



WRC CEO, Dhesigen Naidoo



Fluid Thoughts

The twenty year warning

We are slowly emerging from what has been described as the highest impact El Niño event in twenty years.

The associated drought has had a devastating impact locally and regionally in southern Africa, with our neighbour Zimbabwe in the third year of a drought event and Ethiopia facing the prospect of her worst famine in 50 years. The World Economic Forum pegged water crisis as the highest risk to the global economy in 2015, and Sub-Saharan Africa has realised that risk in a reality bite that will take us years to recover.

What of the future? We have been reminded that the El Niño – La Niña cycles are regular, although the levels of severity are less predictable. The recent El Niño being of a much higher impact than its relatively mild predecessors after 1992.

As a country, water security has become increasingly important in recent times and is a major focus of national policy. There are various planning and forecasting models in development, including the data-rich Water Resources 2012 (WRC) project as partnership between the WRC and the Department of Water and Sanitation to very soon become the premier water balance tool to be used in water planning at the quinary catchment scale. This is being developed in a Wikipedia format that will allow the users to firstly engage the tool on-line for access to real-time data as well as having the option for the user community to update the data sets via an administrator firewall to ensure accuracy and data quality.

In parallel, the WRC has invested in a cluster of forecasting projects to look at the possibilities of the next twenty years. The Commission, in partnership with the Institute for Security Studies' Africa Futures programme and the Pardee Centre based at the University of Denver, have developed a 2035 outlook utilising a combination of available planning data as well as a collection of sentiments of thought leaders in the South African water environment.

The study determined that through supply-side measures of new dams and transfer schemes, we will be able to increase water supply by 16.3% or 2.5 km³ to 17.8 km³ (1 km³ = 1 billion m³). Unfortunately, at the same time, the forecast of the water demand combining our current use patterns as well as our developmental ambitions as contained in the National Development Plan, our water demand in 2035 will be 18.9 km³. This will result in a deficit of 6.1% or 1.1 billion km³.

This is the twenty-year early warning. Our current use patterns are not sustainable. We are the 30th driest nation in the world, and yet our water consumption at 235 ℓ/person/day. That is 32.7% above the global average. Embedded within this lies the core elements of the solution. If we consider our water futures as illustrated in figure 1, our options become clearer.

The path to the higher water security future already enjoys a baseline investment in South Africa today. Minister of Water and Sanitation, Nomvula Mokonyane, has been clear in her 2016 Budget Speech for Water and Sanitation that innovation and creativity will be the drivers both in our water supply diversification as well as increasing our water wise status as a country.

Our efficiency envelope or potential lies in our current use patterns. If we simply reduce our usage to the global average, we will on today's figures avail 1,185 billion m³ of water into the system, thereby offsetting the projected twenty-year deficit.

The pathway to our water prosperous future rests on three drivetrains. The first is the need for higher investment in new and innovative supply options like higher efficiency, low cost, renewable energy driven, low carbon desalination and point of use systems. The second is a switch to 'fit for purpose' regimes for water quality, core to which is the purple pipe revolution enabling water recycling at scale in every household and production line including agriculture in the country. The third is moving to water use efficiency.

The WRC will, through its new initiatives, combine the national surveys of water use for different industrial sectors with international benchmarks to both define and enable the efficiency gains possible and together with industry partners developing a National Water Benchmarking Initiative similar to the Municipal Benchmarking Initiative that is already demonstrating important successes in this domain.

A combination of these actions makes a for a more water secure future. A water secure future that is achievable long before 2035. And if we manage to attain this in every quinary catchment in the country, then we shall have one of the most robust drought mitigation strategies in the world, regardless of the severity of the next El Niño event.

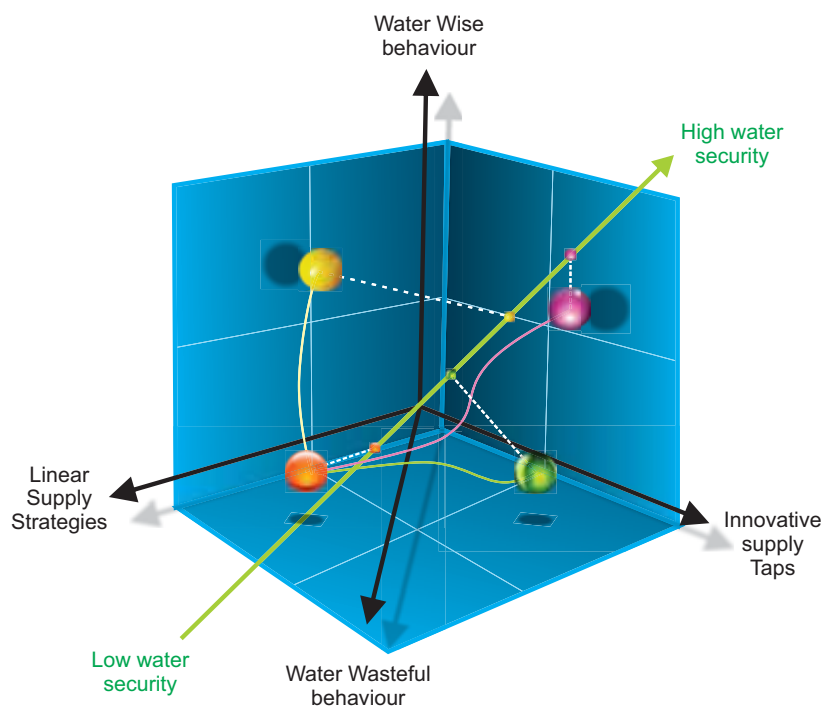


Figure 1.

An illustration of three possible water futures for South Africa. The axes in three dimensions are the levels of water efficiency of use on the one axis; linear to innovative water solutions on the second; and the extent of water security on the third. The current water status (orange) indicates a level of reasonable but vulnerable water security. If our efforts over the next twenty years continue to be predominantly linear solutions to increase supply options while partially tackling the crucial matter of moving to higher water levels of water wise use will definitely improve our water security status (yellow). The best scenario for South Africa is to move to a higher efficiency of use while investing in game-changer creative and innovative water supply diversification. This will enable us to reach much higher and more sustainable levels of water security (purple) moving toward 2035.



Diary

Wastewater technologies

June 13-16

The 13th IWA Leading Edge Conference on Water and Wastewater Technologies will take place in Spain with the theme, 'Evaluating impacts of innovation'.

Visit: <http://www.let2016.org/>

Water history

June 23-25

The International Conference of the Historical Association of South Africa (HASA) will take place at the Riverside Sun Hotel, Vanderbijlpark, under the theme 'Bridging the disciplinary divide: New routes to understanding the Southern African past?' The conference promises a strong focus on specifically water history. Enquiries: Petra Lawson (conference administrator);

Email: conferencepl@gmail.com;

Tel: 083 231 6538.

Aquatic science

June 26-30

The annual conference of the Southern African Society of Aquatic Scientists (SASAQS) is taking place in Skukuza, Kruger National Park.

Contact Petrie Vogel, Tel: (012) 346 1674, Fax: (012) 346 2929

Email: petrie@savetcon.co.za;

Visit: http://www.riv.co.za/sasaqs/pdf/1st_SASAQS_11Jan2016s.pdf

Geology

August 27 to September 4

South Africa is hosting the 35th International Geological Congress in Cape Town. The event is aimed at, among others, contributing to the advancement of fundamental and applied research in the geological sciences and to provide a space where ideas and information can be exchanged across the geoscience disciplines. Visit: www.35igc.org

World water

October 9-13, 2016

The IWA World Water Congress will take place in Brisbane, Australia with the theme 'Shaping our water future'.

Visit: <http://www.iwa-network.org/event/world-water-congress-exhibition-2016/>

Municipal engineering

October 26-28

The annual conference of the Institute of Municipal Engineering of Southern Africa (IMESA) will be held at the East London Convention Centre. The theme is 'Siyaphambili – Engineering for the future'.

Enquiries: Debbie Anderson,

Tel: (031) 266-3263;

Email: conference@imesa.org.za;

www.imesa.org.za



Letters and Opinion

Dam safety not an issue to be taken lightly

My compliments once again to *the Water Wheel* on very informative reporting, particularly in the November/December 2015 issue. One article, in particular, raised my attention, namely Dam Safety – ensuring integrity of SA's 5 000+ registered dams.

I would like to express a few, I hope, relevant comments adding to your well-structured and informative article. My professional interest and gained expertise evolved over more than 45 years from the involvement in the planning, design, construction and particularly the maintenance as well as the refurbishment/hydropower retrofit of the dams in the Southern Africa sub-region. The growth in the procurement of new dams during 1970s and 1980s reached almost the exponential proportions resulting that more than 5 100 dams of all types and sizes are in existence in SA (somewhere it has been stated that South Africa is the eleventh country with most existing dams on the planet).

However, such sizeable and important infrastructure requests a fair amount of attention and investments for its operation and the upkeep. However, most of South Africa's existing dams are visibly ageing, losing the impoundment capacities due to the sedimentation and many are becoming seriously polluted from only partially controlled urban and mining effluent river releases. The surface runoff from the agricultural land is to the large extent also polluted, contributing to the gradual reduction in the water quality of the South Africa's dam impoundments without any significant remedial correction, thus imposing higher water treatment costs on the downstream users.

The biological, toxicological, financial and other factors (some of them not necessarily easily noticeable) are inevitably accentuating focus not only on the integrity of a dam structure (i.e. particularly the dam wall and associated infrastructure as e.g. is a spillway) but also on the diminishing capacity and particularly on the quality of the water

stored behind the dam wall, dictating the overall replacement value of the whole primary water supply scheme.

The urgent importance of the financial constraints of the South Africa's primary water supply infrastructure surfaced in its true reality during 2007 when the Department of Water and Sanitation (than DWAF) introduced the programme on the verification and valuation of major water infrastructure assets (known outside the department as the SAKHILE Project). A consortium of private sector consultancies helped the DWS to develop and establish the Asset Management Project Tool (AMPT) for evaluating immovable national assets.

This tool (and associated processes conducted in the field) enabled the DWS in the condition grade valuating over 320 primary raw water supply schemes (mainly Category III and II national dams) during the 2007/08 financial year. The AMPT is designed to enable the DWS in annual update providing outcomes allowing for relevant budgeting and allocation of funds for the refurbishment and integrity support of the national dams (municipal and private dams are not included in this annual valuation exercise).

The AMPT is also important in providing the background updates allowing for determining appropriate raw water pricing charges (e.g. the Return on Asset and the Future Infrastructure Build charges). The DWS is selling, in most instances, the raw water to other users (e.g. metros, water boards and mining enterprises, etc.). To date, the vital inputs to the AMPT are based on the Dam Safety Reports (DSRs) produced and approved by the DWS's Dam Safety Office. These reports are compiled by the Approved Professional Persons (APPs) together with the assistance of the DWS's regional office staff. A typical DSR (as structured according to the ICOLD and endorsed by the SANCOLD methods and requirements) may comprise several spheres of information, including statistics, hydrology, geology, dam wall

details, spillway details, outlet works details, monitoring and performance observations, risks and Impacts, site inspection report by the APPs with the DWS's assistance, overview of previous recommendations, and conclusion and recommendations.

In general terms an outcome from each DSR is referring and contributing to the Condition Grade Evaluation exercise with regard to the changes in a status at each dam during a period of time between 5 and 10 years. No particular information on the changes in the capacity size due to sedimentation and water quality stored are available from the DSRs. This type and quality of such information are drawn from the other sources within the DWS. However, the frequency of surveys on the sedimentation and water quality is not necessarily matching the frequency in the evaluation of current status of a dam as recorded in the DSRs. The experience gained during a few recent years analysing and utilising the DWS's Dam Safety Reports allows me to suggest that some kind of an alignment between the valuable outcomes of the DSRs and the Condition Grade Valuation exercise (differing in the main objectives) of a dam impoundment scheme is inevitable, if the AMPT has to be supplied with the relevant and qualitative inputs reflecting the reality.

It is obvious from your article that the DWS's Dam Safety Office is facing serious constraints with regard to the competency and numbers of the APPs in the coming years, inevitably jeopardising future valuations of integrity of our dams. There are a few ways how this urgent problems can be mitigated and eventually even eliminated, providing that the stakeholders will be inclined to discuss the way forward. I have some useful ideas and I am prepared to discuss these with the WRC and the DWS's Dam Safety Office.

Bo Barta, Pretoria

(Letter has been shortened - Ed)

SA water treatment legend honoured



The South African water sector has been hit by another blow with the death of water treatment stalwart, Charles Walters, on 7 April, following a struggle with cancer.

According to colleagues and customers at Rheochem, Charles was a legend. Barry Ludolf of Chemanzi, another long time and well-known water treatment expert, recently had this to say “during the days of SA Cyanamid, Charles was the cornerstone of our Sasol 2 and 3 business. He had an exceptional technical ability.”

Charles started his career in water treatment in 1982. The many years he spent with Eskom Technical Department stood him in good stead with future positions. He was one of the pioneers in terms of work on polyamines to replace the traditional use of aluminium sulphate at that time, as well as on Streaming

Current Detectors, now commonly used but at the time state-of-the-art technology.

Charles worked at Rheochem until January 2015, fulfilling the role of Inland Region Area Manager for nearly 18 years. During that time he provided customers with an exceptional service. His ability to problem solve was unquestionable and the commitment Charles constantly displayed left customers with the confidence of knowing that he was always available to assist. From Senior Managers to Plant Operators Charles was known to be the person to call when polymer optimisation help was needed.

Jacqui Swart, who worked with him during the last 18 years of his career, said that with Charles one always knew that things were under control and results would be accurate – he had a unique understanding of the art and science of water treatment and she will always not only be grateful for the contribution he made to growing Rheochem through the early years but for being so dependable as both a friend and colleague.

Charles was an application specialist rather than a sales person and loved his job. He was one in a million and always himself. Charles had an indomitable spirit. He reached across cultural divides without even trying to or being anyone other than who he was – just by being genuine and committed to water treatment.

He will be sorely missed.

UP horticulture student scoops up awards

Mathew Banda, an MSc student in Horticulture in the Department of Integrated Plant and Soil Sciences at the University of Pretoria (UP) has been awarded two prizes from the South African Society for Horticultural Sciences.

He was co-recipient of these two prizes with a student from Stellenbosch. The first prize was awarded to the best oral presentation by a Masters student in Horticulture and the second prize is a travel grant worth R10 000 for the best overall student presentation in Horticulture at the Joint Congress of the Weed, Crop, Soil and Horticultural Societies.

The travel grant is towards payment to attend any international horticultural congress. Banda's research is focused on citrus water use. The increase in demand for irrigation water has prompted research to determine the specific water needs of citrus, which enable farmers to accurately schedule irrigation as per daily plant water use.

This results in saving water and alleviating problems of nutrient leaching, which results in eutrophication, making citrus production more sustainable.

Source: UP

New study investigating drought shocks on industries

The Water Research Commission (WRC) has launched a study to quantify the impacts of drought on South African industries.

This short-term project will investigate the impacts of drought on production, cost of raw materials, export earnings, unemployment, profits, real non-indexed wages, as well as consumption of products, investments and other related factors.

“The primary aim of the project is to produce a set of fact sheets which will provide compelling arguments for early action in the event of a future meteorological drought warning, by describing what the societal impacts of a drought will be,” explains WRC Research Manager, Dr Jo Burgess.

Drought historically has caused direct and indirect economic, social and environmental problems. Some of these

problems are difficult to avoid, even with early preparation. However, other effects are avoidable, especially those stemming from poor economic planning and delayed drought response.

This WRC project is intended to establish a baseline of typical economic consequences of drought. The specific impacts of the 1991/92 and, if possible, 2015/16 droughts in southern Africa can be measured against this baseline to

assess reducible, if not avoidable, costs.

According to Dr Burgess, drought-induced economic losses include those resulting from impaired dairy and beef, crop, timber and fishery production; lack of power for industrial use; decline in agricultural-dependent industries; increased unemployment in agriculture and other drought-affected industries; strain on financial institutions (capital shortfalls, credit risks); loss of revenue to state and

local governments (from reduced tax base); reduced navigability of waterways; and increased costs for transport of water and development of new sources. Such effects are felt by municipalities, business and industry, agricultural enterprises, households, individuals and government.

WRC Research Manager, Dr Sylvester Mpandeli, who is co-managing the project with Dr Burgess, noted that one way to measure the impact of disasters such as

drought is by measuring changes to the gross national product (GNP) or gross domestic product (GDP). Over the last three decades, droughts have reduced GNP by at least 1% in East Africa, North America, South America and Southern Asia, among others.

As part of the study, the research team will hold expert stakeholder workshops and interact with selected industries in South Africa.

Hopping new frog app developed by NWU researcher



North-West University Zoology professor, Louis du Preez, has developed a new application (app) about the frogs of southern Africa.

Prof Du Preez, or the ‘frog man’ as he is known, has become synonymous with frogs and their well-being to which he has dedicated most of his academic career. An established researcher with a C1 rating of the National Research Foundation, Prof Du Preez has authored 102 scientific articles and seven books. He heads the African Amphibian Conservation Research Group, and his research focuses on the well-being of amphibians and in particular on the conservation of endangered species,

as well as the systematics and ecology of amphibian parasite diversity.

The Complete Guide to the Frogs of Southern Africa has been launched on the Apple App Store and Google Play. It was developed by Prof Du Preez in collaboration with Vincent Carruthers.

It is expected that the app will be especially popular with nature lovers, students and scientists. The app contains all 160 familiar species of southern Africa and elucidates them with more than 1 600 photographs, videos, sound bytes of frog calls, details about their habitat and where each species can be found.

The app is interactive, and enables the user to upload a sighting of the different species, with GPS coordinated or location where they were sighted, notes and commentary. It also contains a user-friendly identification key that makes the identification of a specific frog species easier.

To watch a video on the app, Visit: <https://www.youtube.com/watch?v=wwNjYPHRVtg&feature=youtu.be>

Source: NWU

DWS DG calls for groundwater's profile to be raised

Groundwater can go a long way to supplement the surface water to alleviate water challenges.

This is according to the Director-General of the Department of Water and Sanitation (DWS), Margaret-Ann Diedericks.

Speaking at a five-day conference of the Water Resources Group (WRG), Diedericks said that there was an over-reliance on surface water in South Africa at the expense of groundwater. Surface water currently makes up over 70% of total water use in the country.

"There has to be a definite change in mindset with regards to the general over-reliance on surface water while there is an over-abundance of groundwater that can be used for basic needs," noted the DG.

The department was also looking to promote the reuse of water for industrial and agricultural use.

According to Water Research Commission Executive Manager, Dr Shafick Adams, South Africa has an estimated 7 500 million m³/year of groundwater available under drought conditions. This while current use is estimated at between 2 000 and 4 000 million m³/year.

"Groundwater, if managed correctly, has the potential to significantly add to the country's water supply mix," noted Dr Adams. Moreover, compared to large bulk water development projects, such as the building of dams, groundwater was fairly cheap and fast to develop, he added. It could serve either as a sole source of water or augment existing surface water supplies.

At the time of writing, DWS was in the process of supporting drought relief efforts by selectively refurbishing existing boreholes, supporting the maintenance of existing boreholes, as well as supporting the drilling of new boreholes.

Source: DWS



Judge orders study into climate change impacts of new power station

For the first time in South Africa, the Minister of Environmental Affairs has required a climate impact assessment for an environmental approval for a coal-fired power station.

This is after Minister of Environmental Affairs, Edna Molewa, gave Thabametsi Power Project – developer of the proposed 1 200 MW Thabametsi coal-fired power station near Lephalale, in Limpopo – six months to conduct a climate change impact assessment and a palaeontological impact assessment before the project can start.

The order comes after environmental justice organisation, Earthlife Africa (ELA), represented by attorneys at the Centre for Environmental Rights (CER), asked the Minister to set aside the approval of the proposed power station. ELA, together with partner organisation Groundwork and community networks in the Vaal, the Highveld and KwaZulu-Natal, argue that energy from renewable sources should be prioritised over coal-fired power because of coal's detrimental impact on the environment and human health.

As a result, the Minister amended the authorisation, adding the order to conduct the climate change assessment.

In a statement CER said that, while the Minister's

acknowledgement that the climate change impacts of coal-fired power generation is seen as a victory for the organisation, it has a number of concerns about the decision.

"The Minister has not prescribed the scope of the climate impact assessment or the palaeontological impact assessment. [In addition], the Minister has required the reports of both assessments to be submitted to the Department of Environmental Affairs to review, but did not require interested and affected parties to have an opportunity to comment on the assessments."

CER was of the opinion that, by requiring these additional impact assessments, the Minister had conceded that material impacts were not assessed before the approval was granted, which is contrary to the requirements of the National Environmental Management Act. "We believe that the Minister's decision to uphold the authorisation, despite these deficiencies, makes it subject to review by the High Court."

The Thabametsi power station is one of 11 proposed privately-owned coal-fired power plants which have, or are expected to, submit bids to sell electricity to Eskom under the Coal Baseload Independent Power Producer Procurement Programme.



Projects in Progress

Water flowing along with wine at Vergelegen



Vergelegen middle dam at 100% capacity in late summer, proof of the increase in water availability.

All photographs supplied

Somerset West wine estate, Vergelegen, is globally recognised for its award-winning vintages, but this past World Water Day, celebrated every year on 22 March, farm management, staff and visitors raised a glass to the abundant water permeating land once densely packed with invasive alien vegetation.

In what is believed to be the largest private conservation undertaking in South Africa, 2 000 ha (of a planned total of 2 200 ha on the farm) have been cleared and rehabilitated to indigenous vegetation. In the process, the programme has unleashed water resources and generated over 230 jobs for previously unemployed and untrained people, in areas such as bush cutting and hand-picking alien seedlings.

Anglo American acquired the farm in 1987, and the investment in this clearing programme (and other interventions) have made it a leader in the Biodiversity and Wine Initiative, a partnership between the South African wine industry and conservation groups. The estate, which is open to the public, is considered a national treasure and has been nominated as a World Heritage Site.

“Before the implementation of the invasive alien clearing project,

activities such as the planting of pine plantations, Acacia and Eucalyptus woodlots and agricultural development opened pathways for alien plant invasion, said Vergelegen environmental project manager Jacques van Rensburg. “More than 80% of the farm’s natural veld was invaded by pine on the higher slopes, with Acacia and Eucalyptus species in the low-land area.”

As alien vegetation uses up to 60% more water than fynbos, its clearing has boosted water flow. The farm’s environmental treasures now include 80 ha of rehabilitated wetlands, fed by the Hottentots Holland mountain range catchment area. These offer a thriving habitat for numerous species of birds, amphibians, invertebrates and wetland-associated mammals such as otters, mongooses and small buck.

While the slightly acidic nature of the farm’s wetlands limits the number of plants, numbered among them are floral jewels such as Wachendorfia, Watsonia and Aristea. There are also varieties of Ericas and endemic Leucodendrons, many of which are on the International Union for Conservation of Nature’s Red Data List. The farm’s wetland areas also contain a pristine Palmiet bed that helps remove excess nutrients from the water and improves its quality.

Lourens River

The return of indigenous vegetation (which acts as a natural filter) and other conservation initiatives have also contributed to mopping up pollution and encouraging diversity in the Lourens River. This is the only South African river that is a Protected Natural Environment, and the 10 km running through the estate (of a total 20 km) are managed by Vergelegen, the Lourens River Conservation Society, the City of Cape Town and CapeNature.

The river has indigenous fish such as *Sandelia capensis* and *Galaxia spp.* Shy Cape clawless otters can be seen at night, while water mongoose, large grey mongoose and small grey mongoose live off the fish. Large-spotted genets also thrive, while resident bird life includes malachite and giant kingfishers.

On the entire farm, the number of bird species has soared from 80 to at least 142 since the alien vegetation clearing began. The animal population now includes numerous antelope species, leopard, caracal, honey badgers, snake weasels, silver foxes, Cape hares and spotted genet. There are at least 500 different plant species in total.

Local and international scientific research at the farm is coordinated by Vergelegen's Centre of Learning Excellence. For example, Hamburg University of Technology scientists researched the Lourens River water quality, while a Stellenbosch University group undertook research at the estate's vast Rooiland Dam, which stores 2.72 million m³ of water. The dam was used as a negative control in an investigation of the impact of

small-scale aquaculture on the water quality of irrigation dams in the Western Cape.

"Improving the quantity and quality of water at Vergelegen has been one of the many successful outcomes of the alien vegetation clearing programme," said MD Don Tooth. "Our achievements have been a team effort and we are happy to share our conservation research and learnings with other interested parties that could benefit."



Water researchers at Vergelegen have included Nelia du Buisson and Kora Holm from Stellenbosch University, seen here at the farm's Rooiland Dam.



Newly rehabilitated wetland, showing the growth of various restio species.



Dragonfly smashes insect migration records



A dragonfly barely an inch-and-a-half long appears to have shattered the long-distance record for insect flight – travelling thousands of miles as it migrates from continent to continent.

Biologists say the evidence is in the genes. Populations of the dragonfly, called *Pantala falvenscens*, in locations as far apart as Texas, eastern Canada, Japan, Korea, India and South America, have genetic profiles so similar that there is only one likely explanation.

Apparently somehow – the insects are travelling distances that are extraordinarily long for their small size, breeding with each other, and creating a common worldwide gene pool that would be impossible if they didn't intermingle.

"This is the first time anyone has looked at genes to see how far these insects have travelled," notes Jessica Ware, an assistant professor of biology at Rutgers University and senior author of the study that has been published in *PLOS ONE*.

"If North American *Pantala* only bred with North American *Pantala*, and Japanese *Pantala* only bred with Japanese *Pantala*, we would expect to see that in genetic results that different from one another.

Because we don't see that, it suggests the mixing of genes across vast geographic expanses."

According to Ware, these dragonflies have adaptations such as increased surface areas on their wings that enable them to use the wind to carry them. They glide for long periods, expending minimal amounts of energy as they do so.

Dragonflies have already been observed crossing the Indian Ocean from Asia to Africa. "They are following the weather," notes Daniel Troast, who analysed the DNA samples in Ware's lab while working towards his Masters Degree in Biology, which he earned in 2015.

"They are going from India where it is the dry season to Africa where it is moist season, and apparently they do it once a year:"

Moisture is a must for *Pantala* to reproduce, which is why these insects would be driven to even attempt such a perilous trip. "The species depends on it. While many will die en route, as long as enough make it, the species survives" says Ware.

Flight patterns appear to vary. The

hardest of the dragonflies might make the trip nonstop, catching robust air currents or even hurricane winds and gliding all the way. Others may literally be puddle jumpers.

Pantala need freshwater to mate and lay their eggs – and if while riding a weather current they spot a freshwater pool created by a rainstorm – even on an island in the middle of a vast ocean – it is likely they will dive earthward and use those pools to mate.

After the eggs hatch and the babies are mature enough to fly (which takes only a few weeks) the new dragonflies join the swarm's intercontinental and now multi-generational trek right where their parents left off.

For now, details of this extraordinary insect itinerary are an educated best guess, as are specific routes these migrations might take. Much more work is needed to bring may loose ends together.

To access the *PLOS ONE* article,
Visit: <http://journals.plos.org/plosone/article?id=info%3Adoi%2F10.1371%2Fjournal.pone.0148949>



WRC New reports



Report No. TT 645/15

Improving rural livelihoods through biogas generation using livestock manure and rainwater harvesting (Guidelines report)

Increasing fodder production has become essential to solve the problem of diminishing natural grazing veld for livestock in rangeland systems. These guidelines were developed to assist

livestock owners with biodigesters to implement sustainable grazing management practices. This was achieved through determining methods for improving grazing capacity and livestock production in three communal areas in the Eastern Cape, KwaZulu-Natal and Limpopo provinces. The main research report (*Report No. 1955/1/15*) is also available.

Report No. 2009/1/15

A tunable lignocellulosic enzyme system for treatment of industrial wastewaters

The fruit industry is a multibillion dollar industry that is growing rapidly in all regions of the world. The production of juice consumes a large amount of fresh fruit and water, while generating large quantities of recalcitrant material called pomace. Up to 25% by wet mass of citrus fruit production is pomace. The industry does not have a particular use for the pomace and, as a result, it is considered waste. Fruit wastewater has a poor water quality with a chemical oxygen demand (COD) of up to 10 000 mg/L. Fruit wastewater is normally released into the sewerage system, which can result in clogging. If it is introduced directly into rivers it can lead to eutrophication of water bodies. Most fruit wastes are lignocellulosic in nature, which pose specific problems for hydrolysis as an enzymatic treatment, as such substrates are particularly recalcitrant. The proposed process was postulated as a successful and cost-effective solution to the treatment of these wastes and involved the enzymatic treatment of agricultural wastes using suitable combinations of cellulases and oxidases (ligninases) in an effective ratio. The major aim of the Tunable Immobilised Lignocellulosic Enzyme (TILE) system was to treat agri-industrial wastewater using enzymatic processes in order to generate clean water, and at the same time, produce value-added products from such waste. The study focused on apple pomace and apple derived wastes from industries in the Western Cape.

Report No. 2246/1/15

The use of GIS and remote sensing techniques to evaluate the impact of land use and land cover change on the hydrology of Luvuvhu River catchment in Limpopo Province

Land use and land cover changes in a catchment can impact water supply by altering hydrological processes such as infiltration, groundwater recharge, baseflow and runoff. Studies that link anthropogenic factors and land cover to hydrology and water resources have not been widely conducted in the Luvuvhu

River catchment. This WRC study was conducted to evaluate the impact of land cover and land use change on the hydrology of Luvuvhu River catchment. The information derived will help prevent the potential for human conflict over diminishing resources and disease outbreaks related to waterborne vectors. Remotely sensed data and ground survey methods were used to evaluate the changes. A combination of multi-date fine, medium and coarse resolution remotely sensed imagery was used to detect and quantify changes.

Report No. 2163/1/15

Radiative forcing of southern African climate variability and change

This report is concerned with exploring the effects of various forms of tropospheric and stratospheric radiative forcing on southern African climate variability and change. A large set of sensitivity tests, following the experimental design of the Atmospheric Model Intercomparison Project was performed for this purpose. An ensemble of projections of future climate change has also been analysed, to investigate the relative importance of enhanced carbon dioxide concentrations and recovering stratospheric ozone in forming southern African climate during the twenty-first century.

Report No. KV 341/15

A comparison of the South African approach to water resources management and planning with four international countries

This report compares the South African approach to water resources management with four international countries, namely Australia, Brazil, England and the USA. The over objective of the study was to determine whether or not South African can learn from other countries with similar water resources issues and improve the current methodologies, approaches and techniques based on their experiences. This was carried out using the following areas of comparison: legislative framework; required documentation and typical studies carried out; institutional arrangements; and modelling techniques.

Report No. 2238/1/15

Key interventions to improve local groundwater governance

There is a growing perception that groundwater governance is simply not working, especially at the local scale, in South Africa. This perception is increasingly being supported by research. The purpose of this investigation was to address known weaknesses in groundwater governance by identifying and prioritising key interventions that can improve local groundwater governance in South Africa.

To order any of these reports
Tel: (012) 330 0340, Email: orders@wrc.org.za or visit:
www.wrc.org.za