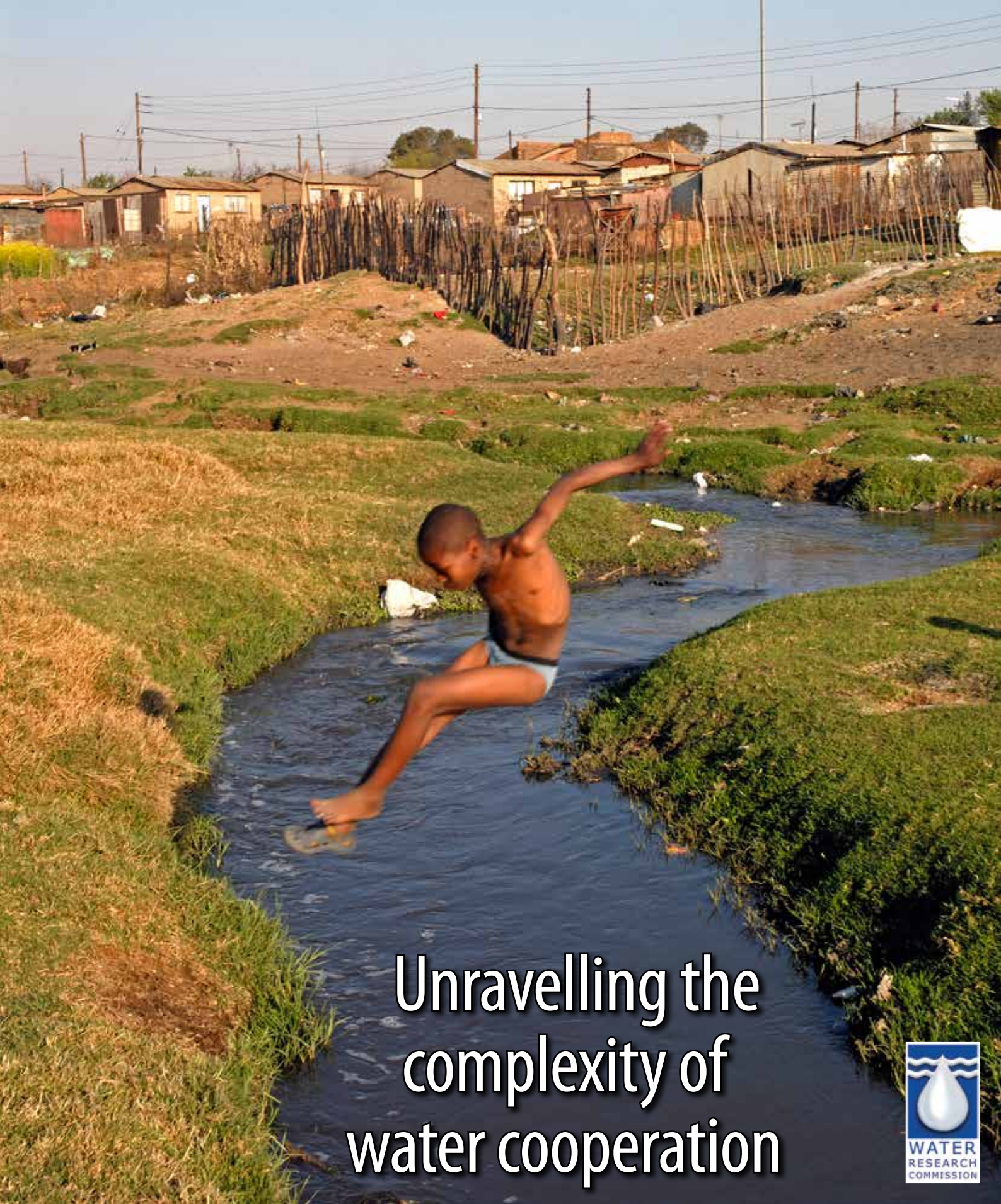


# THE WATER WHEEL

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Unravelling the  
complexity of  
water cooperation





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# CONTENTS

- 4 FLUID THOUGHTS
- 6 UPFRONT
- 10 GLOBAL NEWS
- 13 NEW WRC REPORTS
- 14 WATER COOPERATION  
Shared Rivers Initiative: Supporting the wise use of southern Africa's waters
- 18 POLLUTION  
Study expands SA knowledge of agricultural non-point source pollution
- 22 HUNGER & NUTRITION  
Poor and hungry – Study reveals how little we know about what people eat in SA
- 26 WATER & HUMAN HEALTH  
Detecting the invisible: Encouraging results from study on emerging contaminants
- 30 WATER PERSONALITIES  
Leading the way with innovation in water and sanitation
- 33 YOUNG WATER SCIENTIST  
Every Drop Counts – A water game to remember
- 36 INTERNATIONAL REPORT  
World making peace, not war over water
- 38 WATER HERITAGE  
Steenbras Dam – Faithful supplier of water & power

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#### Editorial offices:

Water Research Commission, Private Bag X03, Gezina, 0031, Republic of South Africa.

Tel (012) 330-0340. Fax (012) 331-2565.

#### WRC Internet address:

<http://www.wrc.org.za>

Editor: Lani van Vuuren,

E-mail: [laniv@wrc.org.za](mailto:laniv@wrc.org.za);

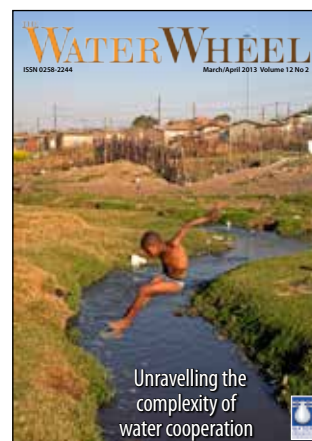
Editorial Secretary: Mmatsie Masekoa,

E-mail: [mmatsiem@wrc.org.za](mailto:mmatsiem@wrc.org.za);

Layout: Drinie van Rensburg,

E-mail: [drinie@wrc.org.za](mailto:drinie@wrc.org.za)

**Cover:** *A young boy jumps over a stream that flows into the Olifants River – one of the rivers under scrutiny in the Shared Rivers Initiative, which is investigating the practicalities of integrated water resource management. Read the article on page 14. (Cover photograph by Graeme Williams/South Photographs /Africa Media Online).*





## World Water Day – working for a brighter water future

On 22 March we once again celebrate World Water Day.

This year is even more special as South Africa's Minister of Water & Environmental Affairs, Mme Edna Molewa, also hosts her SADC Colleague Ministers as the region celebrates this important day in South Africa this year. As a country we represent the global microcosm in many unique ways – not the least being an example of the crossroad between the developed and the developing world.

While we have challenges typical of the developed world, like ageing infrastructure and the water quality challenges associated with hundreds of years of resource intensive industrial activity, we still have the developing world challenges of non-universal coverage of water supply and sanitation and limited developed water infrastructure to support new entrants into the economy.

This is reflected by the trends in the water balance which increasingly move in the

direction of projected negative water balances where supply is being rapidly overtaken by increasing demand. This scenario is exacerbated by climate and weather forecast patterns. The world 'celebrate' may seem inappropriate in the light of these progressive challenges and yet it is not.

The first point of celebration on World Water Day should be an intensified appreciation of this increasingly scarce, most valuable resource. On the most personal level water cleanses us, nourishes us physically, emotionally, spiritually and socially. As a society we acknowledge that the very existence of human society and its development is tied to the availability of adequate water to meet all these demands on a global scale.

The second point of celebration is the increasing solidarity as individual communities, countries and regions realise the need to work together to ensure the best means of protection and sustainable use of the world's

precious freshwater resources driven by various factors. These include higher levels of appreciation of the shared nature of water, and the sharpened focus on the vulnerability of our water systems brought about by the global climate change dialogue and science. The declaration of 2013 as the United Nations Year of Water Cooperation is the theme we carry into our various 2013 institutional strategies. The gathering of the SADC Water Ministers on World Water Day 2013 is testament to this.

A third reason for celebration is the high level of scientific knowledge that is being generated to both increase our understanding of the challenges and developing solutions to meet them head-on. An Elsevier study of *Scopus* publications in 2011 indicated that globally the number of water-related research papers had increased by an average rate of close to 30% per year for the preceding 20 years. A second factor emanating from a 2012

WRC study, this time examining scientometric data from the ISI Thomson Reuters list of journals, indicate that water science productivity ranks 19<sup>th</sup> in the world and South Africa contributes 1.69% of the global share of water related papers compared to the national average of just below 0.5% for all disciplines. It would appear that the South African research community has reason to take a bow on World Water Day.

A fourth reason for celebration is that we are adopting a much more sophisticated approach to developing out the water problematique. We, the researchers, the decision-makers, the water managers and the user communities, are developing an appetite to the complex nature of this 'wicked' problem. The problematique is starting to approach the classical form of a problem tree that offers a framework for its solutions.

The WRC shall in this year of international water cooperation together with various partners, in particular the

### Contextualising the Global /South African water challenge



The topmost circle describes that primary problem of the Demand/Supply equation that is beginning to lean toward a supply deficit. In South Africa this is on the back of the national initiatives to move toward universal water and sanitation access, 20 years of continuous water intensive economic growth and 200 years of industrial, mining and agricultural practices that have challenged the quality of water in our river systems. The further challenge is that an acceleration of economic growth is a fundamental part of the national formula to eradicate hunger, drastically reduce poverty and introduce more people into the ranks of the economically active population in South Africa. The next layer below talks to the challenges of infrastructure (both ageing and an inventory that says what we have is inadequate for South Africa's growing needs). The third layer is the summary of the capacity and capability challenge of inadequate human capital at the correct level of training and competence (technical and managerial), technology gaps as well as technology mastery capability. The final layer of the problem lies in the realm for an increased quantum of knowledge from the natural and physical sciences as well as the social and behavioural sciences to complete the problem-solving toolbox.

Departments of Water Affairs and Science & Technology, be seeking to cement a new set of functional international alliances for the South African water R&D community to make larger, more rapid, contributions to both obtaining a deepened understanding of the nature of the challenges and more importantly developing solutions, technologies and support materials and mechanisms to better enable South African water practitioners and their international partners to help us ensure a much more positive water enabled growth future for Planet Earth. Best wishes to all with your celebrations of South Africa's Water Week and World Water Day.



Domestic wastewater remains one of the most prolific causes of water quality problems in South Africa. The WRC-funded CSIR Sanitation Demonstration Centre, visited last year by the WRC Board, offers a range of sanitation solutions for municipalities.

## Short courses for Water Utilisation Division and Environmental Management

Presented by the University of Pretoria, Department of Chemical Engineering



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**Dates:** 10 - 14 June 2013  
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**Course fee:** R10800.00

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## Letter to the Editor

### Prof Denis Hughes and the Uncertainties of Climate Science

*The Water Wheel* is to be congratulated on publishing the wise words of Prof Denis Hughes (*The Water Wheel* November/December 2012) on the uncertainties regarding climate change.

These statements are timely, accurate and relevant to the present stage of the climate change debate. For too long the proponents of Anthropogenic Global Warming (AGW) have claimed that the science is settled and the Intergovernmental Panel on Climate Change (IPCC) has contended that there is an overall consensus on the issue. Science, by the way, is not based on consensus as Prof Hughes has clearly outlined.

All the AGW forecasts are based on process models which rely essentially on assumptions, and there is no way that the models can be calibrated and proven accurate. This challenge has been carefully avoided by the majority of climate scientists and the technique of denigrating anyone who has the temerity to dispute their findings has been widely used.

As Prof Hughes has said this is not science. Einstein once said that in spite of the wide acceptance of his theories he was fully aware that it would take only one man to prove him wrong. The classic example of this denigration is the treatment meted out to Bjorn Lomborg, author of *The Skeptical Environmentalist*. He was eventually vindicated, but what happened showed the inability of the climate scientists, including South Africa, to meet dissidents in a reasoned, vigorous and open debate. Is it not time for the Water Research Commission to convene a series of seminars to encourage debate?

Can we accept unequivocally that if we change over to a low carbon economy we will avoid the effects of global warming? Why is it that much of the observational data is now suggesting increasingly that temperatures

appear to rise well in advance of the increase in CO<sub>2</sub>? Have the scientists, and the politicians who glibly accept the versions the scientists are pedalling at present, given proper consideration to the implications and consequences of reducing CO<sub>2</sub> emissions or do they not understand the engineering implications of what they are saying? Where are the technologies for carbon capture, for increasing, by orders of magnitude, the present low load factors of renewables such as solar, wind and photo-voltaics or reducing the cost of these renewables? At present they do not exist except in theory.

To meet our needs for the immediate to medium term future while reducing CO<sub>2</sub> output the only options are nuclear or natural gas (South Africa is not endowed with any meaningful hydro-electric resources)? The environmental lobby will virulently oppose the introduction of the latest generation of nuclear power plants which offer the only realistic alternative to fossil fuels and will continue to demand unproven renewables. The present conflict, often ill informed, about fracking is another good example.

Finally, consideration has to be given to the alternative possibility that the rise in CO<sub>2</sub> is not the principal factor in global warming. What if the primary source is a cyclic increase in energy from the sun (the sun after all is the primary driver of climate for without it there is no life on earth)? If this is the case the solutions required will be very different from creating a low carbon economy and we may be faced with massive engineering projects to protect our cities against amongst other sea level rise (note that the sea level has risen about 130 m since the end of the last ice age 11 000 years ago). We need to heed the warnings of Prof Hughes and get a real debate moving before we waste huge sums of money that can be more effectively applied to improve the lives of ordinary people.

**Robert GK Blyth, Pr Eng,  
Cape Town**

### Esteemed award for CSIR scientist



The 2012 JD Roberts Award has been awarded to the CSIR's Dr Kevin Wall. Dr Wall, a registered professional engineer and

town planner, received the award for his leading role in developing innovative solutions for alternative housing, infrastructure asset management and the maintenance of sanitation systems.

Among his lifetime of achievements has been Dr Wall's work to apply franchising models to the supply and maintenance of sanitation infrastructure. His studies have found that the franchising concept and its success in the commercial sector show many characteristics which could alleviate problems encountered in municipal water and sanitation services delivery. At the same time, franchising has the added benefit of stimulating and supporting small business and black economic empowerment opportunities.

Dr Wall has led investigations into the potential of applying franchising principles in the water services industry by the WRC and CSIR since 2005. The franchising model has since been implemented in 400 schools in the Eastern Cape with another 1 100 to follow. In addition 600 households have already benefited.

Awarded annually, the JD Roberts Award is sponsored by Murray & Roberts and held in partnership with the CSIR. Instituted by the contractor in remembrance of company founder Dr Douglas Roberts, the award recognises and promotes competitive and environmentally-sustainable solutions to human dilemmas and encourages scientific research into technology that will enhance the quality of life of all South Africans.

Source: CSIR

### CSIR & DWA seal relationship with MOU

The Department of Water Affairs (DWA) and the CSIR have signed a Memorandum of Understanding (MOU) to jointly develop appropriate and relevant research and technology capabilities to address national priorities in the water sector.

According to CSIR CEO, Dr Sibusiso Sibisi, South Africa's water situation presents the country with an enormous range of opportunities. "In this regard, the multidisciplinary nature of the CSIR allows us to draw from a wide range of skills and expertise in the field of water management."

It was through partnership with the DWA that the organisation hoped to develop an integrated and multidisciplinary solution to contribute to the equitable, efficient and sustainable use of water to ensure that South Africa attains its social and economic growth and development aspirations, Dr Sibisi said.

The MOU follows a number of strategic discussions between the two parties. Cooperation will be sought in a number of thematic areas, including water security in terms of quantity and quality; infrastructure and integrated water resource planning; sector-wide partnerships and collaboration to enable more effective sharing of information; and joint capacity building, among others. Speaking at the event, DWA Director-General, Maxwell Sirenya said: "At a national level, strategic interventions are needed so that we can do things differently. This requires a holistic response, as we have seen that a fragmented and isolated approach results in ineffective solutions."

The CSIR's research work in the areas of water science and catchment management, systems modelling and economic and social sciences, as well as building and construction innovation, among others, hopes to address some of these challenges.

## New programme to build capacity in environmental sector

The South African National Biodiversity Institute (SANBI) has embarked on a major skills development and job creation pilot programme.

Dubbed 'Groen Sebenza' (meaning 'green work') the programme is aimed at developing priority skills in the biodiversity sector to create sustainable

job opportunities for 800 unemployed graduates and matriculants. The human capital development strategy for the biodiversity sector indicates that South Africa has a shortage of skills to manage its biodiversity. Various historical inequalities have also contributed to this skills shortage.

The Groen Sebenza programme has been initiated to respond to these demands, as identified by the various research efforts conducted in the sector. SANBI is partnering with 33 organisations from all tiers of government, non-governmental organisations and the private sector.

According to SANBI, the programme brings young South Africans from previously disadvantaged backgrounds together with experienced biodiversity professionals to learn, grow and eventually gain the competence and confidence to embark on rewarding and meaningful biodiversity careers.

## Tender irregularities hamper infrastructure development, built environment professionals say

South Africa's built environment professionals have voiced their concerns regarding infrastructure bottlenecks and lack of infrastructure delivery in the South African sector.

The Built Environment Professions Grouping (BEP) noted their dismay with perceived inadequacies in government mechanisms to procure professional services. The grouping comprises the Association of Construction Health and Safety Management; Association of Construction Project Managers; Association of South African Quantity Surveyors; Consulting Engineers South Africa; Institute for Landscape Architecture in South Africa; South African Black Technical & Allied Careers Organisation and the South African Institute of Architects.

While these professional bodies welcomed government's revised infrastructure budget in terms of the 18 Strategic Integrated Projects as a positive move, they argue that the barrier to infrastructure delivery lies in the lack of transparency during the procurement processes related to the allocation of professional services and tenders. This manifests itself in the form of obscure decision-making processes and unequal distribution of professional services bolstered by a high potential for corruption coupled with weak accountability mechanisms and lack of scrutiny over allocation of public funds.

One mechanism believed to curb possible corruption is by having greater transparency in the procurement cycle, while the grouping maintains that construction contracts awarded should be openly published. This will increase accountability with infrastructure stakeholders they say.

The BEP further believes that government must include a compulsory evaluation and monitoring unit tasked to, among others, ensure that professionals and departments comply with legislation and offers made with respect to skills and skills transfer made during the bidding stage.

"Professional service providers must be appointed based on a best weighting for price, quality and preference. Best practice in the procurement of professional services is achieved by using a mutually agreed selection methodology (within the legal procurement frameworks) that does not detract from the economic and skills transformation objectives of government," said the BEP in a statement.

"It is vital that the government and built environment professionals work together to create a conducive, sustainable, non-exclusive procurement environment with definitive transformation objectives to ensure efficient project service delivery as well as the sustainable development and growth of the built environment industry."

## Flamingos return following Cape river clean-up

The City of Cape Town is celebrating the return of the Greater Flamingo to the Black River following intensive river clean-up operations.

According to Chair of the Cape Bird Club Conservation Committee, Dr Dave Whitelaw, the Black River is a prominent feature of the city's landscape, being visible from two major roads. "For a number of years, there has been a gradual choking of the river by water hyacinth. The City's perseverance in removing this water weed is applauded, from which the city's image and bird life can only benefit."

The ongoing clean-up programme of the Black River started last year. It entails the control of invasive plants,

removal and disposal of litter, repairs to leaking sewers, and identification of pollution hotspots. While improving the state of the river, the programme is also providing much needed jobs.

"We are committed to building an inclusive and caring society, which means using all of the resources at our disposal to look after the various communities of Cape Town – and the environment in which they live," said Mayoral Committee Member for Economic, Environmental and Spatial Planning, Belinda Walker. "By investing in environmental sustainability projects we are protecting this environment for future generations."

**Source: City of Cape Town**



## WRC Executive Manager chosen as Green ambassador



### Water diary

#### Industry & water March 11-12

The National Cleaner Production Centre of South Africa is hosting the country's first Industrial Sustainability Conference. The conference will focus on issues around enhancing industrial competitiveness through resource efficiency and cleaner production. *Tel: (012) 841-3772; Email: [ncpc@csir.co.za](mailto:ncpc@csir.co.za); Visit: [www.ncpc.csir.co.za](http://www.ncpc.csir.co.za)*

#### International Water Day March 22

International water day is celebrated around the world. This year's theme is 'water cooperation'. *Visit: [www.watercooperation2013.org](http://www.watercooperation2013.org)*

#### Water & Sanitation April 9-11

The International Water and Sanitation Centre (IRC) together various partners, including the African Ministers' Council on Water, WaterAid, and the Water Supply and Sanitation Collaborative Council are hosting a global symposium on Monitoring Sustainable WASH Service Delivery in Addis Ababa, Ethiopia. *Email: [symposium@irc.nl](mailto:symposium@irc.nl) or Visit: <http://monitoringwashservicedelivery.eventbrite.com>*

#### Indigenous knowledge April 17-20

The Department of Science & Technology, in collaboration with North West University, is hosting an international

conference on indigenous knowledge systems at the Birchwood Hotel, Gauteng. The conference will bring together experts, academics, policy makers, government officials, and civil organisations to deliberate on how indigenous knowledge systems, as it relates to science and technology, can be used to the advantage of indigenous and local communities. *Email: [enquiries@nstf.co.za](mailto:enquiries@nstf.co.za) or Visit: [www.nstf.co.za](http://www.nstf.co.za) for more information.*

#### Sludge management May 6-8

The purpose of this conference is to provide a forum for researchers and practitioners to exchange the latest developments in sludge management. *Enquiries: contact Erik Dahlquist at Email: [erik.dahlquist@mdh.se](mailto:erik.dahlquist@mdh.se) or Visit: [www.hsm2013.se](http://www.hsm2013.se)*

#### Hydrology & ecology May 13-16

The 4<sup>th</sup> International Multidisciplinary Conference on Hydrology and Ecology will take place in Rennes, France with the theme 'Emerging Patterns, Breakthroughs and Challenges'. The conference enjoys the support of the International Association of Hydrological Sciences. *Enquiries: +33 2 23 23 5068; Fax: +33 2 23 23 6077; Email: [HydroEco2014@univ-rennes1.fr](mailto:HydroEco2014@univ-rennes1.fr) or Visit: <http://osur.univ-rennes1.fr/HydroEco2013/>*

Newly promoted Water Research Commission Executive Manager: Business Development, Marketing and Communications, Dr Inga Jacobs, has been selected as a recipient of the Green Matter Senior Fellows Award.

Green Matter is a public-private initiative championing the development of quality biodiversity skills. The Green Matter Fellowship is designed to connect a community of outstanding biodiversity champions, to support their professional development and positively profile their work and the biodiversity sector.

The Senior Fellows award recognises the contributions of sector leaders and supports their ongoing work to help support human capital development in the sector. The tenure of the award is one year. During this time, Senior Fellows are expected to play an ambassadorial role for the sector and the Fellowship.

Senior Fellows are also expected to engage with the rest of the Fellowship participants (bursary and professional development award recipients), through face-to-face and virtual networks, and to act as role models and mentors to others.

## New drinking water plant for Botswana

VWS Envig, a subsidiary of Veolia Water Solutions & Technologies South Africa, has been awarded a contract by the AEVMI joint venture to design, supply and commission a 6 000 m<sup>3</sup>/day potable water plant in Maun, northern Botswana.

Located near the banks of the Thamalakane River, the plant is scheduled to be commissioned in September, and will be operated and maintained by Veolia for a subsequent six-month period. The new plant will augment the supply from existing underground water sources which become impractical to maintain during the Okavango Delta's flood season. To maintain consumer demand during these periods, the plant will source water directly from the river.

"River water is high in dissolved organic compounds that give it its characteristic brownish colour and earthy smell and taste, despite its normally low turbidity," explains Peter Healy, VWS Envig Botswana MD. "To make this water suitable for human consumption, we opted for clarification by means of ballasted flocculation to remove the extremely

light-weight organic particles that would otherwise settle very slowly."

Veolia will install its patented Actiflo high-rate clarification system. Featuring footprints that are five times smaller than conventional clarifiers, the system should achieve rapid settling. Healy explains that, after clarification, the water will be polished with multimedia and granular activated carbon filters, and finally disinfected before being fed into the town's pipeline system.

The organisation recommends structural changes to the way in which municipal engineers operate, including the abandonment of long-term employment contracts for key technical and managerial staff. "Tender and bid evaluation committees must include technical, legal and financial executives in joint sittings and professional teams must be allowed to compile reports in an independent manner on tender for the bid evaluation committees."

CESA also calls for the inclusion into procurement legislation of a bribery and corruption act for more stringent action against offenders.





## Water by numbers

- **R5** – The price of Rhodes University's 'idiot-proof' home water quality testing kit, as reported by the *Daily Dispatch*. The kit, developed by doctoral student Catherine Luyt, uses hydrogen sulphide (H<sub>2</sub>S) strip testing to gauge water quality.
- **4 677 Mℓ** – The peak day demand experienced by Rand Water in 2012. The water utility supplied, on average, 3 980 Mℓ/day of water to its customers last year.
- **15 000** – The estimated number of crocodiles that landed up in the Limpopo River from a crocodile farm in Pontdrif following floods earlier this year, *Beeld* newspaper reported.
- **1,3 billion tons** – The volume of food that is wasted each year, according to the Food & Agricultural Organisation, placing unnecessary strain on natural resources. In many African countries the post-harvest losses of food cereals are estimated at 25% of the total crop harvested.
- **7 kg** – The average amount of food wasted per person every year in South Africa, according to the CSIR.
- **13%** – The percentage of wetlands which are still in a natural state in the Western Cape, according to the latest province *State of Biodiversity 2012* report. A further 34% of wetlands have been moderately modified while the remaining 53% are in a critical state.
- **17%** – This is the percentage of river length the Western Cape needs to protect in order to conserve its threatened freshwater fish species, according to the above report.
- **3 100 km** – The length of the South African coastline. There are 300 functional estuaries along the country's coast.

## Professional body calls for more investment in municipal engineers

Corruption and tenderpreneurship, fraud, financial mismanagement, lack of understanding of technical issues/priorities, difficulties with job creation and skills shortages are just some of the challenges that face municipal engineers in South Africa.

According to Consulting Engineers South Africa (CESA), if the country is serious about the empowerment of properly qualified municipal engineers, government should invest in various interventions such as training, development and capacitating of young engineers for employment by the local authorities and make the municipal engineering profession attractive. "Currently, municipal planning is done rather superficially

and only a real municipal engineer and a competent team of visionary planners can sort that out," the organisation said in a statement. "This calls for innovation in unlocking projects, a win-win-mentality, and an entrepreneurial delivery mechanism with sharing of risks."

CESA calls for the embracing of the municipal engineer as a trusted advisor as well as creating a working environment to attract and retain municipal engineers. "Infrastructure delivery's biggest stumbling block is the lack of business integrity which involves, among others, socialising with clients, conflict of interest, use of agents and partners, collusion and bribery and the disregard of procurement regulations."

## International award recognises drinking water quality

The International Water Association (IWA) has awarded Rand Water with an Honorary Award for Excellence in managing its drinking water quality. The award recognises the complexity of the water utility's operations as a bulk water supplier. IWA commended Rand Water for developing a comprehensive training programme and introducing asset lifecycle management as part of its

water safety plan.

The IWA Drinking Water Safety Award scheme recognises excellence in the management of drinking water quality. The scheme is aimed at service providers in low and middle income countries who have made demonstrable progress in improving and sustaining the quality of water provided to urban or peri-urban populations.

**Source: Rand Water**

## Century-old East London WTW in line for major upgrade

The 100-year-old Umzonyana Water Treatment Works, in East London, is to be refurbished in a R50-million upgrade project which will increase its treatment capacity by 30 Mℓ/day.

Royal HaskoningDHV (formerly SSI) has been appointed as the consultant for the project by the Buffalo City Metropolitan Municipality.

"The existing water treatment plant was built in the early 1900s as the main water supply to the Borough of East London and the treatment works has been progressively enlarged from the initial

small, slow sand filtration plant to the existing sophisticated treatment works," reports project manager Victor Helberg. The plant has a present output of some 120 Mℓ/day.

The aim of the project is to meet the increased drinking water demand coupled to new developments and growing number of households in the Buffalo City metro area. The upgrade, which is calculated to meet the anticipated water demand for the next 15 years, will involve the design and implementation of additional sedimentation tanks, sludge ponds, upgrading of

## Water on the web

### [www.thinkeatsave.org](http://www.thinkeatsave.org)

This website forms part of the 'Reduce Your Footprint' campaign launched earlier this year by the United Nations Environment Programme, the Food & Agriculture Organisation and other partners. The website offers simple tips to consumers and retailers on how to stop food wastage. It also allows users to make food waste pledges and provides a platform for those running campaigns to exchange ideas to create a global culture of sustainable consumption of food.

### [www.thewaterchannel.tv/](http://www.thewaterchannel.tv/)

The water channel is an open resource with videos related to water. The website supports, stimulates and inspires people all over the world to work towards better management of water and natural resources. The site is supported by various organisations, including UNESCO and Cap-Net.

### <http://www.capetown.gov.za/en/KeepSavingWater/>

The City of Cape Town's Water & Sanitation Department has launched a new dedicated website aimed at encouraging residents to save water. Online information includes water saving tips, alternative water resources, borehole registration procedure, educational resources, downloadable interactive water audit, posters, pamphlets and videos.

the Mdantsane pump station No. 2, new chlorination and ammonia plants as well as new inlet works.

"The project is especially challenging as portions of previous upgrade work were designed by other consultants, and construction of certain works has been started but not completed," notes Helberg. "Part of our remit is to investigate and incorporate those portions of works into the new upgrade to ensure their effective and beneficial use."

The project is expected to be completed by December 2014.

## UN calls on countries to address lack of women in science and technology

Women and girls run the risk of being left behind in scientific and technological fields if countries do not put measures in place to address discrimination and change traditional attitudes.

This is according to the United Nations (UN), which warned that this gap constitutes an obstacle to nations' progress.

"Women tend to be overrepresented in the humanities and social sciences, and underrepresented in science and technologies, said Claude Akpokavie of the UN International Labour Organisation's (ILO's) Bureau for Workers' Activities. "Measures need to be put in place to redress this imbalance."

According to ILO, the gap between men and women in the scientific and technological fields is linked to pervasive

gender roles and attitudes in different societies – visible in both developed and developing countries – which encourages girls to pursue 'softer' subjects.

Investigations have uncovered gender discrepancies in a number of countries around the world, which are hindering women's participation in science and technology both at school and at work, the agency noted. In the United States, for example, a Yale University study found that women science graduates are discriminated against when applying for research posts. In Iran, the government recently announced that women will be excluded from a wide range of university studies, including nuclear physics and electrical engineering. In China, several universities require women to obtain

higher entry grades than men for science courses.

"Girls are far less likely than boys to study engineering or computer or physical sciences," said Director for ILO's Bureau for Gender Equality, Jane Hodges. "Stereotypes of girls represent them as less interested or capable in certain subjects – such as mathematics and science. This inevitably reduces their access to jobs with better pay or labour markets that may offer better opportunities."

With an estimated 500 million people entering the global workforce over the next decade, Hodges stressed that it is crucial that women in science and technology jobs are not left working at the lowest levels. "Education and



skills training – along with a change in attitudes – are vital to ensure women are not left behind."

Source: UN News

## More investment in agriculture needed



Making more and better investments in agriculture is one of the most effective ways to reduce hunger and poverty while safeguarding the environment.

This is the key message of the United Nations Food & Agricultural Organisation (FAO) flagship report, *The State of Food and Agriculture 2012*.

The world's more than one billion farmers must be central to any agricultural investment strategy as they are the biggest investors in this sector, the report notes. But farmers' investments are often limited by unfavourable investment climates.

"A new investment strategy is needed that puts agricultural producers at its centre," said FAO DG José Graziano da Silva. "The challenge is to focus the investments in areas where they can make a difference. This is important to

guarantee that investments will result in high economic and social returns and environmental sustainability."

New data compiled for the report show that farmers in low- and middle-income countries invest more than US\$170-billion a year in their farms – about US\$150 per farmer. This is three times as much as all other sources of investment combined, four times more than contributions by the public sector, and more than 50 times more than official development assistance to these countries.

Investing in agriculture is clearly paying off, according to the FAO report. Over the last 20 years, for example, the countries with the highest rates of on-farm investment have made

the most progress in halving hunger. The regions where hunger and extreme poverty are most widespread – South Asia and sub-Saharan Africa – have seen stagnant or declining rates of agricultural investment over three decades.

"Recent evidence shows signs of improvement, but eradicating hunger in these and other regions, and achieving its sustainability, will require substantial increases in the level of farm investment in agriculture and dramatic improvements in both the level and quality of government investment in the sector," the report said.

To access the report, Visit: <http://www.fao.org/publications/sofa/en/>



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## Research shows fishways have not helped fish

Despite modern design intended to allow migratory fish to pass man-made structures on waterways, fishways have failed to let economically important species reach their spawning grounds, say an international team of economists and fish ecologists.

The international team, led by JJ Brown of the Masdar Institute of Science and Technology, United Arab Emirates, included investigators at SUNY College of Environmental Science and Forestry, Syracuse; Virginia Tech, the University of Arizona, City University of New York and the University of Victoria, British Columbia as well as the University of Massachusetts Amherst (UMass Amherst).

According to the team, in spite of state-of-the-art fish passage facilities, actual numbers of fish passing through them over several decades reached only a tiny fraction of targeted goals.

The three northeast US river systems studied, the Merrimack, Connecticut and Susquehanna, are historically important for fish populations that migrate from the sea to spawn in rivers.

Numbers of American shad, once one of the America's premier food fish, that passed through dams has hovered around 2% of the target in the Merrimack River and close to 0% in the other two. "Dams are contributing to reduced resilience not only of shad, but all diadromous species," said Adrian Jordaan of UMass Amherst. "The result is that other factors, including

climate change, will have a greater impact on these populations that are at a fraction of their historical levels.

Restoration targets for river herring vary from several hundred thousand to millions of fish. However, in recent years, river herring returns on these rivers have averaged less than a thousand fish. Using publicly available data collected by various agencies since the 1960s, the research team shows that these state-of-the-art fish passage facilities have been unsuccessful.

The authors support finding new approaches to the problem and call for ecologists and economists to propose alternatives to main stem dams. In Maine, they note, one solution was to purchase two main stem dams on the state's largest river, the Penobscot. It offers an ideal situation because it splits into two rivers low in the watershed, allowing augmented hydropower capacity in one branch to compensate the electric utility with alternative power generation.

But Jordaan says it remains to be seen whether the situation there can be improved for fish migrating upriver without more dam removals in the main stem and tributaries.

The researchers caution planners in countries such as China, Laos and Cambodia, where dams are on the verge of being constructed in species rich rivers, such as the Mekong.

## Mercury pollution rising in developing countries

Communities in developing countries are facing increasing health and environmental risks linked to exposure to mercury, according to recent studies by the United Nations Environment Programme (UNEP).

Parts of Africa, Asia and South America could see increasing emissions of mercury into the environment as a result of the use of the toxic element in small-scale gold-mining, and through the burning of coal for electricity generation.

According to the *Global Mercury Assessment 2013* the emissions of the toxic metal from artisanal gold-mining are significantly greater than were reported in 2008. Rising gold prices are driving greater small-mining activity, but new and improved reporting has also provided more accurate estimates of emissions from the sector. Annual emissions from small-scale gold-mining are estimated at 727 t, or 35% of the global total.

Greater exposure to mercury poses a direct threat to the health of some 10 to 15 million people who are directly involved in small-scale gold-mining. The UNEP study assesses for the first time at a global level releases of mercury into rivers and lakes. The report says an estimated 260 t of mercury are being released into rivers and lakes. Much human exposure to mercury is through the consumption of contaminated fish, making aquatic environments the



critical link to human health.

The study provides a comprehensive breakdown of mercury emissions by region and economic sector, and highlights significant releases into the environment linked to contaminated sites and deforestation.

"Mercury remains a major global, regional and national challenge in terms of threats to human health and the environment," said UNEP Executive Director Achim Steiner. "We have many alternative technologies and processes needed to reduce the risks for tens of millions of people. A good outcome can also assist in a more sustainable future for generations to come."

To access the *Global Mercury Assessment 2013* report, Visit: [www.unep.org/PDF/PressReleases/GlobalMercuryAssessment2013.pdf](http://www.unep.org/PDF/PressReleases/GlobalMercuryAssessment2013.pdf)

## Marginal lands are 'prime fuel source' for alternative energy

Marginal lands – those unsuited for food crops – can serve as prime real estate for meeting the nation's alternative energy production goals, according to US researchers.

Scientists at Michigan State University, together with other organisations, have published an article in the journal, *Nature*, showing that marginal lands are a huge untapped resource for growing mixed-species cellulosic biomass. Cellulosic ethanol is a biofuel produced

from wood, grasses or the inedible parts of plants.

"Understanding the environmental impact of widespread biofuel production is a major unanswered question in the US and worldwide," said lead author Ilya Gelfand. "We estimate that using marginal lands for growing cellulosic biomass crops could provide up to 215 gallons of ethanol per acre."

The notion of making better use of marginal lands has been around for nearly

15 years. However, this is the first study to provide an estimate for greenhouse gas benefits, and an assessment of the total potential of these lands to produce significant amounts of biomass.

Among others, the scientists characterised the comparative productivity and greenhouse gas impacts of different crops, including maize, poplar, lucerne (alfalfa) and on-field vegetation. They then used a supercomputer to identify and model biomass production that could

grow enough feedstock to support a local biorefinery with a capacity of at least 24 million gallons per year.

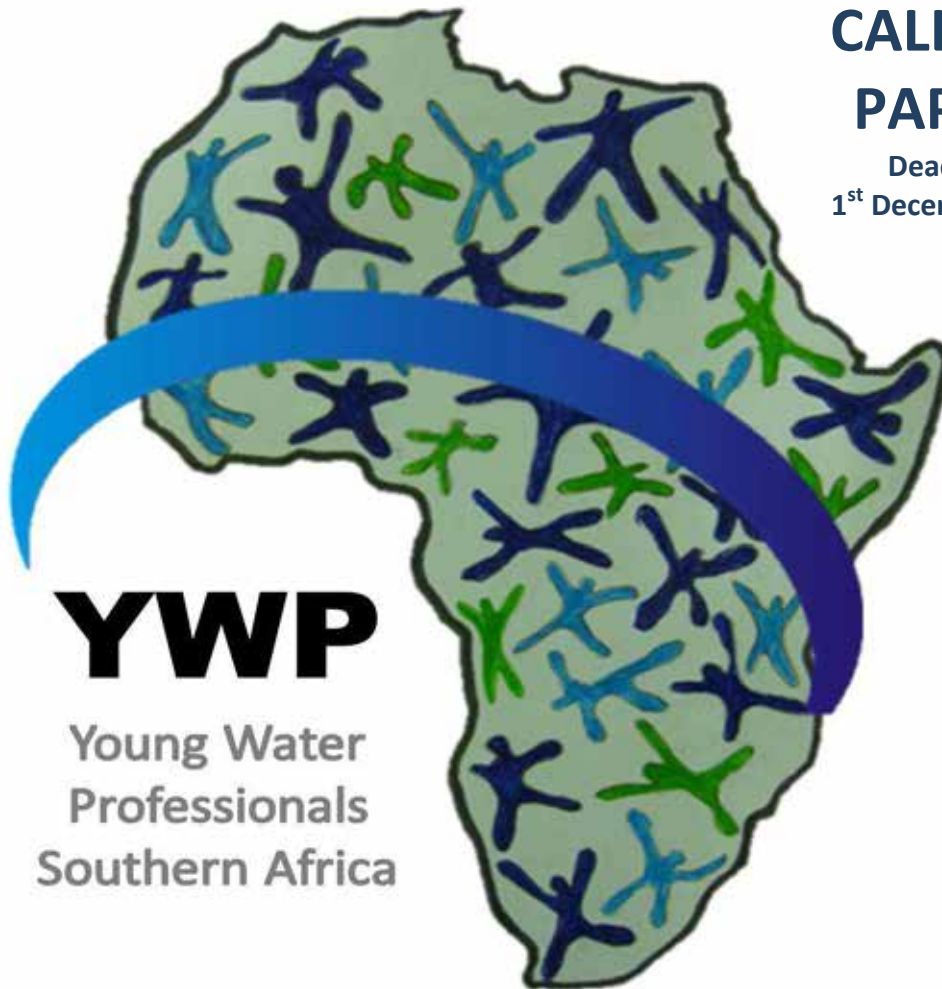
The scientists found that, using marginal lands, the US Midwest could produce up to 5.5 billion gallons of ethanol alone. "The value of marginal lands for energy production has been long-specified and often discounted," said co-author Phil Robertson. "This research shows that these lands could make a major contribution to transportation energy needs."

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## New from the WRC

### Report No. KV 279/11

*The influence on social welfare grants on the dependency on and valuation of wetland ecosystem services (F Lewis; J McCosh & Z Nxele)*

The primary objective of this study was to qualitatively explore whether the introduction of social welfare grants had resulted in a change in the perceived value of, and associated behavioural responses to, wetland ecosystem services by local households. The Mbongolwane Wetland (in KwaZulu-Natal), was used as a case study. This wetland is well known for its importance to local households and small-scale farmers through providing services such as water provision, resource harvesting and crop production.

### Report No. 1918/1/12

*Elucidation of foodweb interactions in South African reservoirs using stable isotopes (WR Harding; RC Hart & LG Muller)*

This research project examined the foodweb structure of the Rietvlei Dam in order to determine the possibilities for fishery biomanipulation as a tool for attenuating the impacts of eutrophication. To do this, the study employed stable isotope analysis techniques for the first time in a South African reservoir.

### Report No. 1968/1/12

*Assessment of the incidence of faecal indicator bacteria and human enteric viruses in some rivers and dams in the Amathole District Municipality of the Eastern Cape Province of South Africa (AL Okoh; T Sibanda; VN Chigor)*

Regional disparities in access to piped water are sizeable in South Africa. When comparing the percentage of the population covered by the service, the lowest rates of access to pipe-borne water are observed in the rural areas of the Eastern Cape. South Africa's surface-water bodies are very vulnerable to pollution, with decomposable organic matter and pathogenic agents, as well as the use of raw/treated wastewater

for irrigation, constituting serious public health risks. This study was motivated by the absence of data on the virological quality of water bodies in the Eastern Cape and the paucity of information of the rivers selected for this study, namely the Tyume and Buffalo rivers.

### Report No. 1904/1/12

*Water, sediment, nutrient and organic carbonic fluxes in small-scale agriculture landscapes (V Chaplot, P Dlamini, C Mchunu, E Oakes, C Orchard, G Jewitt & S Lorentz)*

The fluxes of water, nutrients and carbon at landscape level, in response to natural processes such as soil infiltration by water, photosynthesis or organic matter decomposition, are key regulators of the main ecosystem functions. While most efforts have aimed at describing and quantifying water fluxes at the hillslope or watershed level, little is known about interactions of nutrients and organic carbon in these land features. This research study was undertaken in a 1 000-ha agricultural catchment of the Drakensberg foothills, in the Bergville district of KwaZulu-Natal. It shows a typical association between rangeland, small-scale farming and commercial farming. The study aimed at improving our understanding of the relationship between man and environment in a small-scale agricultural setting, a prerequisite for sustainable use of natural resources and development. Specifically, the project team aimed at understanding the mechanisms of land degradation by both sheet and linear erosion and their consequences on the fluxes of water, nutrients and organic carbon from the ecosystem.

### Report No. 1721/1/12

*Inverse transients to define deficiencies in pipelines (F van Vuuren)*

A major operational and management problem associated with the optimal use of water infrastructure is the identification and quantification of deficiencies

which developed in the system. Two major deficiencies which are difficult to identify in bulk water pipelines is the presence of localised trapped air bubbles and leaks. The objective of this research was to use inverse transients to detect these deficiencies. The procedure of inverse transients is based on the notion that the propagating pressure wave will be influenced by the deficiencies and by analysing the recorded pressures at different locations in the system, the location of the deficiency can be determined.

### Report No. TT 538/12

*Development and applications of rainfall forecasts for agriculturally-related decision making in selected catchments in South Africa (TG Lumsden & RE Schulze (Editors))*

The rationale behind this project was, among others, that the South African climate is highly variable over short and longer periods. This day-by-day as well as intra- and inter-seasonal variability is likely to be amplified by the global changes in climate, along with changes in other baselines such as those of population or land use. Agricultural production and water management are intrinsically linked to climate variability, and many decisions are made based on weather and climate information, especially on assumptions regarding weather and climate in the near future. Farmers need such information to help them plan for operations such as planning, irrigating and harvesting of their crops. Weather and climate forecasting can aid users to make more informed choices and assist in planning activities. However, gaps exist between the products of weather and climate forecasting, both in the links to resulting agrohydrological responses and in the application of forecasting information to agricultural decision-making. Overall, this project aimed to develop and test techniques and models for translating weather and climate forecasts in South Africa into applications for decision support at a range of spatial scales in both rainfed

and irrigated agricultural production and water management, in order to reduce risks associated with vagaries of day-to-day seasonal climate variability.

### Report No. TT 530/12

*The freshwater science landscape in South Africa, 1900-2010. Overview of research topics, key individuals, institutional change and operating culture (PJ Ashton; DJ Roux; CM Breen; JA Day; SA Mitchell; MT Seaman & MJ Silberbauer)*

This study originated as a consultancy contract issued by the Water Research Commission (WRC). The effective management of South Africa's water resources requires an informed and reliable scientific foundation to provide appropriate evidence-based information to guide decision-making. Aquatic sciences, together with engineering, provide this foundation and help to ensure that the country's water resources are managed sustainably.

This study set out to record the evolution of aquatic sciences in South Africa since 1900, identify the external driving forces that helped to direct research, pinpoint the individuals and institutions responsible for shaping the ways in which aquatic sciences developed, and determine the extent to which aquatic sciences have contributed to effective management of South Africa's water resources. This study focused on inland surface waters, while recognising the clear and inextricable links between surface waters and atmospheric water, groundwater, estuaries and open oceans – the other parts of a single, indivisible hydrological cycle.



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# SHARED RIVERS INITIATIVE: Supporting the wise use of southern Africa's waters

*Over the past decades, integrated water resource management (IWRM) has gained prominence as a powerful water management concept. It is an idea that promotes the equitable and sustainable management of a catchment by all who live and share its waters. A closer look at a current research programme aimed at testing IWRM in practice reveals that implementation is much more complex than initially thought.*



*The Letaba River is one of the study rivers in the Shared Rivers Initiative.*

Lant van Vuuren

**E**merging concerns regarding the sustainability of South Africa's water resources contend that despite world-acclaimed legislation, such as the National Water Act (NWA), the ecological condition of the country's river systems – many of which are transboundary – continue to deteriorate.

On the one hand many recognise that at the very least, developments are taking longer than expected to take effect, and an 'implementation lag' is to be expected. On the other hand, with varying degrees of empathy or frustration, stakeholders express the view that government is unable, or even unwilling, to enforce legislation and water users, acting with impunity, take as much as they want. Undoubtedly the reality lies somewhere in between.

There is much that can be shared and learnt between South Africa and its neighbours. The Lowveld river basins, for example, are all shared between neighbouring states. Each country has to achieve their own important resource management and water supply priorities within their portions of their basins.

Each also faces a similar set of needs and challenges in its attempts to balance social development imperatives with management for resource sustainability. There is a clear need to harmonise management and decision-making within relevant institutions and between neighbours to ensure fair and effective policy implementation.

From these concerns has emerged a research programme known as the Shared Rivers Initiative, a transboundary project that aims to understand and effect change in the implementation of policies and legislation relevant to the wise use of the Lowveld river systems. The programme now in its second phase, is led by the Association for Water & Rural Development (AWARD) and is funded by the Water Research Commission (WRC).

## ESTABLISHING THE SUSTAINABILITY OF LOWVELD WATER RESOURCES

**A**s part of Phase I of the Shared Rivers Initiative, AWARD undertook a preliminary assessment of the status of sustainability of the water resources of the Lowveld and the factors that constrain or contribute to this, in order to provide a grounding from which the project was able to design and implement real change. Investigations were carried out in six major river catchments (Levuhu, Letaba, Olifants, Sabie-Sand, Crocodile and Komati). The results of this study are captured in the report, *The Shared Rivers Initiative Phase I: Towards the sustainability of freshwater systems in South Africa* (WRC Report No. TT 477/10).

The investigation did not uncover a rosy picture. Of the Lowveld Rivers investigated, none met the Reserve requirements in terms of river flow. In fact, with the exception of the Sabie River, the situation was found to be generally worse than when the NWA was promulgated in 1998. In many cases, water quality also seemed to have deteriorated. However, some signs of a welcome turnaround were evident, certainly in the Crocodile Catchment which falls in the Inkomati Water Management Area, where new IWRM approaches were due to come online, with water resource classification already underway.

Familiarity with the Reserve was found to vary widely, being better in the Inkomati Water Management Area (WMA) than in the other WMAs, where it was generally weak. Perceptions were often negative: there was a tendency to believe that the Reserve was intended to benefit the Kruger National Park to the exclusion of other stakeholders; the task of interpreting and operationalising outputs from a Reserve determination study tended to evoke

frustration among water managers.

Importantly, the study underlined the importance of a lawful catchment-based system in which water use is authorised, regulated and monitored against the Reserve requirement. This requires not only adequate resources and skills for compliance monitoring and enforcement, but also the involvement of stakeholders in the monitoring, reporting and rectification of transgressions.

Each catchment experienced cases of unlawful water use, often related to issues of municipal and mining expansion and of effluent control. Monitoring and regulation were generally inadequate and lacked coherency. There was a dearth of legal and regulatory support. Owing to the open and unpredictable nature of complex systems, such systems cannot, however, be managed only from the outside.

Self-regulation therefore becomes essential. Throughout all the catchments studied, some degree of self-regulation was evident, especially among established users who share a limited resource. Cases of effective self-regulation provide ideal opportunities for future mentorship programmes.

The Phase I study pointed out that meeting of commitments to the Reserve requires the transformation of policies and practices beyond

*Lake Funduzi, in the Levuhu River catchment, is besieged with sedimentation problems due to improper land-use practices.*



AWARD

**“There is a clear need to harmonise management and decision-making within relevant institutions and between neighbours to ensure fair and effective policy implementation.”**

water conservation and protection. It needs to be embedded in IWRM and requires the collective contribution and synergies of a number of strategies, plans and practices. Progress towards this complex goal was found to vary widely between catchments studied and at different scales examined.

Factors responsible for shortcomings were documented and provide a sound basis for making necessary changes to policies and approaches. Likewise, cases where system resilience was found to be strengthening – especially through collective action, good governance, strong leadership, feedbacks, learning and regulation, offer lessons for weaker situations.

**MOVING INTO ACTION**

Building on the knowledge gleaned from the Phase I study, a second phase of the Shared Rivers Initiative is now underway. The main objective of this project

is to develop a dynamic synthesis of the reasons for the lags in the implementation of the NWA, focusing on the Reserve. It will not be a blueprint for solving the problem, but it will provide the principles and framework to guide water practitioners and managers in solving context-specific problems.

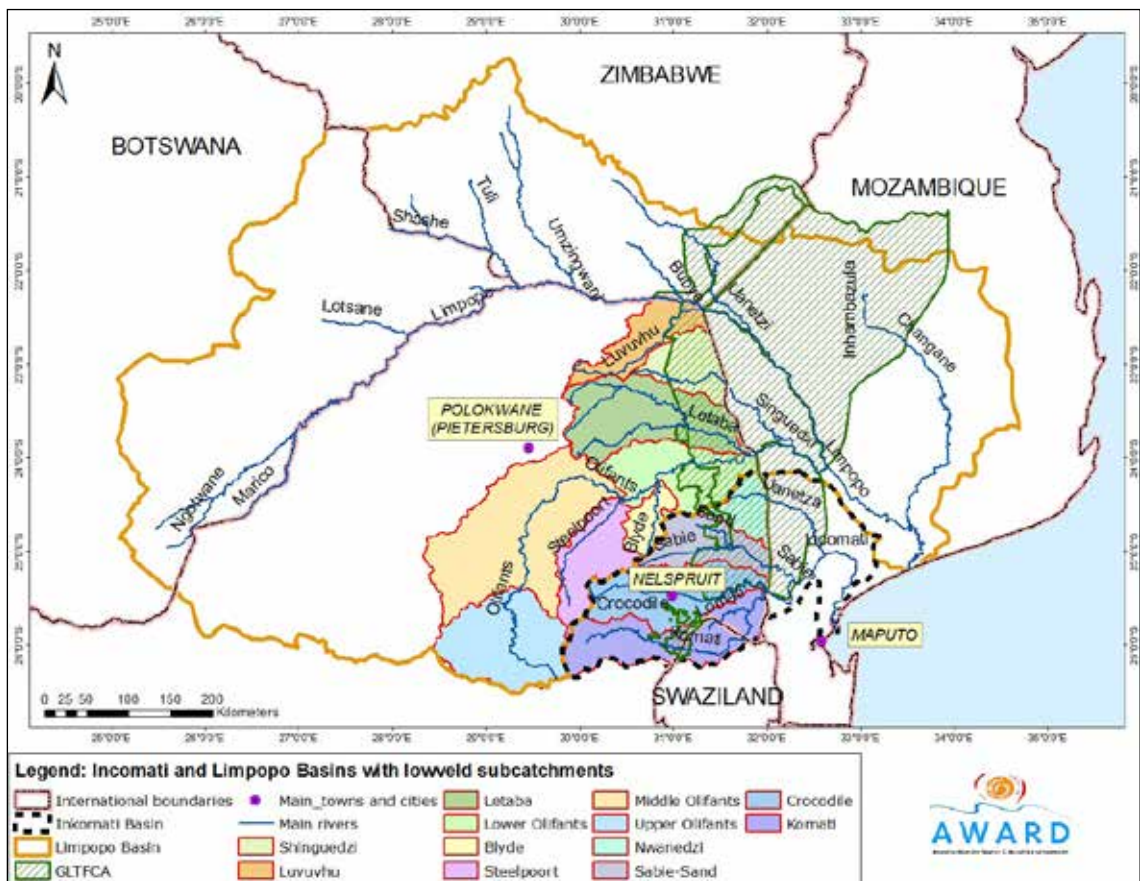
Key to the programme is building of capacity among the people involved in all levels of water resource and service management (relevant spheres of government, agriculture, mining etc.) through action research. A means of working in this study is through collective action, networking, self-organisation and practice-based feedback loops, the aim being to develop these features where they do not already exist. It is anticipated that this will be a collaborative process and some of the outcomes will need to be negotiated.

An important deliverable of Phase II of the Shared Rivers Initiative is to

evaluate the application of legal practices and procedures with compliance with the NWA (with a focus on enforcement and unlawful use) and other legislation related to ensuring sustainability of water resources. It is expected that the output of this study, which was recently completed, will assist government in strengthening its monitoring programmes and prosecution of defaulters.

The legal component has four inter-related areas of activity:

- To undertake foundational legal research around sustainability and enforcement issues related to water resources;
- To undertake a regulatory support project focusing on legal issues related to compliance monitoring and enforcement;
- To document legal case studies and/or focused in depth studies that affect sustainability of water resources, with a focus on compliance, sustainability and/or enforcement; and



The study area, which comprises six major rivers of the South African lowveld.



- To develop professional interest and capacity in water law through the integration of law students in every aspect of the legal component.

Within the context of the NWA non-compliance with the law will directly lead to unsustainable management of the nation's water resources. Consequently, the link between compliance, enforcement and sustainability of the nation's water resources is not difficult to conceptualise.

## MAIN FINDINGS

Several key findings emanate from the legal component of the study. Firstly, it was found that the dearth of legal cases stemming out of the NWA provides little guidance on what constitutes non-compliance with respect to key components of the NWA – such as the classification of resources or the delivery of the Reserve – resulting in uncertainty as to how alleged non-compliance with NWA actions can be litigated in court.

Although court decisions related to sustainability and equity are helpful to understand non-compliance with the NWA, there are few court decisions that directly touch on the NWA implementation issues. Consequently, a lot of uncertainty remains regarding what would constitute non-compliance with important components of the NWA, such as classification of water resources, the setting of resource quality objectives, the finalisation of verification and validation, compulsory licensing, and implementing measures to achieve Reserve determinations. Uncertainty also exists as to how one might prepare a court case which alleges non-compliance with respect to the various components of the NWA.

Secondly, there was found to be a poor understanding of the difference between assignment and delegation of functions to catchment management agencies (CMAs), the latter which is an integral part of IWRM in South Africa as it seeks to decentralise water

resource management. Due to conflicting viewpoints around the assignment and delegation of functions to the CMA and the role the CMA should play in water management, the two CMAs that have been established are far from undertaking the amount of functions that the NWA envisions for them.

Thirdly, the study has shown that regulators undertaking enforcement activities related to water resource protection require substantially more support from within government departments, other government departments and non-governmental organisations. The project reviewed the immense number of challenges on the road leading to an acceptable level of enforcement in order to protect South Africa's water resources and to enable compliance with the NWA.

The research demonstrated that the regulators themselves have a solid understanding of and agree on the main issues facing them. In many instances, they have offered legitimate solutions to tackle these issues. However, as the project team points out, without understanding the underlying causes for the issues that participants identified and how these affect each other, it will be difficult to devise solutions and take meaningful actions to improve enforcement.

In the catchments studied local authorities were found to be major violators of the NWA, with cooperative government requirements making it difficult for the other spheres of government to hold them accountable. Municipalities are critical to ensuring compliance with the NWA and ensuring the implementation of IWRM actions. On the one hand, they can be major violators through mismanagement of wastewater treatment plants, approving unlawful developments, and abstracting water without authorisation. On the other hand, because they have environmental-related powers and responsibilities pursuant to the Constitution, municipalities can also be a major player in promoting compliance with



AWARD

environmental laws.

Lastly, the study recommends that the Water Tribunal's legal mandate and rules under the NWA need to be amended so as to address shortcomings to its functioning as an independent, efficient and expert administrative tribunal. Despite almost ten years since its inception, there is sparse literature reviewing the Tribunal's decisions, its effectiveness in carrying out its mandate and whether its mandate is adequate to enable it to appropriately fulfil its functions as required by the NWA.

Phase II of the study will conclude this year. It is expected that the knowledge gained through the Shared Rivers Initiative will go a long way towards improving cooperative management within South Africa and of the region's transboundary river systems. The latter aspect will be key to Phase III of the study, to be launched later this year. □

*A group of farmers in the Sand River catchment learn about the importance of catchments and the role of planning at this level for sustainable water resource management.*

# Study expands SA knowledge of agricultural non-point source pollution



*All human activities have an impact on water resources. In a water scarce country such as South Africa it is particularly important that all impacts, particularly those that impair water quality, are recognised and managed. A recently published study funded by the Water Research Commission (WRC) has improved understanding of non-point source pollution from agricultural activities. Article by Lani van Vuuren.*

Some kinds of pollution are much easier to identify, measure and control than others. When one is dealing with a sewage spill or dumped chemicals the source and effect of pollution is fairly straightforward. The same cannot be said for fertiliser or pesticides leaching slowly from an irrigated field into the soil. This is but one example of the non-point sources of pollution that a recently published multiyear,

multidisciplinary WRC study aimed to understand.

As project leader, Prof André Görgens, from Aurecon explains, agriculture has been identified as a significant source of non-point source pollution. “Non-point source pollution impacts from agricultural activities include salinisation (through irrigation return flows or salt wash off and leaching under dry land cultivation), eutrophication (through fertiliser leaching and nutrient wash-off from human settlements on farms), sediments (as a result of erosion), pathogens (from intensive animal production), pesticides (through the application of insecticides, fungicides and herbicides), and heavy metals.”

Unfortunately, it seems that non-point source pollution is getting worse, reports Prof Görgens. “The severe deterioration in wastewater treatment by many local authorities across the country during the past 15 years has led to high nutrient

(point-source) loads in many river systems. This sometimes shrouds the nutrient loadings from crop cultivation and dense settlements. We need to take care that this phenomenon does not undermine the much-needed focus on dealing with agricultural non-point source pollution.”

First order estimates were made of nutrients, sediments and pesticides in South Africa’s water resources during an initial scoping study funded by the WRC in 2005. “It was recognised that more detailed research was required to measure and model the impact of this type of pollution from field to catchment scale,” reports Dr Gerhard Backeberg, WRC Executive Manager: Water Utilisation in Agriculture.

This led to the latest study being funded by the Commission, the primary objective of which was to develop an integrated modelling approach to predict agricultural non-point source pollution from field- to catchment-scale for selected

non-point source pollutants. A secondary aim was to develop a modelling approach to examine the economic-environmental trade-offs of agricultural pollution control measures.

The project, which ran for close on seven years, brought together the best available experts from different organisations into one research team. As Dr Backeberg points out, apart from involving specialists in various scientific disciplines, the project also enabled interaction between natural and economic scientists. Nine different institutions and organisations were represented, namely the universities of Pretoria, Free State, KwaZulu-Natal and the Western Cape, as well as the Agricultural Research Council, CSIR, SA Sugar Research Institute, CSIRO (Australia) and Aurecon.

Prof Görgens reports that there are several challenges in South Africa hampering the effective management of agricultural non-point pollution, some of which the project aimed to address. These include inadequate understanding of the economic-environmental trade-offs of non-point source control measures; lack of practical demonstration of the water quality improvements brought about by non-point source control measures; fragmented buy-in by organised agricultural and affected farmers; administrative and regulatory disjuncture between relevant government departments and institutions (both national and provincial) as well as disjuncture between political imperatives and environmental management necessities.

The project was structured into four parallel, but overlapping, phases to ensure research effort synergies and inter-linked research output:

- Phase 1: Observation and monitoring of non-point source pollution processes at point-, field- and catchment-scales (nutrients, sediments and pesticides);
- Phase 2: Developing field-scale non-point source pollution predictive capability via a

bio-physical field-scale model (nutrients and sediments), as well as an expert system (pesticides);

- Phase 3: Developing catchment-scale non-point source pollution predictive capability via catchment-scale biophysical models (nutrients and sediments); and
- Phase 4: Developing economic-environmental trade-off modelling ability, supported by the above biophysical models.

The project demonstrated that combining economic and applied natural sciences in long-term, multi-scale, multidisciplinary research is not only operationally feasible, but also yields notable scientific and technological returns. Apart from numerous cross-disciplinary research process learnings various multiscale and multidisciplinary management decision-support and planning analysis modelling tools were established.

Significant new knowledge has been generated on the identification, monitoring and management of non-point source pollution from agricultural sources in South Africa. “The project allows differentiation between non-point source and point source contributions to the general loadings in river systems; it facilitates prioritisation of non-point source control measures at both field- and catchment-scales; and it highlights the interface between economic considerations and biophysical considerations in water resource quality management,” says Prof Görgens.

With publication of the set of five scientific reports, efforts will now be made to disseminate the results and findings to farmers and officials through information sessions. This will be followed by workshops to determine further actions by various stakeholders. Project members have also presented their findings at numerous conferences and through 15 journal articles.

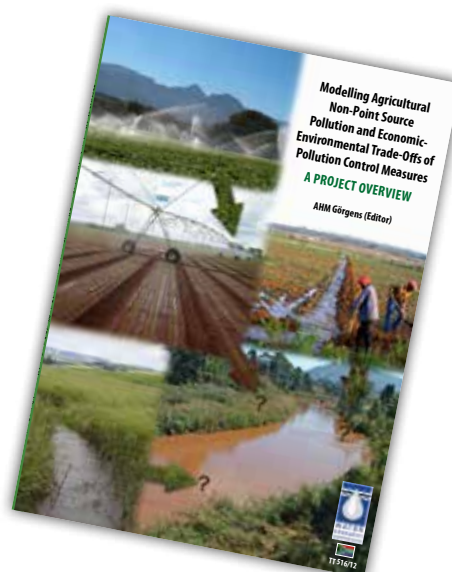
In addition, the WRC has initiated a follow-up project on the contribution of agricultural activities

to pollution of water resources with chemicals contained in pesticides and weedicides in crop cultivation and medicines for livestock husbandry, Dr Backeberg reports. “Attention is given to the impact of these waterborne chemicals on health and the ecology and the extent to which this can be traced to agricultural activities.”

It is anticipated that these efforts will further contribute to sustainable agricultural production while protecting the surrounding environment.

### Reports from this research

- *Modelling agricultural NPS pollution and economic-environmental trade-offs of pollution control measures. A project overview (Report No. TT 516/12)*
- *Modelling nitrogen and phosphorus dynamics in cropping systems at the field scale (Report No. 1516/1/12)*
- *Modelling the fate of pesticides: primary processes, non-point source data collection and guidelines (Report No. 1516/2/12)*
- *Modelling nutrient and sediment dynamics at the catchment scale (Report No. 1516/3/12)*
- *Modelling economic-environmental trade-offs of agricultural non-point source pollution control measures (Report No. 1516/4/12)* □





The heat of the sun provides energy to make the water cycle work.



The sun evaporates water from the oceans into water vapor.

This invisible vapor rises into the atmosphere, where the air is colder.



The water vapor condenses into clouds.



Volcanoes emit steam, which forms clouds.



Air currents move clouds all around the Earth.



Water drops form in clouds, and the drops then fall to Earth as precipitation (rain and snow).



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Snow can melt and become runoff, which flows into rivers, the oceans, and into the ground.



Some ice evaporates directly into the air, skipping the melting phase (sublimation).



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**World Water Day**  
**2013**  
United Nations  
International Year of  
Water Cooperation

You may think that every drop of rain that falls from the sky, or each glass of water that you drink is brand new, but in fact it has always been here and is a constant part of The Water Cycle!



### THE ATMOSPHERE

### CONDENSATION

### EVAPOTRANSPIRATION

### EVAPORATION

### RUNOFF

### THE OCEANS

### PLANT UPTAKE

### GROUNDWATER FLOW

### STORAGE

Rainfall on land flows downhill as runoff, providing water to lakes, rivers, and the oceans.

Some rain soaks into the ground, as infiltration, and if deep enough, recharges groundwater.

Water from lakes and rivers can also seep into the ground.

Water moves underground because of gravity and pressure.

Groundwater close to the land surface is taken up by plants.

Some groundwater seeps into rivers and lakes and can flow to the surface as springs.

Plants take up groundwater and evapotranspire, or evaporate, it from their leaves.

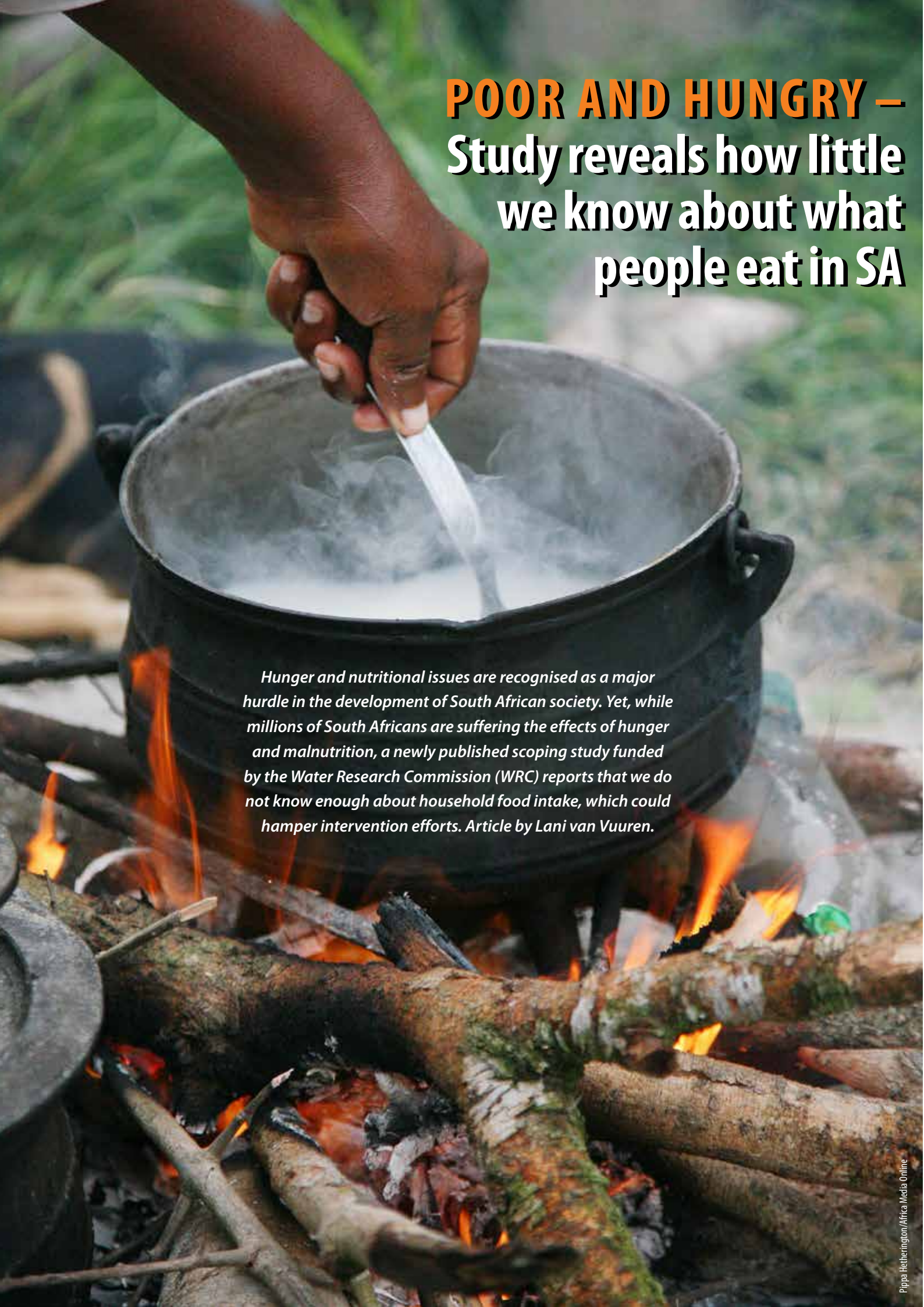
Some groundwater goes very deep into the ground and stays there for a long time.

Groundwater flows into the oceans, keeping the water cycle going.

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TRANSPIRATION

ORAGE

A close-up photograph of a person's hand stirring a large, dark metal pot filled with boiling water. The pot is placed over a fire made of logs and sticks. The background is a blurred outdoor setting with green grass. The text is overlaid on the right side of the image.

# **POOR AND HUNGRY –** Study reveals how little we know about what people eat in SA

*Hunger and nutritional issues are recognised as a major hurdle in the development of South African society. Yet, while millions of South Africans are suffering the effects of hunger and malnutrition, a newly published scoping study funded by the Water Research Commission (WRC) reports that we do not know enough about household food intake, which could hamper intervention efforts. Article by Lani van Vuuren.*

In South Africa, poor rural households are particularly vulnerable to hunger and malnutrition (including overnutrition and undernutrition). The current economic climate and rising food prices are making it difficult for people to achieve a balanced diet. Healthy food seems to be unaffordable for many South Africans and, even more alarming, it appears that, in general, nutrient rich foods tend to have sharper price rises relative to less nutritious foods.

To cope with these conditions vulnerable communities employ various mechanisms, including decreasing their consumption of non-staple foods, such as meats, dairy, fruit and vegetables. This, in turn, increases their risk for micronutrient malnutrition where the body lacks the required vitamins and minerals it requires to function healthily.

One way of improving household food and nutrition security, particularly among the rural poor, is to promote home production of nutrient-rich foods. While many poor residents living in rural areas have access to land and water resources for productive use indications are that food produced at household level currently makes an insignificant contribution to the diet of rural households. In addition, while information is available on what people should be eating on a nutrient level, little is known about what people are actually eating.

It has been recognised that the home-production of specific foods among rural communities should be based on scientific evidence, taking not only current best practice in agriculture and human nutrition into account, but also the socio-cultural context within which the interventions are to take place. Internationally it is accepted that better understanding of the links between agriculture, nutrition and health is a high priority, explains Dr Gerhard Backeberg, WRC Executive Manager: Water Utilisation in Agriculture. “Before researching

water use and nutritional productivity of crops, it is essential to know what food is consumed by poor people; what the nutrient content is of these food products; and which of these foods can be produced by household members, either in homestead gardens or communal croplands.”

These arguments motivated the initiation of a WRC-funded scoping study to investigate what we know about current food intake of rural communities in South Africa and to determine what the knowledge gaps are. The project also investigated the nutritional water productivity of several food crops (for more on this aspect of the project, see ‘Research project helping to tackle malnutrition in South Africa’ in *The Water Wheel* March/April 2012).

The study was undertaken by a multidisciplinary team from the departments of human nutrition and plant production & soil science at the University of Pretoria (UP), the Nutritional Intervention Research Unit at the Medical Research Council (MRC) and the Human Sciences Research Group.

“If we want to change dietary behaviour we need to understand people’s current practices related to food – including the food environment,” say project team members Dr Friede Wenhold of UP’s Department of Human Nutrition and Dr Mieke Faber of the MRC Nutritional Intervention Research Unit. “People get their food from various sources and for different reasons. We cannot impose foods or food practices on people.”

Since malnutrition is the result of many factors, the study took a multidisciplinary approach, including human nutrition, social anthropology and agronomy perspectives. “One plus one is more than two, particularly when each one comes from a different perspective,” says Drs Wenhold and Faber. “When we want to study or promote nutritional status and nutrition security, these many factors need

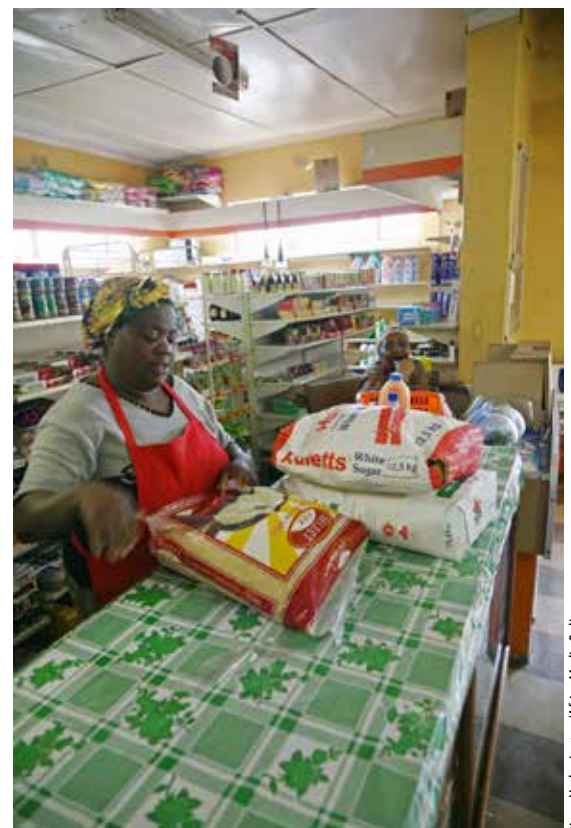
to be addressed: some are directly linked (i.e. immediate causes such as food intake), others are indirect (i.e. underlying causes, such as food insecurity and lack of care), and some are basic causes (e.g. availability of food, access to resources.” This makes a multidisciplinary approach not only advantageous, but necessary.

## DEARTH OF INFORMATION

While several food- and nutrition-related studies have been undertaken in South Africa, particularly at a community and provincial level, the project team found that the available information cannot be taken as being representative of the food intake of ‘rural poor South Africans’. National studies are rare and did not generally distinguish between rural and urban poor, with food data in smaller studies often not comparable.

According to the final study report, the absence of a national

*While it could not be confirmed nationally it seems poor, rural people are buying their staple foods rather than growing them.*



Pippa Hetherington/Africa Media Online

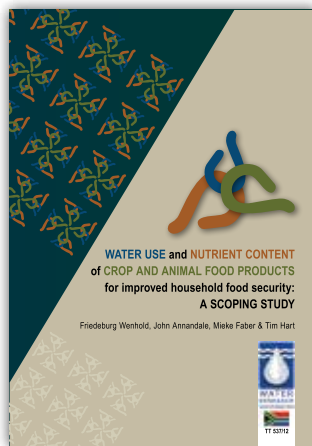
food and nutrition surveillance system makes it difficult to identify periods of food shortages related to factors such as seasonality, periods prior to pay-out of social grants and shocks at household level (such as funeral costs or the migration of an income earner), all of which have been shown to impact on household food security. The vast majority of studies focus on infants and children.

According to Drs Wenhold and Faber, nutritional studies were also found to be limited in many cases. "Questionnaires often focus on the main source of food (which is usually purchased) without going into greater detail on supplementary sources."

The reasons for food intake are determined by a range of factors. These include individual, household, cultural and ethnic group preferences, location, season, income and affordability, historical factors, knowledge and education, and social networks. An understanding of the reasons for food choices is important as these factors influence the food and nutrition security of households and individuals.

The project team found that the reasons for food intake were not considered in many studies. None of the national food surveys reviewed

To order the report, *Water use and nutrient content of crop and animal food products for improved household security: A scoping study* (Report No. TT 537/12) contact Publications at Tel: (012) 330-0340; Fax: (012) 331-2565; Email: [orders@wrc.org.za](mailto:orders@wrc.org.za) or Visit: [www.wrc.org.za](http://www.wrc.org.za) to download a free copy.



considered seasonal difference in food availability and accessibility and how this may impact on food choices. In addition, despite the importance of basic services factors such as access to basic water, sanitation and healthcare, these were not generally considered in any detail in the studies reviewed.

While general trends have become apparent, there seems to be insufficient available evidence to compile a basket of contemporary food intake of poor households in rural areas of South Africa. "The major finding of this scoping study is that we do not know what poor people are eating and where they are sourcing their food," notes Dr Backeberg. "The problem is therefore that informed advice and intervention on a balanced diet with a variety or diversity of foods cannot be undertaken. This means that much more attention must be given to the type of food consumed (which is the source for e.g. carbohydrates, protein and vitamin) and what the best available, most affordable and acceptable source of that food is."

## WHAT DO WE KNOW?

From the findings it does appear that poor, rural households – like many other poor households in South Africa – lack dietary variety. This is the greatest challenge to improving food security and nutrition in South Africa. Diets have generally been found to be monotonous and cereal based, with a low intake of fruit, vegetables and food of animal origin.

Although not conclusive, it seems that most poor people are buying and not growing the food that they are eating. At the same time it is of major concern that available natural resources (water, soil, plants, etc.) are under-utilised. This despite the fact that at least 40% of the population (i.e. 20 million people of which approximately 70% live in rural villages) are hungry and under-nourished.

"More research is required to obtain knowledge, in other words, information that is useful for decisions and actions, on how incentives can be improved and capabilities strengthened. It is absolutely essential that poor people gain secure access to available resources and have practical skills for beneficial food production," says Dr Backeberg.

*Many rural consumers are heavily reliant on informal markets for their food.*

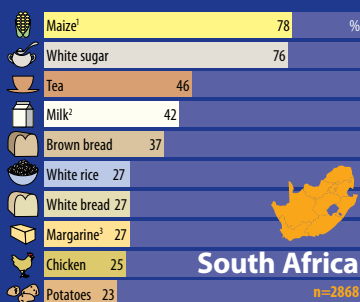
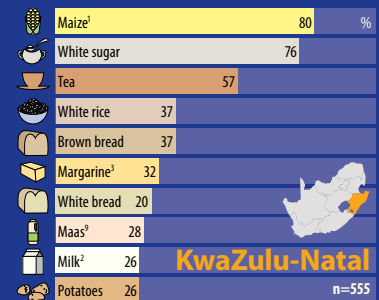
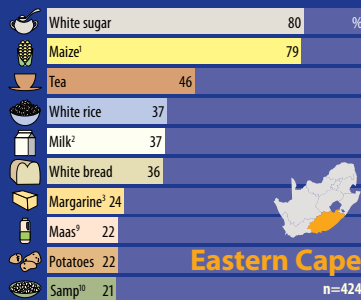
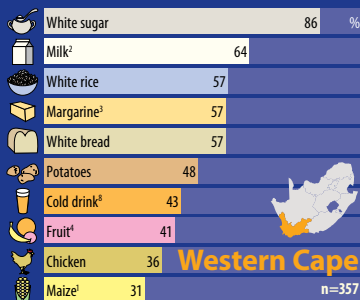
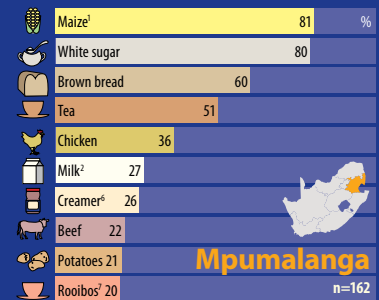
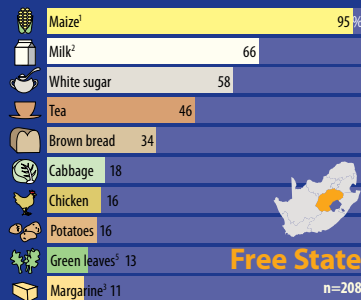
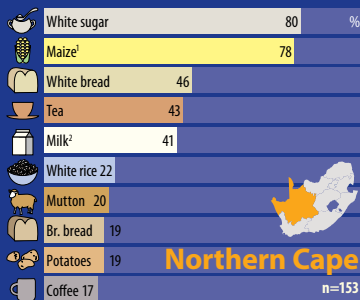
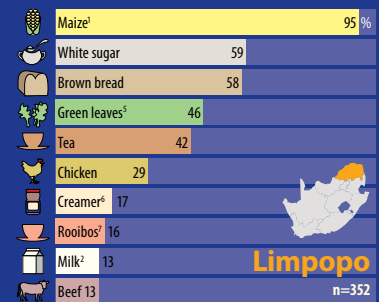
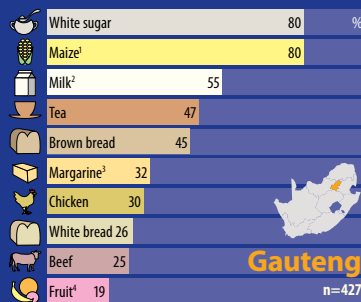
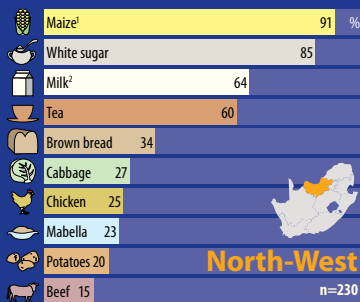


Lani van Vuuren



# Commonly consumed foods

## SOUTH AFRICA



Each bar represents the % of children who ate the food on the surveyed day



- <sup>1</sup> Maize: Maize meal – eaten as porridge
- <sup>2</sup> Milk: Whole
- <sup>3</sup> Margarine: Hard (brick) margarine
- <sup>4</sup> Fruit: Excludes vitamin C- or A-rich fruit
- <sup>5</sup> Green leaves: Green leafy vegetables
- <sup>6</sup> Creamer: Non-dairy whitener used in tea/coffee
- <sup>7</sup> Rooibos: Tea
- <sup>8</sup> Cold drink: Cordial made with water
- <sup>9</sup> Maas: Fermented milk
- <sup>10</sup> Samp: Samp & beans

Source: National Food Consumption Survey | Date: 1999 | Target group: A representative sample of 1-9 year old children



As a result of the high percentages of food purchasing in poor, rural areas, food intake is mainly related to cost and availability. Food prices were found to be higher in rural than in urban areas while wages were lower in rural areas. As a result the regularity of which food products are purchased largely depends on income quantity and frequency. For example, studies of inland villages in the Eastern Cape found children only consumed meat once a month at the time of the monthly pension pay-out.

In addition, variety is generally less in rural areas, even within super-market chains, and many rural consumers are heavily reliant on general dealers, spaza shops and what they can purchase from local informal markets, hawkers and producers. Access to electricity and refrigerators is also a factor when it comes to storing food.

At the national level, South Africans' main food-related purchases are maize, wheat, bread, and salt. Key micronutrients generally lacking in the diet of rural poor people are Vitamin A, iron and zinc. The study confirmed that the onset of HIV/AIDS in southern Africa is exacerbating food insecurity and malnutrition. This is because HIV/AIDS mostly affects the

economically active and able-bodied members of the population, reducing household resilience and ability to recover from shocks and stressors.

Only in some studies was it found that food sources are sourced from the wild. In Limpopo, intakes from green leafy vegetables appear to be higher than the other provinces. In addition, while many households owned livestock, it was not a major source of food for household consumption.

Consumption of non-home prepared foods seems to be on the rise in line with international trends. Away-from-home consumptions include school tuck shops, formal or informal street vendors and fast food establishments as well as food eaten at community gatherings, for example at funerals. Feeding schemes may also be a source of food. Overall, these outside foods seem to be less nutritious (i.e. high in sugar and/or fat) thereby contributing to levels of overnutrition.

## FOLLOW-UP STUDY

While the study has identified many challenges to food security and nutrition in South Africa, it has also identified opportunities. The WRC is already funding a follow-up study focusing on

rain-fed and irrigated production of food crops and their potential to meet the all-year nutritional requirements of rural poor people in South Africa. The provinces of North West, Limpopo, KwaZulu-Natal and the Eastern Cape have been prioritised as this is where the majority of rural poor people live and produce crops under rain-fed and irrigated conditions.

This action research project is aimed at, among others, identifying and strengthening water productivity strategies for home-grown crops in order to improve the supplementation of food for rural poor households from homestead gardens.

Drs Wenhold and Faber point out that close collaboration between nutritional and agricultural specialists is required at all levels to develop sustainable and acceptable strategies to improve production of foods in rural areas. "This will contribute to solving the major nutritional problems encountered, and making sure that communities have the technical support to sustain these. At the same time, it is important to ensure that these interventions are socially, culturally, and economically appropriate."

According to Dr Backeberg the WRC will continue to make food security and improved nutrition a priority as it has done for the past 12 years. "I am absolutely convinced that with current realities of 50% of the population experiencing hunger and 40% to 60% of households being food insecure, priority attention must be given to eradication of hunger and improving household food security.

"Based on the generally accepted definition of food security, this means that all people at all times must have access to nutritious and safe food for a healthy and active life. Only under these circumstances can each individual who is a member of a household and a group in a rural village be economically active and contribute to a caring and prosperous society." □

*The WRC study found that food prices are higher in rural areas while wages are lower than in urban areas.*



Pippa Hetherington/Africa Media Online



## Detecting the invisible: Encouraging results from study on emerging contaminants

*Emerging contaminants are becoming a worldwide concern as world authorities are grappling with the contaminating byproducts of our modern society. A study funded by the Water Research Commission (WRC) has tested the local waters for these previously elusive substances with encouraging results. Article by Lani van Vuuren.*

Humans have witnessed incredible progress in the modern era – our technologies are getting smarter, our beauty products are allowing us to remain beautiful and medical breakthroughs are making us live longer, healthier lives. But these developments come at a price. Pollutants which have erstwhile been undetected and are largely unregulated are now entering our water resources at levels that may be posing risks to human health and the aquatic environment.

New detection and monitoring methods are now allowing us to determine the potential risk of

these emerging contaminants and monitor their levels in our water sources. WRC Research Manager, Dr Kevin Murray, explains: “Emerging contaminants include chemicals and microorganisms that up to now have not been considered a problem in our natural waters. This may be because they are new or because it has only now come to light that they may be problematic as a result of new analytical methods that can now detect them or because of new toxicity information.”

These substances include pharmaceuticals, pesticides, hormones, disinfection byproducts, personal care products and fragrances,

industrial and manufacturing chemicals, nanoparticles, organic solvents and recreational and non-controlled drugs, among others. Since many emerging contaminants are legislatively unregulated this may allow substances to be released into water resources at levels that could pose a health risk.

In some cases, these compounds may interfere with our endocrine systems (these substances are known as endocrine disrupting compounds or EDCs). EDCs have developmental, reproductive, neurological and immunological effects at certain levels of exposure. Research has shown that such effects are most pronounced during prenatal and early post-natal development, at a time when organs and neurological systems develop.

The contamination of countries' water systems by these products is quite widespread. A survey by the US Geological Survey (USGS), for example, found at least one emerging contaminant in 80% of streams assayed. Compounds such as antidepressants, caffeine, cholesterol, the plasticiser Bisphenol A, and triclosan (an antimicrobial found in many disinfectant soaps) are frequently detected in streams.

## EMERGING CONTAMINANTS AND DRINKING WATER

The levels, seasonal fluctuations and effects of emerging contaminants on health at environmentally observed concentrations are largely unknown. Typically, acute toxicity is not a real concern with these compounds (except in the case of a major chemical spill), however, there is concern regarding the potential effects of long-term exposure to low dosages.

Advances in detection and monitoring technology, such as mass spectrometry, have allowed the highly sensitive detection and identification of emerging contaminants

*Christiaan Odendaal, a Ph.D. student in Environmental Management at the University of the Free State, attaches a column to a high performance liquid chromatography system which separates emerging contaminants before they are detected or quantitated in a mass spectrometer.*



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**“Until now, no comprehensive, national survey has been undertaken on the presence of emerging contaminants in drinking water in South Africa.”**

in water samples, thus increasingly attracting the attention of water quality administrators and environmental scientists. Many developed countries have started taking action against emerging contaminants. In the US, for example, the Environment Protection Agency (EPA) has published maximum contaminant level goals while the USGS has an emerging contaminants project and a list of contaminants proposed for regulation. In the European Union, drinking water directives have been issued which include guideline levels for a range of emerging contaminants.

South Africa's present knowledge of emerging contaminants, on the other hand, is not well developed. Until now, no comprehensive, national survey has been undertaken on the presence of emerging contaminants in drinking water in South Africa, and there is no national programme that reviews possible health impacts of EDCs or routinely monitors emerging contaminants in drinking water.

According to Dr Murray, this is partly because the analytical methods required to detect and monitor these contaminants are quite demanding and expensive. Detecting emerging contaminants requires not only appropriate scientific instruments, but also highly-trained

staff. “We are only now beginning to establish the necessary expertise in South Africa to detect and monitor these contaminants.”

It has become crucial to significantly and urgently expand our knowledge on emerging contaminants in our water resources, and to develop a coherent scientific response to this presence. It is for this reason that the WRC has been funding a scoping study into emerging contaminants and their potential influence over drinking water quality in South Africa. The study has been led by the Advanced Biomolecular Research Cluster at the University of the Free State.

The ultimate aim of the research project – which was being finalised at the time of writing – is to provide the necessary scientific knowledge to guide future policy directives regarding emerging contaminants in South Africa. A research strategy to guide further research into emerging contaminants is also being developed as part of the study.

According to project leader, Prof Hugh Patterton, Professor and Director: Advanced Biomolecular Research Cluster, the WRC-funded study has provided an important first glimpse into the state of drinking water in South Africa in terms of the presence and levels of emerging contaminants.

## TESTING THE WATERS

In order to gain insight into the range of possible emerging contaminants present in South African drinking water the project team first undertook a limited, qualitative screen of drinking water in two major cities. Samples were taken at different times over several months. The team used liquid chromatography tandem mass spectrometry – a chemistry technique that combines the physical separation capabilities of liquid chromatography with the mass analysis capabilities of mass spectrometry – to analyse the samples.

The aim of the exercise was to develop a rough list of possible ECs to eventually quantitate as part of a national survey. A total of 11 contaminants were detected over the sampling period. From the initial list three emerging contaminants were selected for further study, namely atrazine, terbuthylazine, and carbamazepine. The first two contaminants are widely used pesticides, while the latter is an anti-convulsant and mood-stabilising drug. The three contaminants were chosen on the grounds of the severity of their adverse health effects as well as their widespread presence in the initial water samples.

Water samples were then taken over four seasons at water treatment plants in all of South Africa's major cities where the treated water enters the reticulation system. Tap water was also tested at several sampling points. All of the water treatment plants were willing participants in the project. Prof Patterson reports that the logistical arrangements to get the water samples back to the laboratory as quickly as possible after taking each sample proved quite a challenge.

Satellite imagery of the sampling sites played an important role in identifying critical precursors of pollution in areas surrounding water treatment plants and in catchment areas. Factors including agriculture,

forestry and human habitation may suggest an expected degree of pollution. For instance, areas of high agricultural activity will suggest likely pesticide pollution. Sites such as industrial areas and power stations will also be important sources of water pollution.

**“The study has contributed significantly to the groundwork required to effectively manage emerging contaminants in South Africa.”**

Carbamazepine was primarily found at higher concentrations in the tap water of Bloemfontein and Pretoria. In turn, atrazine was found to be more prevalent in Bloemfontein and Johannesburg, where run-off from farms in major summer grain producing regions could conceivably introduce the weedicide into the drinking water. The highest concentrations of terbuthylazine were found in Pretoria.

The news was not as bad as expected, however. *All* of the samples analysed for all of the contaminants from all the water treatment plants in each of the four seasons were below the limits at which these contaminants pose a health risk, according to the EPA. This is assuring news, says Dr Murray. “From this project we know that the three selected contaminants at least do not seem to be at levels that should cause immediate alarm. This means we have our eye on the ball at present.”

Prof Patterson adds that, while it is unlikely that the levels of the three emerging contaminants in the drinking water sampled currently pose a risk, there are many emerging contaminants which have not been quantitated, and which still require attention. “There is a clear need for a more comprehensive, routine testing of drinking water

for the presence of emerging contaminants in South Africa, including borehole water and untreated surface water consumed by rural communities. More research is also required to better understand the impact of the many compounds on human and environmental health.”

Various actions can already be taken to reduce the risk posed by emerging contaminants. This includes proper management of landfill and medical waste sites, proper discarding of unwanted medicines, appropriate use of modern pesticides matched to the need of the pesticide, the use of organic agricultural approaches wherever possible, and the strict enforcement of legislation governing introduction of industrial waste into surface water systems.

The study has contributed significantly to the groundwork required to effectively manage emerging contaminants in South Africa. It has also built much needed capacity and expertise. “The project has established a centre of analytical expertise, while providing important information on the levels of some of these contaminants in our drinking water around the country,” says Dr Murray.

Future investigations are expected to build on the results of the WRC project. This will create the armoury of knowledge necessary to take decisive action against the challenge of emerging contaminants in South Africa. □

*Christiaan Odendaal adjusts the flow of a solid phase extraction (SPE) cartridge manifold. Water is passed through a SPE cartridge to concentrate emerging contaminants in a water sample prior to analysis.*



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## Leading the way with **INNOVATION IN WATER & SANITATION**

*Head of eThekweni Municipality's Water and Sanitation Unit, Neil Macleod, manages an organisation with 3 000 staff members and an annual budget in excess of R5,2 billion. Debbie Besseling speaks to him about his extensive experience in the sector and some of the unit's innovative research collaborations.*

**What does your position as Head: Water and Sanitation entail?**

**M**y job is to make sure that the eThekweni Metropolitan region, a municipality which comprises 3,5 million people, has access to quality drinking water supply and sanitation services that disposes of sewage safely.

**You have been with eThekweni Municipality for some 40 years, tell us about the early years of your career?**

**I** was initially a loan student with the Council, they assisted me with paying for my studies. In return I worked for them for a period of four years to pay back the loan. I undertook vacation work for the Council and was

involved in building the 4<sup>th</sup> Aqueduct which serves as a key bulk water main supplying the Municipality. I also worked on the Durban Heights Waterworks project, as I had specialised in water supply and hydraulics at University. I started in the Design Branch, being involved in designing water trunk mains and reservoirs. I gained a lot of experience during the five years that I was in the branch and then was made Manager of Operations. I progressed relatively quickly in the organisation and for the past 21 years have been the heading up the Water and Sanitation Unit.

**What milestones can you highlight that have taken place in terms of water and sanitation developments at eThekweni over the past two decades?**

**A** very significant development was in 1992 when the restructuring took place. The City went from running itself with a Treasurer and a City Engineer to creating business units, where they appointed heads to run every aspect from finance, human resources, through to engineering. These individual businesses were ring-fenced with their own accounts. That was a major change in terms of the

traditional concept of municipal engineering.

The second change that I would like to mention that has taken place over the last 12 years is the way we have brought services to people. In the year 2000, we had a million people without access to services. Since that time the number of people that needed services has grown by a further 400 000. However, in the intermediate time, (other than approximately 50 000 people), the residents of our Municipality now have access to water services. Wiping out the backlog and rolling out services at scale to over a million people, in a relatively short period of time is quite remarkable.

**eThekweni Water and Sanitation is known for its innovation. Tell us about that?**

**A**t eThekweni Municipality we have created a culture of innovation. There is a list of innovations that have come through over the years. If we look at our history and go back to 1997, that was when we started with free basic water. At that time we were extensively involved in engaging with our communities and undertook research to bring in free basic water, which became a national

policy after 2000. This, in turn, led to the invention of flow limiters that enabled us to manage the amount of water delivered to individual homes. The Debt Relief Programme is a relatively new initiative that tackles our debt recovery – we have collected well over a R100-million through this project. These are just a few of the innovations that have been developed by eThekweni Municipality.

### What have been some of the highlights of your career?

On 3 January I had been with the Municipality for 40 years. I have really enjoyed my job and that for me is a highlight of my career. We have been given the political support and an environment in which we can be innovative and try out new ideas and technologies, allowing us to move to new levels. We work in a creative environment where our people can constantly develop. Our work has attracted a significant amount of international attention. As a result I have been fortunate to have met many interesting people, including Prime Ministers, Queen Elizabeth II of the United Kingdom and Bill Gates. Also of significance is how we have made a difference in people's lives by giving 1,3 million people access to water.

### What kind of challenges does the municipality face?

We are typical of most of South Africa's municipalities in meeting the rapid demand for services as a result of urbanisation. We have up to 30 000 families a year moving into the municipality requiring services. That's over 150 000 people moving into the metropolitan area in one year. So we have to wipe out the backlog while also providing services to the people moving into the urban areas. This is an international trend, it is not just a South African problem.

Another challenge for us is non-revenue water (NRW), and the theft of water. The damage this does to our

network and to our overall liability is enormous. A few years ago our NRW was 45% and in more recent months it has been 34%. Half of our NRW is due to water theft and because we have rolled out reticulation across the entire municipality, water is available everywhere.

Having skilled artisans is another challenge. We have been very fortunate that we have been able to retain our skilled management. We just don't have as many plumbers and mechanical artisans and electricians as we used to have. We need more skilled people who work with their hands.

I must make mention of fraud and corruption which seems to be a new cancer that is attacking our organisation and many others across the country. There needs to be harsh penalties to pay for corruption.

### eThekweni has been involved in several water and sanitation innovations, please tell us more about your latest research partnerships:

**Reinvent the Toilet Challenge:** The Pollution Research Group (PRG) in the School of Engineering at the University of KwaZulu-Natal has received a grant from the Bill and Melinda Gates Foundation (BMGF) to participate in the *Reinvent the Toilet Challenge* (RTTC). The Challenge's end objective is to produce

a new-generation self sustaining toilet that is able to convert human waste into sterilised fertilizer, potable water, mineral salts and electrical energy. The new-generation toilets will, in contrast to the current standard waterflush toilet, avoid the use of large amounts of clean water and energy to dispose of excreta and instead will treat human waste as a valuable resource. The toilet will be off-the-grid, doing away with the need for a connection to large electricity, water or sewerage networks. Affordability is a key goal of the RTTC, with a target combined capital and operating cost for the toilet of less than 10 US cents per person per day.

The toilet will integrate several operations to process the different components of the waste stream (faeces, urine, rubbish and wash-water) and recover the useful constituents. The PRG's work covers aspects including the design of a pedestal capable of splitting the four waste components at source, characterisation of the waste input streams, and processes for treating the faeces and urine.

**Nutrient recovery through urine separation: Role of health and hygiene education:** Health and hygiene education is one tool that has been used in many countries in the course of urine diversion



Neil Macleod (second from right) with team members working on research related to nutrient recovery through urine separation.

Over the years eThekweni has rolled out thousands of urine diversion toilets to needy residents.



implementation to encourage acceptance, use and maintenance of the facility. Hygiene education is an indispensable part of water supply and sanitation projects, it ensures improved health and sustainability of asystem after the assistance of technical experts has been withdrawn. This project aims to explore the influence of health and hygiene education on the social acceptance, utilisation and maintenance of urine diversion toilets.

**The Newlands-MashuDEWATS project:** The eThekweni Municipality in partnership with the PRG are investigating a modularised decentralised wastewater treatment system (DEWATS) plant for on-site waterborne sanitation. The plant was designed by the non-profit organisation, Bremen Overseas Research and Development Association (BORDA) which specialises in the design

A typical view inside one of eThekweni's communal water and sanitation blocks.



and implementation of DEWATS plants.

**Communal ablution blocks:** The objective of this study is to explore existing and potential opportunities and challenges to the provision of communal water and sanitation facilities to low-income consumers living in informal settlements of eThekweni Municipality. This study was carried out in 31 informal settlements. In all, a total of 50 communal ablution block sites were surveyed. These blocks consist of two prefabricated shipping containers modified to meet appropriate communal sanitation standards.

The containers (serving male and female users respectively) service 50 to 75 dwellings at a maximum distance of 200 m from the facilities. Male blocks have two washbasins, two urinals two toilets and two showers. Female blocks have two washbasins, two or more toilets and two showers. Provision is made for a store room and for (two)external laundry basins. The municipality has installed a total of 350 blocks in 125 informal settlements and is working towards increasing this number to 2 200 by 2015. Communal ablution blocks are an interim solution to the water and sanitation backlog, while the municipality upgrades informal settlements into fully serviced homes.

Results of the survey shows that a high proportion of household members use communal ablution blocks to meet their water and sanitation needs. On average, households were willing to pay R112.13 per month for improved sanitation. This willingness provides opportunities for exploring innovative ways of entering the WATSAN market. The project was funded by Unilever and supported by eThekweni Water and Sanitation.

**Mini Hydropower:** The municipality intends to install between two and four mini turbines fed by the city's Northern Aqueduct water distribution system. The aqueduct supplies water from the large Durban

Heights treatment works to the city's northern suburbs. Due to the differences in elevation between Durban Heights and the reservoirs, there is excess pressure at the inlets to the reservoirs which is currently dissipated by pressure reducing valves. The proposed turbines will use this pressure to generate electricity, which will be fed into the municipal low tension grid. The expected output of the turbines ranges from 120 kW to 180 kW.

The project, in conjunction with the Water Research Commission, will consist of a feasibility study phase, a construction phase and a three month operation and training phase.



To view an exclusive interview with Neil Macleod at the 2<sup>nd</sup> Faecal Sludge Management

Conference held in Durban last here, Visit: <http://youtu.be/jdClYuSXebw>

## NEIL MACLEOD IN A NUTSHELL

### Likes

I like to be with people that are enthusiastic, passionate and have integrity. On a personal level I enjoy golf, photography and model railways.

### Dislikes

Dishonesty, bad time-keeping (i.e. people that don't keep time). Any type of cruelty or abuse to humans or animals.

### Vision

My purpose in life is to make a difference in the lives of others people. Creating opportunities for people to grow and develop and achieve something in their own right. To make the world a better place.

### Describe yourself in a couple of words

Conservative, impatient, demanding of others people and myself.





# EVERY DROP COUNTS

## – A water game to remember

*Tara Schwulst, a grade 8 pupil from Stirling Primary School, in the Eastern Cape, has received a number of awards for her*

*interactive educational water game, named Every Drop Counts. Debbie Besseling speaks to Tara about her board game, which is not just about having fun, but teaches players of the game important facts about water.*



Conserving water is the responsibility of all South Africans. *Every Drop Counts* is a game that assists pupils to learn and remember important water facts and vital water saving techniques. Tara explains: “The aim of my project was to design a unique water game that could be used as a teaching aid in creating awareness about water use efficiency and water resource management.”

### THE CONCEPT

Tara says that she came up with the idea to create the game when she learnt of some of the concerning facts about water that she had researched, such as the number of children in Africa that don't go to

school because of the long distances they have to walk to fetch water for their families. She extended her research to find out what other water games were currently available and discovered that there were not many educational games that specifically focused on educating the youth of South Africa about important water information.

### THE IMPORTANCE OF THE CORRECT RESEARCH

Tara's initial research involved undertaking a survey to find out how effective her educational water game was as a teaching aid. Four different schools and grades were selected to participate in the survey. The schools included: College Street



Tara Schwulst receives a gold medal from SAICE President 2012 Dr Martin van Veelen.

Tara Schwulst gives an overview of her water board game *Every Drop Counts*.

**“The average score of the first questionnaire completed before the game was played was only 30%. However, the average score increased to 76% after the pupils had played the educational water game.”**

Primary School (Grade 7 learners), East London Secondary School (Grade 10 learners), Sterling Primary School (Grade 5 learners) and Gonubie High School (Grade 11 learners), with 25 learners from each school.

The initial step was to find out what knowledge the learners had about water facts and water saving tips. Tara compiled a questionnaire consisting of 20 questions, which comprised three main sections. These were: Interesting Water Facts, Saving Water at Home and Saving Water in the Garden. Pupils from the participating schools were asked to complete the *Water Wise Questionnaire One*. Thereafter they played the water game *Every Drop Counts*. After all the pupils had played the game,

they were re-tested with the same questionnaire to find out what they had learnt.

One month later, the same participating pupils were asked to complete another set of questions: *Water Wise Questionnaire Two*, also based on the game *Every Drop Counts*, to see how much knowledge they had retained.

## RESEARCH RESULTS

Based on the accumulated research from the 100 pupils from four schools, the average score of *Water Wise Questionnaire One*, the first questionnaire completed before the game was played was only 30%. However, the average score increased to 76% after the pupils had played the educational water game. These results showed that there was an overall improvement of 46%.

A month later, when pupils were re-tested, the average score was 70%. Tara says, “This score indicated that the majority of pupils retained the information that they had learnt through playing the *Every Drop Counts* game”.

Commenting on how the pupils reacted when playing *Every Drop Counts*, Tara says: “The pupils overall enjoyed playing the water game. They said they learnt important information that included facts such as, less than 1% of the world’s water is usable as drinkable water, more than 1,3 billion people do not have access to clean drinking water, and because the water cycle is continuous, we could be drinking the same water that dinosaurs drank millions of years ago”.

At the outset, many scholars were concerned when they realised they did not know the answers to some of the questions in the first questionnaire. However, after playing the game, they learnt a lot and found out many of the answers. Overall, the game made learners aware of the serious situation with regard to South Africa’s water, whilst learning vital water saving tips.




## AWARDS

In November 2012, the Water Engineering Division of the South African Institution of Civil Engineering (SAICE) presented Tara with a Gold Medal in the Special Category of Water Engineering for her project, which she exhibited at the 2012 Expo for Young Scientists. Tara says that she is proud to have received this acknowledgement and is honoured to have received this award from SAICE. "It was a wonderful opportunity to present my water project *Every Drop Counts* to the SAICE President, Dr Martin van Veelen, SAICE CEO, Manglin Pillay, the Committee Members of SAICE's Water Engineering Division, as well as teachers and parents that were present. It was an experience that I will never forget.

In addition, at the Eskom Expo for Young Scientists Regional Finals 2012, Tara received a Gold Medal and a field trip to job-shadow a scientist from the East London Museum. Tara was also the winner of the first prize of a Water Game competition held by the Department of Water Affairs, where she was awarded a prize of a R1 000 and a trip to The National Youth Summit held in Johannesburg in June 2012.

The Department of Water Affairs' theme for National Water Week 2013 is 'Water is life – Respect it, Conserve it, Enjoy it'. Tara Schwulst, a remarkable young water ambassador has contributed by creating an awareness to protect one of South Africa's most valuable resources.

To watch the Youtube video of Tara receiving the award, Visit: <http://www.youtube.com/watch?v=3YiVvDOa4zo> 



Anne Schwulst

Pupils playing the educational water game, *Every Drop Counts*, developed by Tara Schwulst.



Anne Schwulst

Pupils from East London Secondary School playing *Every Drop Counts*.



Anne Schwulst

College Street Primary School pupils completing their questionnaires.

# World making PEACE, not war over water



Europe's Danube River is shared by 16 riparian countries.

**“Since 1820, more than 680 water treaties and other water-related agreements have been signed, with more than half of these concluded in the past 50 years.”**

There is no evidence that wars are looming between governments over shortages of water. This is according to researchers writing in *A World of Science*, a periodical published by the United Nations Educational, Scientific and Cultural Organisation (UNESCO) in January.

In fact, conflicting parties are far more likely to cooperate over water issues as research has shown. Between 1945 and 2008 cooperative events between riparian states outnumbered conflicts by more than 2:1.

Authors of the article, ‘The key to managing conflict and cooperation over water’, say that water has been a productive pathway for building confidence, developing cooperation and preventing conflict, even in particularly contentious basins. The authors are Annika Kramer, Aaron T Wolf, Alexander Carius and Geoffrey D Dabelko. “In some cases, water provides one of the few paths for dialogue in otherwise heated bilateral conflicts. In politically unsettled regions, water is an essential part of regional development negotiations, which serve as de facto conflict-prevention strategies.”

This statement is significant, especially given the fact that the territory of 148 nations falls within international basins and more than 30 countries are located almost entirely within these basins. The high level of interdependence is illustrated by the number of countries sharing

each international basin – in the case of the Danube River there are 19 riparian nations, while 11 countries share the water of the Nile River.

International basins that include political boundaries of two or more countries cover around 45% of the Earth’s land surface, hosts about 60% of the world’s population and account for around 60% of global river flow. According to the researchers the number is growing: in 1978, the United Nations listed 214 international basins; today there are 276, largely due to the internationalisation of basins through political changes, such as the break-up of the Soviet Union, as well as improved mapping technology.

“The high number of shared rivers, combined with increasing water scarcity for growing populations, led many politicians and headlines to trumpet coming ‘water wars,’” The authors note. “In 1995, for example, former World Bank Vice President Ismail Serageldin claimed that ‘the wars of the next century will be about water’. Elaborate, if misnamed, ‘hydraulic imperative’ theories cite water as the prime motivation for military strategies and territorial conquests, particularly in the on-going conflict between Arabs and Israelis.”

However, there is no evidence to support this scenario, the authors say. “While water supplies and infrastructure have often served as military tools or targets, no states have gone to

war specifically over water resources since the city-states of Lagash and Umma fought each other in the Tigris-Euphrates Basin in 2500 BCE (before current era).”

Instead, according to the Food & Agriculture Organisation of the United Nations, more than 3 600 water treaties were signed from 805 to 1984 CE. Whereas most were related to navigation, over time, a growing number addressed water management, including flood control, hydropower projects or allocations in international basins. Since 1820, more than 680 water treaties and other water-related agreements have been signed, with more than half of these concluded in the past 50 years.

Researchers at Oregon State University have compiled a dataset of every reported interaction, be it conflictive or cooperative, between two or more nations where water was the driver of the interaction. Their analysis highlights four key findings. Firstly, despite the dispute in international basins, the incidence of acute conflict over international water resources is overwhelmed by the rate of cooperation. Secondly, despite the fiery rhetoric of politicians, moat actions taken over water are mild. Thirdly, there are more issues of cooperation than of conflict. Lastly, despite the lack of violence, water acts as both an irritant and a unifier.

“The historical record proves that international water disputes do get

resolved, even among enemies and even as conflicts erupt over other issues. Some of the world's most vociferous enemies have negotiated water agreements or are in the process of doing so and the institutions they have created often prove to be resilient, even when relations are strained."

The article points to the example of southern Africa where a number of river basin agreements were signed when the region was embroiled in a series of local wars in the 1970s and 1980s, including the conflict in South Africa, and the civil wars in Mozambique and Angola. Although negotiations were complex, the authors say, the agreements were rare moments of peaceful cooperation between many of the countries.

"After most of the wars and the apartheid era had ended, water proved to be one of the foundations for cooperation in the region. In fact, the 1995 Protocol on Shared Water-course Systems was the first protocol to be signed within the Southern African Development Community."

The key to successful transboundary water cooperation is strong institutional capacity. Naturally arid countries cooperate on water: to live in a water-scarce environment, people adapt to it by developing institutional strategies – formal treaties, informal working groups or generally warm relations, the authors point out.

"Institutions responsible for managing water resources have to be strong to balance conflicting interests over allocation and to manage water scarcity, which is often the result of previous mismanagement. These institutions can even become a matter of dispute themselves. In international river basins, water management typically fails to manage conflicts when there is no treaty spelling out each nation's rights and responsibilities with regard to the shared river, nor any implicit agreements or cooperative arrangements.

"Similarly, at the national and local levels, it is not the lack of water that leads to conflict but the way it is

governed and managed. Many countries need stronger policies to regulate water use and enable equitable and sustainable management."

In countries without a formal system of water use permits or adequate enforcement and monitoring, more powerful water users can override the customary rights of local communities. "If institutions allocate water inequitably between social groups, the risk of public protest and conflict increases."

The example is again taken from the tip of Africa, where in South Africa the former apartheid government allocated water in favour of white voters. According to the authors, this 'ecological marginalisation' heightened the black population's grievances and contributed to social instability.


Another important tool for effective transboundary water management is a reliable database, including meteorological, hydrological and socio-economic data. Hydrological and meteorological data collected upstream are crucial for decision-making downstream. "In emergencies like floods, this information is essential to protect human and environmental health. Tensions between different water users can emerge when information is not exchanged."

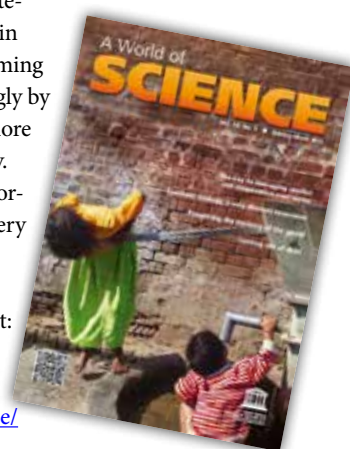
Thankfully, most disputes are resolved peacefully and cooperatively, even if the negotiation process is lengthy. Cooperative water management mechanisms can anticipate conflict and solve smouldering disputes, provided that all stakeholders are included in the decision-making process and given the necessary information, trained staff and financial support to act as equal partners.

According to the authors, cooperative management mechanisms can reduce conflict potential by, among others, providing a forum for joint negotiations; considering different perspectives and interests to reveal

new management options; building trust and confidence through collaboration and joint fact-finding; and making decisions that are much more likely to be accepted by all stakeholders, even if consensus cannot be reached.

The authors note that water cooperation might have to take a different approach in future. As exploitation of the world's water supplies increases, quality is becoming a more serious problem than quantity and water use is shifting to less traditional sources, such as deep fossil aquifers, wastewater reclamation and inter-basin transfers. "Conflict, too, is becoming less traditional driven increasingly by internal or local pressures, or, more subtly, by poverty and instability. These changes suggest that tomorrow's water disputes may look very different from today's."

- To access the full article, Visit: [www.unesco.org/new/en/natural-sciences/resources/periodical/a-world-of-science/vol-11-n-1/](http://www.unesco.org/new/en/natural-sciences/resources/periodical/a-world-of-science/vol-11-n-1/) 



*Africa's shared river basins.*

## STEENBRAS DAM – Faithful supplier of water & power

It was consulting engineer Thomas Stewart who first investigated possible dam sites in the Steenbras River in the late 1800s for water supply to the municipalities of Mowbray and Rondebosch. It was only when seven municipalities amalgamated in 1913 to form the Greater Cape Town, however, that the Steenbras Dam was constructed. Completed in 1921 the

first Steenbras Dam, set against the slopes of the Hottentots Holland mountains, was a modest masonry structure, impounding 27 000 m<sup>3</sup> behind an 8-m high wall. In 1916, the dam was raised by 13 m to meet the increased demand for water in the City. The entire original structure was enveloped in the new dam wall, which increased the capacity of the reservoir by some 60%. In

the 1970s, Steenbras Dam became part of the first pumped storage scheme in the country. The dam, now known as Lower Steenbras Dam, is used as the lower dam, with the Upper Steenbras Dam constructed in 1977.

*Source: In the Footsteps of Giants – Exploring the History of South Africa's Large Dams*



*The two Steenbras dams as seen from the air.*



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