THE WATER WHEEL

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WATER LEGISLATION

Reflecting on 25 years of the National Water Act of – what has been achieved?

WATER AND AGRICULTURE

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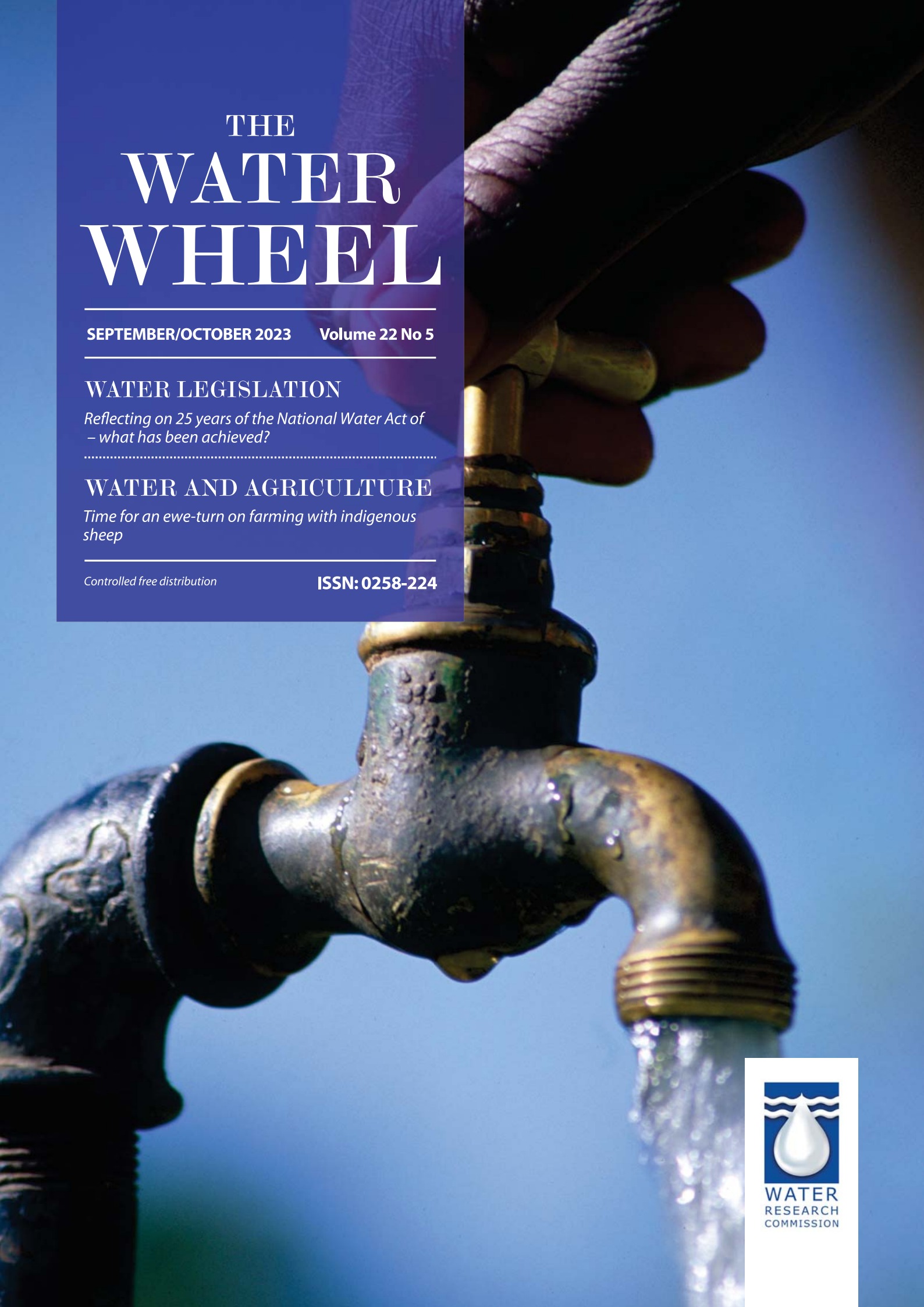

WATER RESEARCH COMMISSION

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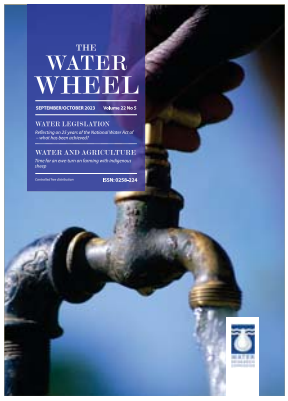
Editorial Committee:
Dr Sylvester Mpandeli (Chair), Ms Manjusha Sunil, Mr Bonani Madikizela, Dr Mamohloding Tlhagale and Sudhir Pillay.

Editorial offices:
Water Research Commission, Private Bag X03, Gezina, 0031, Republic of South Africa.
Tel (012) 761 9300.
WRC Internet address:
http://www.wrc.org.za
Follow us on Twitter:
@WaterWheelmag
Editor: Lani van Vuuren,
E-mail: laniv@wrc.org.za;
Editorial Secretary: Dikeledi Molutsi,
E-mail: dikeledidk@wrc.org.za;
Layout: Anja van der Merwe,
E-mail: anjavdm@wrc.org.za



Twenty-five years after the enactment of the National Water Act we reflect on what has been achieved and the hard work still ahead. See story on page 10.

NEWS

Biodiversity of natural forests key to buffer severity of non-native tree invasions

A new published study has found that the native biodiversity of natural forests largely buffers the severity of non-native tree invasions.

The bad news, however, is that humans remain mostly responsible for introducing non-native tree species to an area in the first place – either intentionally or accidentally. These are two of the key findings from a global study to determine the relative importance of human activity, environmental conditions, and biological diversity as drivers of tree invasions worldwide. The study, titled 'Native diversity buffers against severity of non-native tree invasions' was published in the journal Nature on Wednesday, 23 August 2023.

Prof Cang Hui, holder of the South African research chair in mathematical and theoretical physical biosciences at Stellenbosch University (SU), and one of the co-authors on the study as part of the Global Forest Biodiversity Initiative (GFBI), says trees are exposed to a wide range of ecological and human factors, and tree invasions are both drivers and passengers of global environmental changes. This is because of their size, long life span and important role in forestry, foraging, city landscaping and reforestation, as well as carbon sequestration and climate regulation. Yet invasion biologists have long been struggling to identify the ecological mechanisms driving the invasion success of a small portion of non-native tree species.

Their findings support the biotic resistance hypothesis, which holds that greater diversity in the native community will fill the ecological niches and reduce available resources, thereby limiting non-native species to take up niche spaces. The prominent role of human activities, however, came as a surprise: "Our findings suggest that human activity may overwhelm ecological drivers of invasions and even reduce the influence of ecological processes," he warns.

Repeated human introductions of plant species, especially close to ports and airports, play an important role in the initial introduction process. The severity of the invasion, however, is predominantly a result of the intrinsic diversity of the native community.

It is therefore important to conserve natural forests to maintain high native tree diversity, they write in the paper. Furthermore, because many tree species are introduced purposefully for forestry or to support local livelihoods, they recommend that local stakeholders are included when making decisions about how best to benefit from these managed forests.

To access the study, Visit: https://www.nature.com/articles/s41586-023-06440-7

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New water tribunal appointed

Water and Sanitation Minister Senzo Mchunu has welcomed the newly appointed members of the Water Tribunal, a structure set to hear water-related appeals against the department or any responsible authority in line with the National Water Act.

The Water Tribunal is an independent body established in terms of Section 146(1) of the National Water Act (Act no. 36 of 1998) as amended, and members are appointed on a four-year term. The Act provides for the Minister of Water and Sanitation to establish the tribunal to preside on appeals against the decisions taken regarding declining of water use licence applications, adverse decisions on transfers of water use rights or during the processing of water use authorisations applications, directives issued, as well as claims by a catchment management agency for the recovery of costs.

The newly appointed tribunal is composed of nine members. The members are: Advocate Puseletso Loselo (Chairperson), Unathi Mbeki (Deputy Chairperson), Advocate Nomusa Lekgetho, Rainy Disebo Mashitisho, Maxwell Sirenya, Khuliso Mudau, Peter-John Veldhuizen, Lahlane Malema and Emmanual Mpanza.

According to Mchunu, the appointment of the Water Tribunal completed the institutional arrangement needed for the water sector to thrive. "As you start your four-year term and execute your role, I would like to implore you to be conscious, sensitive and considerate of the role you will be playing in a developmental state this country is."

SA working to accelerate water and sanitation access by 2030

South Africa is working to expedite the realisation of Sustainable Development Goal 6 by 2030, paying special attention to the needs of women, girls and people in vulnerable situations. So said Water and Sanitation Deputy Minister, Judith Tshabalala.

She was participating in the Africa Focus Session held during World Water Week in Stockholm, Sweden, in August. United Nations SDG 6 seeks to ensure safe drinking water and sanitation for all, focusing on the sustainable management of water resources, wastewater and ecosystems. The Africa Focus Session was aimed at fostering partnerships for translating water and sanitation commitments into tangible improvements in the lives of all in Africa and beyond. The outcomes of deliberations will inform ongoing efforts to accelerate the achievement of water and sanitation goals in Africa.

According to Tshabalala, the Department of Water and Sanitation (DWS) manages water resources in a balanced manner to ensure sustainability and economic growth in the country. "Our water resources determine how South Africa experiences and responds to climate change. The climate challenge has brought innovative approaches to water services, such as looking at water infrastructure and sources from a multiple water use perspective.

"The recent water shortages [in the country] attributed to climate change, saw innovation through partnerships and the use of technology to optimise the use of available water resources and access to new water sources."

WATER DIARY

Non-sewered sanitation
10-15 October
The first IWA Non-sewered Sanitation (NSS) conference will be held in Johannesburg. The event, which is being held in partnership with the Water Research Commission, aims to provide stimulus for research an innovation for NSS and off-grid sanitation solutions including faecal sludge management, build the technical and scientific base for NSS and to contribute to scientific knowledge and good practice learnings.
Visit: https://iwa-network.org/events/the-1st-iwa-non-sewered-sanitation/

Wetlands
23-26 October
The annual National Wetlands Indaba will be held in the North-West Province. The theme for this year's indaba is 'It's time for wetland restoration'.
Visit: https://nwi26.org

Municipal engineering
25-27 October
The annual conference of the Institute of Municipal Engineering of Southern Africa will be held in Port Elizabeth.
Visit: https://www.imesa.org.za/

Irrigation
1-8 November
The 25th International Congress of the International Commission on Irrigation and Drainage (ICID) will be held in Visakhpatnam, India. This congress is one of the longest running flagship events exclusively devoted to irrigation technologies and agricultural water management.
Visit: https://congress.icidevents.org

Water and development
10-14 December
The IWA Water and Development Congress and Exhibition will be held in Kigali, Rwanda. The event is described as a forum for showcasing new science, technology and practical solutions across the entire water cycle that work at scale in low- and middle-income countries.
Visit: https://waterdevelopmentcongress.org/

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GLOBAL

Climate monitoring upgrades needed 'urgently' in Africa

Damage and deaths caused by climate-related disasters across Africa will balloon if the continent's so-called 'hydromet' infrastructure for monitoring weather and water is not urgently upgraded, scientists warn.

The climate crisis is increasing the frequency and intensity of floods, droughts and heatwaves, with Africa expected to be among the regions hardest hit, according to a team of risk experts and climatologists, writing in the journal Nature. Over the last two decades, the average number of deaths caused by flooding events in Africa was four times higher than the European and North American average per flood, observed the experts working under the auspices of the University of Cambridge, UK. They say this is down to a lack of preparedness and warning systems.

Systems and technologies across the continent that monitor and forecast weather events and changes to water levels are "missing, outmoded or malfunctioning", leaving African populations even more vulnerable to climate change, the researchers say.

Lead author, Asaf Tzachor, a researcher at Cambridge University's Centre for the Study of Existential Risk, said the implications for Africa's population and economies were catastrophic. "We expect damages and [the] death toll to swell," he noted.

World Meteorological Organisation data highlighted in the study showed that the entire continent only has 37 radar stations (compared to US and Europe's 635). "We found additional disparities in weather forecasting and nowcasting capabilities, as well as poor early warning systems across the continent," said Tzachor.

Localised early warning systems, improved satellite monitoring and training for African meteorologists are hugely important for weather prediction and disaster mitigation across Africa, according to Joab Odhiambo, senior lecturer in the Department of Mathematics at Meru University of Science and Technology in Kenya. "Tailoring warnings to specific regions ensures that the information is relevant and actionable, helping communities understand and respond effectively to imminent threats like floods or droughts. By fostering community engagement, these localised systems enable people to take preventive measures, thereby reducing [the] potential impact of disasters," he added.

The Cambridge University researchers recommend investment in state-of-the-art weather surveillance radars, alongside investments in advanced satellite with microwave sounders to measure moisture in the atmosphere and precipitation rates. "We recommend developing real-time weather simulation and computer modelling, called numerical weather prediction, across all African national meteorological and hydrological services," said Tzachor. "Computational forecasting is critical to pick up extreme weather with [hyperlocal] details—essential when it comes to tracking unfolding climate hazards, such as storm surges and floods."

Source: Scidev.net

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More than half of Earth's species live in the soil, study finds

More than half of all species live in the soil, according to a study that has found it is the single most species-rich habitat on Earth.

Soil was known to hold a wealth of life, but this new figure doubles what scientists estimated in 2006, when they suggested 25% of life was soil-based. The paper, published in the journal ***Proceedings of the National Academy of Sciences***, and reported on in ***The Guardian***, found it is home to 90% of fungi, 85% of plants and more than 50% of bacteria. At 3%, mammals are the group least associated with soils. "Here, we show that soil is likely home to 59% of life including everything from microbes to animals, making it the singular most biodiverse habitat on Earth," write the researchers. Before this study, scientists didn't know what the most species-rich habitat was, says lead researcher, Dr Mark Anthony, an ecologist at the Swiss Federal Research Institute for Forest, Snow and Landscape Research. "In my research circle, many suspected it should be soil but there was no evidence."

He adds; "Organisms in soil play an outweighed impact on the balance of our planet. Their biodiversity matters because soil life affects climate change feedbacks, global food security, and even human health."

To access the original article, visit: https://www.pnas.org/doi/10.1073/pnas.2304663120

Microplastics infiltrate all systems of body, cause behavioural changes

Plastics – in particular, microplastics – are among the most pervasive pollutants on the planet, finding their way into the air, water systems and food chains around the world. While the prevalence of microplastics in the environment is well known, as are their negative impacts on marine organisms, few studies have examined the potential health impacts on mammals, prompting University of Rhode Island Professor Jaime Ross'new study.

Ross and her team focused on neurobehavioural effects and inflammatory response to exposure to microplastics, as well as the accumulation of microplastics in tissues, including the brain. They have found that the infiltration of microplastics was as widespread in the body as it is in the environment, leading to behavioural changes, especially in older test subjects. "Current research suggests that these microplastics are transported throughout the environment and can accumulate in human tissues; however, research on the health effects of microplastics, especially in mammals, is still very limited," said Ross, an assistant professor of biomedical and pharmaceutical sciences at the Ryan Institute for Neuroscience and the College of Pharmacy. "This has led our group to explore the biological and cognitive consequences of exposure to microplastics."

Ross' team, which includes Research Assistant Professor Giuseppe Coppotelli, biomedical and pharmaceutical sciences graduate student Lauren Gaspar, and Interdisciplinary Neuroscience Program graduate student Sydney Bartman, exposed young and old mice to varying levels of microplastics in drinking water over the course of three weeks. They found that microplastic exposure induces both behavioural changes and alterations in immune markers in liver and brain tissues. The study mice began to move and behave peculiarly, exhibiting behaviours akin to dementia in humans. The results were even more profound in older animals.

The study was published in the *International Journal of Molecular Science*.

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NEW WRC REPORTS

Production guideline for African leafy vegetable cultivation in the Capricorn and Vhembe districts in Limpopo

This guideline was made possible by the Water Research Commission (WRC) in collaboration with the Agricultural Research Council on adopting small-scale irrigation farming as a climate-smart agriculture practice through vegetable production systems in Limpopo. The guideline focuses on the practical application of problem-solving strategies in agricultural practices for smallholder farmers in the Capricorn and Vhembe district in Limpopo. This included on-farm activities in informal training talks on seedling production, irrigation installations and utilisation of chameleon irrigation sensors. This included discussions and demonstrations on the principles, processes and methods, and other aspects of mulching. During the regular monitoring visits, smallholder farmers were assisted in planting and applying fertilizers on their farm plots. This guideline summarises progress in human capacity development through school engagement and on-site training to transfer skills to the communities. This guideline argues that accelerating technology transfer to a farming community, including cultivation of indigenous or indigenised crops, climate-smart technologies are a viable option and that provided resources (e.g. agricultural inputs) can increase agricultural production.

WRC report no. TT 914/23
Web link: https://bit.ly/3qMv4tl

Approaches to monitor and characterise the biological stability of drinking water distribution networks

Water utilities use various treatment strategies to ensure that the production of water will not pose a significant health risk to consumers. Where the original focus was on predicting potential changes by controlling parameters such as assimilable organic carbon (AOC) and disinfection residuals, the focus has shifted to the direct assessment of changes in the microbial community within the distribution network using methods such as 16S community profiling, flow cytometry (FCM) and ATP measurements. Most water utilities in South Africa use heterotrophic plate counts (HPC) to monitor the general microbial quality of treated drinking water and to assess the biostability within the distribution network. The superiority of FCM over HPC has been demonstrated in numerous studies. These studies have shown that FCM is fast (results within 15 min), accurate and reproducible and can even be automated. It has been shown to be the most promising method for the direct assessment of changes in microbial communities in drinking water networks. The objective of the project was to provide the necessary foundation for the development of a strategy for the drinking water industry to incorporate FCM when monitoring and managing the biostability of drinking water during distribution as this is a more sensitive and rapid method compared to the HPC currently used. The research is presented in three volumes.

WRC report no. 2884/1-3/23
Web link Volume 1: https://bit.ly/45QGPOp
Web link Volume 2: https://bit.ly/3L27os2
Web link Volume 3: https://bit.ly/3L0dYze

Tracking the evolution of Sars-Cov-2 and the emergence of other infectious diseases in communities using a wastewater-based epidemiology approach

Wastewater-based epidemiology (WBE) is an eloquent alternative in SARS-CoV-2 surveillance and allows for the early detection of SARS-CoV-2. This enables a rapid and consolidated response to curb infection rates and save lives. The use of metagenomic next generation sequencing in wastewater-based epidemiology is well documented. This method has recently demonstrated the ability to recover complete or near complete SARS-CoV-2 genomes from sewage. In this project a next-generation sequencing approach was implemented to assign SARS-CoV-2 lineages in wastewater samples, detect co-occurring pathogens and identify antimicrobial resistance profiles. The next-generation sequencing protocol was divided into an untargeted and targeted approach. The untargeted or metagenomic approach was used to taxonomically categorise wastewater samples and detect the presence and mode of antimicrobial resistance elements. The targeted approach was implemented to amplify the SARSCoV-2 genome in a wastewater sample and perform whole genome sequencing on the resulting amplicons. This information was then used to assign SARS-CoV-2 lineages per sample.

WRC report 3065/1/23
Web link: https://bit.ly/3Pk5LIK

Development and testing of an isothermal amplification and lateral flow assay to detect selected pathogens in water

Sustainable living and One Health principles demand increased surveillance of our environment to ensure a healthy environment, animals, and humans. The use of water resources of variable quality for human and agriculture needs necessitates improved, more sensitive, rapid detection of potential viable and pathogenic microbes in water. While microbial culturing remains the gold standard for diagnostic monitoring of water, molecular detection of pathogens combined with proof of viability of detected microbes are gaining ground to do diagnostic surveillance, especially to detect microbes not routinely tested for. This project was aimed at developing a rapid detection method for selected bacterial pathogens using a combination of isothermal polymerase chain reaction (PCR) method and detection of PCR products using lateral flow. The following were the aims of the project: 1. To develop an isothermal PCR method and detect amplicons using a lateral flow device, 2. To test the optimised method using real world samples, namely various types of water (environmental, tap, treated sewage and reclaimed water).

WRC report no. 3088/1/23
Web link: https://bit.ly/47S9rJ0

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Climate-smart irrigation: Development of a framework for conjunctive groundwater and surface water use for solar-driven smallholder irrigated agriculture

Africa is vulnerable to climate change due to its dependence on rain-fed agriculture and low adaptation capacity. Climate change will likely increase the frequency of droughts and flooding. Aquifer Storage and Recovery (ASR), the purposeful recharge of the aquifer when there is excess water during wet or flooding periods for subsequent abstraction during dry or drought periods has been used for a long time to bridge the gap in seasonal water availability. Bhungroo Irrigation Technology (BIT) is one of the ASR techniques that has been successfully tested in India and Ghana for increasing water availability in the dry season by recharging the aquifer during the wet season. The overall aim was to develop a framework for sustainable conjunctive use of groundwater and surface water using renewable energy in smallholder irrigation schemes in South Africa.

WRC report no. 3085/1/23
Web link: https://bit.ly/3qVPhxe

Designing viable strategies and financing mechanisms for securing hydrological ecosystem services in South Africa: A review, investigation and decision support framework

In general, it has been recognised that addressing ecosystem degradation at scale requires significant financial investment but that such investment also needs to be smarter to yield a higher return on investment. There has been considerable interest in South Africa in finding successful models for financing conservation activities or "nature-based solutions" that improve water security. However, the value and scale of investment into catchment conservation and restoration has been small compared to what is required. Understanding more about implementation and financing options can have important, far-reaching impacts on conserving the health of South Africa's catchments, addressing land degradation neutrality, and protecting water security in the long-term through cost-effective, sustainable approaches. This project seeks to provide strategic guidance for future initiatives to secure hydrological ecosystem services in South Africa, based on an improved understanding of the potential opportunity and viable approaches for investing in hydrological ecosystem services.

WRC report no. 3089/1/23
Web link: https://bit.ly/3QZtZt2

Evaluation of selected targets indicators and reporting methodologies for SDG 6

South Africa is one of 193 countries that are signatories to the Sustainable Development Goal 2030 Agenda, which includes the commitment to achieve SDG 6: Clean Water and Sanitation. The Department of Water and Sanitation (DWS) is mandated to be responsible for the management of SDG 6 which aims to ensure clean water and sanitation for all by 2030. In adopting the goal, the DWS adopted existing indicators (UN Millennium Development Goals), domesticated new indicators, and defined additional indicators (where necessary). Some of the SDG 6 targets and indicators are well established (those carried over from the UN Millennium Development Goals in 2000), while others are less established (those introduced with the adoption of the SDGs or in the years following adoption). At a global level, specialists in various international agencies developed methodologies for all the SDG targets and their indicators, first released in May 2017 and subsequently updated in 2018. At a national level, countries were encouraged to domesticate the methods and to set relevant targets to their context and resources, while maintaining consistency with the targets set out in the SDGs. The project sought to improve our understanding of the context and status quo of SDG 6 in South Africa through the identification of areas for improvement in relation to measurement and monitoring of the SDG 6 indicators in South Africa. The project outcome is for meaningful and pragmatic tracking of South Africa's progress on SDG 6 indicators, to achieve positive progress towards sustainable water resource management in South Africa.

WRC report no. 3090/1/23
Web link: https://bit.ly/45x6LyP

Development of an agricultural drought preparedness framework for South African croplands and grasslands

In recent decades, ample scientific and institutional efforts have been devoted to developing drought early warning systems (DEWS) worldwide. These systems, encompassing reliable weather and climate forecasts, are in use in many countries to assist in preparing for the upcoming season and mitigating climate risk. Farmers, pastoralists and land managers can thus use tailored seasonal forecasts to inform on-farm decisions. However, low adoption of scientific developments has been noted in many cases, the reasons for which centre around trust issues between scientists and end-users, interpretation – and thus relevance – of the information, and the dissemination platforms that are utilized. There is a need to advance on dissemination methods used during the COVID-19 pandemic on communication platforms such as Zoom, Microsoft Teams, SMSs, e-mail and media. This study aimed to develop an agricultural drought preparedness framework to improve operational capabilities of South Africa to cope with drought.

WRC report no. 2968/1/23
Web link: https://bit.ly/45V8JZT

To download any of these reports
click on the web link provided, email:
hendrickm@wrc.org.za or visit: www.wrc.org.za

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WATER LEGISLATION

Reflecting on 25 years of the National Water Act of – what has been achieved?

The renowned National Water Act of 1998 quietly celebrated its 25th anniversary this year. Long after the optimism of a new democratic South Africa faded, experts say realising its aspirations now lie in grinding, and persistently committed hard work. Article by Petro Kotzé.

The National Water Act of 1998 was promulgated 25 years ago, in that time of tremendous optimism and possibility of democratic South Africa. The changes were swift and the challenges were monumental. The 1997 Water Services Act and the National Water Act of 1998 were some of the first sectoral translations into law of the spirit of the new Constitution, expected to reverse the vast inequalities of more than three centuries of colonisation and apartheid.

Until then, water and land were tools to enforce privilege to the descendants of white settlers. Under colonial and apartheid regimes, whoever owned the land, owned the water, and, as a range of laws systematically dispossessed black people of their land over centuries, by the dawn of democracy, 1,2% of the population controlled 95% of the water used in rural areas, and the economic benefits that came with using it.

The new Acts had to undo all of that, and fast, to extend the benefits to all citizens of the land.

There have been great successes. Under the Water Services Act, the government has provided a minimum level of access to water supply infrastructure to 88% of households in South Africa, and at least basic sanitation services to 79% of the population (2019 figures).

The National Water Act is celebrated as one of the most progressive and visionary pieces of water legislation worldwide. Established on the principles of equity, sustainability and efficiency, it placed ownership of water in the hands of the people, held in trust by the state. The Reserve was established to set aside water to maintain the ecosystem and meet basic human needs, with other uses for economic development to be authorised through licensing. Water resources management

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would be decentralised to Catchment Management Agencies to improve participation, transparency, and accountability.

However, 25 years later, key aspects of the National Water Act remain unrealised. In general, water resources have generally degraded since the Act's promulgation and, partly as a result, the Reserve has been criticised as too complex, costly, and challenging to implement. Arguably more contentious is the progress with the reallocation of water for economic activities. Water use rights are still overwhelmingly vested with white, large-scale commercial water users, and Water Allocation Reform Strategy targets of 45% water allocated to black people by 2019 and 60% by 2024 remain woefully out of reach. Only two out of the six, planned CMAs are up and running.

"The fundamental issues remain," says John Dini, WRC Research Manager for Water Governance and as such, he adds, questioning the competence of the Act is pertinent. Yet, experts caution that changing the law will not fix all the problems.

How the Act came to be

It was never going to be easy, says aquatic ecologist Dr Tally Palmer, a co-editor and author of the Act. "There may have been things that could have been fine-tuned better, but, never underestimate the magnitude of the job itself."

While the Water Services Act was relatively uncontested, water use was, and remains, hugely controversial. Speaking at the 20-year anniversary of the National Water Act, civil engineer Len Abrams, a Special Advisor to then-Minister Kader Asmal, recalls that when they started to work on water access and ownership, the VIP protection services of the police visited them in the parliamentary offices in Cape Town. "The water services policy development process was fine – nobody was going to object to everybody getting drinking water but as soon as we started to mess with who owned water and who did not, as soon as we started to talk of breaking the sacred bond between land and water, there was the possibility that someone might get so incensed that they may attempt to harm the ministry."

"Land ownership was one of the most fundamental and contentious instruments of apartheid," Palmer says. At the time, lawmakers deemed it "too risky" to wait for land reform to affect water reform. Their other alternative was to take the administration of water away from land ownership through licensing. Both, she says, were hard alternatives, but the latter was at least possible to imagine.

The Act also recognised Existing Lawful Use, seen as a temporary measure at the time. ELU honours entitlement to water allocated before 1998, under the old, apartheid water law. These users could register their entitlement, instead of applying for a license, until compulsory licensing in a catchment would be introduced. It was envisaged as a reasonable mechanism that would incrementally be changed over a reasonable time, Palmer says.

The set of legal instruments appeared to provide the necessary enablers for the desired outcomes expressed in policy to be realised, but the reality played out very differently. "Hindsight tells us that the administrative load across government of shifting to equity from servicing a very few to servicing everyone was more than the administrative capacity of the country," Palmer says. "When you add that to the political requirements of transformation, it stretched capacity even further."

The licensing process proved to be complex, time-consuming, and expensive, resulting in significant backlogs of applications. As one consequence, the new users and those without existing permits in 1998 who had to formally apply for licenses, could not get them. The new Act thus gave, again, legal status to the unequal distribution of water rights enforced under the previous regime. Furthermore, in many catchments, all the water had already been fully allocated to existing users, with little left for allocation to new ones. As the delayed process to verify the extent and lawfulness of existing water use is still underway, ELU registrations continue to be made today, 25 years since it was created as a transitional measure.

"It is the actions at the individual level that need to change so that we change society. The hope is that there are enough people of vision and courage to keep walking."

Criticism of the Act has been that the roots of the continued inequality in the allocation of water were built into the law. But, says Palmer, "that was not the intention." Instead, she says, it was the shift from land ownership to administration that created the opportunity for unintended privilege. "Greedy people took advantage of the gap unfairly."

GuyStubbs/Independent photographers/African pictures

Since 1994, the government has provided a minimum level of access to water supply infrastructure to at least 88% of households in South Africa, and at least basic sanitation services to 79% of the population (2019 figures).

Others ask that the impact of the Act be analysed from a broader perspective. For one, though water and land rights have been legally split, in practice you cannot apply for water for productive use without access to land to use it on. Failure of water reallocation goes in hand with failures to redistribute land in South Africa. In fact, the persistence of the colonial and apartheid legacy in water use is reflected in the same persistence across all facets of South African society.

It has also been pointed out that legislation, regardless of its values, is not enough to ensure that fairness, equity and the restoration of rights and benefits are achieved. "I naively thought that people would see the logic of fairness," Palmer says, "and that they would comply voluntarily towards a healthier environment and looking after vulnerable people."

Abrams also asked for non-technical drivers, constraints, motivations, and incentives to be considered. These could include corruption and rent-seeking, political influences, hidden agendas, power relationships and historical legacies.

Others point to the fact that 25 years is a very short time period for change, in comparison to the centuries of distorted development that need to be corrected. "We underestimated how difficult it would be to bring about some of the changes that need to happen," Dini says but he adds that we certainly could have been further than we are now. State capture and the undermining and systematic hollowing-out of institutions to achieve certain objectives all rippled throughout South Africa, including the implementation of the National Water Act. Even more factors that have contributed include indecision, and high turnover rates in the political and administrative leadership of the department, among others.

GuyStubbs/Independent photographers/African pictures

Twenty-five years down the line much still needs to be done to transform land and water rights.

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Over 25 years of hindsight

Asked how they would, if they could review the Act, Dini points to opportunities to develop specific mechanisms for authorising water use by small-scale users that, for little cost to the user and administrative effort by the regulator, could enable the progressive realisation of access to water for productive purposes.

The Act is currently undergoing its first major overhaul since it came into effect. The South African National Water Policy Review process aims to address oversight and gaps in the current water policy, with specific emphasis on addressing water equity and redress (also refer to the sidebar, *The National Water Act goes to court*).

While there is no doubt that the current Act is not perfect and there are amendments needed, we must also be cautious of assuming that changing it will on its own bring about the changes we want to see in society, Dini says. Various reports have also cautioned against the temptation to rewrite the law to solve problems that arise from shortcomings in how it is implemented. Recognising first, the differences between the need to amend the Act and the challenges to its implementation and, second, accepting that elements of both are likely to be present simultaneously, will be key, he adds.

Instead, we need the same things that have long been called for, Palmer says, namely capacity and capability. Institutions must start working, individual sewage treatment works must meet Green Drop requirements and municipal infrastructure must be repaired and maintained. Working CMAs need to be established. She also calls for the big sectors to be held accountable. They are agriculture and forestry for water quantity; mining for water quality; and, the government for managing sewage works.

Palmer adds that, if she could do one thing, it would be to support and strengthen the pathways of governance between local government and catchment management agencies. "Practical hard engineering in municipalities must be linked to the way in which the catchment works."

A question of ethics

The Act asks for an ethical commitment to the principles of equity and sustainability, Palmer says. "It's a work in progress." On the ground, however, it needs the hard work necessary towards participatory governance and a healthy environment. "It's the determination to do the hard work that will change small things." Dini points to the DWS as an example, where current Minister, Senzo Mchunu, and Director General, Dr Sean Phillips, have been able to bring about stability and goal-orientated actions in the department. Their approach is perhaps what is necessary to realise the changes that the Water Act called for, he says. "It needs a level of ruthlessness."

There are too many stories of people for whom individual wealth is more important than that of society, Palmer says but for her, the Act still carries the aspiration of an equitable, sustainable, and efficient approach to water use. "It is the actions at the individual level that need to change so that we change society. The hope is that there are enough people of vision and courage to keep walking."

THE WATER ACT OF 1998 GOES TO COURT

Until 2018, the DWS allowed for the trading of a water use entitlement obtained in terms of the National Water Act to a third party. When it issued a circular that water use trading could not be transferred, litigation followed. In November 2021, the Constitutional Court ruled in favour of Lötter, Wiid and the South African Association for Water User Associations (SAAFWUA), and ruled that the circular contradicted the provisions of Section 25 of the National Water Act and that parties may indeed charge fees for transferring the rights. Then, in March 2023, the Supreme Court of Appeal dismissed with costs the subsequent appeal by the DWS.

In his ruling, Justice Mbuyiseli Madlanga sympathised with the intent of DWS and the Act to bring about transformation in water use but noted that the current letter of the law did not permit the department to ban the transfer of water use rights even if this undermined the desired transformation objectives.

The judge stated: "On the contrary, I understand why the state may now be seeking to redress the injustice brought about by this disproportionate enjoyment of water use entitlements. Indeed, one of the factors to be considered to ensure the achievement of the purpose of the Water Act is "redressing the results of past racial and gender discrimination". This attests to the reality of the racially skewed enjoyment of water use entitlements. Unfortunately, the existing legislative instrument does not admit of the redress; at least not in the manner contended for by the applicants in this matter."

This is a really good example of where the Act does need amendment in order to be able to do what it aims to do, and is precisely what DWS has done in the draft amendment currently working its way through the system.

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WATER SERVICES

Municipal water users losing faith in water services - study

A recently published report on user perceptions of water services in South Africa reveals some problem areas requiring attention. Article by Sue Matthews.

The confidence of urban South Africans in their drinking water has declined over the past several years, according to the Water Services Barometer Study 2022, a Water Research Commission (WRC) funded study undertaken in partnership with the South African Local Government Association (SALGA). Only 79% of people in Metros and other urban areas believe their tap water is safe or very safe to drink, compared to 88% in 2015, and this is reflected in their drinking water behaviour. Only 50% of urban consumers now drink tap water without boiling, filtering or cleaning it first, down from 70% in 2015, and the percentage who only drink bottled water has doubled to 8% – although the latter is largely related to people's standard of living.

Rural consumers are far less confident in their water supply, with only 64% believing their tap water is safe or very safe to drink, and 12% responding that they get water from a well or river rather than a tap. No deductions can be made about changes over time because the 2022 study was the first in the series to include rural consumers.

The initial study, conducted in 2011, focused only on urban consumers' perceptions of drinking water quality, while the second in 2015 was broadened to include their perceptions of municipal water and sanitation services. Apart from surveying rural consumers, the 2022 study included a revised and expanded Service Quality Index to assess consumers' experiences, as well as their perceptions about their municipality's effectiveness in implementing Free Basic Water,

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managing a water crisis and dealing effectively with non-payers, illegal connections and corruption. The 2022 study also added a Customer Satisfaction Index that measured consumers' satisfaction with water and sanitation services and tariffs.

For each of the three studies, the survey questions formed part of the NielsenIQ Omnibus syndicated survey, in which multiple clients 'buy space' on a national survey. The questions were developed by the WRC project team – led by Sarah Slabbert of BHI32, who compiled the study reports for the WRC – and were piloted by a group of postgraduate students supervised by Dr Josephine Letsoala from the University of Limpopo's Department of Geography and Environment Studies.

NielsenIQ's syndicated Omnibus Survey covers a scientifically drawn, representative sample of adults (15+ years) living in urban and rural areas nationwide. The 12 questions were asked in personal, computer-assisted interviews that were conducted in the homes of respondents, in the preferred language of the respondent.

The probability sample of 3 302 households was selected using Nielsen's computerised household register (more than 6 million actual addresses in urban areas) and from maps for rural sampling. The sample was stratified by race, by community size within region. The sample is post-weighted to reflect estimated population in 000's. Only the weighted data was analysed.

One of the trends highlighted in the report is the change in relative position of the Metros over time with respect to perceived quality of water. While it is not surprising that Nelson Mandela Bay ranked lowest for the last two surveys, given the ongoing water shortages in Gqeberha and surrounding areas served by the Algoa Water Supply System, the City of Cape Town's plummet from the highest ranking in 2015 to 6th position in 2022 is noteworthy. The City of Tshwane leapfrogged up the list to take the top spot, with 100% of consumers believing that their water is very safe or safe to drink.

The Department of Water and Sanitation's Blue Drop Progress Report 2022, released in March 2022, told a slightly different story. Of Tshwane's 11 drinking water supply systems, only seven achieved acceptable to excellent microbiological and chemical compliance, and both microbiological and chemical monitoring programmes were reported as not adequately aligned to SANS 241:2015 requirements. Cape Town, by contrast, was commended for its excellent compliance in terms of both water quality and monitoring.

"In 2015, 82% of consumers in Metros and other urban areas said that they seldom (less than once a month), or never, experienced interruptions in their water supply. In 2022, this figure dropped to 67%."

People interviewed for the Barometer Study did not generally base their perceptions of water safety on Blue Drop status though. Indeed, they were asked to give a reason for their rating, without being prompted for specific answers, and only 4% of consumers in Metros and other urban areas mentioned their municipality's Blue Drop status when responding. Rather, the fact that nobody got sick as well as the appearance, taste and smell

The 3 302 households surveyed in the Water Services Barometer Study 2022 were considered representative of South Africa's population.

Municipal area								
Metro			Urban			Rural		
1637			927			738		
Province								
WC	EC	KZN	FS	NW	NC	MP	LP	GP
534	348	570	160	204	80	224	244	938
Race								
Black		Coloured		Indian		White		
1976		735		158		793		
Age								
16-18	18-24	25-34	35-44	45-54	55-64	65+		
282	516	723	734	525	328	194		
Living Standard Measure (LSM)								
Group 1-3		Group 4-5		Group 6-7		Group 8-10		
131		754		1487		930		
Education								
Up to primary complete		Some high school		High school complete		Tertiary education		
136		853		1463		846		

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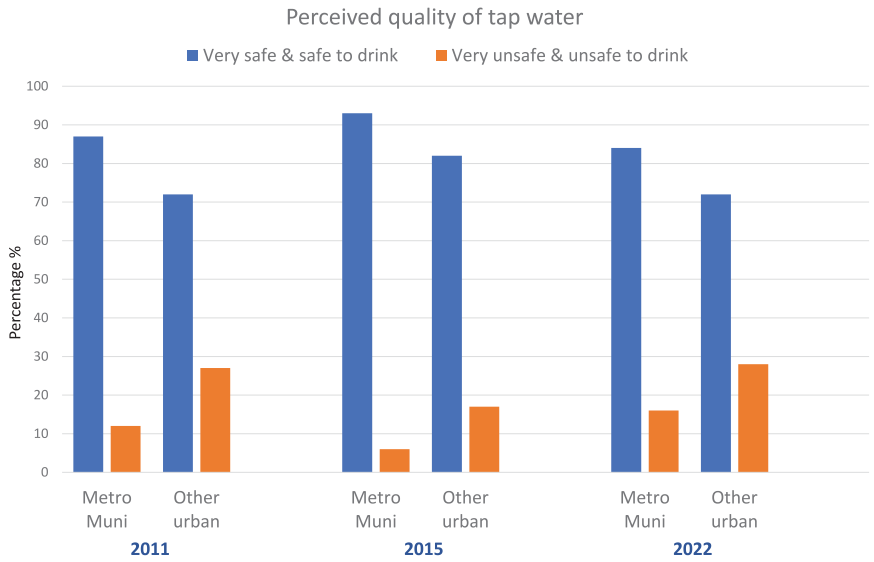
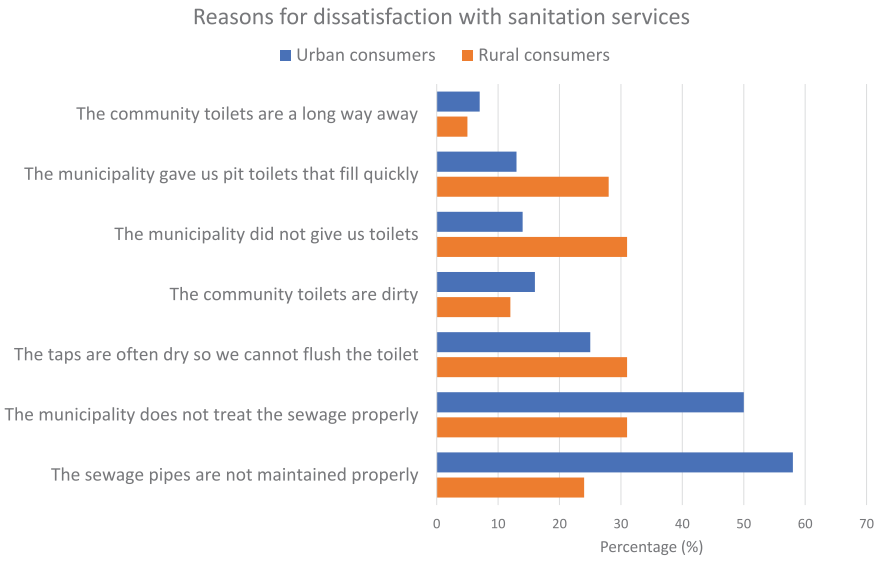
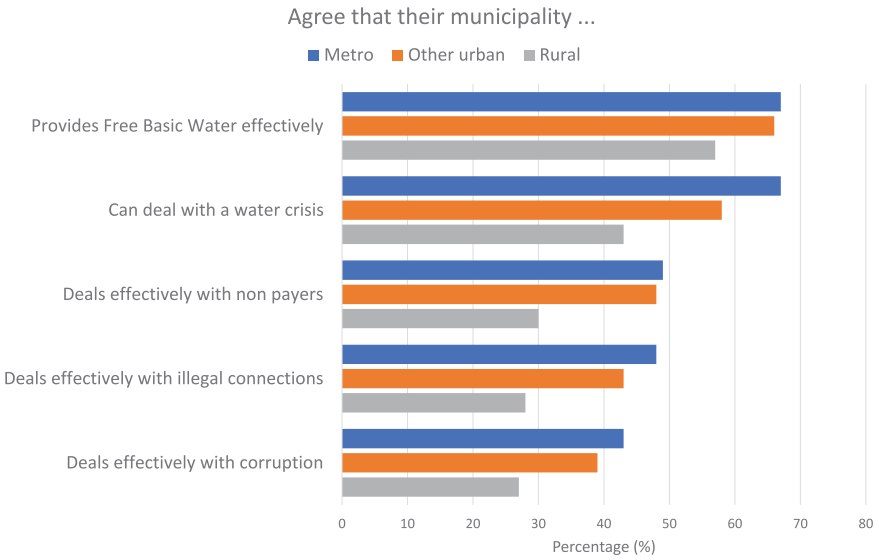


Public perceptions of water quality have fluctuated over the past decade.



Urban and rural consumers have different reasons for dissatisfaction with sanitation services.



Consumers' confidence in their municipality's effectiveness in dealing with corruption is particularly low.

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of tap water were the main reasons behind perceptions – not unlike findings of similar surveys all over the world.

"The smell of chlorine in tap water could either induce a positive perception that the water is safe to drink (15%) or a negative perception that it is unsafe to drink (22%)," notes Slabbert in the report. "The impact of the media on perceptions, although still below 10%, has almost tripled since 2011. This will have to be investigated further, but it is likely that interpersonal interaction on social media is having an impact."

Certainly, in response to fake news circulating in WhatsApp groups in Cape Town in February 2022, when messages were being posted urging the public not to drink tap water and inaccurately linking an outbreak of typhoid fever in the Western Cape to the water supply, the municipality felt compelled to issue a statement assuring residents that its tap water was safe to drink.

It is also possible that perceptions might have been tainted by the unfortunate timing of the survey, which took place in June/July, shortly after loadshedding was ramped up to Stage 6 for the first time since December 2019. Many municipalities experienced problems at water treatment plants because of power outages, the City of Cape Town among them. In early August, it issued a precautionary boil notice after some areas experienced discoloured water. This was lifted a day later when the problem – attributed to a process control fault at the Faure Water Treatment Plant due to the cumulative effects of loadshedding – had been resolved.

Slabbert cautions against drawing speculative conclusions about the reasons for changes in ranking of the Metros for any parameters, but agrees that contextual factors could influence perceptions.

The main issues consumers in Metros and other urban areas have with their municipality's water and sanitation services, according to the Service Quality Index scores, relate to:

- Responding to complaints and queries
- Solving water and sanitation issues in the community
- Repairing leaking or broken water or sewage pipes, and
- Cleaning up sewage spills.

Some 50% of urban consumers feel their municipality never attends to these issues or only sometimes.

"In terms of effectiveness, most urban consumers agree that their municipality gives Free Basic Water to people who need it (67%) and is able to deal with a water crisis like a drought or flooding (63%)," notes Slabbert in the report. "They are less confident that their municipality deals effectively with non-payers (48%), illegal connections (46%) and corruption (41%)."

The Metros scored better than other urban areas for the Service Quality Index, and in this case the City of Cape Town took the top spot, scoring 7 out of 10, with Nelson Mandela Bay again coming in last on 6,09. Importantly, though, perceptions about municipal service quality in both Metros and other urban areas were strongly linked to LSM group. The Living Standards Measure, developed by the then South African Advertising Research Foundation (SAARF), categorises the country's population into 10 LSM groups based largely on household infrastructure and appliances. People from the higher (wealthier) LSM groups rated municipal service quality higher than those from the lower LSM groups.

The percentage of urban consumers who indicated that they don't pay for water increased from 12% in 2015 to 20% in 2022, even though those who said they don't pay because they don't have to stayed about the same. More encouragingly, 86% of consumers mentioned that they actively save water, primarily by not leaving taps running and repairing leaking ones.

While the Service Quality Index is based on consumers' experiences of particular aspects of water and sanitation services, the new Customer Satisfaction Index reflects their emotional response when asked how satisfied they are with water and sanitation services and charges. Consumers in Metros and from higher LSM groups were again found to be the most satisfied with services. Dissatisfaction with sanitation is high for the lower LSMs, which can be expected, given that many of the respondents would not have flush toilets inside their houses. Overall, however, urban consumers cited poor maintenance of sewage pipes and inadequate wastewater treatment as the main reasons for their dissatisfaction.

The findings for rural consumers – based on a sample of 738 households post-weighted to reflect estimated population in 000's – were very different from those for consumers in Metros and other urban areas. Apart from the lower confidence in drinking water quality mentioned earlier, rural consumers have a significantly more negative experience of water and sanitation services and are more negative about the effectiveness of their municipality. They are also significantly less satisfied with the services they receive, but their dissatisfaction with sanitation services is primarily due to problems with on-site sanitation, communal sanitation and an unreliable water supply. So unreliable, in fact, that 29% of rural consumers said that they experience water interruptions at least once a day and 24% at least once a week.

"As rural consumers perceive themselves to be lagging behind in all aspects of water and sanitation services, it is recommended that municipalities actively work to improve water and sanitation services to their rural consumers and address their specific needs as described in this report," notes Slabbert.

Overall, the study found that the main concerns relating to water and sanitation services from the perspective of consumers are water quality and reliability of supply. These two concerns are also raised as reasons for dissatisfaction with water tariffs.

"On the other hand, it was evident that South African consumers are becoming increasingly aware of water scarcity and that they are prepared to actively reduce their water use. It is recommended that public campaigns of the Department of Water and Sanitation and other organisations strengthen this resolve with targeted messaging."

To download the report, The water services barometer study 2022 (WRC report no. TT 909/22), visit: https://bit.ly/3O8bZuA

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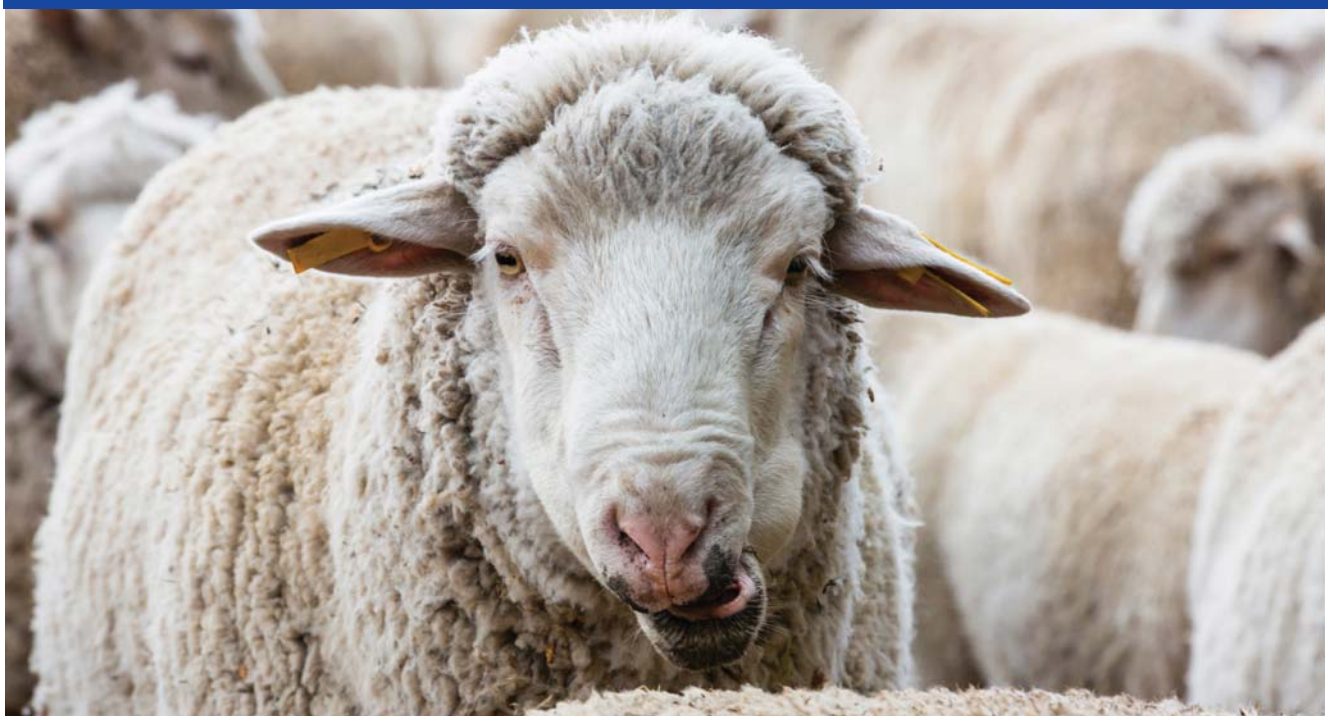
WATER AND AGRICULTURE

Time for an ewe-turn on farming with indigenous sheep

A new study provides insights on how sheep farmers, especially smallholders in semi-arid regions, might better adapt to drought and save water without compromising meat production and quality. Matthew Hattingh reports.



Let's be honest. When you're enjoying a convivial ***dop en tjop*** with pals (your correspondent likes his beer cold and his lamb loin hot off the coals, medium-rare and lightly salted), it's unlikely conversation will turn to weighty topics like the country's water woes. But if you love lamb or mutton, perhaps it should.

Consider this: more than half of South Africa's 22 million sheep are farmed in arid and semi-arid areas. During 2017/18, the drought in the Western Cape forced farmers to slaughter more than 20% of the province's sheep, some 2.8 million animals. Looming climate change will only worsen the frequency and intensity of drought.

And it's a lot more serious than rising braai meat prices. Lack of water makes farming harder, causing hunger and slashing sheep farmers' income. Smallholders keeping sheep on communal land in semi-arid parts of the country have it especially tough, and they feel the lack of good governance and investment in water infrastructure more keenly than commercial farmers, who can better mitigate drought's effects.

Might smarter farming (finding new sources of water and greater efficiency) improve the lot of producers, especially smallholders? What happens when not enough water is available? And how would restricting water supplies to sheep, especially indigenous breeds, affect meat production and quality?

A recently published Water Research Commission report looks at these and other questions.

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Assaying water requirements and hydric stress tolerance of the South African indigenous sheep genetic resources for water and food security (**WRC Report No. 2973/1/23**) is the work of 11 researchers, mostly representing the Faculty of Agrisciences at Stellenbosch University, but also the universities of Cape Town and the North-West.

Meat scientist, Prof Cletos Mapiye and his co-authors found little research on the water requirements and stress tolerance of common sheep breeds in South Africa, and have pursued three main avenues of inquiry to correct this:

- Asking smallholder and emerging commercial sheep farmers how they perceive and deal with water scarcity;
- Determining the water requirements of common breeds and the quantity and quality of their meat; and
- Assessing how different breeds and their meat are affected by water restrictions.

The report starts by reviewing the sometimes inconclusive literature on sheep water requirements. It touches on techniques to better manage rangelands, and how providing sheep with shade or grazing them at night can pay off; and the potential water-saving benefits of adding succulents such as cactus to their diet or letting them eat fresh leaves of alien invasives, or water-rich agricultural byproducts, like grape pomace.

We will focus on the three main avenues here, but first, let's shine a little light on the real hero of this drama, ***Ovis aries,*** the small, timid ruminant we call the domestic sheep. Roughly speaking, sheep come in two types: fat- and thin-tailed. Fat-tailed, with their large tails and hindquarters, account for a quarter of the world's sheep, but nearly twice as much meat as thin-tailed sheep. For the most part, fat-tailed sheep are the indigenous domestic sheep of Asia and later Africa, while the majority of thin-tailed breeds came to this continent in recent centuries, from Europe.

The South African herd includes European breeds and crossbreeds, such as the Merino and Dohne Merino; indigenous sheep like the Damara and Pedi; and composites, which draw on the bloodlines of indigenous and exotic animals. A good example of a composite is the Meatmaster, a fat-tailed hair sheep, first bred in the 1990s and recognised by government gazette, ***nogal***, in 2009.

Indigenous and tropical breeds, the authors note, show greater resilience to water stress than their temperate counterparts, having adapted to environmental conditions. They can convert the fat in their tails and rumps into water to survive without drinking for up to a week. And by storing fat in their tails, breeds like the Damara can better dissipate heat from the rest of their lean and less-insulated bodies.

Other physiological reasons, including an ability to absorb water from their kidneys and large intestines, help tropical and indigenous sheep fare better when water is scarce. There are also behavioural mechanisms. Indigenous sheep forage when it's cool and lap up dew. When they're parched, they eat less, "which reduces heat production from fermentation, digestion and overall metabolism resulting in greater water conservation".

This might seem a convincing case for indigenous breeds, yet the report states that "most producers are hesitant to use indigenous tropical breeds for meat production because of their small frame

The study found that, in general, daily water restrictions up to 20% did not adversely influence growth, carcass and meat quality attributes of the common South African sheep breeds.

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The study identified Meatmaster sheep as the ideal feedlot breed under water-scarce conditions.

sizes and slow growth rates". However, the report notes that although indigenous breeds yield smaller carcasses, they can be productive (a measure of the cost of feeding a sheep versus the price its meat fetches) compared with improved breeds – even in feedlot systems.

Feedlotting, Mapiye explained in an interview, involved keeping lambs (after weaning) in pens and feeding them a high-energy and high-protein diet of mostly maize and soybeans. This helped them reach slaughter weight far quicker than they would grazing. The result is a younger, more tender carcass which fetches a premium. Feedlots produce most of the lamb sold in South African shops and it's essentially the preserve of commercial agriculture. But Mapiye reckons feedlots, combined with the right breeds, could be a real option for smallholders, promising better prices at slaughter, while sparing farmers from having to sell when drought bites.

The report noted that as demand for meat continued to grow and as water scarcity escalated, "the adoption of indigenous and composite breeds or their crosses with temperate breeds has potential to support sheep production for resource-limited farmers".

So who are these farmers, what difficulties do they face and how do they deal with drought? Seeking answers, the researchers interviewed the heads of 252 households, emerging commercial sheep farmers in the arid Northern and Western Cape, and smallholders in the semi-arid Eastern Cape. A structured questionnaire was used to develop a profile of the farmers' circumstances, the breeds they keep and how they manage these, especially as it relates to water.

Most of the farmers surveyed were men – 59% in the Eastern Cape and 86% in the other Cape provinces – and most (67%) identified livestock as their chief source of income. More than half were aged between 50 and 70 and either had primary or no formal education. According to the report, "All the farmers in the semi-arid ecozone were subsistence farmers on communal land, while those in the arid ecozone were commercially-oriented farmers on private land." Farms in the North and Western Cape tended to be considerably larger than those in the Eastern Cape – an average 1678-hectares compared with about 205ha.

Dorper (a long-established, local cross of the Dorset Horn and the Blackhead Persian sheep) was the most common and preferred breed in the arid regions (67%). This was followed by Meatmaster (15%), Merino (13%) and Damara (5%). In the semi-arid areas, nondescript crossbreds (27% of the respondents) were dominant, followed by Dorper (18%), Dohne Merino (17%), Merino (14%), Damara (9%), South African Mutton Merino (9%), Meatmaster (3%) and Dormer (3%). However, most respondents in the Eastern Cape preferred farming with Merinos (70%).

Cash income was the main reason given for keeping sheep by 80% of respondents. Other reasons varied, with smallholders

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in the semi-arid regions more likely to keep sheep for manure, wool, festivities and cultural purposes. This included, said Mapiye, customary fines, ***lobola*** (bride price) and rituals around the initiation of young Xhosa men.

The survey found that extensive farming was the norm, but that farmers in the arid areas were far more likely to rotate their sheep among pasture, giving the vegetation time to recover, than their semi-arid counterparts, 95% of whom practised continuous grazing. The semi-arid smallholders also left their sheep to fend for themselves for water, posing a big problem when intermittent and seasonal streams dried up and man and beast competed for the same sources.

Adapted breeds such as Dorper and Meatmaster that were dominant on the commercially-oriented private farms in the arid regions have long, slim legs, which helped them to walk far for feed and water and to produce more lambs than the nondescript crosses and exotic breeds that dominated semi-arid arid smallholdings.

Sheep were entirely free to mate in the semi-arid regions, but less so in the arid regions. Uncontrolled mating is bad because inbreeding is more likely, leading to poor growth and reproductive rates. Moreover, lambs can be born in the wrong season – when grazing is scarce.

Meat marketing differed too. Arid-regions farmers were more commercially orientated and sold on auction, with the sheep going to the abattoir. Subsistence-oriented farmers in the semi-arid areas sold to local consumers and middlemen. These things had a direct bearing on farmers' incomes and how they perceived water scarcity.

Faced with water scarcity, most farmers in the arid regions explored alternative marketing channels and provided supplementary feeds, the survey found, whereas those in the semi-arid regions "withheld sales, reduced prices for live sheep and meat, and waited for the festive season".
The Eastern Cape farmers cited a shortage of land, followed by a lack of capital, information, infrastructural and institutional support, as the main barriers to them putting measures in place to deal with water scarcity.

The second and third main avenues of inquiry covered in the report, which compared different breeds under feedlot conditions, involved two trials run at Stellenbosch University's Welgevallen Experimental farm, both over 42 days. The first compared the digestibility, water intake and growth, and meat quality of one exotic (Merino), two indigenous (Pedi and Damara) and three composite (Dohne Merino, Dorper and Meatmaster) breeds. The researchers also sought to establish the ratio of water and feed consumed to weight gained. Each animal was weighed daily, with tabs kept on water and feed consumption and samples analysed to learn how much of the nutrients from their feed ended up in their faeces, urine and meat.

After the sheep had been slaughtered and weighed, income-over-feed costs were calculated. Meat samples were subject to panel tasting by experts and in the lab, the researchers worked to quantify a host of quality attributes – including moisture lost during cooking, intramuscular fatty acids composition, meat shelf-life, colour and toughness. The findings on this ran to more than 20 pages, but briefly: "Pedi, because of its smaller body size, had the lowest water and feed intake. The Damara had a comparable water balance to the three composite breeds, despite it and the Meatmaster having superior nutrient intake and digestibility. A similar trend was observed with average daily gain, which was greater for the Damara and Meatmaster than the other breeds."

When it came to income over feed costs, Dohne Merino led the field followed by Meatmaster, Merino, Dorper, Damara and Pedi. The authors noted the two indigenous sheep breeds had the lowest intramuscular fat content, "with the Pedi having a more desirable fatty acid profile compared to the other breeds".

"Minor and inconsistent breed effects were reported for meat shelf-life and sensory attributes. However, the Merinos had slightly more tender and juicier meat than other breeds."

The final avenue of inquiry compared the effects of different levels of water restriction – 0% (control), 10% and 20%. The study found that Meatmaster and Pedi had a lower daily water intake than Dohne Merino. However, Meatmaster and Dohne Merino had superior carcass weights, income-over-feed costs, and more tender meat than the other breeds. "In general, daily water restrictions up to 20% did not adversely influence growth, carcass and meat quality attributes of the common South African sheep breeds." The authors felt Meatmaster could be the "ideal feedlot breed under water-scarce conditions".

It was suggested that water-saving strategies should target farmers most in need, particularly less-educated women smallholders who were entirely reliant on income from extensively farmed non-adapted breeds in semi-arid regions. Mapiye said the report also highlighted the need for more research, policies and legislation to improve water supplies and monitoring, innovations in livestock farming, and the "capacity of stakeholders" to manage water resources for livestock.

More than just ***tjops*** to chew over at the next braai, then.

Dorper sheep are preferred in arid regions, such as the Karoo.

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FOOD WASTE

How to fight food loss on South Africa's farms

Study pinpoints various ways to decrease food loss on farms, and potentially putting it on the plates of thousands of South Africans instead. Article by Petro Kotzé.

It remains a perplexing fact that millions of SouthAfricans are hungry every day, while millions of tonnes of edible food are being discarded or left to rot. Food loss and waste are a global scourge, and the impact is felt intimately and plays out in the health and development of the poorest of the poor.

In South Africa, out of almost 17,9 million households surveyed in 2021, 2,6 million had inadequate access to food and 1,1 million households experienced a severe lack of food. More than half a million (683 221) households with children aged five years or younger experience hunger. A large part of the reason is rising living costs, making food inaccessibly expensive to those who need it most.

Yet, a staggering 45% of the total food supply (production plus imports less exports) is said to be wasted and lost across the food value chain. Every year about 10.3 million tonnes of edible food in South Africa is being discarded or left to spoil, the cost of which is enough to feed 16 192 children two nutritious meals every day for a year.

The most wasted food types are seeds and pulses, followed by fresh fruits and vegetables, which make up an estimated 44%. The bulk of this (49%) takes place at the processing and packaging stage in the value chain, and a further 18% at consumption. Though those stages have been relatively well-researched, there is a near-complete lack of data on food loss at the very first stage, although an estimated 34% of food is lost there, on farms.

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The link between food waste and water

According to the World Resources Institute, 1.3 billion tons of food is wasted every year, wasting 45 trillion gallons of water in the process, representing 24% of the estimated water used for agriculture globally. The sector is the largest water user in the world, accounting for roughly 70% of freshwater use globally. In semi-arid South Africa agriculture accounts for roughly 60% of water consumption.

A recent study by the Cape Town-based Behaviour Change Agency (BCA), commissioned by WWF South Africa, the WWF Nedbank Green Trust and Food Forward, aimed to start closing that gap. The project investigated the root causes of food wastage at primary production.

Though the primary drivers for fruit and vegetable wastage are environmental factors mostly beyond our control, such as the weather, pests and diseases, there's also a component to loss that we can manage, says project leader and neuroscientist, Jorique Fourie. "Identifying what we can change is a big step in the right direction. Behaviour is one of those, she says, so we wanted to see what kinds of behaviour lead to food wastage, so we can start to address them."

To understand farming, speak to the farmers

Fourie conducted 15 semi-structured interviews with farmers in person or over the telephone. Four manage fruit farms, five vegetable farms and six a mixture of both in the Western Cape, Eastern Cape, KwaZulu-Natal, and Limpopo. The questions probed farmers' awareness, attitudes and behaviours around food waste, including the value they place on reducing it, and what their food waste management practices are. Their findings delivered a handful of surprises, as well as numerous opportunities for improvement, served up straight from the farms.

Fourie says, unexpectedly, most farmers viewed food loss in a positive light. They saw it as a chance to improve, or a potential source of food for communities that don't have enough, she says. To dig into how that attitude could be used to decrease food loss, the researchers first had to investigate how it happens, and found that food loss is rooted in numerous components of the farming process.

Over and above the mentioned environmental causes, the farmers pointed out several causes classified as 'behavioural' by the researchers. These relate to the actions of the actors in the supply chain, including farmers, farm workers, retailers, suppliers and consumers. A surprising one, Fourie says, was the incorrect use of pesticides, identified as a major contributor to food wastage by the farmers they spoke to. Chemical mismanagement can include a lack of knowledge and training on the use of specific products, unintentional and uninformed mistakes, and generally risky behaviour that leads to crop damage and eventually, waste.

Further waste is caused when buyers or consumers reject produce that does not meet aesthetic requirements. According to the project report, "farmers sounded quite frustrated at the often unrealistic aesthetic standards required for a fruit or vegetable to be accepted into the food supply chain." Though most farmers' frustration was focused on middlemen such as retailers and promoters, consumers are influenced by the media and marketing to want perfect fruits and vegetables, even when quality, taste and nutrients are not compromised by blemishes.

Poor decision-making before the harvest was identified as a third behavioural contributor and the reason for "major" food losses. Poor decisions on water management, planting practices and timing, planning and timing of harvesting and crop monitoring can all cause crop loss. The respondents said that good management necessitated farmers to be "intricately involved in and present at every step of the process, from planting to harvesting and packing, along with their team."

Many farmers also cited labour practices, meaning the way crops are harvested and handled during production. Labourers that lack skills and training as well as personal work ethic, can damage crops.

Over and above environmental and behavioural causes, crops are also wasted because of market-related causes, for example, when there is an oversupply of crops. There is often a cycle, the farmers explained, in which a successful crop fetches a high market value in one year, floods the market in subsequent years and is then followed by "dry seasons" where its supply decreases again. This inevitably leads to a supply-and-demand issue, creating favourable circumstances for oversupply during the subsequent year. One farmer said, "I know it probably won't be good for competitive reasons, but if we could just somehow be warned that a lot of farmers plan on planting the same crop, we can make other plans." Other interviewees suggested creating district-based commodity associations or study groups that can preplan and share information to determine the number and

The way crops are harvested and handled during production play an important role in food waste. Labourers that lack skills and training as well as personal work ethic, can damage crops.

Lani van Vuuren

Various factors, such as weather or the oversupply of crops can lead to food being left to rot in the field.

type of crops farmers intend to plant.

Low market values also contribute to loss. If a surplus of certain crops is supplied, demand and market values decrease, leaving farmers under pressure to achieve profit margins. Farmers said it was not economically viable to even harvest the produce when there was a lack of demand – it makes more financial sense to let it rot in the field.

Farmers are placed under even more pressure due to skyrocketing input costs. The price of fertilizer, for example, has increased by 134.6%, from R6 821 per tonne to R16 001 per tonne between March 2021 and March 2022 (according to the National Agricultural Marketing Council). Farmers now face a situation where, one explained, "The cost of harvesting, storing and sending food into the supply chain no longer justifies the cost required to grow that food in the first place." The result can be, again, crops that are left unharvested.

More causes stem from the supply chain. These include high transport costs, delays at ports and the high costs of packhouses. Political causes include unrest, riots and loadshedding.

Challenges to managing food loss and waste

Fourie says that though all the farmers they spoke to were eager to address food waste, they reported that they experienced several barriers in their way. The biggest were the logistical challenges of redistributing surplus food, the high transport costs and the prohibitive time necessary to organise this. Increasingly expensive input costs have already emptied coffers of any surplus funds to manage waste.

Another major challenge identified is the cost and time required to train staff to prevent or manage waste. Farmers said that easy access to training, especially on correct pesticide use, was a problem. There are also regulatory hurdles such as unjustified legislation to benefit certain countries' produce and EuroGap2 restrictions on the use of organic, affordable pesticides and substances that are available in South Africa.

Another barrier is worker behaviour, though some of these, the report states, refer to deep, systemic, societal issues. One farmer said that they now mark staff pay days as unviable for harvesting, as no workers will show up because they are out spending their money. This results in the harvest being postponed, with an immediate effect on end-product shelf-life and quality.

Where there's a farmer, there's a way

All farmers said they wanted to address food loss and waste on their farms and believed other farmers do too. However, policy changes will not motivate them to do so, Fourie says. "Not one mentioned policy," she says, when they were questioned about their motivations to address food loss. Instead, she says, they found the farmers were driven by intrinsic incentives. "It is important to have policies in place, but that is not necessarily going to change the behaviour of the farmers."

Most had a financial imperative, saying that profit margins were already so tight, that all potential sources of income should be made use of. Secondly, the farmers felt they had a moral obligation to feed people and to improve the country's food security. "Their responsibility towards their communities and the people they provide food to daily encourages them to limit any waste that could have been a meal," the report states.

In conclusion, enforcing stricter laws on the control of food wastage on farms would not be a recommended strategy for bringing about change. The inherent motivation of farmers – be it financial or moral – is enough to drive meaningful change.

The study suggested various opportunities to reduce the scourge of wasted food. Most prominently, is the provision of logistical support to redistribute surplus food. Another is to quantify food loss on farms. Less than half the farmers could

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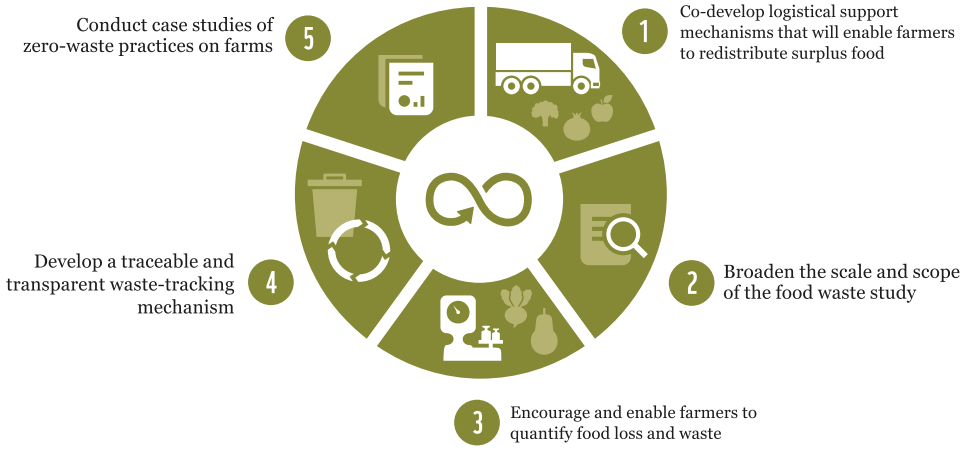

Five improvement opportunities for reducing waste as identified by the report.

estimate the amount of food lost on their farms, Fourie says.

Of those interviewed, two farmers reported zero waste on their farms. One did so by focusing on changing the behaviour of farm workers, and constantly educating and involving staff in the farming process. This farmer reported a drop in wastage from 35% to 0% as a result. Valuable follow-up research would be case studies to document their methods and successes for possible future training and education of other farmers.

Changing behaviour to change food loss

A final behaviour change strategy would probably be segmented into different target audiences, including farmers, farm managers, farm workers, and so forth, but requires a follow-up project, Fourie says. She adds that their findings, however, are already inspiring. Intrinsic motivation is integral to any successful behaviour change strategy, she says, and this is exactly what they found on farms. The interviewees felt that there was hope and opportunity, and they could facilitate change. "They were excited about it."

The farmers she spoke to had a lot going against them, Fourie says, mentioning political issues, climate extremes and droughts and rising costs to name a few. Regardless, they say they will keep on doing it and giving their best. "We have an extremely resilient farming community," Fourie says. That was an important indicator that we have such a big opportunity to implement behaviour change programs."

Any follow-up work will depend on funding, but Fourie says this is a good start and, she would advise any other roleplayers to start at the same place. "There is a tremendous amount of knowledge in our farming communities," she says, adding that there also seems to be a disconnect between what happens at farms and at policymakers or other players involved in the sector.

Reducing food wastage should be considered of critical importance in South Africa, in order to make more nutritious, safe and affordable food available, in particular to children, the report states. A large part of that solution, Fourie says, is within relatively easy reach right on our doorsteps.

For more information: Fourie J, Engelbrecht K, Govender P, Pillay P and W Engel. 2023. ***Food loss and waste in farming: Insights from South African farmers***. WWF South Africa, Cape Town, South Africa. (https://wwfafrica.awsassets.panda.org/downloads/food_loss_and_waste_report.pdf)

Additional source: Increasing reliable, scientific data and information on food losses and waste in South Africa, a Technical Report written by SHH Oelofse, T Polasi, L Haywood L and C Musvoto for the CSIR and the DST

The high expectation for aesthetically pleasing fruit and vegetables is given as a reason for food waste.

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WATER AND HEALTH

Why cholera is 'pretty damn smart' and how we can beat it

The recent cholera outbreak in South Africa has brought back attention to this waterborne disease. Three experts share their views. Matthew Hattingh reports.

The precise origin of the cholera and the exact strain of the toxin-producing bacteria that has claimed 47 lives this year, mostly in Hammanskraal near Pretoria, remains a lot like the polluted waters of the region's Apies River, murky. What is clear, however, is that the loss of life could have been avoided. Ensuring drinking water safety is the key to beating the infectious diarrhoeal disease, but to get this right we will need to do two things: hold officials and politicians to account over our dilapidated or non-existent wastewater treatment systems; and press into service more cheap-and-cheerful, household-based water treatment systems.

These were a few of the views and recommendations that emerged during an online seminar hosted by the Academy of Science of South Africa, aimed at improving understanding of the disease and finding ways to curb it. Prof Jerome Singh, principal investigator for the Academy's Scientific Advisory Group on Emergencies, told the 14 August webinar that urgent steps were needed if we were to avoid more Hammanskraals.

The advisory group, which brings together scientists from across the country, identified some of the causes of the current outbreak – which started in mid-April before tapering in mid-June – and suggested measures to put things right. Singh said Hammanskraal was "symptomatic of a widening collapse of wastewater treatment facilities almost nationwide", which was increasingly affecting even big, well-resourced cities. And he warned that unless action was taken against mismanagement, the collapse would "continue to unfold, precipitating multiple, concurrent human health and environmental emergencies".

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An international expert on law, ethics and public health, Singh said South Africa's water sector was "beset by multiple challenges". He mentioned incompetent leadership; apathy; a lack of maintenance and the necessary skills for this at existing treatment plants (exacerbated by people retiring or quitting); and a failure to build new plants to meet the needs of our growing population.

Funding for this work was in short supply, but was being squandered, he said, criticising the spending of public money on "issues that are really not important when we should be dedicating it to bread-and-butter issues at a local government level". Meanwhile, citizens who can't or won't pay for services, and vandalism compounded matters.

How do we improve skill levels? Singh called for initiatives to build capacity. He also suggested we look at how top graduates, especially engineers, might be enticed to "work in rural municipalities to make sure their water treatment plants work, and so that people don't get cholera". He further called on the departments of Water and Sanitation, and Cooperative Governance and Traditional Affairs, the South African Local Government Association and municipalities to work together to promote governance and to "urgently engage" with water services providers.

Singh endorsed measures for training and equitable water pricing, but said this would need Cabinet-level political support. He called for governance and legislative reform and measures to increase "transparency, accountability, competence, and operational efficiency". He added that, "There doesn't seem to be anything that is done towards services officials when they fail to act, when they fail to ensure that basic maintenance is done, or they fail to take into account a five- or 10-year plan to take into account the increase in population."

The Auditor-General and others had been flagging problem areas for years, but there had been no consequences for the officials implicated and this needed to change. "If people are dying, and this is as a result of direct negligence, where it is foreseeable that this is going to happen, people need to face disciplinary action and where applicable, criminal charges. Because unless you have an accountable system, you're going to have continued cholera outbreaks and continue deaths when this is a very, very preventable and avoidable situation."

Singh wanted to see citizens educated so they know their rights — and know what should be expected of public officials. At the same time, measures were needed to encourage people to safeguard infrastructure and to "promote responsible stewardship of water and wastewater management". He called for a campaign to foster a "deep reverence" for water across the country, including in informal settlements where pollution and sanitation problems abound. Surveillance must be improved too, so outbreaks could be detected earlier, saving lives. There had been a "lot of exciting science" and technological developments, including around no-flush toilets and decentralised treatment systems, and Singh called for funding for more research and innovations.

Innovations, particularly on-site and decentralised solutions, held great promise in the fight against cholera, medical microbiologist Prof Eugene Cloete told the webinar. Cloete, who is CE of the Cape Higher Education Consortium, shared an excerpt from a 1996 World Health Organisation fact sheet that identified the provision of safe drinking water and the proper disposal of human excreta as trumping all other interventions when it came to public health and national development. But he stressed that ensuring the safety of drinking water was "the most important thing" for preventing cholera.

To underline this point, Cloete, shared findings of a study on the 2000-2004 cholera outbreak in KwaZulu-Natal, which by March 2004 had resulted in 575 deaths. The study found that cases of cholera correlated strongly with a lack of potable water rather than with a lack of sanitation. In one, far northern region of the province, for example, where the bucket system was commonplace, no cases of cholera were reported, whereas in other areas where sanitation was considerably better, many cases of cholera were reported.

"If we want to make sure people do not get cholera, the number one thing we have to do is to provide safe drinking water," he said. But how do we do this where people are isolated? How do we reach the 300-million people in Africa who lack access to safe drinking water and who live in places where it's hard to pipe water to? Cloete said that in municipal areas water safety plans (which were readily available) must be followed. For rural areas he advocated "empowering people at the point of use" by equipping them with appropriate technology.

He briefed the webinar on a Water Research Commission-funded project which harvested rainwater from shack rooftops. Cheap solar heaters were then used to pasteurise the water (an idea borrowed from the dairy industry). Provided the water was heated to 80°C and above for more than a minute, it was found to kill all microbial pathogens. What's more, the system was gravity fed, so required no electricity and was expected to last for more than 25 years with only minimal maintenance.

He said individual systems could provide 800-1 000 litres of water a day, making it ideal for villages, clinics, hospitals, schools and orphanages. "It brings water to people in a safe way at a very low cost," Cloete added, mentioning a per capita cost of R3.70 per person, per year.

An even simpler and cheaper approach involved putting rain or river water into half-blackened plastic bottles and disinfecting it by exposing it to sunlight. The method was "pretty effective" In providing potable water using ultraviolet irradiation, "but not as effective as heating the water to temperatures of 90°C-plus", he said.

Chemical treatment of water, including using household bleach, was another option, particularly in emergencies, but Cloete cautioned that this came with costs and complications, including getting the dosage right. Like Singh, Cloete stressed the importance of surveillance in controlling cholera outbreaks and he questioned to what extent it was up to scratch, suggesting that if we improved surveillance we might find cholera has been under-reported.

What about using vaccines to deal with cholera outbreaks? Prof Nicola Page, principal medical scientist with the National Institute

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for Communicable Diseases, said there was some debate among experts, with the general view being that vaccines were more useful for "really big outbreaks where you want to prevent them from spreading further" or "where providing clean water or treating water wasn't sufficient".

This was because it takes time to procure vaccines and roll them out, by which time (as was the case with the current outbreak), the disease may already be on the wane. She said other African countries have used the vaccine for much bigger, less localised outbreaks than Hammanskraal.

Three vaccine formulations have been developed with one licensed in South Africa. The vaccine must be kept cold (complicating matters) and given in two doses, 10 days apart, with efficacy kicking in after eight days after the second dose. The vaccine remained 85% effective after 12 months, tailing off to 50% over two years. Boosters were needed to sustain immunity. For children under six, the vaccine offered less protection, with immunity waning after six months.

On the plus side, the vaccine was cost effective, safe, easy to administer and built herd immunity.

Page provided the webinar with a lively overview of the ***Vibrio cholerae*** bacteria, some of the different strains, serogroups, serotypes, biotypes and variants of these; how these developed; how they worked; and how they were transmitted.

Vibrio (from the Latin for quiver) bacterium, evolved or mutated over time to be capable of surmounting the formidable defences the human body erected in its path, she explained.

Once ingested, it must adjust rapidly to the hostile conditions of the human gut. "They put out this protein arsenal to help them get through the acid of the stomach. Despite these proteins, only a few vibrios actually reach the small intestine. And this is probably why the infectious dose is quite high."

But assuming cholera bacteria do make it through to the small intestines in sufficient numbers, "their job is not over". "They have to cope with additional antimicrobial agents, things like bile salts and antimicrobial peptides."

Next, they must penetrate the intestine's internal mucus layer to reach the epithelial (intestinal tissue) cell surface. This is some feat, when you consider that the layer is 100 to 400 times thicker than the length of a cholera bacterium. That the cholera can manage this epic journey was thanks to the mucin enzymes it produced, plus their "wonderful polar flagella", the tail-like appendage which helped them burrow through.

"In addition to this, if they don't have enough to worry about, they have to overcome colonisation from other gut microbiota. And they do this by activating a type six secretion system. This basically operates as a molecular syringe that kills bacterial competitors when they come into contact with the cholera bacteria," said Page.

"So I think they're pretty damn smart," she said with an infectious enthusiasm for the topic.

Once through and attached to the intestinal epithelial cells, the cholera starts multiplying, forming micro-colonies and expressing toxins which are taken up by the cells, impairing their function and resulting in a massive release of electrolytes and water. This leads to the diarrhoea characteristic of the disease.

With ***Vibrio*** now reaching a high cell density and nutrient levels in the intestine decreasing, "the bacteria know it's time to leave the party". Some detach from the epithelial surface and escape in the faeces. Page said that individuals who have not received effective antibiotic treatment can shed ***vibrio*** for up to 10 days after infection, "releasing the bacteria into the environment and increasing the risk of further infections downstream".

Treatment is relatively easy and successful for most people, but time was of the essence.

"If we can get people rehydrated promptly, they usually survive," said Page, adding that this might mean 6-litres of fluids in the case of moderately dehydrated adults. But severely dehydrated individuals were at a risk of shock and required rapid administration of intravenous fluids. Antibiotics can help too.

In response to a question about the source of the Hammanskraal outbreak, Page said although the water tested did not meet standards, only one sample (from a tap) detected strains of disease-causing cholera bacteria. "But just because we didn't find it, doesn't mean it wasn't there. I am not sure we will ever really know what the source was. But the fact that the water was bad probably didn't help matters at all."

Water Research Commission research manager Dr Eunice Ubomba-Jaswa, a medical microbiologist and research manager with the Water Research Commission, moderated the webinar. A recording of it can be viewed at https://youtu.be/Al-0wFenwuw.

GCIS

President Cyril Ramaphosa with officials from the Department of Water and Sanitation and the City of Tshwane at the Rooiwal Wastewater Treatment Works outside Hammanskraal in June this year. The malfunctioning of the treatment plant has been cited as a potential factor for the outbreak of cholera in the area.

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THE WATER WHEEL

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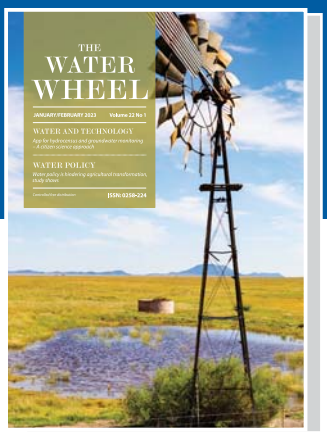

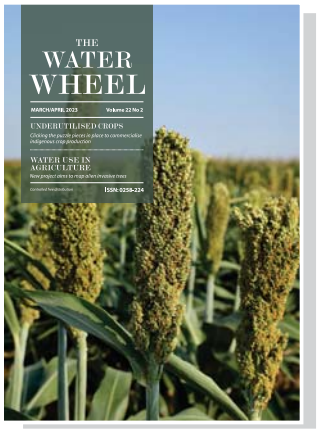

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Tel: +27 (0) 12 761-9300
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