under his supervision and are researchers either at universities or in industry. "Working with postgraduate students keeps me

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motivated, because one realises how much one has invested extensively in future research offspring in the field of water quality."

**Drawn to research and a career in sustainable water provision**

Prof Mamba was drawn to a career in science and technology early on. "I was intrigued during my PhD that contrary to what many think, there is still lots to discover in science, engineering and technology (SET)." He says the challenge of innovation and making a contribution to enhance knowledge that already exists were driving forces that motivated him. "What made SET research very attractive is that it is based on universally accepted principles and whatever outcomes or finding of the research, it immediately draws the attention of peers internationally and the benefits of such innovations are not just for local consumption but they can equally apply elsewhere in many other parts of the world.

"In order to attract funding for research and to remain relevant, I had to identify a problem that exists which affects mankind and the country as a whole," explains Prof Mamba. "In my reading and consultations it became apparent that the uncertainty with respect to water quality and its contamination was a major challenge and it accounted for untold ill health occurrences and in some unfortunate cases, fatalities. The main research question that one had to grapple with pertained to the quest for drinking water technologies that would remove organic pollutants in water even at very low concentration levels of parts-per-billion."

**A message to young scientists**

Prof Mamba says young scientists must not underestimate themselves. They should be proud of their achievements. "You have so much creativity and many untested ideas within you that can blow your mind, let alone make this world a better place. Do not underestimate the potential that resides within you. Unleash your God-given talent, intelligence and remain resilient with your self-belief while shutting out the voices of negativity."

Prof Mamba is well qualified to inspire young scientists. He has supervised to completion over 80 Masters and doctoral students and has published at least 220 papers in peer-reviewed journals. Besides his established international collaborative research network with other esteemed universities locally and abroad, he has presented his research work in several local and international conferences. Prof Mamba's passion is a creating sustainable solutions that would ensure that the water resources are maintained and preserved for future generations.

Previously the Head of the University of Johannesburg's Department of Applied Chemistry, Prof Mamba was subsequently appointed Dean of the Faculty of Science at the University of Johannesburg before moving to UNISA to establish the Nanotechnology and Water Sustainability Research Unit. In 2010 he was awarded the status of Chartered Chemist (CChem) and Chartered Scientist (CSci) by the British Royal Society of Chemistry (RSC) and the British Science Council, respectively, Professor Mamba is now the Fellow of the Royal Society of Chemistry of the UK and is rated C1 by the NRF. He is a member of the Academy of Science of South Africa.

The NSTF-WRC Award can be bestowed upon either an individual, team, partnership or an organisation in recognition of demonstrated leadership, innovation and impact. This new award seeks to give recognition to contributions considered either together or separately. Additional criteria include:

- Leadership in water research, development and knowledge generation that considers transformation and growth of the human capital pipeline for sustainable water management in South Africa;
- Exceptional contributions towards informing and shaping the national water landscape through policy, decision-making and legislative enhancements. The work recognised could include knowledge-based advocacy.
- Innovations that demonstrate sustainable solutions to water challenges in South Africa. These could include technology, service, process, or social innovations with impact within, between and beyond organisational boundaries;
- Outstanding work in trans-disciplinary approaches and water projects towards the empowerment of communities; and
- Improved models for integrating water opportunities into entrepreneurship and new product developments that will have a positive impact on water management in South Africa.

*"The challenges around the contamination of water, cause untold ill health and in some unfortunate cases, mortality. Hence I began my pursuit of research funding to provide solutions in this important field."*

**More about the genesis of the NSTF-WRC award**

The WRC and the NSTF have over the years collaborated on water management solutions and towards enhancing strategic dialogues on water security.

"The Commission plays a strategic leadership role in water research, development and innovation, and the partnership with the NSTF demonstrates the need to move research to impact," explains WRC CEO, Dhesigen Naidoo. "The NSTF-WRC award will undeniably create a platform to honour and recognise outstanding achievements in water management that often go unseen and encourage the sector to be more pioneering."

The NSTF is in agreement. "Improved access to water and environmentally-sensitive management of water resources feature prominently in the Sustainable Development Goals and – from this year – at the NSTF-South32 Awards. The NSTF and Water Research Commission are collaborating on this new award for research in water management, knowledge generation and solutions." adds NSTF Executive Director Jansie Niehaus.

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# WATER AND AGRICULTURE

## Beyond the farm gate: FruitLook unlocks bigger picture

*Rising input costs, increased competition for water and recent weather woes are compelling producers to improve their water use efficiency in terms of agricultural yield per amount of water consumed. Jorisna Bonthuys looks at how an online service called FruitLook is strategically placed to support local fruit and wine producers on their journey towards more efficient water use.*

Changing farming conditions due to climatic shifts are already a reality.

Globally, the year 2016 was the hottest year ever recorded, surpassing the exceptionally high temperatures of 2015. During this period South Africa experienced one of its worse droughts in decades, putting a strain on producers and consumers alike.

South Africa, like the rest of southern Africa, is expected to be vulnerable to food insecurity, water scarcity and climate change over the coming decades. The agricultural sector is the biggest consumer of water and therefore most vulnerable to the expected change in weather patterns caused by climate change.

Water availability is set to be the single biggest factor in limiting agriculture production. Already water issues are compounded by the fact that demand outstrips supply in many parts of the country.

"Alternative sources of water will have to be found, and we need to reuse what limited water sources we have as much as possible. The optimum utilisation of existing water resources is key to agricultural development and growth, with the associated jobs it creates," says André Roux. Roux recently retired as Director for Sustainable Resource Management in the Western Cape's Department of Agriculture.

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In the Western Cape – the heart of the country's fruit and wine production region – strict water restrictions are in place due to severe water shortages caused by insufficient winter rainfall over the last few years.

In August 2017 many of the dams in the province had reported levels drastically lower than levels recorded at the same time during previous years (44% in August 2016 compared with 18% in August this year). Without additional rainfall in the coming months, producers are up for a challenging production season.

Unfortunately, these droughts might not be isolated events. Climate models predict a gradual to rapid change in climatic conditions and an increased likelihood of extreme weather conditions like hail, flooding and prolonged droughts in the Western Cape. The picture does not look the same everywhere, but the direction of change is clear.

This is forcing managers and irrigators to re-evaluate their strategies for growth in the local agricultural sector. There is an increasing need to improve the efficiency of resource use to mitigate impacts of climate change, says Roux. Farmers will need to produce 'more crop per drop'.

**Space technology supports farmers**

The face of natural resource management is changing with satellites and remote sensing playing an increasing role to inform decision making on farms, says Dr Caren Jarmain. She is an independent researcher and research associate at the Centre for Geographical Analysis at Stellenbosch University. "Irrigation and proper water management can play a major role in enhancing water productivity and food security in our region," Jarmain believes.

This is where FruitLook, supported by a Dutch company called eLEAF, has proven especially useful to many local fruit and wine producers.

It uses satellite-derived information to help farmers decide about optimal timing, extent and location of inputs such as water and fertiliser. It is thereby helping to take some of the guesswork out of irrigation.

This is possible thanks to its ability to collate relevant information that is not always visible to the naked eye (for instance of surface temperatures and plants that experience stress). By doing so, FruitLook provides weekly overview maps describing growth, water and mineral content on a 20x20m pixel basis for almost every production block in the Western Cape. Producers and consultants alike use this data to determine the placement of soil moisture probes, detect drainage problems and evaluate irrigation efficiency post-seasonal.

Currently, Fruitlook is only available to fruit and wine producers in the Western Cape. The area covered by the satellites it employs now roughly stretches from Lutzville and Vredendal (in the north) to the Hemel and Aarde Valley (in the south) and Montagu and Bonnievale (in the east). During the 2017/18 season, the area will be further expanded eastwards all the way to the eastern boundary of the province, to include for the first time the Langkloof area as well as the grazing areas of the dairy industry in the Tsitsikama area and the hops producing areas near George. This means all major agricultural areas in the Western Cape will be covered by FruitLook's from next season onwards.

The system, subsidised by the Western Cape Department of Agriculture, give local farmers access to high-end data products at no cost. By doing so, the agricultural sector is supported to become more resilient to climate change by empowering farmers to make better-informed decisions on resource management and especially the use of water for irrigation.

**More about FruitLook**

- Fruitlook is an online tool that helps farmers improve yield and save resources by providing weekly data maps describing crop growth, water use and mineral content.
- It integrates satellite data with geographical data and weather information in complex models and produces user-friendly, farm-specific data maps.
- It is helping fruit and wine farmers in the Western Cape optimise water use and improve productivity by enabling enhanced management of resources.
- FruitLook provided data on 182 600 ha of fruit crops and 5.7 million ha in total during the 2016/17 season. Approximately 34 860 ha of current data was used by farmers as well as 29 550 ha of historical data for comparative purposes.
- The service includes data maps on, among others, biomass production, actual evapotranspiration, evapotranspiration deficit, biomass water use efficiency and nitrogen contents.
- It allows a grower to see where an orchard or vineyard has received sufficient or insufficient irrigation.
- Almost half of the producers using it indicated they have cut their water use with a tenth. One in every ten producers says they are using almost a third (30%) less water than before.

*Source: SA Fruit Journal, Fruitlook.*

**Applying FruitLook in farming**

Many producers find Fruitlook a valuable tool, especially when it is integrated with other technologies. Anton Müller, Kromco's technical advisor, considers FruitLook especially useful to detect irrigation issues, for the placement of soil moisture probes, the detection of drainage problems and to evaluate just how efficient irrigation regimes were during the previous season. Kromco is one of the largest deciduous fruit packing facilities in the Western Cape and many of the growers in the Elgin and Grabouw region that supply to them, now employ this technology.

Some farms in the Grabouw region have, for example, been able to reduce their early season water use with up to 30%. This was done using FruitLook in combination with soil moisture probes, Müller indicated. Sometimes issues related to irrigation in an

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orchard are also first noticed thanks to unusual changes flagged by FruitLook's growth data.

Others like Karen Cluver, the manager of the fruit section of the De Rust farm near Grabouw, uses FruitLook's parameters for biomass production, water use efficiency and evaporation deficit to identify any emerging problems, including non-efficient growth in blocks throughout the season. Using biomass and water use parameters have enabled them to use about 20% less water than before. Says Cluver, "The data allows us to re-evaluate the growth of our crops and how much or how little water we are giving." Growth differences in a vineyard or block are, for instance, often linked to soil differences, related to water and growth.

FruitLook's data is not only useful in season but also to look back on a season to see how producers fared from a management perspective. It allows a grower to see where an orchard or area of an orchard has been over- or under irrigated, Jarmain points out. "The technology offers producers the opportunity to save water, but also to manage their orchards or vineyards within the required norms to optimise production."

The biomass production parameter has also been used by for early disease detection in orchards and vineyards and the effective treatment of only the affected areas, that resulted in significant cost savings in the disease treatment.

FruitLook reflects farm specific and regional conditions. And therein lies the beauty of using this kind of remote sensing tool that can look back in time and space. "A better picture emerges of what is happening on the whole farm when you integrate this with your existing farming practices," Müller says.

**Beyond the farm gate**

Although satellite products have been around for decades, producers and consultants alike now have free and timeous access via the Internet to products that would have been too expensive before. "Big data" and remote sensing can help a great deal to help make agriculture more water efficient in future, researchers believe

In the case of FruitLook, the application of remote sensing is aimed at providing farmers with the right information to help them increase their water use efficiency (providing the correct amount of water at the right time).

The data behind FruitLook can also be useful beyond the farm gate, explains Jarmain. It is already used for regional analysis (including research into yield prediction) and water resource management (including drought detection, water audits and water footprinting).

Remote sensing is applied in various ways. Some local researchers are mapping irrigated areas with it and doing research on the water footprint of crops. Others are interested in river discharge, improving efficient water use on farms or identifying just how much of our precious water resources are currently being used by water thirsty alien invasive plants and trees. Collective efforts are also under way to gain a better

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understanding of what this means for water availability in future. Heaps of data get collected in the process that needs to be interpreted.

Dr Jarmain is, for instance, involved in a research project on behalf of the Water Research Commission (WRC) performed by the University of Stellenbosch to determine the actual area under irrigation and the volume of water required annually for this. FruitLook's data is used to calibrate models that are being developed to estimate actual crop water use across the country. She is also involved in a research project on how Fruitlook can be used to make yield projections. The researchers are looking at phenological as well as yield data. They use statistical analysis and machine learning to discover relationships between remote sensing data and yield data, to model future yield.

Meanwhile, various national strategies have been developed to cope with current and future water crises in South Africa. How does FruitLook fit into these regional and nationwide strategies to deal with water and environmental challenges? It provides valuable information on actual crop water use of the previous week of the selected crop, orchard or vineyard.

Roux explains, "This can guide the irrigators to optimise the water use in the current week. Water savings of more than 10% are quite common for the users of the FruitLook data and saving water also result in electricity and fertiliser savings. Reduced irrigation water runoff reduces or eliminates the pollution of our rivers and streams with fertiliser enriched water, which has a tremendous positive impact on the environment."

Roux believes the optimal use of the limited irrigation water available this summer season (due to the drought) will be crucial for farmers to produce a quality crop given the water restrictions in place. "FruitLook's data will significantly contribute towards an increase in agricultural water use efficiency. This all starts by assisting irrigators to manage their limited water resources in the upcoming irrigation season."

**Farming for the future: SA's water realities**

- South Africa is one of the 30 driest countries in the world, with an annual average rainfall of less than 490 mm, a significantly lower amount than the world annual average of 814 mm.
- More than 80% of the country is hyper-arid to semi-arid. The rainfall climate of South Africa varies considerably across the country.
- Eight percent of South Africa's land provides more than half of our run-off and freshwater resources.
- About two-thirds (63%) of all water consumption countrywide is by farmers who are its biggest direct users.
- Based on current usage trends, South Africa is expected to face a water deficit of 17% by 2030, and this shortage will only be worsened by climate change.
- Demand for water is increasing rapidly due to population growth, development initiatives, extreme weather events, climate change and pollution.
- In the Western Cape, 43% of the available water resources are used for irrigation. Fruit crops have a nett irrigation requirement of between 7 000 $m^3$ and 11 000 $m^3$, depending on the type of crop and where it is grown.
- One millimetre evapotranspiration per day is the same as 10 $m^3$ per hectare per day.

*Sources: WWF-SA, Fruitlook.*

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# HYDROLOGY

## Seasonal hydrological forecasting - current state of play

*South Africa's dependence on dam-based storage of water, coupled with its variable climate, underlines the importance for seasonal forecasts of water resources (predictions of climate and water resources issued three to six months into the future), and the mainstreaming of these forecasts into water resources management. Piotr Wolski, Chris Lennard, Chris Jack, and Mark Tadross of the Climate System Analysis Group (CSAG) at the University of Cape Town provide a look at the current status of seasonal hydrological forecasting in South Africa.*

As highlighted by the current situation in the Western Cape, managing and preparing for drought events requires a comprehensive strategy addressing all aspects of water resources management. Planning and preparedness at seasonal and annual time scales plays an important part of that strategy. This is because optimal operation of water-supply systems, merged with pre-emptive demand management activities, when informed by appropriate forecasts, might mean the difference between the various levels of water restrictions and thus the magnitude of associated economic and social impacts. With increasing water demand and projections of decreasing rainfall and increasing temperatures as a result of climate change, it seems highly likely that our water-supply systems will be stressed even more frequently in the future.

Yet, in South Africa, relatively little research has been focused on hydrological and water resources predictions at seasonal time scales, with only a handful of research projects in the last decade, few local-scale operational implementations of a seasonal hydrological forecast, and no operational forecast at the country scale. Hydrological forecasting in South Africa appears to have received by far less research attention than the seasonal climate forecast, or seasonal agricultural forecast.

**What are the reasons of such status quo?**

Preparing an actionable seasonal hydrological forecast is a difficult undertaking, and there are two principal reasons for that. Firstly, the seasonal hydrological forecast is generated within a science and practice domain that spans, at a first sight similar, but in reality rather disparate disciplines – climate science and

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hydrology. That has some surprising implications. Secondly, seasonal hydrological forecasting needs to rely on seasonal climate forecasting, and the latter has mixed but typically fairly low predictive skill.

Some of the above issues were debated in a workshop organised within the Water Research Commission (WRC)-funded study titled, ***Use of land surface models for seasonal hydrological forecasting in South Africa*** project in October 2016. The workshop brought together researchers and practitioners from across the climate-hydrology interface, with the South African Weather Service (SAWS), CSIR, University of Pretoria, and CSAG representing the main institutions involved in seasonal climate forecasting in South Africa, and the WRC, Department of Water and Sanitation, consulting companies, as well as catchment management agencies, representing water resources management researchers and practitioners.

The institutional or "domain" divide was clearly seen. The currently ongoing research activities around forecasting the hydrological responses aiming towards the determination of viability and skill of such forecast, as well as operationalising such forecasts, were carried out exclusively by the climate forecast producers. For them, these activities were the natural "next" step extending the utility of their seasonal climate forecast products. That process was, however, happening with little input from the side of water resources practitioners and researchers.

As the workshop discussions revealed, these activities could definitely benefit from hydrological expertise through bringing in the knowledge of appropriate hydrological datasets, and through the selection of study locations where modalities of seasonal forecasts could be easily understood without complexities arising from specific characteristics of the hydrological environment, and their anthropogenic transformation.

For example, SAWS was focusing their efforts on development and evaluation of a hydrological forecast for the Olifants River catchment. Such a forecast, on the one hand, addresses a need for seasonal information in a catchment where water resources are heavily developed. On the other hand, that catchment was considered inappropriate by the hydrologists to be a test bed for development of methodologies and evaluation of forecast skill. This is due to the domination of groundwater recharge and presence of numerous dams and offtakes that affect streamflow, which, without detailed information about them, only confuse and dilute the assessment of quality of forecast results. Similarly, streamflow forecasts generated by climate scientists for Zambezi, Limpopo and Umgeni turned out not to be used by, or in fact useable for water management communities, although some skill (i.e. the ability to predict responses) of these forecasts could be demonstrated. That lack of adoption was, as discussed, due to the fact that hydrologists were not involved in, and did not guide the process of forecast development, and thus the forecast product was not really speaking to their needs and requirements for the type of information needed in water resources management.

It is not only the climate scientists that do not reach out. The workshop discussions revealed that the forecast activities carried out within the water management community were based on generic datasets such as a synthesised forecast issued by SAWS, or the seasonal climate outlook generated by SADC. These activities were not cognisant and not taking advantage of the uncertainty and skill measures associated with full climate forecast datasets, as well as the position of these forecasts in the landscape of available multi-model, multi-method information.

Apart from the critique of current practices, however, a number of positive points have emerged from the workshop discussions, mostly indicating the direction of further developments and activities. These are summarised below.

1. There is a clear understanding across the communities that while new sophisticated tools, models and approaches are undoubtedly needed, there is also scope for research on the value of tools, methods and datasets that are simple, and often already in place (e.g. statistical or hybrid forecast models). These should be explored first, for the new methods to target identified gaps in knowledge and deficiencies of simple tools. An example of such applications is the direct statistical downscaling of seasonal climate forecast to streamflow.
2. Seasonal forecasting usually focuses on surface water, but groundwater-relevant information is of potential value, and thus there is scope to diversify information generation and models to capture groundwater forecast aspects.
3. There is a need for creating a single "consensus" climate forecast product targeted at the hydrological and water management community, rather than generate alternative, competing products coming from several institutions. It is difficult for hydrologists/water managers to navigate the landscape of various climate forecast products without having an intricate knowledge of their nuanced characteristics.
4. The "consensus" forecasts should be "custom-built" for a particular audience, purpose, and spatial and temporal scale. For example, drought forecasts should be different from flood forecasts and streamflow forecasts.
5. At this stage, there are neither regulatory nor technical guidelines in South Africa as to how the seasonal climate information should be included in the water management practice. Whether and how dam managers use seasonal forecasts remains an individual choice that is dependent on the ability of an individual to subjectively accommodate that information in the decision-making process. Additional complexity arises because the decision-making in water management takes place at various time scales from daily to multi-annual, depending on the size of the system, and issues at hand. Clearly, guidelines need to be developed in cognizance of the decision-making time scales as well as the evolving characteristics of relevant climate forecast products. Those guidelines should take advantage of the annual processes of revision of operational rules that are typically in place in most of water management systems. Those processes could be used to determine the seasonal information needs, but also may be influenced by seasonal forecasts. For example, yield curves for planning dam releases could be adjusted annually to accommodate seasonal outlook in the context of current conditions, and consider acceptable levels of risk under uncertainty.
6. The majority of models that are used to design and revise dam operating rules are based on stochastic approaches, and thus the probabilistic forecast data can be relatively easily accommodated within them. Yet, there has not been any concerted efforts to develop, or test appropriate methodologies and approaches within that context.
7. Some aspects of dam management require information

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on the 1 to 5 to 10-year time scales, and the hydrological/water management community would welcome forecasts at these time scales. Forecasting at these, so called "decadal" time scales is, however, contested, as there are limited sources of predictability at such time scales, and these are rarely captured by climate models. At this stage, no activities are carried out on this in South Africa. There is, however, some scope for exploring forecasts based on statistical time series analysis i.e. recognising long-term (10 to 20-year) cycles in rainfall.

**Seasonal climate forecasting – a lost cause?**

As far as the second of the main problems, i.e. the quality of the seasonal ***climate*** forecast is concerned, this has been a topic of a large number of research projects conducted in the recent decades globally and in South Africa. Nowadays, we equate seasonal climate forecast with numerical, i.e. computer-based climate predictions, and with the ever increasing computing power, and complexity of global climate models we would expect a considerable improvement in the quality of such forecasts. However, the improvements are only, at best, incremental. Importantly, this is partly caused by the very nature of the climate system, rather than by the quality of climate models.

The actual climate system, as well as the climate system simulated by climate models, is often considered to be an example of a chaotic system. Chaotic systems are characterised by their sensitivity to small changes in their state (e.g. pressure, temperature and winds at a particular point in time) such that these small changes can rapidly expand into large changes in the system state as time progresses. Because it is impossible to perfectly observe and provide the exact state of the real climate system to a climate model, the model simulated state will rapidly diverge from the real climate system. Weather forecasting, i.e. predictions at one to five days ahead, relies on this occurring slowly enough so that we can predict weather based on knowledge of the current state of the atmosphere.

However, predictions at time scales of one to three months and beyond are dependent on whether or not there exists what is called a source of predictability. That is often a process or phenomenon in the climate system that varies slowly enough to be predictable at the seasonal scale, and that exerts its influence on weather over the target forecast area. Quite often, that source of predictability is a specific configuration of sea surface temperatures, whose influence propagates through the atmosphere. The well-known influence of the El-Niño/La Niña phenomena is the prime example of a source of predictability, but there are others similar phenomena too.

As a result of last decades' research, we know now that in South Africa the seasonal predictability in the summer rainfall region is strongly dependent on the status of El-Niño. In general, climate models are able to predict with a reasonable accuracy anomalously wet seasons during strong La Niña episodes, and are slightly less accurate in predicting anomalously dry seasons during strong El Niños. The skill of these predictions is best in the northern and north-eastern parts of the country. Unfortunately, it appears that currently we have very limited ability to predict rainfall in the winter rainfall region and during the neutral El Niño years. Either sources of predictability do not exist, or the climate forecast models are not able to capture them adequately.

**Where is the way forward?**

The above seem to point towards three themes of further activities:

1. Developments and improvements in seasonal climate forecasting
2. Understanding of hydrological environment and hydrological tools and models in the context of seasonal forecast
3. Initiation of case studies as a platform for co-learning and creation of cross-disciplinary expertise

The first theme has been the subject of much study through many WRC and other projects, however, the latter two have not received equivalent attention.

In an effort to improve our understanding of the potential of seasonal hydrologic forecasting (the second theme above), research activities of the current WRC project focus on modalities, limitations and potential of a seasonal hydrological forecasting system to simulate regional-scale hydrological responses in South Africa. Its particular concern is minimising the dilution of climate forecast skill during the process of translating climate data into hydrological information. Through its activities, the project aims to create a knowledge basis for an operational seasonal hydrological forecasting system enabling regular forecasts of runoff, streamflow, shallow groundwater and soil moisture, addressing aspects such as frequency and intensity of events, as well as mean conditions. The project is motivated by the possible contribution of a reliable seasonal hydrological forecast to management and operation of such elements of South African economy as water supply, hydropower generation, agricultural activities and disaster (flood and drought) prevention and preparedness. Final report of the project will be released in mid-2018.

Below we present results one of the project activities aiming at assessment of sources of predictability in hydrological system at seasonal time scales.

Unlike in the climate system, where the influence of its current state typically does not extend beyond 1-5 days, in hydrological systems that influence can potentially be much longer – sometimes reaching a year or more. The current state of a hydrological system pertains simply to the amount of water in the various storages along the water cycle path, such as groundwater, soil moisture and surface water. The state of a hydrological system at a point of time in future will thus be dependent on the combination of the influence of its current state, and the influence of weather between now and that future point of time. In modelling language, the first is called a model's ***initial condition***, and the second a model's ***boundary condition*** of ***boundary flux***.

The relative importance of the two factors will be dependent on characteristics of the hydrological environment such as depth and type of soil, size of the phreatic aquifer, topography, vegetation, density of river network, as well as on the variability and magnitude of the boundary fluxes. In environments with shallow and poorly permeable soil, initial conditions will play little role in determination of system's state in future. In environments with deep soil, and river network linked to a large phreatic aquifer, initial conditions can have stronger influence, particularly during seasons characterised by low variability of boundary fluxes. These two situations have different implications

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for the operationalizing seasonal hydrological forecast that is based on integration of seasonal climate forecast with a hydrological model. In the first environment – skill of seasonal hydrological forecast will be dependent on the skill of the climate forecast. In the second – that skill will play lesser role, and what will be important is the precise determination of initial conditions, which can be based on observed monitoring data timely assimilated into a good quality hydrological model.

In the WRC project, we set up a series of model experiments meant to quantify the relative influence of the initial and boundary conditions on the forecast of hydrological variables such as runoff, soil moisture and actual evaporation. These experiments were based on a specific type of a hydrological model - the so called Land Surface Model, and we have used model called VIC. The experiments involved running the hydrological model multiple times (so called ensemble simulations) with individual simulations differing in either initial condition or in boundary condition. By analysing how strongly outputs of those ensemble simulations differ, we could conclude about the relative importance of the boundary conditions and initial conditions.

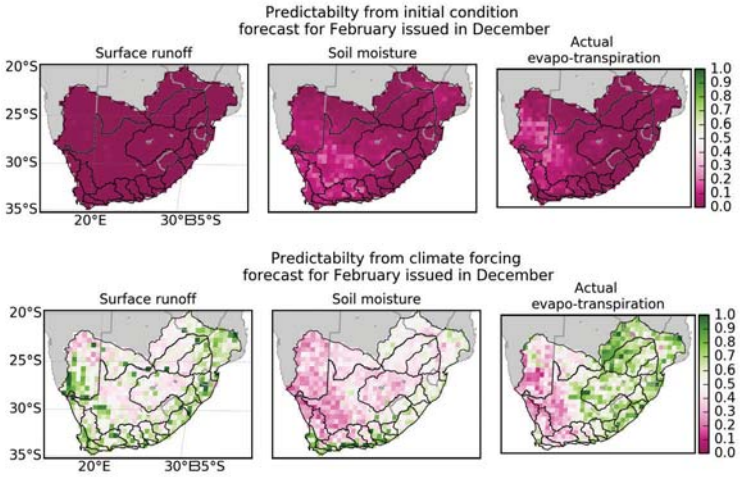


*Figure 1.A quantification of the relative roles of initial conditions and boundary forcing (climate variables) in seasonal hydrological forecast in South Africa's hydrological region. Low values of the illustrated index indicate low level of predictability.*

Results for forecasts of core summer season (Dec-Feb) indicate (Figure 1) that surface runoff across the entire country displays very low, almost non-existing sensitivity to the initial conditions. The role of initial condition in the forecasting of soil moisture and evaporation fluxes is, however, stronger, particular in the arid, western part of the country. These regional differences are somewhat surprising, as the arid regions with shallow soils (as in Fish River system) are not expected to maintain a long "memory", and they need to be investigated further. Additional interpretation of the simulations, although not illustrated here, can be made in terms of the influence of "organizing" or "disorganising" feedbacks in the hydrological system, and thus the level of uncertainty of the forecast added through simulating the hydrological responses. In that, it appears that in the summer months the constraining of uncertainty happens in the central and western parts of the country, while the opposite, i.e. inflation of uncertainty occurs there during the winter months. Broadly similar interpretation can be made for soil moisture and evaporation.

These results, although regional in scope, inform about the opportunities for development of local scale forecasts, which, unfortunately, in most of the country have to rely on the quality of the seasonal climate forecast. It is important to note that by nature these results pertain to small, headwaters catchments rather than to large river basins. We have not investigated that at this stage, but it is highly likely that at the scale of large basins the influence of initial conditions is stronger, and seasonal forecast can strongly benefit from appropriate incorporation of monitoring data into hydrological forecast models.

Within the third theme identified above concerning the creation of cross-disciplinary expertise and co-learning, based on the outcomes from workshop organised within the project it appears almost no formal theoretical and/or practical activities have taken place. This is concerning as themes 1 and 2 above could make significant progress in each separate "silo" but this would have no or limited bearing on the development of reliable hydrological forecasts. It is only once several disciplinary teams spend an adequate amount of time together to understand each other's philosophic and methodological space that a well designed experiment can be developed and executed. An experiment where the climate community is cognisant of the philosophy and practicalities of the hydrology community and their models, and where the hydrology community understands the philosophy of seasonal climate prediction and the limits inherent in its methodologies will produce a seasonal prediction system with relevance to both communities.

We therefore urge communities interested in both seasonal climate and hydrologic prediction to actively engage in co-exploratory activities in order to elucidate research questions that would improve our understanding of and ability to produce such forecasts. This engagement has to be long-term to allow for the iterative improvement of research questions and subsequent improvement of predictive ability. Furthermore, funding agencies should design funding models able to sustainably support the cross-disciplinary research described in this article. Lastly, although our focus has been hydrological seasonal prediction, the principles herein likely apply to other sectors like agriculture, health and disaster risk management.

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# WEF NEXUS

## Driving the Water-Energy-Food nexus in the context of sustainable development

*The Water – Energy – Food (WEF) nexus refers to the interconnections that exist between water, energy and food sectors. Since 2011, the WEF nexus approach has been promoted as an integrated and sustainable approach to managing key sectors related to water resources, energy and food security. Sylvester Mpandeli reports.*

These three are critical to sustainable development, with synergies and trade-offs, that if not managed well can derail sustainable development efforts. This realisation led to global leaders meeting in 2011 at the World Economic Forum in Davos, Switzerland, agreeing to drive the WEF nexus in a sustainable or integrated way.

Although the Millennium Development Goals missed an opportunity to clearly factor the WEF nexus especially in its targets, there is hope that the approach will be adopted under the Sustainable Development Goals (SDGs) framework. After the Sustainable Development Goals agenda was established by the United Nations (UN) in 2015, the WEF nexus activities were factored in as part of the SDGs, especially goals 2, 6 & 7 (Figure 1). Based on the decisions taken by the UN on the SDGs, various countries, including South Africa, are at various stages of driving the WEF nexus both at technical and policy levels.

In response to the global trend in adopting the WEF nexus approach, in 2012, the Water Research Commission (WRC) initiated its WEF Nexus Lighthouse with a goal to start championing water, energy, food planning and development


*Figure 1. The 17 Sustainable Development Goals agreed upon by 193 countries in UN General Assembly in 2015 (Source: UN 2015).*

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for South Africa in a sustainable manner. Since then, the WRC through its Research & Development (R&D) branch, has organised various activities under the banner of this lighthouse. This includes:

- (a) Profiling WEF activities championed by the WRC and its partners to facilitate knowledge sharing, and coordinate and align activities;
- (b) Hosting a series of dialogues involving key stakeholders aimed at improving understanding of the WEF nexus and the opportunities for integration of knowledge and solutions for improved uptake;
- (c) Hosting a series of dialogues and workshops on specific thematic focus areas such as biogas and biofuel generation in relation to water use and food security;
- (d) Hosting international workshop & science-policy dialogues with key strategic partners and global communities of practice; and
- (e) Publishing scientific papers for knowledge dissemination.

As a knowledge generation organisation, the WRC has a responsibility to drive alignment of its thrusts and programmes or focus areas linked with national priorities such as the National Development Plan (NDP) and other policies. This also extends to alignment with regional initiatives such as the SADC Secretariat's programme 8 on the WEF and the African Union's (AU) Vision 2063, among others.

As a country, South Africa has a responsibility to champion the WEF nexus. The challenges that South Africa is facing make it urgent for the country to adopt sustainable development approaches such as the WEF nexus. These include, but are not exclusive to the poverty-unemployment-inequality nexus; rapid population growth; rural to urban migration due to lack of job opportunities in rural areas; water scarcity, which is being exacerbated by climate variability and change; increasing demand for food due to population growth and dietary transitions and increasing food insecurity among the rural poor; increasing energy demand to meet South Africa' economic development goals, and the focus on agriculture, specifically expansion of irrigation, as a driver of rural economic development and employment creation.

Tackling these challenges will require coordinated efforts among different economic sectors, mostly water, energy and agriculture. The WEF nexus emphasises the inextricable linkages between the three sectors and that actions in one area often have impacts in one or both of the others.

There are key challenges that are being faced across these three sectors. For example, conversion of productive agricultural land for industrial or residential use threatens food security. Other examples include the expansion of coal-mining activities linked to energy generation in Mpumalanga, which threatens both water resources and food security. Other examples include the drive to increase irrigated agriculture, which places pressure on available water resources and creates new demand for energy for pumping water.

What these examples highlight is that, while all these initiatives have good intent to develop the country, lack of WEF nexus trade-offs could threaten their ability to translate into meaningful and sustainable development. The WRC, therefore, has a responsibility to raise awareness about the WEF nexus interlinkages and to create a platform for discussion of practical solutions that include the negotiation of synergies and trade – offs linked to the WEF nexus issues.

The WEF nexus presents an opportunity to promote integrated planning in a sustainable manner. It also presents a framework for directly achieving some of the SDGs such Goals 2, 6 and 7 with indirect potential to achieve SDGs 1, 8 and 9 through job creation and innovations linked to the WEF nexus sensitive planning. The WRC, for its part, will continue to drive research, development and innovation linked to knowledge generation on the WEF nexus. The translation of this knowledge into an actionable plan that can be adopted by policy makers remains the next frontier.

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# WATER REUSE

## New WHO guide on potable reuse

*A new publication providing guidance on the potable reuse of water is now available from the World Health Organisation (WHO).*

Potable reuse can represent a realistic and practical source of drinking water in many circumstances. Featuring contributions from several countries, including the Water Research Commission, the publication, ***Potable Reuse. Guidance for producing safe drinking water***, describes how to apply appropriate management systems to the production of safe drinking water form municipal wastewater. The scope of the guidance includes both direct and indirect potable reuse.

According to the WHO, the document builds on the organisation's existing Guidelines for Drinking Water Quality, (GDWQ) with information on specific aspects of potable reuse, including the quality and protection of source waters, types of treatment processes, additional monitoring and considerations, potential use of environmental buffers and engineered storages, and public acceptance.

The guidance is intended for use by drinking water suppliers and regulators who are familiar with the GDWQ and, in particular, the 'framework for safe drinking water', including water safety plans. As the starting point of potable reuse schemes is untreated wastewater, proponents should also be aware of the potential application of sanitation safety plans. The guidance could also be useful to others with an interest in potable reuse, including environmental health and water resource professionals.

**Drivers for potable reuse**

Population growth, increased urbanisation, catchment pressure, expanding areas of water scarcity and the impacts of climate change on water availability are all increasing pressures on existing drinking water resources, resulting in the need to identify new or alternative sources of drinking water supply. Between 2014 and 2050 the world population is expected to increase by 33% from 7.2 billion to 9.6 billion.

During this period, urban populations are projected to grow by 61% from 3.9 billion to 6.3 billion, with the largest increases expected in Asia and Africa. This projection means that the percentage of people living in urban areas will increase from 54% to 66%, with urbanisation in 89 countries expected exceed 80%. At the same time, droughts and flooding associated with climate change and climate variability are also increasing pressure on water supplies.

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**Advantages and challenges of potable reuse**

| Advantages | Disadvantages |
|---|---|
| Climate independent water supply | Source wastewaters are very poor quality with high concentrations of microbial pathogens and can potentially contain a broad range of chemical contaminants |
| Existing collection systems and, in many cases, established conventional treatment processes in close proximity to population centres | Generally includes use of complex treatment processes and a high level of technical expertise and understanding |
| Reduced environmental impacts from discharge (particularly from microbial hazards and nutrients) | Consequences of failure could be high |
| Typically less expensive than seawater desalination | While public acceptance is growing, concerns about the use of wastewater as a source of drinking water need to be addressed by education and public participation |
| Growing public acceptance | |

One response is to reduce vulnerability to these impacts by increasing resilience, diversity, adaptability and sustainability of drinking water supplies. Developing new and preferably more climate independent water resources in close proximity to major population centres should be a priority. Potable reuse, and, in coastal areas, seawater desalination meet this definition.

Potable reuse can produce large volumes of drinking water from wastewater available from established collection systems in both coastal and inland locations. In addition, it can reduce negative impacts of microbial hazards and, in some cases, nutrients from wastewater discharges on marine and freshwater environments. Urban settlements represent the main point sources of coastal and riverine water pollution with wastewater discharges being significant contributors.

The number of potable reuse schemes is increasing. From the pioneering starts such as Windhoek Goreangab plant (originally established in 1969), potable reuse systems have been established in several continents. A number of these schemes are discussed in case studies included in the WHO guidance document. The majority of potable reuse schemes have been developed in the twenty-first century and it is expected that potable reuse will increase as populations and pressure on finite water resources continue to grow.

Economically and practically, potable reuse compares favourably with seawater desalination, which is also increasing in use. In some cases, such as Singapore and Perth (Australia), desalination is used in combination with potable reuse. Limitations of seawater desalination are that it is restricted to coastal areas and has high energy use. Except for schemes involving pumping to distant environmental buffers (where used), potable reuse is less expensive than seawater desalination, the WHO publication points out.

**Challenges for potable reuse**

Potable reuse involves producing safe drinking water from wastewater. Due to the very poor microbial quality of municipal wastewaters and threats from chemical contamination, potable reuse is often a complex activity generally involving advanced treatment processes and substantial management expertise. It can involve coordination of separate wastewater and drinking water treatment plants.

Before proceeding, proponents should ensure that they have sufficient resources and capabilities (financial, technical and operational) to implement potable reuse schemes safely and sustainably. The consequences of poor design or failure of control measures are substantial.

**Implementation of potable reuse**

Careful attention needs to be paid by authorities to ensure the consistent supply of safe drinking water from all drinking water schemes, including from potable reuse, noted the WHO in its new publication. This includes the need for water safety plans, monitoring, management and communication.

The guidance document notes that a key to successful implementation of potable reuse is planned and targeted public engagement to build acceptance, confidence and trust. Critical steps in the process are agreement that drinking water supplies require augmentation with new water sources and, that after consideration of plausible alternatives, potable reuse is the preferred and accepted choice.

There have been examples where potable reuse scheme have not proceeded due to public opposition. There is also evidence that public acceptance can be achieved, with the support of successful engagement programmes leading to schemes proceeding.


To access the publication, *Potable reuse. Guidance for producing safe drinking water*, Visit: http://bit.ly/2vKOzSg

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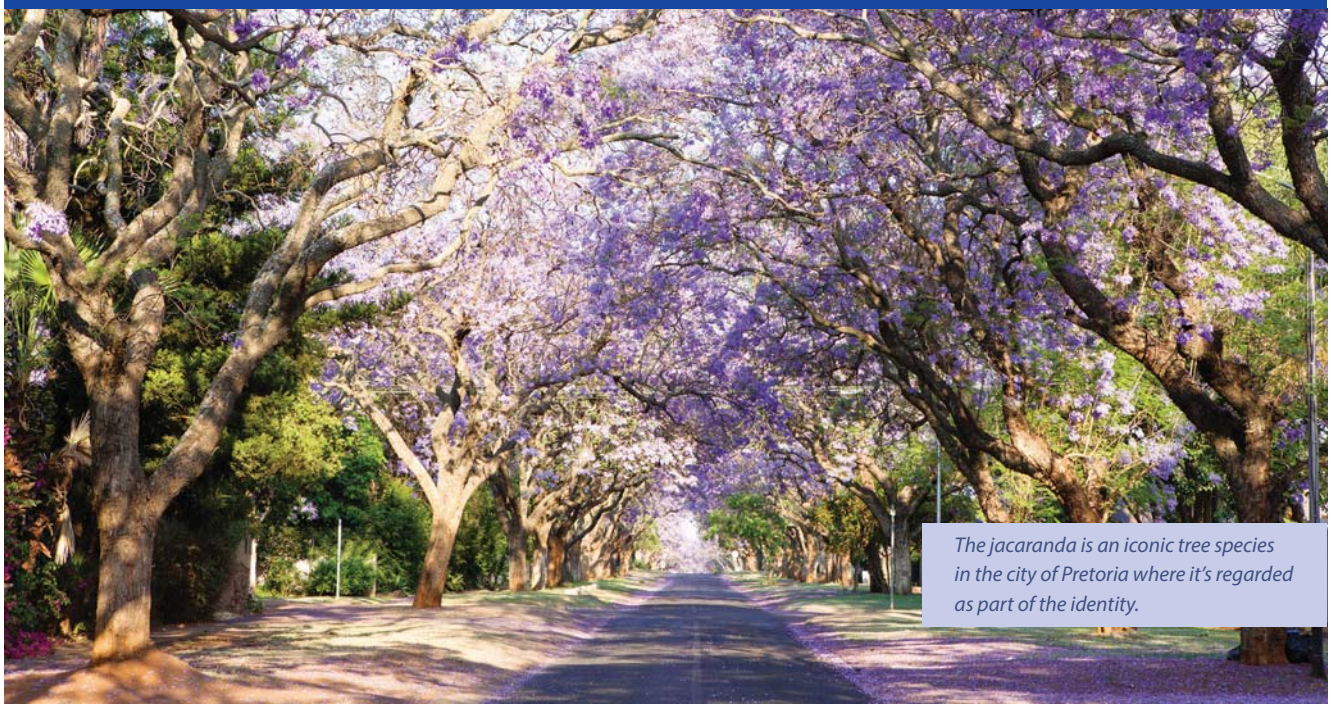
# INVASIVE ALIEN SPECIES

## South Africa should sort out the bad from the really bad on its invasive species list

*Are all alien invasive species equal? Tsungai Zengeya explores the difference between harmful and beneficial alien invasive species in this article, originally published by The Conversation Africa.*



*The jacaranda is an iconic tree species in the city of Pretoria where it's regarded as part of the identity.*

Alien species have been introduced to Africa for a variety of reasons. They provide food, raw materials for industry, ornamental plants, recreation in the form of sport fishing, hunting and pets. Some that are highly valued have been moved around widely. And in some areas they now form prominent components of societies and ecosystems, like the domestic cat, for example.

Many alien species bring considerable benefits. But some have become invasive, causing a loss of biodiversity, changes to ecosystems, economic losses and, in some cases, even affecting people's health.

The shrub Prosopis or mesquite is an example. It was introduced to South Africa to provide fodder, firewood and shade in arid parts of the country. But it's also a major water user. And two trout species (*S. trutta and O. mykiss*) are used for recreational angling and commercial aquaculture. But they've also been implicated in having a negative effect on the environment.

Managing invasive species is therefore critical. In South Africa the movement and use of 552 listed invasive species are managed under the Biodiversity Act and regulations attached to it. But not all the species on the list are equally harmful. Several may in fact be relatively harmless.

All the listed species under these regulations require management. Given that the capacity is limited, regulations should arguably focus on priority species because not all are necessarily harmful to the extent that would justify spending large amounts of time and effort on keeping them under control.

The question then is: are there some species that could be

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removed from the list? In a recent study by the South African National Biodiversity Institute we set out to answer this question by classifying species as inconsequential, beneficial, destructive or conflict generating species. This was done by assessing the relative degree of benefit they brought and their negative effects.

**Beneficial and harmful species**

The classification was done by using a simple scoring system. It had two categories for the negatives (ecological and socio-economic) and two for the benefits (economic and intrinsic).

**Inconsequential species**: these make up 55% of the species listed under the act and in the regulations. They were associated with relatively low costs and low benefits to society. Species in this group had limited distribution or no known impact and were largely introduced as ornamentals or pets. Some examples include the eastern grey squirrel (*Sciurus carolinensis*), European perch (*Perca fluviatilis*), and the Père David's Deer (*Elaphurus davidianus*).

Destructive species: these make up 29% of the list. They don't bring substantial benefits to society or the environment, but they have a highly negative impact. Many were introduced accidentally and are regarded largely as pests and weeds. Examples include invasive rodents like the black rat (*Rattus rattus*) which causes damage to infrastructure and transmission of zoonotic diseases and pitch canker (*Fusarium circinatum*) a growing threat to pine plantations and forests worldwide.

**Beneficial species**: they make up 10% of the list and have clear social or environmental benefits. For example the jacaranda (*Jacaranda mimosifolia*) is an iconic tree species in the city of Pretoria where the species is regarded as part of the identity and "sense of place" of the city. Active management is not necessary or should only be done in particular cases.

**Conflict-generating organisms**: these can be either beneficial or destructive, depending on one's perspective or what value is placed on them. They make up only 6% of the list. There's huge disagreement about whether these species should be controlled, or how they should be controlled. Examples include woody plants introduced for forestry, erosion control, sand dune stabilisation, agriculture and as ornamentals. Acacias and pines are examples.

Animal examples include species like the Himalayan tahr which was introduced to the Table Mountain National Park. The goat has been the focus of eradication attempts, despite strong opposition. It also includes species introduced for aquaculture like maroon and brown trout. Managing trout has been highly contentious, with conflicting views about whether they pose a risk, or deliver a benefit. This has led to them being listed and delisted. The trout fraternity refuse to acknowledge that trout are invasive species and highlight the lack of scientific evidence of the risks they pose.

**Finding common ground**

We need to keep sight of the fact that there is general agreement on 94% of listed species. By identifying the small number that are generating the greatest tension, it's more likely discussions can be held to reach common ground on regulation. Most countries in Africa don't have invasive species regulations. But there's growing recognition that they're needed. South Africa offers useful lessons on how this could be done.

The control of species listed under the country's biodiversity act is compulsory. This means that plans to manage them have to be drawn up and implemented. But this doesn't seem sensible given that not all are equally harmful and resources are limited. Our study suggests that some of the species currently regulated could be removed from the list.

Countries wanting to set up a system of managing invasive species could start by classifying a prospective list of candidates. Policymakers could then quickly bring out legislation against the most damaging and destructive ones. At the same time, discussions could be had on the ones that generate conflict with the aim of reaching consensus.

This would allow managers and regulators to focus on the most destructive species – as well as those that are at the centre of fierce disagreement.

*Managing trout is a contentious issue with conflicting views about whether they pose a risk or are beneficial.*

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# Water KIDZ

## Stop food waste in its tracks

*Have your eyes ever been bigger than your stomach? You know, where you heap too much food on your plate and don't end up eating it all? It seems the world has the same problem – and it is leading to a whole lot of waste not only of food, but of the water used to grow it as well.*

Across the world, about a third of all food produced for people gets wasted – that's like buying ten bags of shopping at the supermarket and popping three bags in the bin as you leave the shop. Or asking your mom for three sausages and leaving one on your plate untouched. What a waste!

This massive food waste is occurring despite the fact that there are at least one billion people who don't have access to enough food at all. But it is a problem that we have to address. With every morsel of food that is wasted, we also waste the energy, water and other resources required to produce that food.

The WWF estimates that in South Africa, ten million tons of food go to waste every year. This accounts for a third of the food produced in the country every year. Together, fruits, vegetables and cereals account for 70% of the wastage and loss. In South Africa, this wastage and loss occurs mainly in the food supply chain. Food waste may be higher in lower income households compared to higher income households due to their lack of refrigeration facilities or improper storage of food.

South Africa is a water scarce country. Throwing away food also means throwing away the water required to grow it. The water that is loss along with wasted food would fill over 600 000 Olympic swimming pools. Given that farming consumes 62% of total freshwater used in South Africa, this is a huge waste of scarce water resources in a country that is semi-arid.

About 90% of waste in South Africa is disposed of in landfills. This leads to the production of methane gas and carbon dioxide. Methane is a potent greenhouse gas that contributes to climate change.

Food waste is becoming a more important item on the government's agenda – the South African government is a signatory to the United Nations' Sustainable Development Goals, of which target 12.3 sets a target to reduce food waste by 50% by 2030.

In South Africa, most food waste occurs in the food-supply chain – before it reaches the consumer –during the transportation, storage, handling or processing step. That doesn't mean there aren't actions you can take to reduce your own food waste. Every person can help to eliminate food waste.

What can you do? First of all, help your family not to buy more than you need. The shopping list should become the family's new best friend. By cutting back on buying food, you will not

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only avoid waste but save some money too! Unless you are sure you are going to use it, stay away from 'buy one get one free' offers. Why not donate the excess food to a charity?

Learn the difference between the 'sell by' date and the 'use by' or expiration date. A sell by date is set by manufacturers that produce food (such as milk, for example) with a thought of how much time the consumer has to enjoy the best taste of the produce after buying it. A use by date is more important. This date tells you the recommended time by which the product you bought is safe to consume.

Fruits such as apples, last up to two weeks longer if you keep them in the fridge. If they've had a knock you can try putting them in a pie, crumble or smoothie. See that overripe banana? That can be turned into a smoothie as well. And while we're talking about fruit, why the obsession with 'perfect' fruits and vegetables? Just because that carrot has a funny shape, doesn't mean it is not tasty.

*Sources:*
*WWF, Food loss and waste: facts and figures (http://bit.ly/2eJLkWW)*
*FAO, Food waste footprint (https://www.youtube.com/watch?v=IoCVrkcaH6Q)*
*www.saynotofoodwaste.org*
*www.usethefood.com*

*Move older produce to the front of the fridge.*

All of us are left with, well, leftovers from time to time. Some leftovers (such as soup) can be frozen and used at another time. If you have a green thumb and keep a small garden in the backyard, the organic leftovers can be composted and used as fertilizer. Another idea is becoming creative with your leftovers and turning them into something more delicious (mmm, rice pudding, banana bread, spinach and feta muffins!)

Our refrigerators and cupboards have become graveyards for our food. We buy and buy and buy, then store it all away and forget what we bought in the first place. An easy way to address this is to remind yourself to put the new arrivals at the back of the fridge, and push the older ones to the front.

*Don't throw away overripe bananas. They make delicious smoothies.*

*Don't let your eyes dictate what goes on your plate – plate up just enough.*

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# LIMPOPO RIVER WARRIOR AWARDED ORDER OF THE BAOBAB

On 28 April 2017, President Jacob Zuma bestowed the 2017 National Orders on distinguished local citizens and eminent foreign nationals who have played a momentous role in building a free democratic South Africa and who also have made a significant impact on improving the lives of South Africans in various ways. The ceremony took place at the Sefako Makgatho Presidential Guest House in Pretoria and honoured Ms Pfarelo Rebecca for her outstanding contribution towards improving river health in her village in Limpopo.

The Order of the Baobab bestowed on Ramugondo recognises South African citizens who have contributed to community service, business and economy, science, medicine and technological innovation.

*Rebecca Pfarelo Ramugondo with President Jacob Zuma.*

When our rivers are used as dumping sites, many people sit and watch while others prefer to act on this as they know water is a scarce resource. For some of our communities, local streams are their only source of drinking water. Ramulongo could not tolerate the continuous degrading of water quality of streams in her village.

Ramulongo is a true community builder. The 42-year-old hails from Ingenane Yak Ha-Manhole. She started a project to clean local rivers and streams after they were turned into dumping areas. The rivers they worked on were the only source of water for local communities. Ramulongo formed a group of young men and women to clean rivers and streams, called 'Tshikofokofo Adopt a River Project' with the aim of providing potable water. "I started this project on 3 August 2010 with the aim of protecting water resources and the surrounding environment. I did this to avoid health problems, as domestic water should be free from harmful pathogens, chemicals and foreign objects," confirms Ramugondo.

In her village, there is no clean piped water supply and villagers rely mostly on unprotected springs. Ramugondo's objective was to conserve and protect water resources from pollution to ensure sustainable food security and human health in the surrounding areas of Ha-Makhuvha village.

"The project started with 100 people, 87 women and 13 men, mainly students from FET colleges. Many dropped out because of a lack of funds. However, they received support from the Department of Water and Sanitation, who trained them in waste management and firefighting. Vhembe District Municipality also helped them by collecting the garbage they collected from the river," says Ramugondo. She is one of those people who could not sit and watch the quality of water degrading in her village of Ngwenani Ya Ha-Mapholi in Limpopo.

This project has also encouraged other communities to start a similar project in areas such as Dwerani, Tshirole, Matangari, Tshidzivhe, Sheshe, Makonde, Mukula, Malavuwe, Luvuvhu and others.

The Baobab award is not the only recognition Ramulongo has received; it comes after three other awards from national, provincial and local government levels. Ramugondo says, "Our biggest concern now is people who continue polluting rivers and streams, because they think that we are being paid for doing this job."

At a special event, held on 22 August, Ma Ramugondo was given a special award by the Water Research Commission, in association with the Energy and Water Education and Training Authority. The award is a token of acknowledgement and appreciation for her contribution to the well-being of rivers in South Africa.

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# 14TH INTERNATIONAL WATER ASSOCIATION (IWA) SPECIALIST CONFERENCE ON WATERSHED AND RIVER BASIN MANAGEMENT

to be held 9 – 11 October 2017,
in the beautiful Skukuza Camp, Kruger National Park, South Africa.

## ABOUT THE CONFERENCE

The conference will be hosted by the IWA Watershed and River Basin Management Specialist Group, in partnership with the Water Institute for Southern Africa (WISA) and IWA-South Africa (IWA-SA), and will address cutting edge issues related to sustainable watershed management, with a special focus on emerging issues related to climate change.

## PAYMENT DEADLINE

**16 June 2017:** Early Registration (including speakers & accommodation)

**1 August 2017:** Normal Registration (after this date, no accommodation will be available at Skukuza camp)

Please also keep these deadlines in mind when paying through your employer and with a purchase order.

## HIGHLIGHTS

Excellent programme - a diverse programme comprising of various sessions related to watershed and river basin management ranging from technical approaches and assessment tools for improving water resource management, to the water-energy-food nexus, to lessons learned in the South African context. Sessions comprise of a balance between local and international presentations as well as natural and social sciences. Additionally, a fourth parallel session provides the opportunity for topic-specific workshops.

World renowned keynote speakers - Leading international practitioners and academics such as **Professor Aaron Wolf** (transboundary water conflict and cooperation specialist and professor of geography at Oregon State University), and **Dr Brian D'Arcy** (biologist and catchment planning specialist and one of the leading people in the UK encouraging rural BMPs, and developing the Sustainable Urban Drainage Systems philosophy and approach)

Technical tours - a selection of highly relevant and context-specific technical tours are arranged such as the Sabie River and catchment tour, and the Inyaka Dam and Catchment Tour.

Fun social programme - seeing as this is a destination conference, the conference provides the opportunity to immerse yourself in the South African bushveld, from bush braais, to evening safaris and not forgetting local entertainment.

**For registration categories and costs go to ww.rbm2017.com/index.php/registration**

## CONTACT DETAILS

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**VISIT:**
**www.rbm2017.com**

# DEEPLY ROOTED IN SOUTH AFRICA WATER SOCIETY

www.wrc.org.za

The Water Research Commission not only endeavours to ensure that its commissioned research remains real and relevant to the country's water scene, but that the knowledge generated from this research contributes positively to uplifting South African communities, reducing inequality and growing our economy while safeguarding our natural resources. The WRC supports sustainable development through research funding, knowledge creation and dissemination.

The knowledge generated by the WRC generates new products and services for economic development, it informs policy and decision making, it provides sustainable development solutions, it contributes to transformation and redress, it empowers communities and it leads various dialogues in the water and science sectors.

The WRC Vision is to have highly informed water decision-making through science and technology at all levels, in all stakeholder groups, in innovative water solutions through research and development for South Africa, Africa and the world.

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WATER RESEARCH COMMISSION

THE POWER OF KNOWLEDGE TO THE PEOPLE