



WRC CEO, Dhesigen Naidoo



Fluid Thoughts

Drought 2016 – Ushering in a new cycle of extreme weather patterns

Despite recently good rains, South Africa remains in the throes of a drought episode, and one that mirrors the 2015 phenomenon of a drought-heat wave combination.

This is in spite of the fact that the worst El Niño cycle in more than twenty years has ended. The South African Weather Service predictions are optimistic and indicate that we will have a return to reasonable rainfall patterns this summer in terms of volume, but chronologically shifted. It also appears that one of the important changes, as indicated in earlier Water Research Commission (WRC) reports, is that while the overall seasonal rainfall volume may be similar to normal rainfall years, the rainfall episodes are shorter and more intense.

The recent flash flood episodes are testament to this new pattern. We also know that recovery to normal storage in our dams will be a multi-year project, and we need to be wary of the possibility of an early intense La Niña, flood cycle. In short, our water constraints will be here at least for a while, and we must adjust strategy accordingly.

South Africa's water scarcity is now an undisputed fact, and the vulnerability of all, from ordinary householders to major industrial players are now clear. This has already translated into personal and national hardship, with water restrictions and rationing with many cases of emergency options like water trucks being employed to ensure that basic needs are met. The economy has taken strain with the lack of water representing not only constraints to growth in many sectors, but even threatening survival in some sectors like agriculture.

With the latter, we are seeing the challenge to national food security, and related food price inflation. The knock-on effect on both the national growth forecasts as well as the sustainability of household level economic security has been intensely negative. The long-term consequences may be more dire as farmers that were already on levels of only marginal economic security may be pushed over the edge, on the back of an extended drought, into abandoning agriculture in favour of other short-term economic security measure. Thus, intensifying the risk outlook of South African agriculture. This consequence tree can be mapped for other industrial sectors in the country.

Water security in South Africa cannot be pegged on the hope

of a return to normal rainfall patterns alone. We have to adapt to the new water availability. This means tightening our water belts significantly and striving for higher levels of water efficiency in all areas.

We must make it a goal, as the thirtieth driest country in the world, to move down from our current use of 235 litres/capita/day for total water use, to at least the world average of 177 litres/capita/day. That will result in a saving in excess of 3 billion litres of water per day.

A key part of empowering this move is of course knowledge and information. The WRC is digging deep into its, and its partners knowledge repositories in order to enable this. Access to the research reports and related documents will be facilitated by the launch of a new, much more easily accessed WRC Knowledge Hub.

“Our water constraints will be here at least for a while, and we must adjust strategy accordingly.”

Already in this repository are close to 1 500 WRC documents examining and analysing the phenomenon of drought and various adaptation and coping strategies; as well as the building blocks of better water management to mitigate the impacts of future extreme event episodes. In addition, the new updated DroughtSA portal will be launched as a principal support tool for all stakeholders and the general public as a key information support tool to deal with both the drought as well as more generally water scarcity in South Africa.

We invite everyone to use these knowledge services and become part of the South African Water Ubuntu initiative. What we do individually, positively or otherwise, has huge consequences for the system as a whole. In this season of celebration and giving, the biggest gift we can give is a chance for better water security by being water wise. The best of season's greeting to all our readers.

Special accolade for WRC Research Manager



Water Research Commission (WRC) Research Manager, Bonani Madikizela, has been recognised by the Wildlife and Environmental Society of South Africa (WESSA), who presented him with an honorary lifetime achievement award earlier this year.

Madikizela was one of 90 Lifetime Conservation Achiever Award winners, celebrated for their life dedication to conservation in South Africa. The awards were introduced specially for the organisation's 90th anniversary.

The Lifetime 90 Achievement Award presented to Madikizela was in recognition of his sterling work in fighting against the degradation of South Africa's freshwater ecosystems and for the restoration of biodiversity in natural resources.

Madikizela has spent more than 20 years working with natural resources, focusing in particular on water resource quality and bio-monitoring with respect to inland freshwater ecosystems such as rivers, dams and wetlands. Madikizela is a research manager in the Water Resources unit at the WRC, and has previously worked at the departments of Water Affairs and Environmental Affairs. As WRC research manager Madikizela's role includes prioritising, supporting, and coordinating research done by a variety of organisations and independent consultants across South Africa.

Due to historic lack of attention to wetland health and biophysical integrity, Madikizela's focus is currently biased

towards wetlands and also includes river rehabilitation, with the intention to provide methods and guidelines that ensure sustainable utilisation of these resources, but without furthering biodiversity loss. This quest has led to interactions with experts in aquatic ecosystem research and development at national and international levels.

WRC CEO, Dhesigen Naidoo, said "We congratulate Bonani for receiving such a prestigious award, which positions the WRC personnel as leaders in the applicability of research that is managed in a way that encourages exploratory and innovative investigations."

While expressing his gratitude for the award, Madikizela said, "The 90 Lifetime Conservation Achiever Award means a lot in boosting one's self esteem. Even more inspiring is to be recognised at the time when the country is in dire need of water specialists that need to be turning their heads around due to the ongoing water scarcity challenges facing South Africa".



Water Diary

Sanitation November 19

Each year, World Toilet Day calls on the global community to do more to address the sanitation crisis. This year, the theme of 'toilets and jobs' focuses on how sanitation, or the lack of it, can impact on livelihoods.

Visit: www.worldtoiletday.org

Odour control February 14-16

The International Water Association (IWA) Symposium on Tastes, Odours, and Algal Toxins in Water: Occurrence and Control, will be held at the University of New South Wales, Australia.

Visit: www.iwatando2017.org

Faecal sludge management February 19-22

The Fourth International Faecal Sludge Management Conference (FSM4) will be held in Chennai, India. FSM4 aims to bring together professionals working in the sector, including utilities, service providers, cities, governments, academics, scientists, consultants, donors and industries to support the global initiative of disseminating sustainable solutions for faecal sludge management.

Visit: www.fsm4.susana.org

Water storage and hydropower March 14-16

The International Conference on Water Storage and Hydropower Africa 2017 will be held in Marrakech, Morocco. The event is supported by the International Committee on Large Dams. Email: africa2017@hydropower-dams.com for more information.

Large rivers April 18-21

The Third International Conference on the Status and Future of the World's Large Rivers will be held in New Delhi, India. Topics to be covered include hydrology, hydraulics and water quality; sediment transport and river morphology; ecology and restoration; and integrated river management.

Visit: <http://worldslargerivers.bku.ac.at>

Water history June 15-17

The conference of the International Water History Association will be held in Grand Rapids, Michigan, USA. The conference is co-hosted by the Western Michigan University.

Visit: www.iwha.net



Durban municipality launches WhatsApp line to report leaks



To make it easier and convenient for the public to report any water-related issues and to expedite the Municipality's response, eThekweni Municipality has launched a WhatsApp water reporting line.

The WhatsApp Water Reporting number is 073 148 3477.

The project is part of the City's ongoing effort to make communication with its 3.5 million residents simpler, fast-track service

delivery, reduce the water leak repair turnaround time and water wastage.

The telephone line allows the public to report leaks, burst pipes, illegal connections, blocked sewer drains, water supply interruptions and any other water-related issue to EThekweni Water and Sanitation (EWS) Unit.

The WhatsApp channel also has the facility for consumers to send location pins of problems which will assist in locating problem areas. Customers will have their chat history with EWS kept for reference on unresolved issues.

Customers will at times be asked to take pictures of the leaks or bursts to allow correct coding of faults to be done at capturing stage.

Water department signs agreement with Italy

Water and Sanitation Minister, Nomvula Mokonyane, has signed a landmark water cooperation agreement with Italy.

The memorandum of understanding (MoU), which was signed in October, saw both countries committing themselves to developing initiatives aimed at mitigating climate change by providing sustainable and integrated water resources. Part of the agreement is that both South Africa and Italy will ensure education, training and research in the fields of water quality enhancement, water resource management, water service management and rural sanitation technology.

The agreement will also ensure that both countries work on joint projects that will enhance capacity building, technology

transfer and technical assistance. These projects will mainly focus on empowering previously disadvantaged groups in the society such as women, youth and people with disabilities.

During the signing ceremony in Johannesburg, Minister Mokonyane said the agreement will ensure that both countries share knowledge expertise to fight climate change. She said South Africa's partnership with the Italians is aimed at assisting the country to strengthen its wastewater treatment capacity as well as rural and urban onsite and offsite sanitation systems.

"We have also agreed to cooperate in integrated water management solutions, including the reuse of wastewater for

material and energy recovery. Given our current water challenges as a result of drought, water management is a critical resource and tool required by our government," said Mokonyane.

A Joint Steering Committee will be established to ensure the commitments made in the agreement are carried out. The committee will comprise three representatives from the Department of Water and Sanitation and Italian Republic Department of Environment, Land and Sea.

The signing of the MoU follows a visit by an Italian delegation to South Africa in April. The objective of the visit was to identify implementable joint projects on water.

Spotlight turns to aquaculture in inter-departmental initiative



The Department of Environmental Affairs, in collaboration with the Department of Agriculture, Forestry and Fisheries (DAFF), has commissioned the CSIR to conduct a strategic environmental assessment (SEA) for aquaculture development in South Africa.

The purpose of the assessment is to support the responsible growth of the aquaculture industry in South Africa, noted Lizande Kellerman, CSIR environmental scientist and project manager for the SEA. She explained that the SEA aims to achieve this in two ways: firstly, by identifying suitable areas where environmentally sustainable aquaculture development can be prioritised and incentivised. Secondly, by providing a streamlined and integrated management and regulatory framework to reduce compliance complexities and improve decision-making processes.

The SEA will cover all nine provinces and includes offshore and land-based aquaculture for both freshwater and salt water species.

Aquaculture is the fastest growing food production sector in the world. An additional 50 million tons of fish is required to feed the world population by 2030, and it is anticipated that worldwide, this production will come mainly from aquaculture.

Aquaculture includes the breeding, rearing and harvesting of plants and animals in salt or freshwater. In South Africa, aquaculture is still in its infancy and has thus been identified by government as a priority area for economic growth. However, the sector faces several challenges, including the over-regulation of the sector, production being focused on a few high-value species, scarcity of freshwater and a harsh marine environment, among others.

Food prices driving increase in 'hidden hunger'



Huge food price increases mean that many South Africans are eating less, skipping meals and buying filling food that lack nutrients.

Food inflation has risen rapidly over the past year, fuelled by the drought, a weak Rand, and, some say, market manipulation by retailers.

A 25 kg bag of maize meal – South Africa's staple food – has increased by almost a third in the past year, now costing R225.82. Meanwhile, onions cost 75% more and potatoes 70% more than a year ago.

"The prices really get your heart beating. All of the big things have gone up," a woman told the Pietermaritzburg Agency for Community Social Action (PACSA), which monitors the cost of food.

Speaking in a focus group, women said that because of high prices, they prioritised food that filled them up – maize meal, flour, rice, sugar and oil – and cut back on meat, vegetables, and dairy. "We make maize meal porridge for breakfast and uphuthu (stiff porridge) for lunch or dinner," one explained.

PACSA tracks the cost of a basket of 36 basic foods, and found that the average

annual increase was 15% – double the average wage increases, and more than double the increase of state pensions and child support grants.

A quarter of households report experiencing hunger, with a further 28% at risk of going hungry.

It now costs R3 027 to feed a family of five with a nutritionally complete diet, according to PACSA. But the average monthly salary for skilled workers in 2015 was R3 650 – which means that low-income households are unable to afford a balanced diet.

"Households prioritise the payment of transport, education, electricity, burial insurance and the repayment of debt before food. Food is typically the last expense households prioritise because it is one of the few expenses households can control," noted PACSA researchers Mervyn Abrahams and Julie Smith. The researchers warned that women are at greatest risk of damaging their health "because they absorb inflation in their bodies: they eat last and their plates are least diverse."

Source: www.health-e.org.za

Water department achieves first clean audit in years

Parliament's Portfolio Committee on Water and Sanitation has commended the Department of Water and Sanitation for achieving its first unqualified audit since 2009.

The department in November tabled its 2015/16 annual report to the Parliamentary Portfolio Committee on Water and Sanitation. The report showed that underspending at the department was reduced from R3 billion to R189 million.

All accruals from previous financial years were addressed during the financial year under review. The average timeframe for paying suppliers was reduced from 86 days to an average of 23 days. Fraudulent activities by officials worth R4.5 million were uncovered and have been addressed through disciplinary processes.

"Twelve cases of financial misconduct were opened and 11 cases were won by the department. Charges included fraud, negligence, violation of supply chain management procedures and fruitless

expenditure.

"Sanctions imposed for financial misconduct included dismissals, suspensions and demotions, suspensions without pay and written warnings," the department said in its presentation.

Eleven bulk water schemes were completed, benefitting over 78 000 households and 34 816 households were provided with interim or basic water supply in the 27 priority districts. The department also implemented the River Eco-status Monitoring Programme in 62 rivers.

A total of 116 licences were issued to strategic sectors, 79 of which were in agriculture, 12 in mining, 11 in industry and 14 in energy, releasing 11.9 million m³ of water for productive use. For these achievements, Auditor-General, Kimi Makwetu has named the Department of Water and Sanitation the most improved national government department.

The Portfolio Committee extended

its support to the department and encouraged officials to actively engage the committee on challenging areas, especially on inter-governmental relations. Water and Sanitation Minister, Nomvula Mokonyane, said the unqualified audit opinion came amid a challenging environment.

"Below normal rainfall during the 2015/16 summer rainfall season resulted in the meteorological, hydrological, socio-economic and agricultural drought that was experienced across the country. As a result, a number of emergency interventions had to be implemented in the provinces of KwaZulu-Natal, North West, Free State and Eastern Cape.

"Those emergency interventions, however, had the unintended consequence of contributing to an increased amount of irregular expenditure during the financial year under review," said Minister Mokonyane.

Source: SAnews.gov.za

Schools benefit from toilets that mimic nature



Eight Johannesburg schools are benefiting from the installation of Arumloo toilets, a new sanitation innovation.

The micro-flush toilet is one of the technologies that have been selected for demonstrated by the Water Technologies Demonstration Programme (WADER) – a joint programme of the Department of

Science & Technology and the Water Research Commission (WRC). Developer, Jonny Harris, explains that with a design based on the well-known Arum lily, the Arumloo toilet is capable of flushing on less than two litres of water compared to conventional toilets, which typically use between six and nine litres per flush. The toilet is also designed to work as a pour flush toilet (where water is poured in by hand) utilising greywater.

According to Dr Valerie Naidoo, WRC Executive Manager of Business Development and Innovation, the development of the Arumloo is both exciting and encouraging since it shows how WRC research and development funding for biomimicry can catalyse innovation, thereby supporting competitive product development and enterprise development. Biomimicry is an approach to innovation that seeks sustainable solutions to human

challenges by emulating nature's time-tested patterns and strategies.

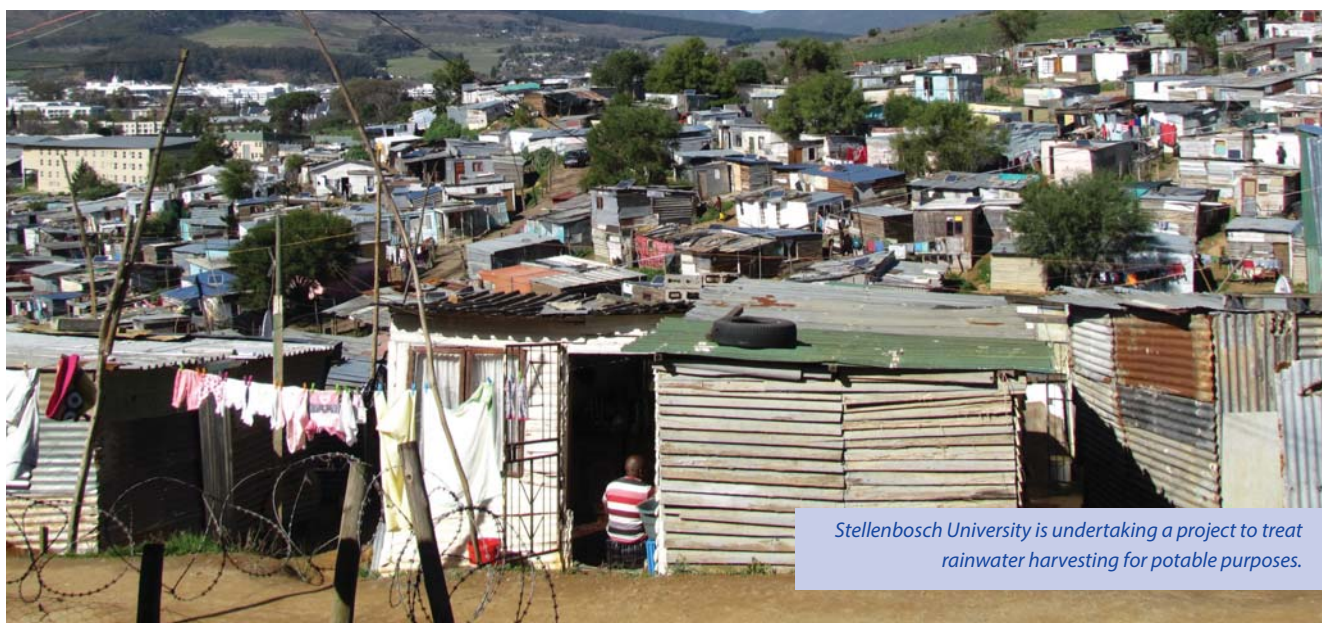
The technology was selected for demonstration after WADER, in partnership with the South African Local Government Association (SALGA), put out a call for innovative water and sanitation technologies and solutions that will contribute to improving water conservation, efficient use, cost-effectiveness and efficient management of water and waste in the municipal environment. Johannesburg Water has helped to identify eight schools where 60 Arumloo units are being tested on a pilot scale.

WADER Manager, Dr Manjusha Sunil, said that such innovative and potentially disruptive water savings solutions are essential for our water sector since South Africa is predicted to have a 17% water deficit by 2030.



Projects in Progress

Upscaling rainwater harvesting for domestic use



Stellenbosch University is undertaking a project to treat rainwater harvesting for potable purposes.

A microbiologist from Stellenbosch University, Dr Wesaal Khan, is part of an international consortium of specialists that have been tasked to develop a range of sustainable solar disinfection (SODIS) technologies that will provide affordable access to safe drinking water to remote and vulnerable communities.

Dr Khan, who heads the water resources laboratory in the Department of Microbiology, will focus on the use of SODIS systems to treat rainwater harvested on household and community level.

“South Africans living in rural areas are familiar with the concept of rainwater harvesting. But while communities in the Eastern Cape can routinely use the rainwater for drinking purposes, our research shows that this is not the case in especially urban areas,” she explains.

Rainwater in these areas become contaminated with heavy metals due to air pollution. The debris of plants and

faecal matter from birds and small animals also tend to collect on roofs and then pollute the rainwater harvested from these roofs with microorganisms.

Dr Khan warns that the disease-causing organisms isolated from rainwater tanks during their trials are associated with a number of diseases, such as diarrhoea, pneumonia and intestinal worm-related infections, among others.

The aim of the current project, called WATERSPOUTT, is to upscale and develop new large-scale solar disinfection technologies. WATERSPOUTT is the acronym for ‘water sustainable point-of-use treatment technologies’.

The ideal is to design a system that will produce sufficient quantities of treated per day so that it can be used in both household and community settings, such as schools and clinics.

“The idea is to supplement municipal services, supplying drinkable water, with

the rainwater harvesting technologies so that people can use the rainwater for domestic activities such as washing the dishes, laundry and personal hygiene,” she adds.

Based on 30 years of research, SODIS is one of the simplest and cost-effective water treatment technologies currently available. It uses the combined effect of ultraviolet radiation and the heat from sunlight to inactivate the whole spectrum of microbes and even bacteria such as *Vibrio cholera* and protozoa such as *Cryptosporidium*. The only requirement is that the water should be stored in a clear plastic or glass bottle and left in full sunlight for six to eight hours.

The project is funded by the European Union’s Horizon 2020 programme and is led by Prof Kevin McGuigan from the Royal College of Surgeons in Ireland. He has been involved with SODIS research for more than 20 years and pioneered the use and promotion of the two-litre bottle SODIS technology.



Global

The world needs more women engineers, says global firm



In the developing world, far more young minds need to be attracted to engineering and, in particular, women, who remain under-represented in many fields, must be part of the solution.

This is according to consulting

engineering firm, Aurecon.

Earlier this year, the company hosted 25 female Grade 10 and 11 learners from schools in South Africa, Zambia and Zimbabwe at its Tshwane office as part of a programme to promote

science, technology, engineering and mathematics (STEM) careers among girls. The programme was run by Taungana, a movement that seeks to empower rural South African high school girls by providing them with the opportunity to access and explore STEM careers. This year marked Aurecon's third successive year of supporting the movement.

One of the key aims of the programme is to help the girls identify potential entrepreneurial projects in their communities and to develop these ideas into a business case. To support this, the firm took the girls through a design thinking session, a human-centred methodology that necessitates innovation and creativity to solve critical problems.

The learners were required to 'ideate' – a process that encourages the exploration of different possibilities and solutions for the challenges they encounter in their respective communities – specifically in the spheres of agriculture, health, public transport and education.

Foreign farms increase the risk of conflicts in Africa – study

For the first time, researchers point to areas in Africa where foreign agricultural companies' choice of crops and management of freshwater are partly responsible for the increased water shortages and greater competition for water.

This, in turn, increases the risk of outright conflicts between all those who need water – plants, animals and humans.

During the twenty-first century, foreign companies have lease large tracts of

land in Africa – more so than in other parts of the world – in order to produce cheap food, cheap timber and cheap raw material for biofuels. An interdisciplinary study from Lund University, in Sweden, shows that about 3% of the land leased in Africa by foreign companies have been registered as currently in production, for the purpose of growing crops. For various reasons, the companies have either pulled out or not started producing on other leased land.

The study also shows that the crops that

foreign investors decide to grow often require more water than the traditionally grown crops. Furthermore, it shows that the same crop can have very different needs for water, depending on the climate where it is grown and which irrigation systems the companies use.

The researchers in Lund, together with a colleague in France, have developed a model that shows how much water is needed for different production systems, in different types of climates, in different parts of the continent. The model takes

into account both the size of the land and the type of irrigation system.

This model has enabled researchers to distinguish between areas where rainwater accounts for the largest share of irrigation water, and areas where large foreign agricultural companies satisfy more than half of their water needs by using freshwater sources, such as groundwater, rivers and ponds.

This has allowed the researchers to highlight the areas around the continent where increased competition for water escalates the risk of water-related conflicts between different sectors and ecosystems.

“Our research can perhaps lead to foreign investors showing greater consideration for how much water is necessary, in relation to how much water is actually

available,” said physical geographer, Emma Li Johansson, who was in charge of the study. “Hopefully, the results can serve as a basis for documents that regulate the water consumption of large-scale farming companies.”

The results have been published in the journal, PNAS (www.pnas.org)

Young children most vulnerable when it comes to nutrition



Five in six children under two years old are not fed enough nutritious food for their age, depriving them of the energy and nutrients they need at the most critical time in their physical and cognitive development, according to a UNICEF report released earlier this year.

“Infants and young children have the greatest nutrient needs than at any other time in life. But the bodies and brains of millions of young children do not reach their full potential because they are receiving too little food, too late,” said France Begin, Senior Nutrition Adviser at UNICEF. “Poor nutrition at such a young

age causes irreversible mental and physical damage.”

UNICEF data show that poor nutritional practices— including the delayed introduction of solid foods, infrequent meals and lack of food variety – are widespread, depriving children of essential nutrients when their growing brains, bones and bodies need them the most.

The findings reveal that, among others, young children wait too long for their first bites. One in five babies hasn't been fed any solid foods by the age of 11 months.

It also shows that half of children aged six months to two years are not fed the minimum number of meals for their age, increasing their risk of stunting.

In addition, less than one-third of children in this age group eat a diverse diet – meaning from four or more food groups daily – causing deficiencies in vitamins and minerals.

In sub-Saharan Africa and South Asia, only one in six children from the poorest households aged six to 11 months eats a minimally diverse diet, compared to one in three from the richest households.

Improving nutrition for young children could save 100 000 lives a year.

Making nutritious foods affordable and accessible to the poorest children will require stronger and more targeted investments from governments and the private sector. Cash or in-kind transfers to vulnerable families; crop diversification programmes; and fortification of staple foods are key to improving nutrition for young children.

Community-based health services that help caregivers learn better feeding practices, and safe water and sanitation – absolutely critical in preventing diarrhoea among children – are also vital.

“We cannot afford to fail in our fight to improve nutrition for young children. Their ability to grow, learn and contribute to their country's future depends on it,” Begin concluded.

THE WATER WHEEL

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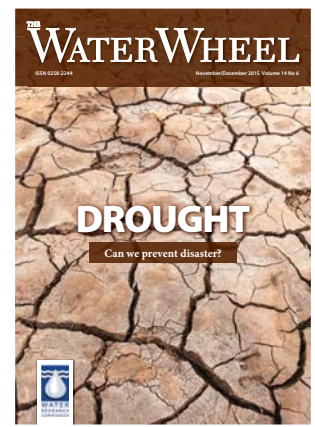
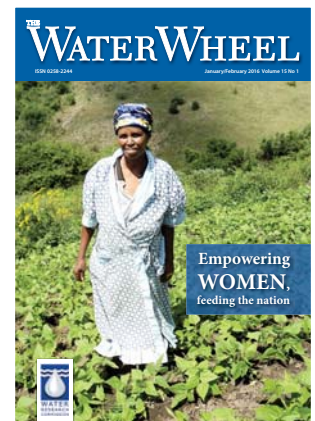
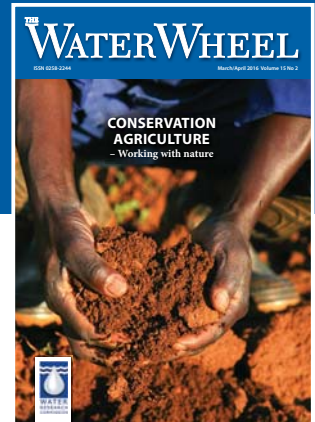
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New WRC reports



Report No. TT 661/16

Nutrient and energy recovery from sewage: towards an integrated approach

The transition to a low-carbon and resource-efficient economy has begun, also in South Africa. Wastewater is increasingly viewed as a 'water-carried waste', presenting opportunities for recovery of nutrients and energy, as well as water.

Ecologically and economically more sustainable sanitation and wastewater management solutions are being explored and implemented. Amongst the sewage-borne resources, phosphorus is an important, non-substitutable nutrient for all life forms, particularly in the growth of plants, and is therefore essential in ensuring universal food security. Human activities have disturbed the natural phosphorus cycle and remain heavily dependent on mining of non-renewable rock phosphate. As a result, there is a particular interest in phosphorus recovery. This technology transfer report firstly explores phosphate recovery possibilities from wastewater, relative to its potential South African market and developments in wastewater treatment. It is structured to address the following aims: Investigate available nutrient recovery technologies and their products, focusing on phosphate; describe a number of cases that have adopted nutrient recovery and assess these from a sustainability perspective; investigate the characteristics of recoverable fertilizer products and obtain viewpoints of experts along the fertilizer-produce value chain on likely social acceptance; present and analyse two cases of how a nutrient recovery process could be incorporated together with energy recovery via anaerobic digestion.

Report No. 2242/1/16

Polycyclic Aromatic Hydrocarbons (PAHs) in the aquatic ecosystems of Soweto/Lenasia

Polycyclic aromatic hydrocarbons (PAHs) consist of fused benzene rings and the congeners have varying numbers of benzene rings, usually between two and six. They have a widespread distribution due to their formation by incomplete combustion of organic materials and are continuously released into the environment making them ever-present. Anthropogenic activities largely increase the occurrence of these pollutants in the environment. A measurable amount of these PAHs are expected to find their way into aquatic ecosystems. In a previous study completed for the Water Research Commission (Project no. K5/1561) on persistent organic pollutants in freshwater sites throughout the entire country, the PAHs had the highest levels of all of the organic pollutants analysed for. According to this study Soweto/Lenasia was particularly burdened with high PAH levels which was the main motivation for further, in-depth

investigation into this area, focusing on the PAHs only. In this study the potential exposure of humans and wildlife to the 16 priority PAHs was investigated. The sites were selected in the suburban areas of Moroka, Lenasia, Fleurhof, Eldorado Park, Orlando West, Orlando East, Nancefield and Dobsonville. The main aim of this study was to determine the levels of the 16 priority PAHs in the Klip River that flows through the densely populated urban areas of Soweto and Lenasia. In addition, the pollutant profile of the 16 parent PAHs in the sediments was investigated, by comparing site PAH composition percentages to determine origin of the pollution, i.e. pyrogenic vs petrogenic. The final aim of this study was to determine the toxicity posed by the PAHs in the study area.

Report No. KV 356/16

Knowledge brokering and dissemination of irrigation management guidelines for training of extension advisors

South Africa faces particular challenges regarding water supply. Parts of what was already a dry country have become noticeably dryer over the past 30 years. Rising temperatures and changing rainfall patterns will have further consequences for food production and water supply. The National Development Plan 2030 proposes the advancement and expansion of agricultural development through effective land reform and growth in irrigated agriculture. This goal, however, requires skilled and well trained agricultural advisors to support smallholder farmers with decision making on opportunities open to them. For many farmers, but especially smallholder farmers, extension advisors play a pivotal role in building capacity through programmed learning and access to information. Appropriate training of extension advisors is urgently required that can respond effectively to the needs of smallholder farmers and to enable them to successfully integrate into the food value chain. The better the extension service – the better the smallholder operation. This report starts by providing the rationale for brokering and dissemination of the learning material, which is followed by an overview of agricultural education and training pathways in South Africa. A brief description of the current training programs offered at agricultural colleges and universities of technology approached precede syntheses of the bilateral discussions and workshop outcomes. Finally, concluding thoughts and the way forward for the implementation and uptake of the learning material is provided.

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