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THE WATER WHEEL is a two-monthly magazine on water and water research published by the South African Water Research Commission (WRC), a statutory organisation established in 1971 by Act of Parliament. Subscription is free. Material in this publication does not necessarily reflect the considered opinions of the members of the WRC, and may be copied with acknowledgement of source.

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Letters to the Editor

(E-mail: jand@wrc.org.za)

CLIMATE CHANGE

Rod Camp Pr Eng from Cape Town writes:

I agree with WJR Alexander's dissertation, however I believe we must not lose sight of the possibility that the increase in gases such as carbon monoxide, carbon dioxide, nitrous oxides and particulate matter such as sulphur can have serious consequences on the health of living organisms and human life.

We must therefore continue to strive towards reducing these emissions and expedite the planting of more trees, such as pines, which are efficient carbon recyclers.

Dr Heather Mackay from Pretoria comments:

While I have the greatest respect for Prof Alexander's work during his long and distinguished career, some statements in this particular article regarding the impacts of global warming are questionable, since they are based on his averaging of hydrological parameters over the whole of South Africa, which is not really meaningful when considering potential regional impacts of global warming. I am also concerned about his sweeping statement that the effects of global warming will be "beneficial to the natural environment". Prof Alexander's view that increased surface water flows will be beneficial to the natural environment is simplistic and trivializes this important issue, since there is plenty of good scientific evidence that increased flows, whether average or peak flows, can have significant negative impacts on aquatic ecosystems, just as reduced surface flows do.

I think it would be irresponsible not to publish a counter-view to Prof Alexander's article in order to provide some balance.

WATER PURIFYING DEVICES

Mr HP Beyers, a retired analytical chemist from Kokanje, writes:

Water quality for potable and domestic purposes no doubt has become a crucially important issue in South Africa. However, these days, exaggerated and doubtful claims about the cure of all ills (including cancer, asthma, arthritis, etc) through the use of "pure" water are made in advertisements in the press, and a stream of opportunistic salesmen and merchants are exploiting the gullibility and ignorance of the public by foisting a variety of water filters and purifying devices on them. Very often these ill-informed salesmen are just out to make a fast buck. They are seldom adequately technically equipped to advise potential buyers about the merits and disadvantages of a particular water purifying device. They confront the ignorant with incomprehensible "technicalities" such as reverse osmosis, acetate membranes and what have you, producing highly purified potable water. Cursory reference is also made to activated carbon filters and ceramic, nylon and UV principles. I doubt if reference is ever made to the South African Bureau of Standards' revised standard for drinking water. There should of course be certain advantages to connect a water filter to your kitchen faucet. But it does not begin and end there. An intimate knowledge of the feed water quality (analysis to SABS standard) and compliance with the regulations of the departments of Health and Water Affairs is vital in evaluating a system and its performance, including the reduction and elimination of micro-organisms. Few users of these filters, for instance, realise that if the chlorine, which is added during the water purification process, is removed, the end-product is "unprotected". The common complaint is usually the smell and taste of chlorine.

I would like to know if any research has been done to investigate the performance of these domestic water purifying devices, and whether there is any literature available on their effectiveness or guidelines for purchasing such a filter.

(The WRC has not officially tested any of these devices. Maybe our readers could assist or share their experiences with domestic water filters with us – Ed.)

CAREERS IN WATER

Mr Bruce Ramushu from Masemola writes:

I am a 24 year old man, currently working at a pressure castings company, but with my mind and heart in the water sector.

In May 2003 I obtained my N3 certificate at the then Northern Province Community College. Due to lack of finance I was unable to further my studies and was forced to look for a job. I tried the Department of Water Affairs for training, hoping to gain experience, but in vain.

I want to do a diploma in water care which many South African technikons offer on a fulltime basis, but which I unfortunately cannot afford, because I cannot leave my job for the classroom.

I wonder if there is any way in which you could help me reach my goals? In future, I would like to see my picture in the *Water Wheel*, sharing my knowledge about eutrophication, stabilisation, desludging, sewage water treatment, etc. with other readers.

PH.D. AWARDED IN GROUNDWATER

Dr Kevin Pietersen, Director: Water Resource Management at the Water Research Commission, was awarded a Ph.D. degree on 16 March 2004 by the University of the Western Cape for his thesis "A decision-making framework for groundwater management in arid zones (with a case study in Namaqualand)". Pictured after the ceremony are from left: Dr Shafick Adams (who received a Ph.D. for his studies into recharge processes in basement aquifers), Prof Yonxin Xu from the University, who acted as supervisor, and Dr Pietersen.

WATER RESOURCES AS ECOSYSTEMS

Scientists, Government and Society at the Crossroads

South African Society of Aquatic Scientists Conference 2004
In association with the Department of Water Affairs and Forestry, and the Water Research Commission
Monday 5 July – Thursday 8 July 2004
Eskom Convention Centre, Midrand, Gauteng

Aquatic scientists in South Africa have always had a close relationship with sectors of government and parastatals responsible for the management of water resources and protection of aquatic ecosystems. Together scientists, policy makers and managers have, over the last three decades, brought South Africa to the forefront of thinking and technology for the integrated management of aquatic resources.

Over the last decade aquatic scientists in South Africa helped to stimulate the development of ground-breaking policy that recognises the ecosystem as the resource, and that sets out an approach which supports management of water resources as ecosystems. Innovative technology for integrating and operationalising the dual management imperatives of resource protection and resource utilisation was developed in parallel with this policy. Throughout, there has been a constructive engagement between sectors, particularly between scientists and government, that is unrivalled in the world, even if the road has been rocky at times. The policy, its supporting legislative framework and tools for its implementation, have the world on the edge of its seat in anticipation.

Our new legislation mandates a major redistribution of costs and benefits of using aquatic ecosystem resources. Achieving this in the letter, and spirit, of the Act and our Constitution, presents unprecedented challenges to scientists, government and society. They jointly hold the keys to successful implementation of an ecosystems approach to water resources management.

The conference aims to capitalise on our legacy of constructive engagement to find an exciting way forward, in a partnership between scientists, government and society.

THE PROGRAMME

The programme is designed to ensure participation by all SASAqS members, aquatic science students and a broad range of other professionals who can become partners in this challenge. We encourage all participants to engage the conference and session themes in their papers or posters, but as always, there will be room for specialised research presentations. If you have any queries you are welcome to contact the organisers of the various main sessions.

INFORMATION

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BIOFOULING:

A Unique South African Solution to an Expensive Problem

In May this year, a major brewery in Port Elizabeth will be the first to test the abilities of a new biofilm monitoring and treatment system – one that looks set to save industrial water users hundreds of thousands of rands in production and running costs.

Professor Eugene Cloete with the full-scale laboratory model of the Rotoscope, which is being used at the University of Pretoria for ongoing studies and monitoring.

Developed at the University of Pretoria, the Rotoscope is a uniquely South African answer to a problem that costs global industry several billion Euros a year. The system is designed to monitor and treat the formation of unwanted biofilm – the accumulation of bacteria, proteins, algal material and fungi that causes the deterioration in the microbiological quality of treated water.

The corrosion and weathering caused by this biofilm can lead to considerable damage, ranging from contamination of pharmaceutical or microelectronic products, to reduced efficacy of heat exchangers, unexpected corrosion of stainless steel and premature destruction of mineral materials.

In a nutshell, the Rotoscope aims to provide an affordable on-line, real-time, non-destructive method to monitor biofilm. And at roughly a tenth of the price of similar high-end systems, it holds huge promise for local companies who want to improve the price and quality of their products. Once commercialised, it could also capture a substantial slice of the somewhat underserved overseas market.

According to local company BTC Products & Services, who have been licensed to manufacture and market the Rotoscope, there are only two other commercial units currently available. Both sell for around 40 000 Euros each, and are bought almost exclusively by large utility companies.

BTC owner, Hugh Mitchell, says that the first three Rotoscope prototypes will be installed at the brewery in Port Elizabeth by mid-May, and five to ten units will be under evaluation by June. The units will be used in the brewery's pasteuriser, and to measure biofilm formation in a pipeline carrying re-treated effluent.

"This 'test' phase will determine the robustness of the unit as well as the value and practicality of the data and information it generates," he explains.

"We have secured funding from the Department of Trade and Industry, as well as the support of three major organisations, for the commercialisation process. We hope to sell the first two commercial units to our technology transfer partners in the USA and in England."

The Rotoscope aims to provide an affordable on-line, real-time, non-destructive method to monitor biofilm – at roughly a tenth of the price of similar high-end systems.

This success follows more than two years of internally-funded development by Rotoscope inventors Professor Eugene Cloete (head of the Department of Microbiology and Plant Pathology at the University of Pretoria) and Professor Fanie van Vuuren (from the Department of Civil and Biosystems Engineering).

"I have been studying biofouling and biocorrosion for the past 10 years and one major challenge has always been monitoring the adhesion of bacteria to surfaces exposed to water and the adverse effects that go along with this," explains Prof Cloete.

"In 2002 I organised an international conference on biofouling monitoring to discuss the challenges and review what was on the market. This led to the publication of a book on biofilm monitoring, of which I was co-editor. What became clear was that there was no affordable on-line real time non-destructive method to monitor biofilms. My many contacts in the industrial water treatment industry, and their need to control biofouling, added to the challenge."

BIOFILM: A DIFFICULT CUSTOMER

So what is biofouling, and what makes it such a tricky – and widespread – problem?

Prof Cloete explains that when water-borne bacteria congregate in sufficient numbers they form a film on the surface of pipes, tanks and indeed any piece of equipment. This

BIOFOULING CONTROL – A SOPHISTICATED SCIENCE

Many bacteria are *planktonic* – they float around in water. Most microbiological work is done using these suspended cultures on water samples. The bulk of the bacteria that cause problems, however, are *sessile* – attached to a surface.

Once bacteria attach to a surface they go through a series of changes, the most obvious of which is the excretion of a slimy material, referred to as biofilm. Linked to this is the problem that when bacteria attach to a surface, a whole different set of genes are activated, making it a significantly different organism to deal with compared to the planktonic material suspended in the water.

Industrial process water or potable water is not a sterile system, so there is a level of biofilm in all systems that is inherently present without causing problems. Problems occur when the biofilm builds up ("biofouling"), creating dead biomass and therefore a nutrient source that leads to re-growth of organisms in the water.

Biofilm structures vary according to flow conditions in a water system, for example, a turbulent flow produces homogenous and slimy biofilms, which are harder to "inactivate" than biofilms produced by laminar flows.

Also, the effectiveness of a disinfectant or biocide depends on the age of the biofilm as well as its particular physical and chemical structure. To complicate things even further, the same type of bacteria can vary from site to site.

Biofilms do not conform to any mathematical model; they vary in thickness, density and composition from point to point, and in any given process water system. Treatments that work at site A might not work at site B, and therefore there is no standard level for the removal of biofilm.

Water flows from a slipstream of the main process water, into the Rotoscope through this pipe, before being channelled up to the rotating plastic wheel.

Inside this section of pipe is a series of removable glass slides. Biofilm forms on these slides as well as the plastic wheel, and while the wheel provides for real time monitoring, the slides give the user the option of sending samples away for more in-depth analysis and testing, if required.

At the centre of the Rotoscope is a rotating plastic wheel that is half submerged in the main process water. Biofilm forms on the disc and is measured by green and/or infrared light that is projected onto the back of the disc (which is covered). The front of the disc is clear, which means the system could also be used to visually monitor algal growth, where relevant.

A digital measuring unit is linked to the red/green light box on the back of the plastic wheel. This unit measures the refraction of the light, which changes as biofilm forms on the wheel's white surface. When a pre-determined threshold is reached, the unit send a signal to the chemical dosing unit and a slug dose is released into the main water tank of the system.

ABOUT BTC PRODUCTS & SERVICES

BTC Products & Services is a local disinfectant specialist focussing on stabilised chlorine dioxide and its applications, primarily in the food safety, agricultural and water treatment industries.

Services include trouble shooting in terms of disinfection and sanitising; microbial sampling of water, produce, swabs and air samples; ethylene measurement; and the design, development and installation of dosing and monitoring equipment.

The company's chlorine dioxide generators make BTC a logical partner in the Rotoscope commercialisation, in that they make the on-site generation and delivery of chlorine dioxide possible.

"biofilm" is a living organism which consists of mainly water, bacteria, suspended solids, corrosion products, algae, yeasts /molds, protozoa and molluscs.

Biofilm is typically found wherever liquid and a solid surface interface, such as in heat exchangers, cooling towers, municipal water storage and the food and beverage industry. To prevent contamination of water and related products, biofilm development must be monitored and treated continuously by taking water samples and measuring plate counts to determine the level of microbiological contamination. "Even the most efficient organisation work on the principle that if

these samples are clear then the whole production will be clear from microbiological contamination," says Prof Cloete.

This is extremely costly, which means most companies are restricted to intermittent testing and treatment.

"However, this film has been found even in water that has been tested and shown to have very low microbiological counts when water samples are plated out. Therefore product loss still occurs as a result of microbiological contamination, even though quality control samples show little evidence thereof."

BTC's Hugh Mitchell adds that currently, biofilm management is based on decisions made from the results obtained from bulk water samples – even though research shows there is little correlation between planktonic bacteria (floating in water) and sessile (attached to surface) bacteria of the same type.

"Any strategy that incorporates antifouling technologies will therefore be more cost-effective if the extent of the biofilm can be monitored online and in real time, without destroying the biomass formation," he says.

Most monitoring techniques rely on the removal of biomass from the system in the form of coupons that have been exposed to the fluid for a given period. These samples are then sent away and analysed, which is time-consuming and require skilled personnel.

"Usually biofilm is only detected after it has already caused economic losses," says Mitchell. "Current treatment techniques are also problematic, as many are based on the assumption that if one kills the organisms in the bulk water, one will prevent the formation of biofilm. However, biofilms are resistant to many non-oxidising biocides and re-growth of biofilm is inevitable. This often leads to significant overuse of poorly selected disinfectants or biocides, which raises costs and creates environmental concerns."

THE CHEMICAL DOSING QUANDARY: SLUG VS. CONTINUOUS

Continuous low-level chemical dosing is often used in the removal or detachment of biofilms. However, slug dosing – which is part of the Rotoscope system – has been demonstrated to be significantly superior. "In many cases, the level of detachment changes by factors of 10 to 100 times for slug dosing compared to continuous dosing," says Mitchell. "Slug dosing is also more cost-effective."

> "It is a proactive system, in that biofilm forms in the Rotoscope before it forms on mild or stainless steel. This means that appropriate dosages of biocide can be released before biofilm becomes a serious problem."

HOW IT WORKS

Besides real-time, online monitoring of biofilm, the Rotoscope automatically releases a dose of biocide used to disperse the biofilm, whenever a threshold level is reached.

The device has a rotating plastic wheel that is half submerged in water flowing from a slipstream of the main process water. Biofilm forms on the disc and is measured by green and/or infrared light reflecting off the white surface. The frequency of measurement can be varied, from every five minutes to every 120 minutes and/or be continuous.

"It is a proactive system, in that biofilm forms in the Rotoscope before it forms on mild or stainless steel," explains Prof Cloete. "This means that appropriate dosages of biocide can be released before biofilm becomes a serious problem in any system."

Simply put, the Rotoscope is immediate, effective, non-destructive, continuous and affordable.

The technology has been patented in South Africa, with international patents pending. Each unit is expected to sell for between R35 000 and R50 000, and the most significant applications are expected to be in industrial water systems like paper mills, cooling towers, brewery pasteurisers, water utilities, water distribution pipelines and heat exchangers.

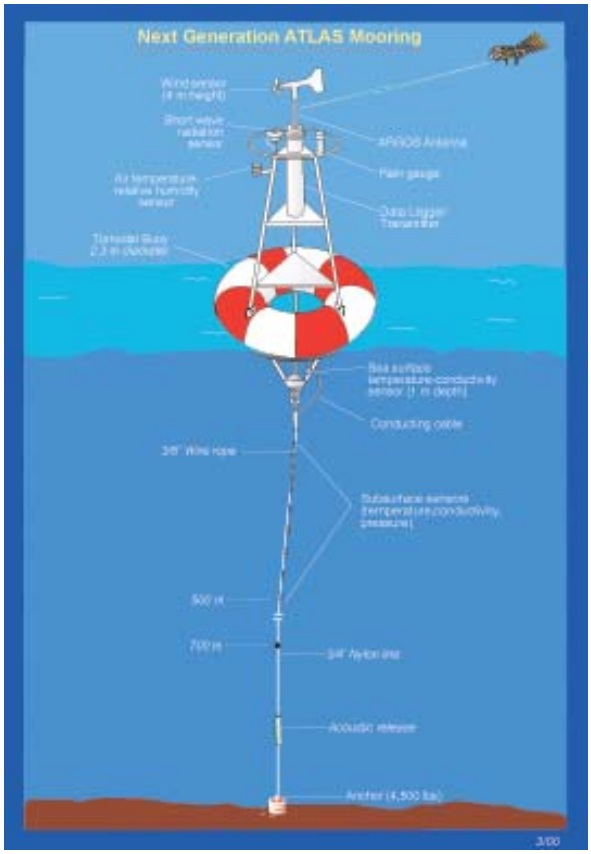
For more information contact:
Hugh Mitchell, BTC Products, Tel (011) 794 9193/ 9239
Prof Eugene Cloete, University of Pretoria, Tel (012) 420 3265.

Forecasting Benguela Niños

Benguela Niños occur when warm seawater from the equator moves along the southwest coast of Africa towards the South Pole and penetrate the cold upwelled Benguela Current. To determine what effect these Benguela Niños have on weather patterns and rainfall over southern Africa, Sue Matthews spoke to researchers at the University of Cape Town.

Benguela Niños have much the same effect on weather as their more famous namesake on the Pacific coast of South America. Just as oceanic warming due to El Niño brings heavy rain to Peru and neighbouring parts of Chile, Benguela Niños cause floods along the coast of Angola and Namibia as warm water from the tropical Atlantic Ocean is advected southwards into the northern Benguela region.

"It's important to develop an early warning system for Benguela Niños, yet we know very little about how they work," says Mathieu Rouault, who last year completed a WRC-funded study on the role of the



An ATLAS mooring system costs in the region of $50 000 and must be recovered and replaced every year for routine maintenance.

Launching an ATLAS instrumented buoys

oceans in southern Africa's rainfall.

"Satellites can't give all the information we need, and numerical models don't integrate all the phenomena happening in the region. There are a handful of drifting buoys in the south-east Atlantic, but they only measure surface pressure. We need an observing system that can tell us what's going on in the ocean, because if we understand the mechanisms behind the development of Benguela Niños, we can improve the forecasting."

ATLAS BUOYS

Nowadays, El Niño is fairly well understood, and it's possible to predict the onset of an event up to six months in advance. This can be largely attributed to the array of 70 ATLAS instrumented buoys deployed in the Pacific Ocean during the early 1990s. The observing system was developed as part of the TOGA research programme to understand the ocean processes governing the El Niño Southern Oscillation (ENSO) phenomenon.

Later it was decided to extend the observing system into the tropical Atlantic Ocean. France, Brazil and the USA took on the task of developing PIRATA – the Pilot Research Moored Array in the Tropical Atlantic – which consists of 12 ATLAS buoys moored in the area between 15°N and 10°S.

Three extensions to this observing system have since been proposed, one of which is the south-east extension (SEE). This would entail installing two ATLAS buoys in the tropical waters off Angola. Dr Rouault is chairman of the PIRATA-SEE committee, and recently conducted a feasibility study on the extension for the Benguela Current Large Marine Ecosystem (BCLME) programme. The programme is a joint initiative of South Africa, Namibia and Angola that was kick-started with funding from the Global Environment Facility (GEF).

"Benguela Niños have a big impact on fisheries, which is why the BCLME programme is interested in the PIRATA extension," he explains.

WARM SEAWATER

During the 1995 event, for example, the entire coast from Angola's Cabinda Province to central Namibia was covered by abnormally warm water – in places up to 8°C above average – to a distance of

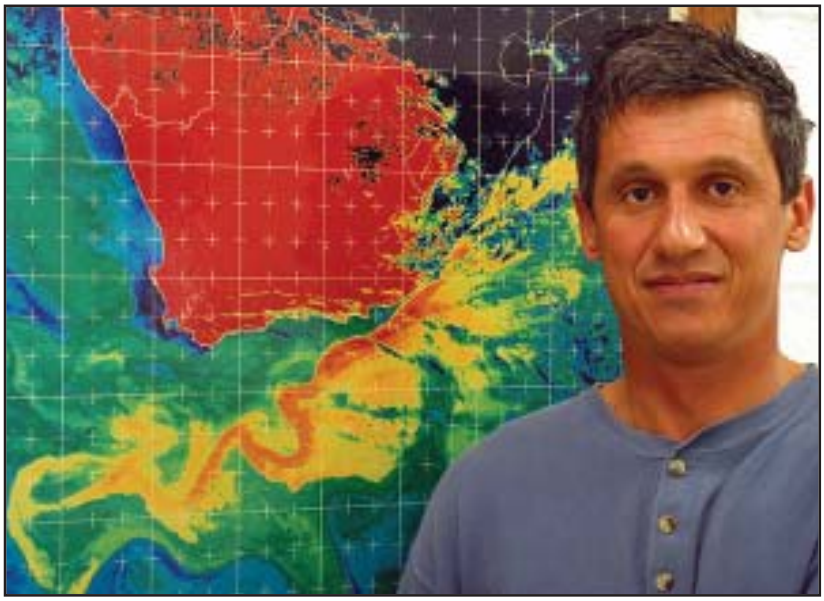
more than 300 km offshore. The effect was disastrous. Sardine, horse mackerel and silver kob died *en masse*, while those sardine that managed to escape the warm water by moving south were heavily fished by the Walvis Bay fleet. Hake migrated offshore, and the anchovy stock, already at a low level, collapsed completely. The seal population was almost halved after many adult seals succumbed to starvation, and the entire cohort of pups either died or aborted.

Clearly, it would be wise to adjust fishing quotas in the run-up to a Benguela Niño, but to do this some advance notice is required. And this is the ultimate objective of PIRATA – to enable resource prediction in the adjacent countries, whether it be for water, agricultural or fisheries resources.

The ATLAS buoys monitor a host of oceanographic and meteorological parameters. A typical mooring includes an anemometer (wind speed), air temperature and humidity probe, pyranometer (short wave radiation), rain gauge, combined temperature/salinity sensors at the surface and at 20, 40 and 120 m depth, temperature sensors at 60, 80, 100, 140 and 180 m depth, as well as temperature/pressure sensors at 300 and 500 m depth.

The data are transmitted to shore via satellite and are available in near real-time on the Internet and the World Meteorological Organisation's Global Telecommunication System. Apart from helping scientists to learn more about how variations in sea temperatures, winds and other climate variables affect the tropical Atlantic region, the data can be used in ocean and weather prediction models, and to validate measurements derived from satellite remote sensing.

Each ATLAS mooring costs in the region of $50 000 and must be recovered and replaced every year for routine maintenance. A five-year PIRATA-SEE project would cost $600 000 for two moorings, but Dr Rouault has recommended initially conducting a year-long demonstration project involving only one mooring without meteorological instruments. This is largely to allow the risk of vandalism to be assessed.



Dr Mathieu Rouault from the Department of Oceanography, UCT, is chairman of the PIRATA-SEE committee.

"Vandalism has been a problem for PIRATA," he admits. "Sometimes it's just the wind vane that is stolen, but fishermen probably also damage the mooring when their gear gets tangled in it."

If the PIRATA-SEE project proves to be a success, however, Dr Rouault is hopeful that a similar kind of observing system can ultimately be deployed in the Indian Ocean.

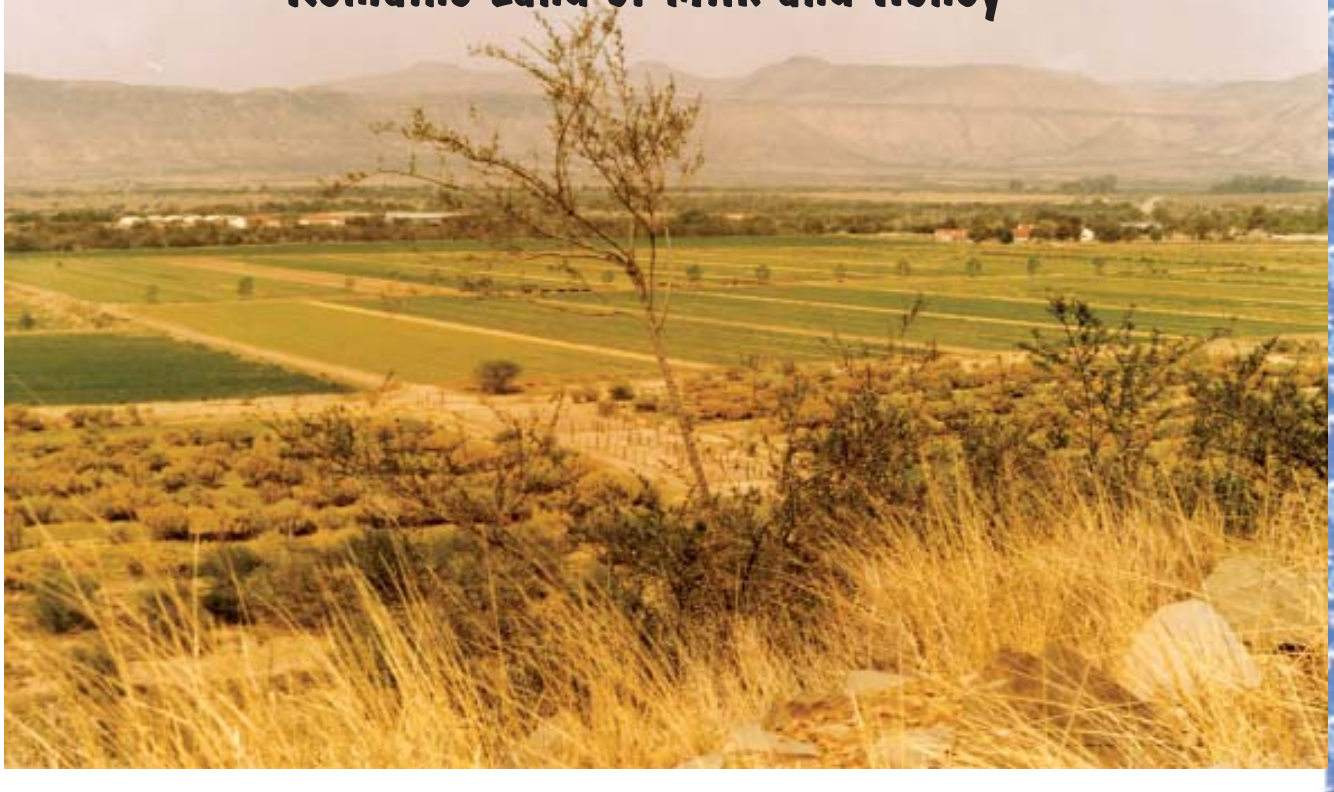
"Our WRC project indicated that the Indian Ocean is more important to southern Africa's weather than the Atlantic," he says. "We've shown that the increase in extent and intensity of droughts over the last 30 years is linked to a warming of the Indian Ocean, probably due to a slight change in the frequency and duration of El Niños. On a more local scale, the Agulhas Current has a big impact on coastal weather extremes, because evaporation results in high levels of water vapour in the air above it. This moisture can be advected to the coast to feed storms and tornadoes."

"Nevertheless, there are a lot of advantages to initially doing an extension of an existing array of moorings, and joining an international initiative like PIRATA. They'll help us in training technicians and calibrating the sensors, and we will be able to obtain tried and tested moorings at a relatively low cost. If we can show that the region is capable of maintaining one or two moorings, we'll be much more credible by the time we're ready to tackle the Indian Ocean. It's not likely that we'd be able to put any moored instrumentation in the Agulhas Current though – it's so powerful that an ATLAS mooring wouldn't last a day!"

Water Control Ensures

Great Fish River Valley

Remains Land of Milk and Honey



Hippos once wallowed in pools of the Great Fish River; later African and European went to war on her banks. Today the river supports a flourishing agricultural industry yet water hasn't always been abundant. The Great Fish River Water User's Association is playing a crucial role in the administration of this vital resource to ensure the valley survives.

It's 1974 and the Great Fish River in the Eastern Cape is in flood. A newspaper photographer snaps a picture of farmer Oscar Evans wading, waist deep, across the swelling water. In his hand is a tiny mouse scooped up as it swam for its life.

The flooding river wreaks havoc but it cannot defeat those living on its banks, no matter how small. On dry land Evans gently lets the gasping creature go and continues on his way to buy candles at the trading store. The next day the picture makes front-page news – a symbol of the spirit of those living in the 200 km-long valley.

The Evans family have lived on their farm, Melrose on the Bedford side of the Great Fish River, since 1890. Then the Great Fish River was already a "sloot" ferrying water to an increasing number of farms in the valley. Before this though, at the end of the 1700s, the French ornithologist and explorer Francois Le Vaillant described the Great Fish as a series of marshy vleis filled with wallowing hippo. Today the giant Gariep Dam in the Free State feeds the river. It has become a rushing torrent that provides water to irrigate agricultural land throughout the valley.

The Great Fish has sustained mankind for centuries. The Xhosa, with their herds of cattle, regarded the river as their own after driving out the Bushman before the arrival of Europeans. The frontier wars between the European settlers and the Xhosa were based on

access to land and, more crucially, the river. Without water no one could survive and it was with the Great Fish River between them that European and African clashed in eight wars between 1779 and 1853. Most of the skirmishes were fought in the Great Fish River Valley.

When settlers arrived in the 1700s the river provided ample water for all farmers in the valley but by the 1950s the resource was under pressure as more and more land was irrigated.

For this reason Evans has been involved in the administration of water in the valley since he took over the farming of Melrose from his father.

For many years he served on the Renfield Irrigation Board, one of the sub-areas of the Great Fish River Water User's Association (formerly the Great Fish River Irrigation Board). He was also water bailiff for 14 years responsible for ensuring that farmers in the district shared the resource honestly.

WATER USER'S ASSOCIATION

The Water User's Association comprises 17 sub-areas each supervised by a water control officer reporting to a management committee of farmers.

Altogether there are 380 commercial farmers (including black land owners) farming 33 000 arable hectares in the Great Fish River Valley. The biggest crop is lucerne (60%), (produced for several major dairies in the valley and along the Eastern Cape's southern coast,) followed by maize (30%) and wheat (10%). Sheep, angora goats and bees are also farmed.

Irrigation is by far the biggest job provider for towns like Somerset East, Cradock, Cookhouse and Hofmeyr.

Mr CT (Chris) Troskie, former chairman of the Great Fish River Irrigation Board

Andreas Engelbrecht, CEO of the Water User's Association, explains that farms in the northern part of the valley between Teebus and Elandsdrif have a water quota of 13 500 m^3 per hectare per annum while those between Elandsdrif and Middleton receive 12 500 m^3 per hectare per annum.

Crops are irrigated with water led to farms by a series of open earth canals. Flood irrigation is the most popular means of watering although farmers are increasingly switching to the more economical and effective "pivot" irrigation.

"There is a growing awareness of the importance of protecting water as a resource," says Engelbrecht, "farmers know flood irrigation uses more water than is sometimes necessary and, when they can, they are switching to more economical ways of watering."

WATER LOSSES

Chris Troskie, owner of the farm Kokskraal near Cookhouse and a former chairman of the Great Fish River Irrigation Board for 19 years, says the open canal system used to transport water to farms loses as much as 15% of water through seepage, growth of vegetation on the canal banks and evaporation.

"When the Gariep Dam was finished in 1969 there were plans to build concrete furrows and pipelines through the whole distribution system but it never happened. I doubt it ever will because of a lack of funds," says Troskie.

Water for crop irrigation in the valley is released into the Fish River from the Gariep Dam via an 88,8 km tunnel, with an internal diameter of 4,8 m. The tunnel directs water southwards to the Brak River a tributary of the Great Fish. The Gariep distribution system is part of the great Orange River water distribution project that was first conceptualised in the 1920s. Without this water there is no question the valley would not be able to support the vast and sophisticated farming operation that has developed in recent years.

DROUGHT

After the drought in the 1950s, nearly 20 years before the completion of the Gariep dam, it was clear that the government irrigation dams in the Great Fish River Valley (Grassridge, Lake Arthur and Kommando) could not keep up with the demand for water and farming in the valley came under threat.

The former government was eager to please its rural electorate and awarded huge subsidies to those working the land, even so the drought meant many families were forced to abandon their farms. The government stepped in buying 70% of the agricultural property in the valley, reorganising it into

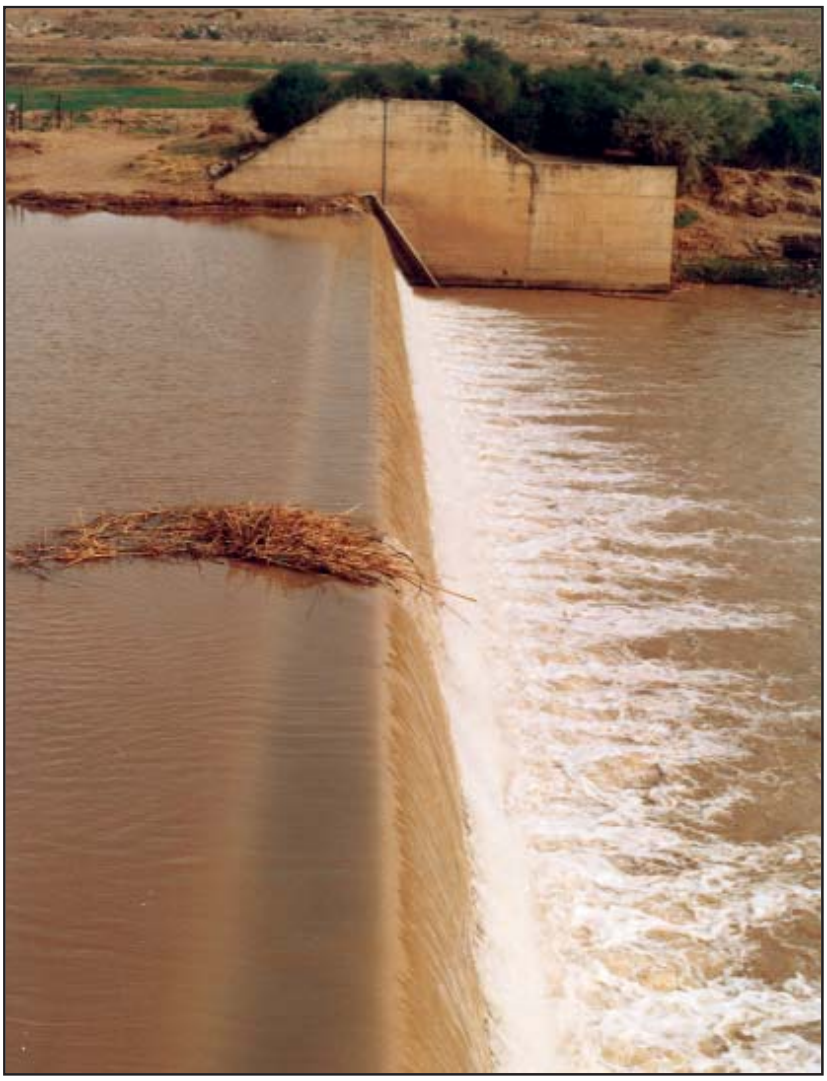
more economical lots before re-selling. Farms in the upper valley were 85 hectares, in the middle 60 hectares and in the lower valley 45 hectares. Today many of these smaller farms have been amalgamated into major agricultural operations measuring up to 500 hectares.

"With constant government support farmers had it easy. The problem is they looked for handouts when the going got tough and eventually many couldn't cope when that government support disappeared," explains Troskie.

INGENIOUS WAYS

When a resource is scarce or has to be shared it is inevitable there will be some who try to take more than is their right. Over the years farmers have thought up ingenious ways to redirect water onto their land and, in his time as water bailiff, Evans once had to remove a dead cow, legs in the air, which was apparently being intentionally used to block a furrow. In another instance a farmer complained he wasn't receiving his full quota. Evans elaborates: "We inspected his sluice and couldn't see anything wrong, it was the right height and width. It was only when we looked under the water that we found the farmer had blocked the sluice under the water forcing the stream onto his property."

Then there was the farmer who made his overweight wife sit in the furrow to block the stream. "The sheer size of her body gave him enough time to pack mud around her and redirect the water his way." In the most recent incident (only a couple of months ago) a farmer and water bailiff began throwing punches over access to water. "They both landed up in the canal," chuckles Engelbrecht.



The Scanlen weir in the Great Fish River

MEASURING QUOTAS

Measurement of water is a constant area of debate. Currently quotas are measured with a parshall flume.

"There is far more accurate technology available for measuring quotas," says Engelbrecht, "which would solve a lot of problems but it is prohibitively expensive."

New technology by farmers is improving the use of water in the valley. One example is a laser that is fitted to a scraper towed by a tractor. The laser measures the gradient of the land and constantly re-adjusts the tilt of the scraper. The end result means there is less run off and more effective irrigation keeping erosion and wastage to a minimum.

The Great Fish River Valley has a history as rich as its soil and continues to play a major role in South African agriculture. The river supports several towns and ensures work for thousands of people. "It's a resource we have to manage and protect," says Engelbrecht, "without it a thriving part of our country would suffer and an important landmark in local history would be lost."

Water and Household Food Production

The headline read "worst drought in 100 years", but the Strydkraal women said "we have buried the hunger".

Just before Christmas, Eva Masha, Emily Masha and Lucy Masha completed their water harvesting tanks in their residential stands in Strydkraal community, Sekhukhune District, Limpopo Province. They are now literally" reaping" the rewards!

Apart from the food they harvested they were finalists in the Women in Water 2004 award made by the Minister for Water Affairs and Forestry for their pioneering example.

No fewer than 12.5 million people in South Africa live in 2.4 million rural households. These are people with limited income and food costs are a major concern to many. However, gardening and farming currently play a limited role in village survival strategies. This is understandable considering present circumstances. For one, people want water for gardening. They regard the lack as a major constraint.

The programme of household food production propagated by the Water for Food Movement, spearheaded by Tshepo Khumbane and Marna de Lange, holds great promise. The secret lies in the integration of innovative new thinking and traditional wisdom.

FACTORS THAT MAKE THE DIFFERENCE

People believed that there was no water, but the rain is there for the harvesting by gathering, leading and distributing run-off in small earth channels.

Water can be stored for dry spells and winter in "do-it-yourself" below ground reservoirs.

Deep fertile soils can be created in the barrenness by trenching, if necessary, and mixing in household and organic wastes.

There are ways and means to sustain yields and quality with a minimum of chemical inputs.

Manually operated hand or treadle pumps provide a "hose for all" making watering a manageable chore.

So the women do literally "bury hunger". They dig underground reservoirs and trenched fertility beds as well as earth channels to collect and control run-off.

Digging an underground reservoir is hard work, but the rewards are sweet.

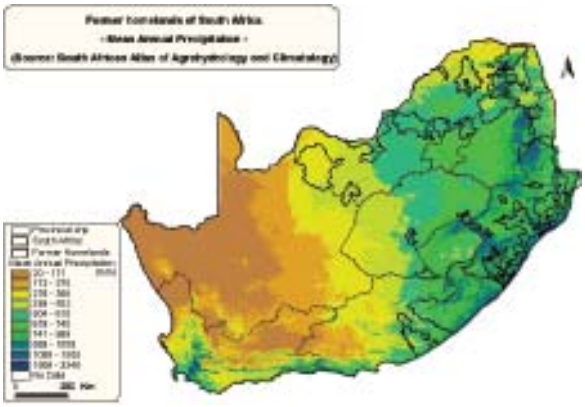
Full tank in the drought, all that is now needed is a bucket or a hand pump and hose.

The closed reservoir - all her own work - simple, safe and effective.

WHERE DOES ONE FIND THE WATER?

The areas where the villages are located are superimposed on this annual precipitation map (see p. 18).

Note that they are mostly located in areas of the country with reasonable rainfall and can count on receiving an average of at least 400 to 600 mm of rain annually. This applies even in areas now perceived as being too dry to grow anything!

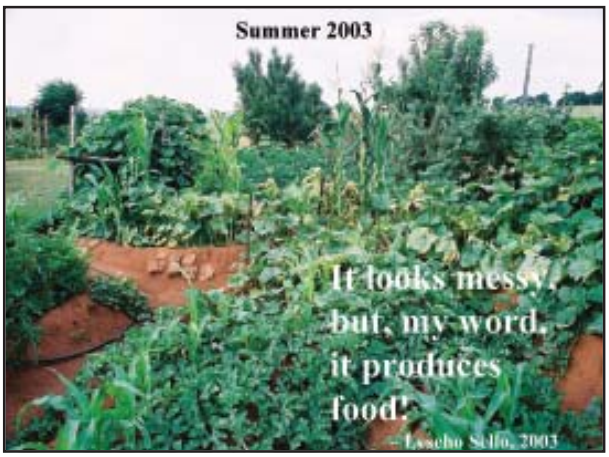


Five hundred mm of rain falling on a roof or other impermeable area represents half a cubic metre of water available for storage per square metre of roof. Thus an area of 50 square metres can provide 25 cubic metres of water that is sufficient to see a 100 square metre intensive garden through a full winter.

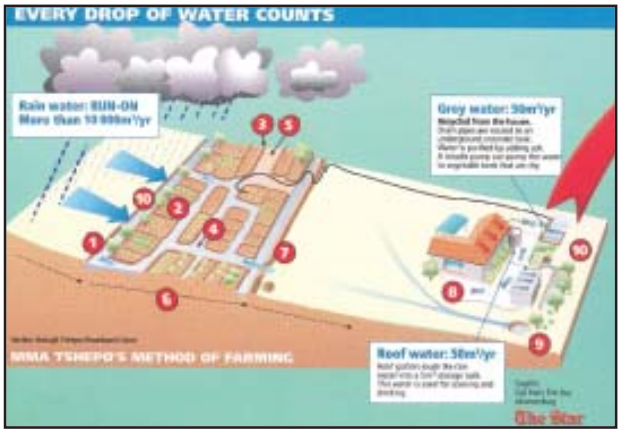
If the area is hardened such as a lapa or road where the run-off would be about 50% of that off an impermeable roof, it would only take about 100 square metres to provide the 25 cubic metres - still a very small area. Even if the water must be harvested from the veld, assuming run-off at 10%, the area required would only need to be 25 m long and 20 m wide!

SUMMER PRODUCTION

The intensive beds are laid out with paths between them that also serve as irrigation canals. Water is gathered from the surroundings by collection drains and discharged into the paths between the beds. This water infiltrates the deep beds and virtually doubles the impact of the rain shower. This run-on principle is of major importance. The rain may normally be sufficient to produce a crop without run-on, but certainly not the high yield that can now be attained and is equivalent to that achieved under intensive irrigation.



Note the deep path/irrigation channel that directs and stores run-on water that then seeps sideways into the deep "fertility beds".



Courtesy of *The Star* newspaper

A trench is dug across the slope of the land to catch run off.

Beyond the trench, the vegetable beds are dug a metre deep and filled with organic matter, grass, leaves, manure and ash and mixed with soil. The beds are fertile and absorb and retain moisture.

The beds are edged with paths that serve the purpose of channelling the water between the beds. The water then seeps into the beds over time. Excessive water is diverted into storage or safely disposed of down a slope.

During dry spells and in winter water is drawn by bucket or pumped back from storage and the beds watered conventionally by hosepipe or sprinkler.

WATER STORAGE

The villages are located in the summer rainfall regions with dry winters so that water harvested during the rainy season must be stored to provide for irrigation through winter. The quantity of water required depends on the area of the garden beds, climate, and crops grown and when they are grown. Storage is essential and a variety of reservoirs are being assessed.

An estimate has been made of the storage required per 100 m^2 of garden beds to cater for a typical winter crop mix. If reliance can be placed on recycling 2 m^3 of household water (grey water) per month then the storage volume required is significantly reduced.

Storage volume required: Cubic metres per 100 square metre vegetable garden				
	Limpopo	Bloem (FS)	Alice (EC)	Dundee (KZ-N)
Run-off only	27	20	19	27
+ grey water	17	11	10	19

WINTER PRODUCTION

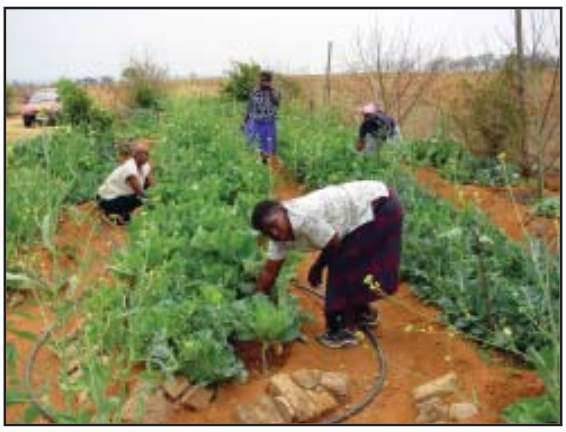
The planning and management of a household garden is an art in itself. Crops and their planting dates will depend on the climatic circumstances and the requirements of the family, the compatibility of companion crops and the rotations that are necessary to maintain fertility and control pests. Intensified small-scale farming of this nature can only be justified if the full irrigation requirements of the crops can be met.

Concentrating production in these intensive beds has many advantages. The initial digging of the trenches and their filling is a major undertaking but the follow up in subsequent seasons is not arduous. Production is intensive and yields are well up to the standards achieved on the very best commercial farms under irrigation.

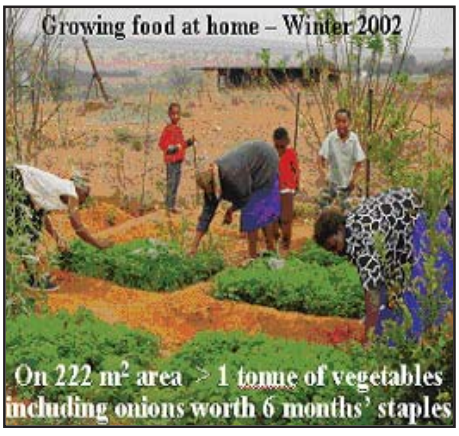
THE ROLE OF THE WATER RESEARCH COMMISSION FUNDED MODEL SAPWAT

SAPWAT played an important role by developing the "numbers" required for planning, policy development and implementation. Once the production plan has been drawn up for each individual bed in the garden, the irrigation requirements can be developed by applying the Sapwat routine. SAPWAT takes into account crop growth characteristics and both crop production and irrigation system management in arriving at estimates of crop irrigation or run-on requirements on a monthly basis. Monthly requirements in cubic metres for the garden as a whole can then be developed and finally generalised for application in the area.

The next step is to establish the catchment areas required to supply the monthly water requirements and the storage volumes that need to be provided for dry winter months and the inevitable dry periods during the rainy season. This is a relatively simple process of calculating water balances once estimates have been made for run off percentages from impermeable roofs, roads and paved areas and from grazing and cultivated areas. SAPWAT helped show that the seemingly impossible was quite feasible in most of the rural villages.



Watering in winter by hose, note the run-on channels for intensified summer production.



The Water for Food movement is grateful for the support provided by the International Water Management Institute (Africa), the Institute for Agricultural Engineering of the Agricultural Research Council, the National Department of Agriculture, the Limpopo Department of Agriculture and the Department of Water Affairs and Forestry.

Photographs provided by the Water for Food Movement – many thanks.

Women and Water: How is Gender Policy Working on the Ground?

by Robert Berold
Photographs by Ella van Tonder

Women are cooking, washing, watering gardens. They are the people using water, not the men.

The gender policy of the Department of Water Affairs and Forestry (DWAF), formulated in 1997, was designed to promote gender equality both within DWAF itself and in its activities at community level. The policy required a quota of at least 30% (since increased to 50%) of women in all decision-making committees as well as adequate participation and technical training.

How does the policy work out in the rural areas, far away from DWAF head office in Pretoria? The Water Research Commission (WRC) conducted a research study in the Peddie area to find out. Fort Hare lecturer Priscilla Monyai looked at four villages close to the town of Peddie in the densely populated former Ciskei, between Grahamstown and King Williams Town. About 4 000 people live in the villages of Cisira, Ncala, Nqwenerana and Mgwangqa. All get their water from the Peddie water supply scheme which began supplying clean drinking water in 1999.

I drove to the Peddie area one spring morning with Priscilla Monyai's research assistant Don Nyatela to revisit the research informants. The direct benefits of the scheme were obvious. As we drove the dusty village roads, we came across concrete standpipes on many of the street corners, at least every 200 m. The villagers buy prepaid tokens to use the standpipes, and the water is cheap, less than half a cent per litre.

In the municipal offices we met members of the original Project Steering Committee. Clearly the scheme had improved everybody's lives. Mrs Kota, who lives in Cisira village, used to collect water from the dams and rivers, carrying a bucket on her head like all village women. The quality of the water was not good in those days, she said, because goats and pigs shared the water source. In the town of Peddie itself, people used to rely on boreholes and windmills. The Peddie TRC and DWAF got together to remedy this situation, and in 1995 they started planning a water supply and treatment plant. The scheme was completed in 1999 at a total cost of R42 m., and was opened by President Mbeki.

WOMEN

DWAF gender policy was implemented from the outset. Besides requiring 30% of all decision-making bodies to be made up of women, the policy also required that women be trained for some of the jobs in construction and post-project service provision. The scheme allowed for the training of 'village water service providers', one per village. Their task was to ensure that all the services were running, the pipes were not leaking, the taps at the standpipes not broken.

"Women were deeply involved from the beginning" says Velile Kaulela, one of the original steering committee members. "That's how it should be, because the issue of water is about women. They are the ones who are suffering to get water." He assures us that the steering committee exceeded the DWAF gender quota and that some of the committees were led by women.

Velile Kaulela is an unusual man. He works as a social facilitator for the Peddie Women Support Centre. He tells us that most of the workshops he runs are to sensitise men about domestic violence. "Because of unemployment and retrenchments, men find themselves inferior. The wife is working, the man is not working – the problem starts there. Men have this stereotype to be dominant in the family. We are sensitising people about what the constitution says – all people are equal. But there is a lot of work to be done in rural areas." He remains optimistic, though. He is proud of the fact that last year, on Human Rights day, 50 local men signed a pledge never to resort to violence in their families.

WRC REPORT

Before coming to Peddie I had read Priscilla Monyai's WRC research report (No 1021/1/02), in which she points out that a quota cannot be the sole cornerstone of a gender policy. Many other barriers need working on in order to change the stratification between men and women in traditional Xhosa society.

Monyai writes "Cultural norms restrict women from asserting themselves in the presence of men ... Culture does not allow women to interact with outsiders such as project implementing agents." Cultural activities such as traditional feasts are common in the Peddie area, and women are expected to do the preparations. "Women find themselves having to divide their time between domestic duties, cultural activities in the villages, and community projects.

"Consequently, very few women are involved in different community projects, and they are thinly stretched …Married women are not allowed to make decisions by themselves. They have to ask permission from their husbands or from male relatives to attend meetings... Married women are not allowed to say their name in public gatherings, that is, a married woman is not able to introduce herself and announce her surname lest she dishonours her husband."

How, I wondered, was any gender policy going to contend with these traditional practices? The project steering committee agreed it was tough. "In some of our villages, when we are having a meeting, women are scared to stand up." But, they said, "If you give women a chance to lead, they express themselves". Things have come a long way from Kaulela's father's time "when the meetings were attended by men only, there were no women to be seen."

BOTT SCHEME

The Peddie water scheme is a BOTT (Build Operate Train and Transfer) scheme, which means that the community is involved in the sustainability of the scheme, and to a certain extent the maintenance. The water services authority in charge of running the scheme is the Amatole District Municipality, based 150km away in East London. They carry out routine inspections and hold monthly meetings with the community based organisation (CBO) to discuss problems.

The CBO 'village water service providers', who work on contract, call in the Amatole District Municipality when they meet problems they cannot cope with. Most of their job is to monitor the social use of the scheme,

and to sell the pre-paid tokens. Velile Kaulela thinks they should be given more responsibility for the maintenance. "If the pipe breaks, they cannot repair it. The BOTT ends with O – operations," he says.

Cindy Minkley, deputy director of Operations and Maintence at Amatole District Municipality says the issue of more technical training and responsibility is not closed. It will be considered when the municipality undertakes its next major assessment of work functions.

CECILIA KAULELA

After meeting the steering committee we drove up and down the rutted roads to Cisiga village, 8 km out of town, and spoke to Cecilia Kaulela, mother-in-law of Velile, who is the water service provider in her village. It was pension payout day and many people were gathered round the trading store, buying bags of provisions with their pension money. She called a number of women together and we sat in the shade of a huge old tree.

"It's true that the scheme has improved our lives, because we have clean running water" said Mrs Kaulela, "but women were not much involved in the meetings where the decisions were made. The decisions were made mainly by men. The scheme is not how we want it as women."

I asked her what she meant. "We want water inside the yard. Some of the standpipes are 200 m away, and that is too far, especially for an old woman living alone. Right from the start we asked Amatole District Municipality to provide the standpipes in the yards, but they said it was too expensive. We told them we were prepared to pay those costs. You can do nothing without water – that's why we want water in our yards. We need it for growing food." The other women all nodded in agreement. They said they were not going to let it end there. They have taken their demands to the ANC and SANCO and the Peddie Municipality.

Nonzaliseko Mombengu of Mgwangqa village does her washing at one of the pay-as-you-go standpipes in the village

When I spoke to Cindy Minkley, she knew about the requests for water lines to houses. "We are sympathetic to the need for household connections" she said "but the government's first commitment is to eradicate the water services backlog to at least a basic 200m walking distance. We are currently developing policies which will meet this need, and we have communicated this in our monthly meetings with the CBO. As soon as the policy is clear, we will be able to offer households water in their yards where this is technically feasible". She thought that the villagers were being optimistic about being able to afford the extra water.

I came back a few days later with Ella van Tonder, my photographer friend. The veld around the villages looked very dry. We visited the water treatment plant, a neat up-to-date treatment unit with settling and chlorination tanks. We drove around the four villages with Mrs Kaulela, photographing women washing clothes, collecting water at the standpipes, watering their parched gardens, making mud bricks. Some of them were still walking one or two kilometres to the streams and dams to carry water, because they couldn't afford the prepaid tokens.

GENDER POLICY

As far as I could see, the water scheme at Peddie was working relatively well, despite the complaints. It was not clear to me, though, how this reflected gender policy in practice. At the University of Fort Hare I asked researcher Priscilla Monyai. In her view, lots could have been done better. For example, she said, the social consultation in the Peddie project had been far too rushed. The contractors hired social consultants to do some gender capacity building

"but the time they were given was too limiting – just a few weeks. The project was all about providing water, and the gender aspect was just an afterthought."

Mr Jako, the Peddie steering committee chairperson agreed, but added "You see, when the project started, it was after a long battle. You found that people were so excited to get water. When these other issues like gender were raised, you found that people were impatient."

PUTTING POLICY INTO PRACTICE

According to Priscilla Monyai, the problem goes deeper than what happened on this particular project. "The whole problem lies in how DWAF policy is conceptualised. What does DWAF want to achieve, and how does it want to achieve it?" If policy is not formulated properly, says Monyai, projects will continue to fall short of the needs of people. After all, she says, a project is only a manifestation of policy. "To what extent have the intended beneficiaries had any input? You ask them. They will just say, We were called to a meeting."

She continues, "If the community has no feeling of ownership, it is because they are treated as passive recipients. This is what happens when government gives projects to private contractors, who are driven by the profit motive. Usually they are engineers who want to get the job done as quickly as possible. But there are always alternatives" she says. "In each social context there will be different experiences. You just need to take the policy framework to the beneficiaries and you will find they will come up with solutions."

Monyai believes that the problem has to be tackled in DWAF's top management. When she did her research, the Gender Unit was housed in the Directorate of Special Programmes, which had relatively low status in the organisation. She wrote in her report that the responsibility for gender policy should be moved to the office of the Director General to give it the necessary authority.

DWAF

It is a few years since Monyai's research for the WRC was carried out. Perhaps things at DWAF had changed. I phoned Rossetta Simelane, deputy director in the Directorate of Water Services Support, who is closely involved with gender policy on the ground. At the time of the WRC research report the gender policy was relatively new, she said, but in any case "The quota was never meant to be an end in itself, it was a starting point, a means to an end. We wanted to create an environment in which a more active gender policy could follow. What has changed since the 90s are the responsibilities now given to local government. Municipalities have taken over a lot of the work formerly done by private companies, and they engage directly with DWAF." DWAF now runs gender training programmes especially in the Eastern Cape, Limpopo, KZN and North West provinces. In the Eastern Cape, there is a water sector gender forum.

TRANSFORMATION

The gender unit has been moved, not to the Director-General's office but to the new Directorate of Transformation — which includes gender, equity, and HIV. Every year progress around transformation is discussed in a meeting chaired by the minister, and every Directorate in the department has to include transformation issues in its workplan. There are now specific performance indicators for gender in the monitoring and evaluation stage of all water projects.

"We are moving from quantity to quality, beyond the numbers game, we are looking deeper into how we can enhance real participation by women," says David Mahlobo, Director of Transformation. "In order to do this, we have to build capacity. We have started a programme giving priority to women's bursaries – the majority of those getting bursaries are now women. We have also started a developmental programme for managers and supervisors, with an emphasis on gender equity". He added that the Office of the President, through its Office of the Status of Women, regularly calls for progress reports from DWAF, and from all government departments. So does the Commission for Gender Equity.

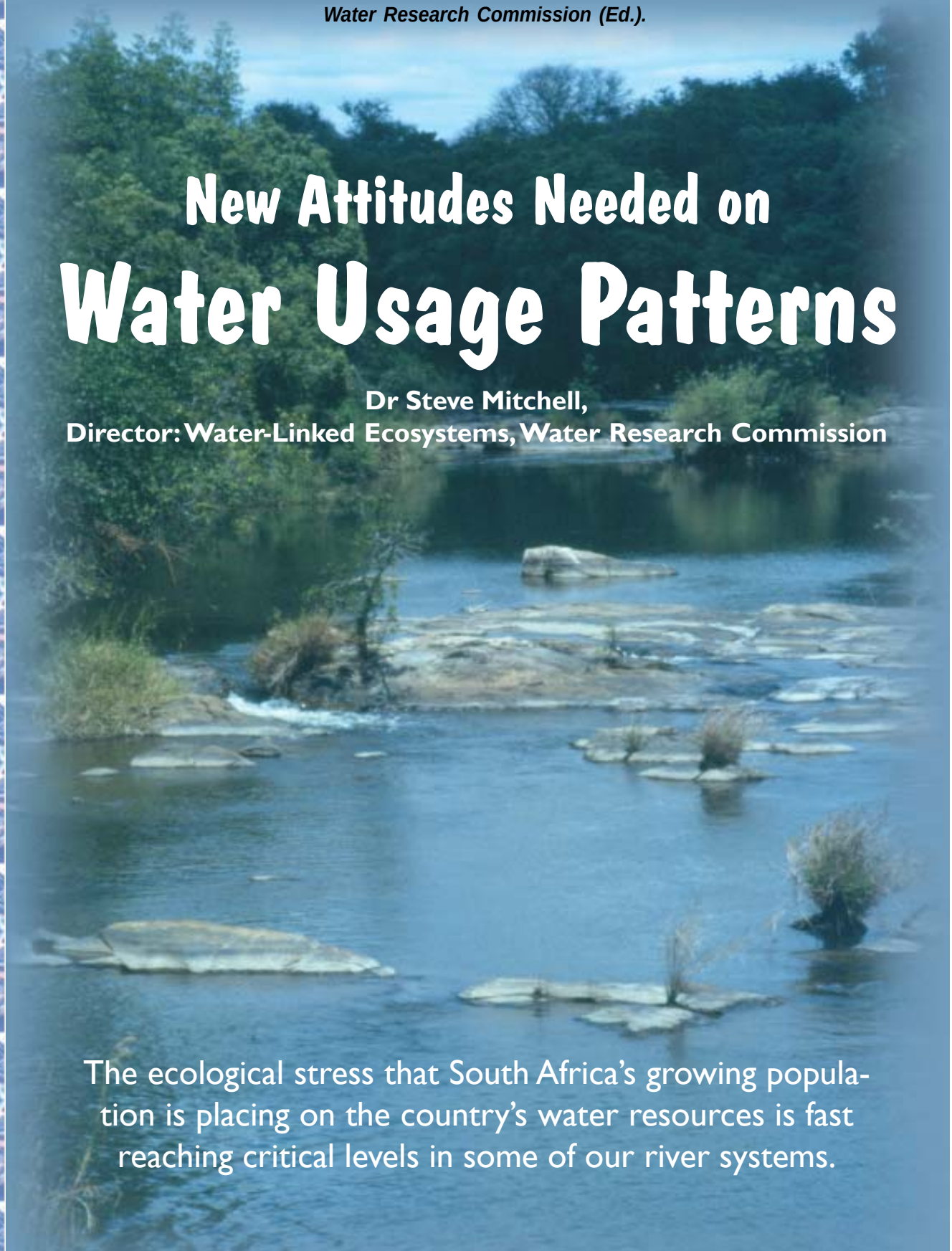
I asked Rossetta Simelane whether there is sufficient commitment to Gender Equity in DWAF. "It varies" she said. "Looking at our history, it's still an uphill battle. But most of us are behind it. There are still some components of DWAF who think this is all a waste of time, but we in Water Services have moved, and Water Resources is definitely moving." Her concern is the monitoring and evaluation of Gender Equity. How to measure it accurately? How to come up with good key performance indicators?

Changing the gender balance of South African society is clearly a long term process, which will have varying degrees of success at the community level. As Barbara Schreiner, Deputy Director-General at DWAF put it: "It is easier to write good policy than to turn it into reality. The gender policy of DWAF is excellent, but implementing it carries a number of challenges. Meeting the required 50% quota of women on all structures has been difficult. While there is general awareness of the quota system, exercising control by and participation of women is still an uphill battle in many areas. This is a battle that we will continue to fight for many years to come."

It looks as if the Water Wheel has stepped on a real "landmine" with the publication of Prof W Alexander's article on climate change in the previous Viewpoint. (See Letters to the Editor). To present a balanced picture on the important issues of global warming and climate change, a counter-view will be published in the next edition of the Water Wheel. Please note that the ideas and facts presented in the Viewpoint articles are those of the authors. They are aimed at stimulating debate and are by no means a reflection of the official standpoint of the Water Research Commission (Ed.).

New Attitudes Needed on Water Usage Patterns

Dr Steve Mitchell,
Director: Water-Linked Ecosystems, Water Research Commission



The ecological stress that South Africa's growing population is placing on the country's water resources is fast reaching critical levels in some of our river systems.

Organised industry is already aware that it needs to clean up its effluent, and most leading manufacturing companies are happy to undertake the recommended remedial actions. However, much remains to be done, and acceptance of some lifestyle changes that many people will regard as radical is also required of domestic water consumers. What is needed, in brief, is awareness that South Africa is a water-scarce country, and a consequential change of attitude on the part of citizens at all social strata regarding their water usage patterns. A focused, ongoing public awareness building programme will be required to achieve this.

A FACT OF LIFE

The plain, inescapable fact of life which needs to be recognized is that unpredictable rainfall patterns are typical of the latitudes just outside the tropics, in which South Africa falls. Water resources such as rivers and groundwater are consequently less assured here than in the more rain-favoured tropical and cool-temperate latitudes.

Human memory is short, and many of us forget the cyclical nature of our region's rainfall. We tend to regard the high rainfall years as the norm, and those years with less than the long-term average as atypical "drought years". Adding to the problem is that our growing population harbours unrealistic expectations of an unlimited supply of clean water for homes, farms and industries. This applies to the urbanised section of the population, which for so long simply had to open a tap to receive water, that they have little experience of a less reliable water supply. It applies equally to rural communities only now being reached by pipelines, to whom this godsend is perceived as promising unlimited benefits.

People also have untenable faith in the ability of the sewerage system to convey wastes "out of our lives" – from phosphate-bearing farm and domestic wastes to harmful and even toxic industrial wastes – oblivious of the fact that we are simply flushing our problems on to downstream water users.

Research indicates a new scenario now emerging in the quality of the water that many of us consume. The EDCs (endocrine disrupting compounds) contained in some domestic water appear to be affecting human, animal and plant hormones, resulting in reduced reproductive capacity. Throughout the industrial world, sperm counts are lower than those of a generation ago, with outright sterility as a frightening ultimate threat.

What is needed ..... is awareness that South Africa is a water-scarce country, and a consequential change of attitude on the part of citizens at all social strata regarding their water usage patterns

Successful ongoing remedial action to ensure hazard-free effluent will carry high costs, for industries and residential and farming communities alike, with unavoidable effects on the economy. Indeed, many industries and communities would not, today, be financially viable if they had to bear the full costs of their water usage and polluting activities. While much effluent is now cleaned at source, compared with a generation ago, and the ingredients thus removed and recycled, there is still a long way to go. Many offenders unknowingly flush toxins and plant nutrients such as phosphates down the drain.

NATURAL WATER SYSTEMS OVERLOADED

We have always expected the environment – perceived as free-flowing rivers bathed in Africa's bountiful sunshine – to undertake the required pollution treatment, free of charge. The problem is that while the environment obliges to a considerable extent, humankind has created a huge overload on the natural water systems of the world, which, increasingly, those systems are unable to bear.

In some instances the natural water systems are able, by means of dilution, to accommodate the phosphates and other materials injected into them. But no longer do they have the diluting capacity that they once had, due to withdrawal of water from the systems for domestic, agricultural and industrial use. This shortfall is aggravated in dry seasons, which in South Africa occur regularly. The result is phosphate and other nutrient build-up, leading to algae blooms with consequent bad smell and water taste, alien plant multiplication (such as water hyacinth) where elements of these plants occur, rotting vegetation, withdrawal of oxygen from the water, toxicity and the death of fish and other aquatic life.

It should be born in mind by those who don't feel concern for "little fishes", that visible fish kills are a symptom of a far bigger and more acute situation than simply the loss of a bunch of fish. The effects extend to humans, not only those living on the river banks, but to people throughout the country, as illustrated below.

The unrestrained multiplication of alga species, including the toxic blue/green algae, doubles the cost

of water treatment. This cost obviously falls on the community and also imposes a significant cost factor on industry – a strong argument indeed for keeping the resource in good condition.

Water authorities – led by the Water Research Commission, Department of Water Affairs and Forestry and Environmental Affairs and Tourism, as well as the provinces – have, in the past decade developed the National Biomonitoring Programme to establish and monitor the impacts of various effluents on the condition of water bodies, and they are further developing this methodology. The know-how thus gained affords industries the opportunity to monitor their own activities.

WATER ACT

The National Water Act of 1998 includes two innovative sections that regard not only water but the whole aquatic environment as a resource. Thus, no longer are fish and other aquatic life perceived as being in competition with domestic users, industry and agriculture for the resource (water) – they been recognised as PART OF the resource itself. The Act looks at the cumulative effect of pollutants that the total resource can cope with, and allows water authorities to put a cap on water usage and injection of effluents where the effects are too damaging.

Stream flow reduction as a result of major dams, irrigation farming and planted forests (of which South Africa has the highest level in the world) is always controversial. The trend now is to work on the "polluter pays" principle. And if the pollution is toxic, the activity concerned can be prohibited.

South Africa's wet-dry cycle in conjunction with ever-growing human usage has created a nutrient imbalance in most rivers. This adversely affects their ecosystems, with some organisms more sensitive than others to change. The all-too-frequent effect is the loss of sensitive species and an increase in "weed" species which will ultimately lead to the loss of ecosystem resilience and sustainability.

The Sabie River - all biological life in the main stream was exterminated in the late 1800s through gold-mining effluents.

..... while the environment obliges to a considerable extent, humankind has created a huge overload on the natural water systems of the world .....

CYANIDE

An early and very telling example of ecosystem destruction was that of the gold mining industry in the Pilgrim's Rest area which poured cyanide-bearing effluents into the Sabie River (Mpumalanga) during the late 1800s. All biological life in the main stream was exterminated. Fortunately, the upper reaches of its tributaries were not affected, and the fish invaded the main stream once injection of the toxins ceased. Today, the Sabie is South Africa's richest river systems.

This illustrates nature's resilience in response to restorative measures. However, loss of the refuge areas that would result from heavy exploitation of the resource will result in the loss of capacity to recover. Ongoing monitoring is thus necessary to maintain biodiversity.

In contrast to the Sabie River, the Olifants and Crocodile Rivers (also in Mpumalanga) which are subject to heavy water withdrawal and industrial effluent discharge, are today degraded and less able to maintain their biodiversity.

BIODIVERSITY

This brings us back to the "little fishes" referred to above. Biodiversity is the basis of any ecosystem. When the system begins to lose its ability to perform the tasks we rely on it to do, as is happening in the two aforementioned rivers, its human users lose more than is often appreciated. For example,

reduction in water flow and water quality is likely to lead to an increase in bilharzia amongst the local human population that draws its drinking and washing water directly from the river. This reduces their quality of life, increases absenteeism among workers of local farms, plantations, sawmills and other industries (people from the economic sector who can least afford this) leading to loss of productivity. The adverse effects of this can extend to the turnover of companies, leading to reduction in the dividends paid to shareholders in distant cities who may never come into contact with the river concerned. Treatment of the bilharzia patients also increases State hospital costs, leading to competition for tax revenues.

Rivers whose flow is curtailed by the withdrawal of water for human use are often reduced to pools of standing water. This provides ideal summer breeding conditions for the mosquito population, which in turn increases the malaria infection rate of the local population – with similar adverse socio-economic effects to those caused by bilharzia infection.

It will thus be appreciated that, in the words of the poet, "no man is an island unto himself". The socio-economic well-being of all in South Africa, not only those who live along the banks of given rivers, is affected by environmental conservation or the lack thereof.

SPORT FISH

Another form of environmental degradation which is not commonly recognized as such but which has irreversible effects, is the practice of introducing sport fish into waters for recreational angling. Predatory trout and kurper reduce the indigenous fish species and thereby impact on the natural ecosystem. In the Olifants River (Western Cape) seven of the eight indigenous species of fish are now either endangered or critically endangered due to competition from alien fish species.

WE HAVE NO CHOICE

In summary, we have allowed our water resource to degenerate. As a result, people living along many river banks are adversely affected, with the ripple socio-economic effects extending throughout South Africa.

> People's attitudes have to be changed, and we have to accept responsibility for complete water and effluent treatment and the costs thereof

We have reached the point where we have no choice. People's attitudes have to be changed, and we have to accept responsibility for complete water and effluent treatment and the costs thereof.

Industry will have to accept that there are ways to recover all the pollutants from waste water. Recovery of the heavy and other metals in waste water is not only each polluter's environmental responsibility to the rest of society and the economy; recycling can also enable the company to make full use of the raw materials it buys in. Ultimately, this will be to the benefit of the bottom line.

On the domestic side, about 50% of the household effluent that currently goes down the drain could instead be put to use in watering the garden. This will save the householder outlay at present expended on the purchase of drinking-quality water used for purposes where a lower quality of water would suffice. This recycling of "grey water" refers to bath water.

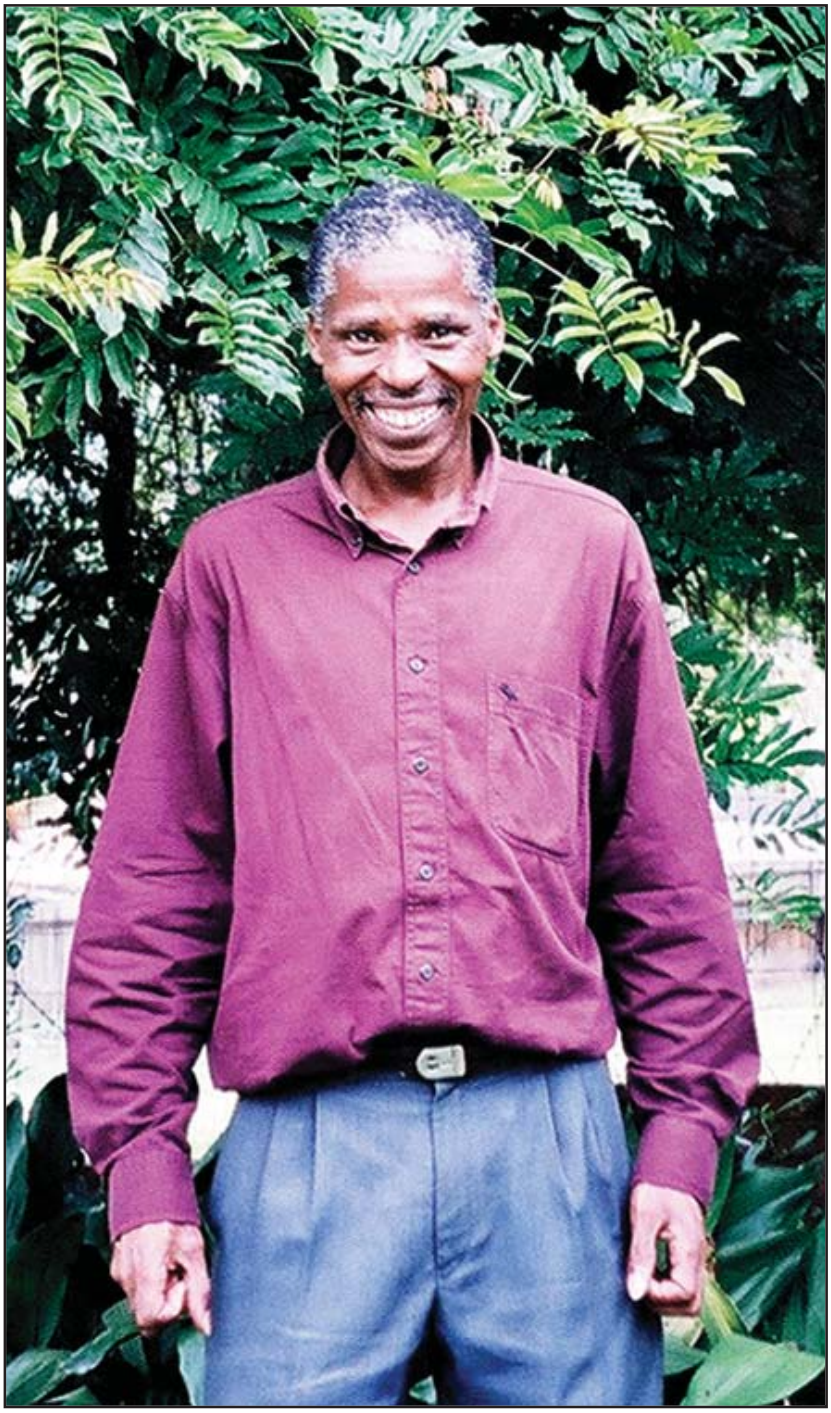
There is further potential for householders to make a contribution, in the form of eco-sanitation – waterless toilets, in which wastes are recycled into valuable fertilisers and which avert the cash outlay required to flush drinking-quality water into the sewerage system. User resistance to this concept will have to be overcome through attitudinal change. Wealthy and environmentally advanced Sweden leads the way in eco-sanitation. Water-scarce countries may have no alternative but to follow its example.

Innovations now taking place in water supply and waste treatment are extremely exciting. They enable industry to produce more cleanly, and they can enhance the bottom line. For example, motor service shops have by and large got over the practice of discharging used motor oil down the drain. There is a thriving industry which collects old oil and purifies it up to new oil standard. Large and small industries which flush toxic wastes down the drain should similarly look to the suppliers of the source materials to take back the wastes, where they can be profitably recycled.

Again, it is a matter of attitude and taking responsibility for environmental conservation at all levels of society.

What is thus needed, as a national priority in increasingly water-scarce South Africa, is a change of attitude on the part of all citizens and decision-makers in industry. We cannot put it off. If we mean business, we must practise what we preach – and put our money where our mouths are.

Bongikhosi Mthembu – Committed to Saving Rainwater and Soil



Bongikhosi Mthembu lives in Durban, and works in a field of science for which he has a lifelong passion, i.e. soil and water, the most important resources and basis for all human, plant and animal life. Life on earth depends on these, and if we don't conserve these resources, use soil in a sustainable manner, and retain as much of our meagre rainfall as we can, our livelihoods will be affected adversely.

KWAZULU-NATAL

Bongi grew up in the Highflats area near Ixopo in the midlands of KwaZulu-Natal. In this rural area, people depend on farming and work the land. His interest in agriculture started early in his life, and he felt driven to make the most use of the piece of land available to his family. As a youngster, he kept his own garden, and planted vegetables and field crops, mostly maize and dried beans. He helped to fence the land and protect the crops from livestock. At the age of about eight or nine, he noticed that the yield from the land was low, especially during drought and times of little rainfall. While he observed this, he heard his elders speak about it, but no-one seemed to offer any solutions.

Rainfall is sparse in the low-lying area of Ixopo. Most of the land is steep, but it is all the people have to use. In summer, when most of the rain falls, the run-off of rainwater is dramatic, and the rain washes the soil away. He noticed as a youngster that plants growing along the Umzimkulu River did better, but

when the river burst its banks, these crops were washed away.

From Standard 5 to matric, Bongi looked after the vegetable garden at his rural school, and studied agriculture as a subject. He noticed many aspects of agricultural practices, and began to realise that these were not always effective. As a means of reducing soil erosion, strips were left between fields, so that grass could grow along these strips, and hold the soil better. However, the methods of ploughing did not help in the long-term. The mould board plough buries most of the residual plant when tilling, and exposes the soil to erosion, with the impact of rain drops. The disk plough does the same, whether pulled by oxen or tractor. These observations are still central to the research he is currently doing.

CWAKA COLLEGE

After he completed his schooling, Bongi went to the Cwaka College of Agriculture (now renamed Owen Sithole College of Agriculture) near Empangeni, where he spent two years doing his diploma in agriculture. He went on to Fort Hare University where he did an honours degree in agriculture. Thereafter he joined the provincial Department of Agriculture, at Eshowe and worked as an agricultural scientist for 8 years.

After this time, Bongi went to the USA from 1992 until 1995, and studied at North Carolina State University. He completed two masters degrees during this period in Plant Science and Agricultural Education (or as it is sometimes called Agricultural Extension).

Since 1996 he has lectured at Mangosuthu Technikon in Land Use Planning, Soil Science, Field Crop Production and Extension (of Agricultural and Development Issues). The latter subject is concerned with transferring scientific information to farmers, and making this information accessible and understandable to communities.

Bongi is now doing his Ph.D. through the University of KwaZulu-Natal (UKZN) in Pietermaritzburg, through the School of Applied Environmental Sciences. The overall subject of his thesis falls under the discipline of Grassland Science (under Prof. Kevin Kirkman, co-supervisor and head of discipline). The title of his thesis is the *Impact of Agroforestry Systems on Soil Moisture Content and Fodder Production in Moist Transitional Tall Grass Veld.* He is doing this under his supervisor Dr Terry Everson, and Project Leader and Co-supervisor, Dr Colin Everson.

As a youngster Bongi had observed the washing away of soil after heavy rains, and knew that something had to be done to stop this.

As a youngster Bongi had observed the washing away of soil after heavy rains, and knew that something had to be done to stop this. The tillage systems used, promote soil erosion. Rainwater does not penetrate the soil, but runs off, and washes the soil away. This results in both water and soil loss.

AGROFORESTRY

Bongi's current research involves the conservation tillage system, which is better because it conserves both water and soil. This involves agroforestry, whereby trees are planted between crops, e.g. fruit trees, or fodder trees, such as Leuceana, Acacia and mulberry trees. The roots of the trees hold the soil and protect against wind and soil erosion.

Bongi has become involved in a CSIR project in collaboration with UKZN and Mangosuthu Technikon in the Bergville area in the foothills of the Drakensberg. Here he has been implementing a research project to determine the role of agroforesty and pasture species in solving the problem of fodder shortage in communal dairy farming systems. He has planted fodder trees, *Leucaena* (exotic) and *Acacia karoo* (indigenous). In between the trees he has planted pasture grasses – cocksfoot and tall fescue – for dairy cows, as well as maize and dolichos, a legume crop.

The project is still in its infancy, and the trees are now 1.6 m tall, but will not grow much this winter because they lose their leaves and become dormant. A small-scale dairy farmer, Simon Mbhele, is involved in this project, and the results will be extended through him. After the experiment, the results will be implemented on a larger basis.

Trees are a source of fertility, and Bongi will be looking at their impact during this experiment, and the impact of improved soil and water retention on fodder products. Trees make an impact on nitrogen provision, which improves soil fertility. Trees change the micro-climate, and can help to reduce evaporation and make conditions cooler. Bongi will be looking at the effect of these trees on pasture grasses.

In our country, where rainfall is low, erratic and unreliable, we have to conserve whatever rain we get. Bongi believes that agroforestry is a measure to conserve our most precious resources, rainwater and soil, and has committed himself to a lifetime of scientific study to help people to put this theory into practice.

SOUTHERN AFRICA & AFRICA 2004

WATER QUALITY
JUNE 23-25

The 1st of three training courses on Environmental Water Quality in Water Resource Management will be held in Bryanston, Johannesburg. The 2nd and 3rd training courses with the same theme will be presented on August 25 – 27 and November 17 – 19, respectively.
Enquiries: Mike Adams, LabHouse (Pty) Ltd, PO Box 344, Cramerview, 2060. Tel: 011-463 5760. E-mail: mikea@labhouse.co.za
Web: www.labhouse.co.za

MUNICIPAL WATER
JUNE 28 – JULY 1

The annual South African Prepayment Week (SAPW 04) Conference and Exhibition will be held in Johannesburg.
Enquiries: Andrew Evans. Tel: 021 700 3500. Fax: 021 700 3501.
E-mail: Andrew@spintelligent.com

WASTEWATER
JUNE 27-30

An IWA specialist conference on water and wastewater management for developing countries will be held at Victoria Falls in Zimbabwe.
Enquiries: Innocent Nhapi, Department of Civil Engineering, University of Zimbabwe, Box MP167, Mount Pleasant, Harare, Zimbabwe. Tel: 263 (0) 4 303288.
E-mail: wamdec2004@eng.uz.ac.zw
Web: www.uz.ac.zw/engineering/civil/wamdec2004

ECOSYSTEMS
JULY 5-8

The South African Society of Aquatic Scientists will hold its 2004 conference at the Eskom Convention Centre in Midrand, Gauteng. The theme is: "Water resources as ecosystems – scientists, government and society at the crossroads".
Enquiries: Lesley Stephenson, Conference Coordinator, Division of Continuing Professional Development, University of the Witwatersrand, PO Box 327, WITS 2050. Tel: (011) 717-7031. Fax: (011) 339-7835. Cell: 083 679 0697.
E-mail: stephensonl@ebe.wits.ac.za

WATER RESOURCES
AUGUST 3-6

An international conference on Water Resources of arid and semi-arid regions of Africa (WRASRA) – Issues and Challenges will be held in Gaborone, Botswana.
Enquiries: EM Shemang, c/o Department of Geology, Faculty of Science, University of Botswana. Private Bag UB 00704, Gaborone, Botswana. Tel: (+267) 355 2537. Fax: (+267) 3185 097.
E-mail: waterconference@mopipi.ub.bw or shemae@mopipi.ub.bw

ENVIRONMENTAL MANAGEMENT
OCTOBER 5-7

A short course on environmental management will be held at the Post-Graduate Centre of the University of Pretoria.
Enquiries: Ms Anneke Kruger.
Tel: (012) 420 5026. Fax: (012) 362 5285.
E-mail: anneke.ce@up.ac.za

GROUNDWATER
OCTOBER 11-14

A short course on model sensitivity analysis, data assessment, calibration and uncertainty evaluation will be presented at the University of the Western Cape.
Enquiries: Dr Shafick Adams, Groundwater Group, Department of Earth Sciences, University of the Western Cape.
Tel: 021-959 2637. Fax: 021-959 2438.
E-mail: groundwater@uwc.ac.za

WASTECON 2004
OCTOBER 11-15

The WasteCon 2004 Congress with the theme: Integrated Waste Management, will take place at the Sun City resort in North West Province.
Enquiries: Stan Jewaskiewitz, PO Box 79, Allen's Nek 1737, Gauteng. Tel: 011 675 3462. Fax: 011 675 3465.
E-mail: iwmsa@iafrica.com
Website: www.iwmsa.co.za

FOG
OCTOBER 11-15

The 3rd international conference on fog, fog collection and dew will be held at the Commodore Hotel, Victoria and Alfred Waterfront, in Cape Town.
Enquiries: Prof Hannes Rautenbach, University of Pretoria. Tel: 012 420 4111.
E-mail: hannes.rautenbach@up.ac.za

SOLIDS-LIQUIDS
NOVEMBER 8-9

The 2nd international symposium on Solid-Liquid Separation (SLS '04), organised by Minerals Engineering International, will be held at the Mount Nelson Hotel in Cape Town.
Enquiries: Dr Barry Wills.
E-mail: bwills@min-eng.com

GROUNDWATER
NOVEMBER 22-24

A short course on fractured rock aquifer assessment will be held at the University of the Western Cape.
Enquiries: Dr Shafick Adams, Groundwater Group, Department of Earth Sciences, University of the Western Cape.
Tel: 021-959 2637. Fax: 021-959 2438.
E-mail: groundwater@uwc.ac.za

2005

WASTEWATER TREATMENT
AUGUSTUS 9-12

A conference on the "Sustainable management of residues emanating from water and wastewater treatment" will be held at the Sandton Convention Centre in Johannesburg.
Enquiries: Dr Heidi Snyman at
e-mail: hsnyman@golder.co.za

OVERSEAS 2004

ICOLD
MAY 16-22

The 72nd annual meeting of the International Commission on Large Dams (ICOLD) will be held in Seoul, Korea. Theme: Environmental considerations for sustainable dam projects.
Sub-topics: Natural environment; Water quality and ecological environment; Socio-economic environment.
Enquiries: Korea National Committee on Large Dams. 462-1 jeonmin-dong, Yuseong-gu, Daejeon 305-390, Korea. Tel: +82-42-860-0316~7 / Fax: +82-42-860-0488.
Or register online at
http://www.icold2004-seoul.or.kr

HYDROSCIENCE
MAY 30 – JUNE 3

The 6th international conference on hydroscience and engineering (ICHE-2004) will be held in Brisbane, Australia, with the central theme: "Enhancing the sustainable water resources and environmental quality of the world through the advancement of hydroscience and engineering".
Enquiries: Dr Mustafa Altinakar, NCCHE, School of Engineering, the University of Mississippi, Carrier Hall, Room 102, University MS 38677 USA.
E-mail: iche@ncche.olemiss.edu

WASTEWATER TREATMENT
JUNE 1-4

The 2nd IWA leading-edge conference on water and waste-water treatment technologies will be held in Prague, Czech Republic.
Enquiries: International Water Association, Alliance House, 12 Caxton Street, London SW1H0Qs, United Kingdom. Tel: +44 (0)20 7654 5500. Tel: +44 (0)20 7654 5555.
E-mail: LET2004@iwahq.org.uk

ECWATECH
JUNE 1-4

The 6th international trade fair and conference about water, ecology and technology will be held in Moscow, Russia.
Enquiries: Mr Sergey Malygin. SIBICO International Ltd, PO Box 173, Moscow 107078, Russia. Tel: +7 (095) 975 5104.
Fax: +7 (095) 975 3423.
E-mail: ecwatech@sibico.com
Internet: www.ecwatech.com

RIVERS
JUNE 21-26

A short course and symposium – River Mechanics '04 - will be held at the Colorado State University Campus, Fort Collins, Colorado, USA.
Enquiries: Pierre Y Julien, Office of Conference Services. Tel: (970) 491-7501.
Fax: (970) 491-7747.
E-mail: OCSReg@ColoState.edu

ICE
JUNE 21-25

The 17th international symposium on ice (Ice mechanics and forces; Ice-water-atmosphere interactions; Ice ecology and management etc.) will take place in Saint Petersburg, Russia.
Enquiries: Alex Kosarev – Tel: +7 (812) 535-88-94. Fax: +7 (812) 535 6720.
E-mail: gladkov@hydro.vniig.ru
Web: www.vniig.ru

WATERSHED 2004
JULY 11-14

The Water Environment Federation (WEF) will sponsor an international speciality conference in Dearborn, Michigan, USA, on integrated resource management and environmental protection using watershed approaches.
Enquiries: WEF, 601 Wythe Street, Alexandria, VA 22314-1994, USA. Tel: 703 684 2400 x 7010. E-mail: watershed04@wef.org

HYDROLOGY
JULY 12-16

This conference – Hydrology: Science and Practice for the 21st Century – will be held in London, United Kingdom, and is designed to bring together hydrologists involved in scientific research and operational practice to address key issues affecting hydrology in the new century.
Enquiries: For more information, please visit the website: www.hydrology.org.uk/bhs2004/welcome.htm

WATER GOVERNANCE
AUGUST 29 – SEPTEMBER 1

An international speciality conference on "Good water governance for people and nature: What roles for law, institutions, science and finance?" will be held in Dundee, Scotland.
Enquiries: American Water Resources Association – 4 West Federal Street/PO Box 1626, Middleburg VA 20118-1626.
Tel: (540) 687 8390. Fax: (540) 687 8395.
E-mail: info@awra.org

ANAEROBIC DIGESTION
AUGUST 29 – SEPTEMBER 2

The 10th World Congress – Anaerobic Digestion 2004 - with the theme: Anaerobic Bioconversion for Sustainability will be held in Montreal, Canada.
Enquiries: Mrs Marie Lanouette, National Research Council Canada, 1200 Montreal Road, Building M-19, Ottawa, ON, Canada K1A0R6. Tel: (613) 993-0414.
Fax: (613) 993 7250.
E-mail: ad10.2004@nrc-cnrc.gc.ca
Website: http://www.ad2004montreal.org

BIOTECHNOLOGY
SEPTEMBER 6-8

The first international meeting on environmental biotechnology and engineering will be held in Mexico City in Mexico. Delegates will be provided with up-to-date information on advances the remediation of soils and aquifers, microbial ecology and the application of molecular biology to solve environmental problems.
Enquiries: Dr Hector M Poggi-Varaldo, CINVESTAV-IPN, Department of Biotechnology and Bioengineering, PO Box 14-740, Mexico DF 07000 Mexico.
Tel: 52(55) 5061 3800 (ext 4324 or 4336).
Fax: 52(55) 5061-7002

ECOHYDRAULICS
SEPTEMBER 12 – 17

The 5th international symposium on ecohydraulics will be held in Madrid, Spain.
Theme -"Aquatic habitats: analysis and restoration".
Enquiries: The Secretariat – Londres, 17 – 28028 Madrid, Spain. Tel: +3491 361 2600.
Fax: +3491 355 9208.
E-mail: ecohydraulics@tilesa.es
Web: http://www.tilesa.es/ecohydraulics

TROUT FARMERS
SEPTEMBER 16-18

The 50th conference and trade show of the US Trout Farmers Association will be held in Twin Falls, Idaho, United States.
Enquiries: Mary Lee.
Tel: 304 728-2167. Fax: 304 728 2196.
E-mail: ustfa@intrepid.net

WORLD WATER
SEPTEMBER 19-24

The International Water Association (IWA) will hold its 4th world water congress in Marrakech, Morocco.
Enquiries: AMEPA – Tel: +212 3763 2093.
Fax: +212 3763 7682.
E-mail: sehi@elan.net.ma
Web: http://www.iwahq.org.uk/

AQUACULTURE
SEPTEMBER 26-29

The Australasian Aquaculture 2004 conference will be held in the Sydney Convention and Exhibition Centre in Darling Harbour, Australia.
Enquiries: Dr Tom Lewis. 73 Lansdowne Crescent, West Hobart 7000. Tel/Fax: (03) 6231 9230. Cell: 0417 537 806.

DAM SAFETY
SEPTEMBER 26-29

The 21st annual dam safety conference and exhibition will be held in Phoenix, Arizona, USA.
Enquiries: Susan Sorrell. Tel: 859 257 5140.
E-mail: info@damsafety.org
Web: http://www.damsafety.org

WETLANDS
SEPTEMBER 27-30

The 9th international conference on Wetland Systems for Pollution Control will be held in Avignon, France.
Enquiries: The Secretariat. CEMAGREF – 3, bis quai Chauveau, 69336 Lyon Cedex 09, France. Fax: +33 4 7847 7875.
E-mail: wetlands@lyon.cemagref.fr

AQUACULTURE
OCTOBER 20-23

The conference "Aquaculture Europe 2004: Biotechnologies for Quality" will be held in Barcelona, Spain.
Enquiries: The Secretariat. Tel: +32 59 323859. Fax: +32 59321005.
E-mail: ae2004@aquaculture.cc
Web: http://www.easonline.org

International Training Network (ITN)
13th ITN Conference
23-25 September 2004, Harare, Zimbabwe

The provision of adequate water and sanitation facilities remains one of the biggest challenges faced by developing countries. One of the Millennium Development Goals is to reduce by half by the year 2015 people who do not have access to water and sanitation facilities. The Millennium development Goals are an agenda for reducing poverty and improving lives that world leaders agreed on at the "Millennium Summit" in September 2000. Safe accessible water improved sanitation and positive hygiene behaviour are entry points for poverty alleviation.

Around the world 1.1 billion people lack water and 2.4 billion lack sanitation. Over 300 million of those people live in Africa, the continent that has the highest poverty levels. The alleviation of poverty, increasing sustainable water and sanitation coverage in Africa requires efforts by all stakeholders (government, civil society, NGOs, private sector and external support agencies). It is against this background that you are being invited to the 13th ITN conference, to share ideas, experiences and information on how water and sanitation services can be improved in Africa.

The 13th ITN conference will be held back to back with the Water, Sanitation and Hygiene (WASH) fair. It will be hosted by the Southern Africa Development Community (SADC) Water Sector Coordinating Unit (WSCU) and the Institute of Water and Sanitation Development (IWSD) from 23 to 25 September 2004 in Harare, Zimbabwe. At the same time IWSD will be commemorating its 10th anniversary. Key issues of discussion will be progress in the implementation of the Millennium Development Goals as well as marketing sector, services, and products. The theme for both the WASH Fair and the ITN Conference is Poverty, Hygiene, Water and Sanitation.

Conference Themes

The Organising Committee welcomes papers that raise challenges, analysis and debate on the following:

- Knowledge Management in WASH and the role of Resource Centres
- Accelerating access to sanitation and poverty reduction
- The Water Resources Management concept and poverty: a practical reality or a dream?
- Hygiene promotion: where are we?

Conference Fees

The Conference fee will be US$ 250 per person and it will cover the following:

- Tea/Coffee for the duration of the conference
- Lunches for the duration of the conference
- Conference materials
- Conference bag
- Tickets for attending the Water, Sanitation and Hygiene Fair

Payment of Fees

Fees paid before 20 August 2004 will be US$220, thereafter US$250.
The fees should be paid into the following account:

Account Name:	Institute of Water and Sanitation Development
Bank Name:	Barclays Bank of Zimbabwe
Account Number:	65-79101
Branch:	Avondale
Swift Code:	Barczwhx
Country:	Zimbabwe

A copy of the payment slip should be sent or faxed to the Institute of Water and Sanitation Development.

Student Fees

These will be US$100 or equivalent in local currency. Proof of studentship will be required.

Important Dates

30 July 2004:	Submission of final papers
20 August 2004:	Early payment of Conference fee deadline
23 September 2004:	Opening of the WASH Fair
23 September 2004:	Deadline for final payment of conference fee
23 September 2004:	ITN Conference begins