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Newsletter of the Water Research Commission

In This Edition

My African Dream

Prof Wim van Averbeke grew up in Brugge, Belgium. He had strict but loving and industrious parents who were influential in his personal and academic development, shaping him into a tenacious professional, a patient parent and supervisor and a good husband. His wife, Ntsiki, and his friend, Vuyo Duba, introduced him to Africa, its people and its cultures.

In 1980, Wim completed a Licentiate (equivalent of a Bachelors (Hons) degree) in Science, majoring in Geography at the University of Ghent, Belgium. He conducted his final-year research project in regional Geography in Greece, which exposed him to the study of soils. In 1982 he completed his M.Sc. at the University of Ghent, majoring in Soil Science. Owing to a slump in the European economy, Wim moved to South Africa early in 1983.

Wim worked at the University of Fort Hare for 18 years, where he gradually broadened his knowledge of soil science. "Young as I was, Prof Giel Laker and Dr Malcolm Hensley (Wim's supervisors) still trusted me to deliver acceptable work, which was an empowering experience." During mid-1984 Wim explored the possibility of studying towards his PhD: exploring the relationship between soil properties and crop yield under rainfed conditions. At the time, the Department of Crop Science was conducting the Ciskeian Ecotope Evaluation Project. The objectives of this project corresponded with Wim's interests and inclinations. "I teamed up with Prof Jean Marais, the project leader, who became my PhD supervisor. He was a great scientist and extremely meticulous. We especially dreaded the time when he visited the sites when we were planting an experiment. My style of supervision is based on his approach. He believed that a PhD student is, first and foremost, a student. He used student-supervisor interaction to transfer his knowledge and research skills to me, enabling me to grow towards meeting the requirements of a graduate. For me that was a wonderful experience, and I try to perform a similar role for my students here at the Tshwane University of Technology (TUT)."

Wim's association with the WRC commenced in 1995 when, as acting Director of the Agricultural and Rural development Institute (ARDRI), he was invited by the WRC to apply for funding. His first WRC project was an investigation of irrigated food plot production in the Eastern Cape. Subsequently, irrigated smallholder farming has increasingly featured in the WRC research portfolio. "I am currently working on a project aimed at identifying best practices in smallholder irrigation, which is based at Dzindi in Limpopo Province. I am very excited about that project, because it has given me the opportunity to test some of the ideas I developed over the years." This project is also empowering a multitude of students from historically disadvantaged backgrounds at different levels, from final year Diploma to D Tech.

Wim believes in the value of work. "People who work have a purpose in life, and this applies to all forms of work, including small-scale farming. A society in which large numbers of people do not have work has a serious problem. Water research is very important for the world at large and for South Africa in particular. Finding ways to do more with less, and transferring this knowledge to the society at large will co-determine the future of our country. The reproduction of research skills in the world of water is, therefore, of critical importance for South Africa. The role of the WRC in the reproduction of human resources for water research is crucial to the well-being of the country."

Wim, The WRC is proud of your work and your efforts in building capacity in the South African water sector.

A thumbnail sketch of selected students under Wim's supervision (with WRC funding)

Most of these students come from a background of poverty. Many of them come from households with single parents. Finance was a major factor that determined their careers and their future. WRC support is greatly appreciated, including a monthly stipend for these students.

Muendana Judith

Final-year N Dip student, 23

"I also want to continue my studies doing B Tech and M Tech."

Nemutanzhela Livhuwani

Final year N Dip student, 24

"I want to carry on studying, and I want to help other people with farming. I also would like to start my own farming project. I particularly like the poultry project we are running at Dzindi."

Muobeleni Masala

Final year N Dip student, 24

"I want to get a job, preferably with the Department of Agriculture (to get money) and to carry on with my studies."

Mohlala Mathume Lawrence

Final year N Dip student, 23

"I want to be educated at least to B Tech level, but preferably up to M Tech and want to be successful in farming or any other business related to agriculture."

Rakhumba Mashudu Abraham

Final year N Dip student, 22

"I want to become a farmer, and that is why I like my training at Dzindi. I also like to help other people."

Chabalala Mihloti

Final-year N Dip student, 25

"I want to further my studies. I want to continue with B Tech and to get a better life."

Ralivhesa Khathutshe Eric

M Tech student (Innovative Poultry Production System), 28

"My dream is to be a well-known researcher and to continue my studies and become an academic."

Juma Khadija Ali

M Tech student (*Solanum retro-flexum*), 37

"I would like to carry on with my studies and obtain a PhD. I would like to be an academic."

Ramusandiwa Tshililo David

B Tech student, 24

"I would like to end up with a doctoral degree."

Tshikalange Tshililo Eunice

M Tech student (Chinese cabbage), 27

"I would like to work in a research station and I would also like to improve my knowledge of basic sciences and further my studies."

Mohamed Suleiman

D Tech student (Livelihoods and farming on smallholder irrigation schemes), 41

"I would like to become a recognized expert in the field of livelihoods and associated policy."

Moila Percy

B Tech graduate and prospective M Tech student, 27

"I would like to become a good researcher."

Farewell Reshmili and Sunita

Sunita Kalan was appointed Manager: Intellectual Property (IP) on 1 November 2003. She has contributed greatly to the WRC, especially as far as establishing an IP policy is concerned. Sunita has joined Deloitte.

Reshmili Frank Joined the WRC in December 2003 as Manager: Human Resources (HR). She streamlined the HR functions at the WRC, especially the creation of the various HR policies. Reshmili has joined Nokia.

The WRC wishes these two young ladies well in their new job environments.

Lala Ngoxolo Nonhlanhla

The WRC receptionist, Nonhlanhla Nxasana, passed away on 17 May. She leaves behind two children, Namhla and Mzwandile. Her bubbly personality and warmth will be missed by all at the WRC. The WRC staff members convey their condolences to her family on their sad loss.

Welcome Thea

Thea Theron is the WRC's new Financial Officer. Thea worked in the South African Air Force before joining the private sector. "I enjoy working with figures and people," says this enthusiastic lady. I am still grappling with this combination!

Ms Theron holds a Bookkeeping Diploma (1999). Thea received many accolades, the most significant being a Certificate of Commendation: Best worker for accuracy and figures. Such attention to accuracy is vital in the WRC Financial Section! Thea feels at home at the WRC and receives support from her team members.

Thea enjoys her family: her husband and her two daughters. When she is not balancing the books, Thea relishes in activities such as gardening, reading, watching movies and visiting coffee shops. Thea, the WRC welcomes you and your expertise.

Launch of SAFe Water

The WRC was a key role player of the SAFe Water project which was launched on 9 May 2006 at the Sheraton Hotel, Pretoria. The WRC also co-ordinated the public relations component of the launch.

Within the framework of the South African-French research agreement on scientific co-operation, the Ministry of Science & Technology of South Africa and the Ministry of Foreign Affairs of France have decided to provide financial support for research networks within projects carried out by scientists of the two countries. The idea is to promote the constitution of bilateral networks, involving at least one team from each country.

The programme aims to:

- Understand the context of the high priority water research thrusts in South Africa
- Facilitate the establishment of joint research projects
- Provide funding for the exchange of post graduate students
- Build and strengthen the capacity of researchers within the identified projects
- Enable researchers to use specialized facilities in each other's countries
- Arrange joint workshops
- Position researchers to submit joint research proposals to funding bodies such as the European Union

The Director-General (DG) of the Department of Science and Technology, Dr P Mjwara and the Deputy French Ambassador, Mr Roland Galharague, launched the project. The initial project agreement spans four years and both parties are optimistic about future successful collaboration.

Dr P Mjwara, DG of Science & Technology, and Mr Roland Galhargue, the Deputy French Ambassador launch the SAFe Water project

Renias Graduates!

Dr Renias Dube obtained his PhD: Water Resource Management from the University of Pretoria. His thesis is titled *Appropriate positioning of modelling as a decision support tool for surface water resources planning in South Africa.*

Renias was recently appointed Head of the Cross-cutting Domain: Water and the Environment.

As a research manager, he worked with local researchers in several water research projects, which resulted in 31 research publications and research papers at national and international level. Most of these research publications were published through the WRC and involved the inputs of several other local and international researchers. He is currently a national committee member of the South African National Committee for the International Association of Hydrological Sciences (SANCIAHS), a member of the Working for Water programme's national hydrological research panel based in Cape Town and a member of the national Water Resource Systems Simulation Technical Advisory Group which is based at the Department of Water Affairs and Forestry's Head Office in Pretoria.

The WRC on show

The WRC exhibited at the Johannesburg Water *Festival of Water* on 21-26 April in Newtown, Johannesburg. The focus group was high school learners and the WRC distributed material such as *Water @ Work: A Career Guide*, *Water Wheel*, and *A Little Gift and Other Short Stories*.

The WRC was one of the exhibitors at the National Water Summit at Gallagher Estate on 4-5 May. WRC reports and other publications were in great demand. The WRC interacted with other key role players in the South African water sector.

The WRC and the World Water Forum, Mexico – Creating a South African Island

The 4th World Water Forum was held in Mexico City on 16-22 March 2006. The WRC was part of a WISA (Water Institute of Southern Africa) initiative to create a South African island which showcased projects and initiatives stemming from the vibrant South African water sector. The WRC's eye-catching poster and multimedia presentation formed a part of the visual component of the exhibition. Various WRC staff members attended the conference.

From left to right: *Kevin Pietersen (WRC); Thoko Zikwaza (DWAF); Rivka Kfir (CEO, WRC); MG Ferguson (Ambassador to Mexico) and Eiman Karar (WRC)*

UKZN/eThekwini Municipality Urban Water Management Project

Guests at the UKZN function

A unique and beneficial partnership in an urban water management project between the University of KwaZulu-Natal (UKZN) and the eThekwini Municipality was formalized at an event which took place on Thursday, 13 April 2006 at the Comsa Lounge on the Westville campus. The occasion saw the official handover of a cheque for R1 million to UKZN as the first payment of a R5 million commitment by the Municipality for the facilitation of the project.

The eThekwini Municipality, through its Water and Sanitation division, bears the responsibility for the delivery of water and sanitation solutions to the eThekwini region. In order for them to better fulfill this mandate, they need to undertake comprehensive research in this area. Therefore, this partnership will be mutually beneficial to both parties concerned. The UKZN's Pollution Research Group (PRG) has extensive experience and expertise spanning a period of 36 years. The PRG focuses on promoting cleaner production, reducing water pollution from industry and the cost of water treatment processes.

"This partnership is an example of how the University and the city can work together to improve the well being of the people in Durban and the country. I look forward to the new challenges and rewards that this relationship will bring," said Chris Buckley of the UKZN Pollution Research Group.

Prof Buckley being interviewed on SABC TV

One of the PRG's funders, the Water Research Commission (WRC), has been involved with the PRG since 1990, funding projects to the tune of R17 million. Jay Bhagwan, Director of Water Use and Waste Management from the WRC said, "the partnership and the MoA between UKZN and the eThekweni Municipality, signifies a long awaited transition where local government recognizes the resources academic research centres offer in providing scientific solutions to many of the services challenges. The investment by the Municipality will not only enhance the capacity of the centre but will ensure that the necessary skills and competencies are nurtured and developed for its benefit."

The WRC assisted with the media coverage relating to this event.

The WRC @ the WISA Conference

The WISA Biennial Conference 2006 was held at the ICC, Durban on 22-25 May. WRC personnel attended the conference and also presented papers and conducted workshop sessions. In addition, the WRC Knowledge Café was open for business: disseminating knowledge (WRC publications – CDs and hard copies), taking orders for WRC reports and answering queries and questions relating to WRC research projects. WRC project leaders, Research Managers and Directors were involved in no less than 70 presentations and workshops for the duration of the conference. The WRC was a key role-player and sponsor at this major event.

***Above**: Judas Sindana assists visitors at the WRC-WIN SA exhibition stand*
***Left**: Some interested delegates at the WRC exhibition stand*

What's New

Report No 1165/1/06 (Contractor: University of Stellenbosch)
Development of technology for the selective removal of bioactive pollutants by ligands, non-covalently immobilized on membranes

The presence of biologically active organic species in water is of international concern. A group of these chemicals is known as endocrine disruptive chemicals (EDCs) which act as pseudo hormones, oestrogen-mimicking agents, and have been held responsible for the global reduction in male fertility. This project aimed to develop a technique by which biologically active species could be separated from water by way of a recognition system, which is very specific for the species targeted. In this study the foundation was laid for the non-covalent immobilization of different ligand binding moieties on hydrophobic synthetic membranes. All the biochemical problems associated with the expression of the oestrogen receptor-binding domain have largely been overcome. This will help to expedite the development of an EDC recognition tool, once the ligand-binding domain of the oestrogen receptor has been expressed in large quantities by fermentation.

Report No 1425/1/06 (Contractor: South African Weather Service)
Daily rainfall mapping over South Africa: Modelling

At the beginning of 2003 the South African Weather Service (SAWS) website began to offer a set of detailed daily maps of the previous day's rainfall over the whole of RSA and some neighbouring territories. This product was the outcome of the SIMAR (Spatial Interpolation and Mapping of Rainfall) research programme. The regular publication of the maps allowed designers/researchers involved in SIMAR the opportunity of receiving feedback from users with a view to improvement of the product. This follow-on project (Daily Mapping of Rainfall over South Africa: Modelling) and its companion project (Daily Mapping of Rainfall over South Africa: Infrastructure and Capacity Building) together address the various infra-structural, capacity-building and computational issues needed to ensure that the daily rainfall mapping programme of the SAWS is so improved that it meets user needs for high-resolution rainfall data in the best possible way. In this modelling study, six areas of improvement of SIMAR were earmarked for research and all were successfully addressed. The techniques relating to these areas of improvement have been combined in a new Improved Rainfall Merging Algorithm for producing optimally estimated rainfields called IRMA.

Report No 1500/1/06 (Contractor: University of Cape Town)
Climate variability, climate change and water resource strategies for small municipalities

This study investigated the adaptive capacity of small towns and communities in the Northern Cape Province to climate variability, specifically drought. By testing these strategies against sustainable development criteria, planning policies for national and water resource planning and management are recommended to ensure water security against the impacts of climate change. A simple multi criteria decision analysis methodology was used to test the long-term suitability of the strategies developed. This was done in consultation with representatives of the various Local Municipalities in the Northern Cape Province and members of the Provincial Drought Task Team. Emphasis should be placed on demand side management given the finite amount of water. This is reinforced by the fact that the top three strategies rated by the stakeholders were all on the demand side. Groundwater is likely to be most severely affected, with the groundwater table dropping due to reduced recharge. Strict groundwater management systems should be put in place with early warning mechanisms to report depleted groundwater reserves. Continual monitoring of the aquifer against climate conditions will provide some knowledge of the future potential under projected climate conditions.

Report No 1344/1/06 (Contractor: Pulles, Howard & de Lange Inc)
The assessment and classification of inorganic manganese containing wastes

This project aimed to establish whether the current methods employed for the hazard rating and classification of wastes containing manganese are appropriate, and whether, under specific conditions, other methods which better represent the behaviour of such wastes exist, or can be devised. Pyrometallurgically generated wastes were used to develop a generic approach to the management of inorganic manganese-containing wastes. Based on these results the authors proposed a revised classification methodology to assess the hazard rating or risk posed by manganese containing wastes. It is thus concluded that inorganic manganese-containing wastes cannot all be classified in one category. The predominant form of manganese found in the waste plays a significant part in assessing its risk potential. The impact of other trace metals and the chemistry over the long term also need to be considered. This project concluded that the current methodology applied to the classification of manganese containing wastes is inappropriate as it does not consider the mineralogy and kinetic aspects of the waste in question. It is recommended that the existing methodology be revised and that the technical process described and presented in this report be implemented.

Report No 1276/1/06 (Contractor: University of Pretoria)
Prevalence, survival and growth of bacterial pathogens in biofilms in drinking water distribution systems

The aim of this project was to gather data on the occurrence and distribution of biofilms of drinking water distribution systems. The prevalence of pathogenic bacteria in biofilms of drinking water distribution systems and containers used for distribution and storage was studied in various locations by two research teams. The survival of water quality indicator bacteria and of certain bacterial pathogens in biofilms in drinking water distribution systems was studied using on-line systems over a period of 18 months. For this purpose a larger, pressure-tolerant variant of the Pedersen device, the Greenwood device, was designed, constructed and installed in three locations. Water and biofilm samples were taken and analyzed. The aerobic heterotrophic count was determined, and specific pathogens tested for, including *Klebsiella, Salmonella, Staphylococcus* and *Pseudomonas*. Bacterial biofilms were detected from all surfaces of drinking water distribution systems sampled, indicating that surfaces were not completely covered in biofilm. A large number of *Aeromonas*, one of the causative bacteria of travellers' diarrhoea,

The WRC @ the SABC Career and Training Faire, Pretoria

The SABC Career and Training Faire commenced its shows in February. The event will be held in ten centres in South Africa from February until August. The WRC, together with the Department of Water Affairs and Forestry (DWAF), exhibited at the event in Pretoria. The WRC printed the WRC career guide, *Water@Work*, for distribution at this event in the various centres. The guide was printed in the form of booklets as well as CDs. Learners commented that they found the guide valuable and informative.

were obtained from a variety of biofilms. Biofilms developed on the surfaces in the three online systems. The results of all three units showed a variable degree of biofilm development based on the heterotrophic bacterial density. Biofilms are a real threat to water quality and can grow even in well-maintained distribution systems. To prevent or minimize biofilm development, residual chlorine levels should be high enough to ensure that water is sufficiently disinfected from the start to the finish of the distribution line. Water stored in tanks before distribution should be monitored regularly and tanks cleaned and disinfected regularly to prevent the development of a biofilm on the tank walls. It is important to understand the risk involved in supplying "contaminated" or inadequately treated water.

Report No 1393/1/06 (Contractor: Envi-Sabie Scientific)
Nanoporous polymers for the removal of organic contaminants in water

Examples of organic contaminants found in water supplies include halogenated hydrocarbons such as trihaloethylene, tetraethylene and trihalomethanes, aromatic compounds (e.g. benzene, toluene and phenolic compounds), pesticides, hormones, plasticizers, medications and many others. Conventional water purification technologies such as activated carbon, reverse osmosis, zeolites, and molecular sieves have failed to remove organics to desired levels. Recently, new, nanotechnology based, nanoporous cyclodextrin polymers have come to the fore to compete with activated carbon in performance, cost and availability. The aim of the project was to synthesize a number of nanoporous cyclodextrin (CD) polymers and test their ability to absorb high priority organic pollutants from water at µg/L levels. CD polymers were successfully prepared in the laboratory giving a 100% yield of the product. When water samples containing a high concentration of organic pollutant (concentrations of 10 mg/ℓ) were treated, the polymers were not as effective at removing organic contaminants as granular activated carbon. However, the polymers were extremely effective when lower concentrations (10 ng/ℓ) of water samples spiked with known organic contaminants were treated. In contrast, the organic pollutants could still be detected after treating the same samples with GAC. The CD polymers can be easily regenerated to original adsorptive capacity and do not saturate quickly. The preparation of the polymers is inexpensive and simple, although still more expensive than activated carbon. It is foreseen that a large potential exists for the use of these polymers in certain niche applications, such as the final polishing of water to high-purity levels for the more demanding uses.

Report No 1303/1/05 (Contractor: University of Cape Town)
Western Cape river and catchment signatures

A previous project (Report No 754/1/01 "Assessing the ecological relevance of a spatially-nested geomorphological hierarchy for river management") had demonstrated that individual rivers had unique assemblages of fauna. This project aimed to investigate these results in greater depth in order to develop an understanding of the observed phenomenon. Upon investigation it was found that the signatures were caused by subtle changes of species within each major taxon group from catchment to catchment. The shifts in species in least disturbed (LD) sites from catchment to catchment must be caused by underlying environmental conditions. Water chemistry proved not to be a factor for the rivers investigated. While fish do have an effect, they are not entirely responsible for the signatures. Geographical location did explain some of the observations. In order to assess the possible influence of sampling point on the signatures, different permutations of sampling points were investigated using the South African Scoring System (SASS). It was shown that this had little impact on the outcome in terms of computed scores. River and catchment signatures are real biotic fingerprints of upper rivers and catchments in the Western Cape, distinguishing each from the others. Perennial rivers have more stable aquatic communities than non-perennial ones and therefore may be expected to have much clearer signatures. Alien fauna and flora appear to be breaking down the biotic signatures. Rivers appear to have abiotic signatures too. A management implication of river and catchment signatures is that biodiversity could be reduced at the community/landscape level through catchments not being recognised as unique entities, and more than one river within each catchment needs to be conserved at a very low level of disturbance for this reason.

Report No 1117/1/06 (Contractor: University of the Western Cape)
Geomechanical modeling as a tool for groundwater exploration of fractured rock aquifers in the Namaqualand region, South Africa

Stress Mapping Technology (SMT) is a computer-based method, relying on rock mechanic principles and stress-strain relationships, which seeks to transform strain data, in the form of a solid geology map, to stress data. A modelling technique in which dilatancy (fracture permeability) in the crust is due to variations in mean stress allows for the wide variety of structural settings of fractured-rock localities. These variations are a consequence of regional deviatoric stress acting on an inhomogeneous rock sequence. Thus, a technique that measures variations in mean rock stress, such as SMT, has the potential to generate viable dilatant sites, which could be exploration targets for fractured-rock aquifers. In areas where the SMT method is applicable, a main advantage over previous lineament-analysis procedures is that once the tectonic history of a given area is determined, it is possible to predict which structural features, or combinations thereof, would likely be targeted for groundwater development. In this way, the siting of new boreholes can be facilitated more effectively, even in areas where no previous borehole information exists. The congruence of stress anomalies and known groundwater abstraction locations, as well as fracture density and fracture frequency in the study area demonstrates the usefulness of the technique as an additional data layer in groundwater exploration.

Reports can be ordered at orders@wrc.org.za