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In This Edition



A Model Researcher

Professor Roland Schulze's parents both had no more than primary school education. However, their parental instinct and foresight prompted them to motivate their children to achieve greatness through education. This foundation was strengthened by Mr Fritz Rencken, a platteland primary school principal who taught his pupil lateral and holistic thinking. It seems like the final touch of perfection was effected by Prof Peter Tyson and Prof John Daniel, the former of whom exposed Roland to rigorous fieldwork whilst the latter inculcated a concern for meticulous detail of expression. All this is epitomised in the success that Roland has achieved in the field of hydrology.

Prof Schulze graduated with a PhD at the University of KwaZulu-Natal in 1975. As a professor of Hydrology and Head of Discipline, Prof Schulze has many accolades to his name, the most noteworthy being the SA Institute of Agricultural Engineers' Gold Medal for outstanding contributions to hydrology in South Africa, which was presented to him in 1990. He has also been honoured with the Fellowship of University of Natal in recognition of distinguished academic achievement (1991); the Fellowship of Royal Society of SA for distinguished contribution in the furtherance of science in SA (1993) and life membership of international Water Academy, Norway (2003).

Roland joined the then University of Natal in 1969 as a junior lecturer and in 1975, upon completion of his PhD on catchment evapotranspiration modelling and after a stint in the UK, returned to the university as a senior researcher in the Department of Agricultural Engineering, to head up the WRC-funded Agricultural Catchment Research Unit. The acronym for this unit lent its name to the ACRU model, the development of which commenced in the early 80s. He then progressed through the ranks of associate professor (1981), full professor (1987) to post level 7 professor (1993-).

When asked about the highlights of his career, Prof Schulze said, "Seeing a collection of enthusiastic young hydrologists and engineers in the 1980s and 90s gel into a team working towards common goals in applied hydrology, was one the highlights of my career. Another was seeing the academic discipline of Hydrology grow from the lukewarm reception it was greeted with when I first suggested the idea to university authorities in 1981 to now being one of the bigger science disciplines on the Pietermaritzburg campus, earning the envy of others for its enthusiasm, success and cohesiveness."

This eminent researcher experienced a turning point in his career during a 7-month stay in 1981 at the USDA Hydrology laboratory in Washington, where concepts of both the SCS-SA and the ACRU models were nurtured and crystallised. He has also participated in the international arena through sabattical leave in Hull (UK), Washington, Logan (Utah, USA), Bonn, Wallingford (UK), and Wageningen (Neth), as well as through international programmes such as the IGBP, International Dialogue on Water and Climate, UNESCO Institute for water Education, where he gives 20-40 lecture series each year, and the UNESCO-HELP (Hydrology for the Environment, Life and Policy) initiative. Prof Schulze has been involved in a variety of publications. The 1995 version of the ACRU model handbooks and the 1997 South African Atlas of Agrohydrology and Climatology (both WRC-funded) are well known in hydrology circles.

Roland's association with the WRC commenced in 1975 with the establishment and operation of five small hydrological research catchments in the midlands of KwaZulu-Natal, the data from which were to be used in model development. From small research catchments the scope of research expanded to provincial and eventually to countrywide level. There was a progression "from the SCS to the ACRU model, from compiling an agrohydrological atlas to supporting integrated water resources management, and from land-use to climate-change impacts modelling." The WRC, according to Roland, "has been a key factor in keeping South African water research at the cutting edge internationally and could well be the envy of many countries around the world."

Roland is bent on successfully supervising the completion of two WRC projects: one on climate change impacts on the water resources of South Africa, the other on updating the *SA Atlas of Agrohydrology and Climatology*. He would also like to completely revise and update the ACRU model documentation "for I believe that in servicing the needs of the National Water Act, the era of modelling at time steps beyond the daily has now outlived its purpose."

Dr George Green, Deputy CEO at the WRC, who has had a long association with Prof Schulze says, "Roland's passion for agrohydrological modeling has been apparent from when I first met him about 25 years ago. Its no surprise, therefore, that the ACRU model, which was being conceptualised at that time, now occupies an important niche in operational hydrology and water resource management in South Africa, particularly where land-use, land-cover, climate-variability and climate-change impacts are issues in question. But of equal significance has been the role of ACRU in capacity building. Countless young hydrologists under Roland's close supervision have, through the years, faced and met the dual challenge of improving the understanding of complex hydrological processes as represented in the many algorithms which make up ACRU and of ensuring, despite the growing complexity of the model, that ACRU remains convenient and easy to use."

The collective influences of his late parents as well as his mentors have resulted in this eminent leader adopting a simple personal philosophy: "It is important not to sway, but to stay. It is only then that one's work attains credibility and is applied in real world problem-solving. I have become a firm advocate of mixing sound theory with application, of mixing sound teaching with research, of managing young people and colleagues with a personal touch of encouragement and, as one becomes a senior scientist, of playing roles of synthesiser of research and pre-emptor of research needs."

Prof Schulze, you and your painstaking work on the ACRU model are appreciated by the WRC and the country. Your contribution has been an inspiration to others in the field of hydrology.

The WRC @ the WISA Conference

The WISA Biennial Conference was held at the Cape Town International Conference Centre from 2-6 May 2004. The WRC CEO, Directors and Research Managers participated by organising workshops, chairing sessions and disseminating knowledge at the WRC exhibition stand.

The WRC exhibition stand assumed a different format: a knowledge café. Visitors were encouraged to sit and peruse reports or chat to the CEO, Directors or Research Managers whilst enjoying coffee and cookies in the shape of the WRC logo. Many reports were ordered. The WRC also unveiled its Strategic Research Portfolio (2004-2006). This took the form of a printed booklet and a business card size CD which were handed out to delegates.

The highlight of the conference was the appointment and inauguration of the new President, Mr Jay Bhagwan, a Director at the WRC. Jay stated in his speech, "Thus, as professionals, leaders, practitioners, we are all contributors to the vision of "Some for all, forever"- A cause that is the very fabric of our 10 years of democracy as well as the future of our beautiful country. Hence, we must all take some credit and celebrate ten years of achievements in the water sector and, as we look ahead, we must face the challenges that lie ahead." Read Jay's speech on the WRC website www.wrc.org.za.

Jay Bhagwan (President of WISA) delivering his inauguration speech

Judas Sindana assisting visitors at the WRC Knowledge café

Jay Bhagwan presenting Claire Reed (Winner: SA Youth Water Prize) with a certificate of achievement

Women in Water Awards

The Minister of Water Affairs and Forestry, Mr Ronnie Kasrils, played host at the Women in Water Awards which was part of the National Water Week celebrations. One of the WRC Research Managers and Head of Cross-cutting domain: Water and the Environment, Dr Heather Mackay, was part of the adjudication panel. Among the women who were honoured was Claire Reed, the recent winner of the International Youth Water Prize, which was held in Stockholm. Claire was the winner in the "Researcher Under 35" category and the WRC was the sponsor of the prize of R10 000 in this category.

From left to right: Hon. Minister Kasrils, Claire Reed, Dr Rivka Kfir (CEO: WRC) and Prof H Kasan (Chairperson: WRC Board)

What's New

Report No 1194/1/02 (Contractor: CSIR)
Determining the water use and growth of forest plantations through GIS-based integration of remote sensing and field data in the 3-PG model

The "process-based" 3-PG model shows great promise in predicting growth and water use in forest stands. It is based on a simplified treatment of the major physiological processes governing growth and water use in stands of even-aged trees. Tree growth predictions have been validated in a number of forestry species from widely different climate and site conditions. It was concluded that the 3-PG model appears to be capable of describing the physiological state of trees growing in a wide range of conditions and that it has the potential for improved predictions of growth and water use for a wide range of forest stands.

Report No 769/1/03 (Contractor: University of Stellenbosch)
Fabrication and production protocol for capillary ultrafiltration membranes and modules

Capillary membranes are narrow-bore tube-like membranes, which are self-supporting. Typical operating pressures are below 2 bar. The membranes are used for both water and effluent treatment. Owing to the membranes being self-supporting, it is possible to reverse the flow across the wall of the membranes by reversing the pressure differential. This allows the membrane to be back flushed effectively. The membranes are housed in shell-and-tube modules, which are simple to construct. The project was three-fold: capillary membrane production development, membrane modification and axial-flow module and manifold development. Research was initiated during the course of the project to test the integrity of both membranes and modules.

Report No 999/1/03 (Contractor: ARC)
Evaluation of predictive models for pesticide behaviour in South African soils

The project sought to evaluate existing computer-based models, which were developed in Europe and the USA for their efficiency in predicting pesticide behaviour under South African conditions. The evaluation was aimed at recommending implementation of the use of the most suitable model by pesticide registration authorities. This should lead to the reduced risk of pesticide contamination of ground and surface waters from pesticide application, leading to improved water quality, especially water used by rural communities.

Report No KV 142/03 (Contractor: University of the Free State)
PUTURUN: A simulator for rainfall-runoff-yield processes with in-field water harvesting

In order to quantify long-term crop production risks with different production techniques, it is necessary to carry out crop simulation studies.If long-term runoff data are not available , these studies require reliable simulation of rainfall runoff processes and need long-term rainfall intensity data. In the WRC project titled "Estimation of rainfall intensity for potential crop production on clay soil with in-field water harvesting practices in a semi-arid area," a model was developed to simulate a rainfall intensity-runoff-yield process. However, the rainfall intensity, runoff and crop yield models were not linked by software to form one comprehensive simulator. In this project, a complete simulator for crop yield, which links the combination of rainfall-runoff processes to the crop model, has been developed. This report includes the model description and the user manual (installation and simulation run).

Report No 939/1/03 (Contractor: Rhodes University)
Bioreactor systems for the conversion of organic compounds in industrial effluents to useful products

This project focused on the application of oxidative biological reactions, catalysed by a selection of enzymes produced by a small range of organisms. These enzyme catalysts included laccases, peroxidases and polyphenol oxidases. Specific industrial wastes were identified which contain high concentrations of the aromatic phenolic and polyphenolic components. These effluents were used in the programme as authentic samples on which the biological activity of the selected biocatalysts were tested. The project included investigations into the biotransformations of a range of phenols and polyaromatic hrdrocarbons using the various oxidative biocatalysts. The selected enzymes are produced by particular organisms. The research included investigations of enzyme production and biofilm growth as well as pollutant degradation.

Report No 1191/1/03 (Contractor: University of Pretoria)
Microbial characterisation of activated sludge mixed liquor suspended solids

In activated sludge wastewater treatment systems, the 'active biomass' fraction breaks down biodegradable substrates and synthesises the products into living organisms. The active biomass is thus an important process parameter, but there is currently no reliable method for determining it analytically. Adenosine triphosphate (ATP) is present in all microorganisms and can be measured with great sensitivity. The objective of this investigation was to use ATP as a measure of the active biomass fraction in activated sludge. The experimental results obtained indicate that ATP correlates well with oxygen utilisation rates (OUR), demonstrating a correlation with metabolic activity. Compared to total plate counts (TPC), ATP was found to be a better biomass estimator due to higher counts (more than one log unit difference) and smaller standard deviations. By contrast, mixed liquor suspended solids and volatile suspended solids tests grossly over-estimated the viable population as measured by ATP or TPC. In all cases, a higher viable biomass (active fraction) value was also consistent with better orthophosphate removal in the plants studied, indicating that the viable biomass concentration is a key factor in phosphate (nutrient) removal by activated sludge systems. ATP was concluded to be a 'better' measure of biomass activity than mixed liquor suspended or volatile suspended solids, with TPC and OUR broadly following the trends reflected by ATP measurements.

Report No 1069/1/03 (Contractor: Rand Water)
Cytotoxicity and invasiveness of HPC bacteria

The SABS specifies a HPC limit of 100 cfu.mℓ^{-1} for drinking water. Studies conducted in Canada and the USA revealed that these commonly used indicator bacteria may not be as harmless as perceived. Many of these potentially pathogenic bacteria are associated with primary and secondary infections in immuno-compromised individuals such as the very young, the very old, patients with AIDS, patients with cancer, the undernourished and patients who are organ recipients. This project investigated the presence of HPC bacteria which show potential pathogenic features in treated drinking water in excess of the HPC water quality guideline of 100 cfu.ml^{-1}. Major benefits of this study were the expertise and technology which have been established in an important area of water quality analysis that are not only of significance for public health, but also for water utilities and water institutions setting up water quality guidelines.

Report No 1040/1/03 (Contractor: University of Port Elizabeth)
A two-enzyme cleaning-in-place programme for South African dairies

This study aimed at developing a CIP system based on lipases and proteases, which would result in a more acceptable effluent being discharged while still providing effective cleaning for all surfaces in the dairy industry in South Africa. The twin enzyme lipase/protease CIP system proposed and investigated a more acceptable effluent when compared to the current chemical CIP practices. Novel biocatalysts were isolated from *Serratia liquefaciens* and *Acinetobacter lwoffi* and these were shown to be able to provide a safer and cheaper alternative to chemical CIP systems. A "mini dairy" was constructed. The milk and cleaning solutions were pumped through the system using a centrifugal pump. This allowed for the evaluation of the new technology as well as for the verification of the efficacy of current cleaning regimes.

Report No 953/1/03 (Contractor: University of Cape Town)
Role of the oceans in South Africa's rainfall

The aim of this project was to investigate aspects of the role played by the Indian, the Atlantic and the Pacific Oceans as well as the Agulhas Current on rainfall over southern Africa. It has contributed to unravelling some of the physical mechanisms linking the ocean and climate variability in South Africa. It has further elucidated the considerable effect of the Indian and Pacific Oceans on the yearly variation of rainfall over South Africa. The Agulhas Current has also been shown to play an important role, especially through enhancing local weather systems and storms and has highlighted significant changes over time in the teleconnections linking southern African rainfall variability to oceanic and atmospheric conditions.

Report No 911/1/03 (Contractor: University of Pretoria)
Prediction of the formation of density currents for the management of reservoir sedimentation

Reservoir sedimentation causes an average annual loss in storage capacity of 130 million m^3. This study investigated the use of a new theory based on minimum stream power at the plunge point, to predict the formation of a density current. Laboratory tests were carried out with sediment transport to verify the theory. Clear water flume tests were also carried out to investigate the velocity distribution at the plunge point and the critical hydraulic conditions required for stable density current formation. Field data from 3 dams were used to verify the theory. The density current formation and location of plunging was forecasted with the minimum input stream power theory.

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



Great Work, Prof Momba!

It is well known that the health of a community is significantly affected by its drinking water quality. The unavailability or inaccessibility of supplied water in most rural areas leads to the direct use of untreated water from rivers, streams, boreholes and other sources for a variety of domestic purposes. The rural communities of the Eastern Cape Province often experience disease epidemics due to poor sanitation or water of low microbiological quality.
Since 1997, Prof MNB Momba has been working on water research projects at the University of Fort Hare. These projects include research in groundwater, surface water and river water used for domestic purposes by most of the rural communities in the province. The research projects aim at examining the risks associated with microbiological hazards in order firstly, to establish whether exposure to microbiological agents add to the increase in water-related diseases in the Eastern Cape province; secondly, to raise community awareness of the microbiological quality of drinking water sources and thirdly, to develop strategies to ensure sustainable and effective treatment of drinking water.

The research team's interest in water research generated support from the WRC in 1999. The main concern of the team is to monitor the performance of small water distribution systems in providing safe/potable water. Recently, the WRC approved funding for the research focusing on the improvement of small water distribution systems nationally in which Prof Momba is one of the research leaders. This study aims at improving the different parameters used in small water treatment plants, which cause failure in their supply of potable water.

Due to wastewater treatment processes, the research team under Prof Momba' supervision also has an ongoing research programme which examines the performance of the wastewater treatments plants and the protozoa predation study project.

Prof. Momba has established a Molecular Diagnostic Laboratory (MDL) through her research funding from NRF and WRC. The MDL was officially inaugurated on the 27th of November 2003 by Professor Derrick Swartz, the Vice Chancellor of the University of Fort Hare and the Water Research Commission (WRC) representative Dr. IM Msibi.

Professor Maggy Momba (above left) the coordinator of MDL giving a speech during MDL opening. The Water Research Commission (WRC) representative Dr. IM Msibi (above right).

Dr Msibi and Prof Momba at the opening function

Rand Water Chair in Water Utilisation, University of Pretoria

The University of Pretoria has appointed its third Rand Water Chair in Water Utilisation, Prof. Evans Chirwa, who has been active in that capacity since October 2003. Professor Chirwa comes from Howard University in Washington DC (U.S.A.) where he worked as Lecturer and Research Associate in the Environmental Engineering Group of the Department of Civil Engineering. While at Howard University, Prof. Chirwa conducted research on biological phosphorus removal and nitrification/denitrification processes for the Washington DC's Blue Plains Wastewater Treatment Plant. Prof. Chirwa obtained his Ph.D. from the University of Kentucky in the year 2001. His dissertation research on biological chromium removal from water and wastewater opened a new subject area now studied at several institutions around the world. His interest in research for the improvement of water quality began thirteen years ago (1991) when he was involved in research on the natural coagulant from the African tree (*Moringa oleifera*) as an alternative to aluminium and iron based salts. Prof. Chirwa's expertise lies in the optimisation of water treatment processes, biological remediation of organic and metallic pollutants, and water resource development for rural communities.