Message from the CEO

Water is an essential element in the world. Without this precious liquid, we would not be able to work, run machines, produce goods, keep clean and healthy and, above all, survive! South Africa is a water-stressed country and the need to conserve water becomes even greater in this context. The talk of water restrictions, dam levels being low, a lack of rainfall are typical symptoms of such a chronic syndrome.

The Water Research Commission (WRC) engages stakeholders in solving water-related problems which are critical to South Africa's sustainable development and economic growth and is committed to promoting a better quality of life for ALL South Africans.

In the South African context water is seen as a common and social resource. Water is recognized as being essential for sustaining life. However, water is also recognized as an economic good which has a major impact on wealth creation, poverty alleviation and the well-being of people.

People working in the field of water make a major contribution to the quality of life of individuals as well as the long-term sustainability of the country. You, the learner, have a distinct role to play in ensuring the sustainability of water resources in South Africa. The WRC recognizes this and has produced a booklet on career opportunities in the water sector: *Water@Work*. This invaluable guide was distributed to every high school in the country.

We need more skilled people in the water sector, particularly people from disadvantaged backgrounds. Hence, this guide is an avenue to meeting this critical goal. There are many opportunities for people who would like to pursue a career in the water sector, be it in central, provincial, or local government, the water industry, other related services or academia.

It is important that you, the learners, make the correct subject choice for your future so that you enjoy job satisfaction and, more importantly, so that you are a valuable asset to your country's machinery. This guide has been specially designed for you, should you be interested in becoming part of South Africa's vibrant water sector Use it wisely.

This special edition of *The Water Wheel* complements *Water@Work* by presenting you with case studies of people who have made waves (no pun intended!) in the water sector; people who have made a difference (and found it stimulating!) in South Africa's dynamic water sector.

Finally, I trust that you have enjoyed reading the articles that we have selected especially for you, the learner. If you are interested in pursuing a career in the field of water, the career guide will be of great assistance to you. I want to take this opportunity of wishing you well for this academic year.

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Food from used water - p 10

Hartbeespoort Dam - p 16

Musa Nzimakwe - cholera survivor - p 21

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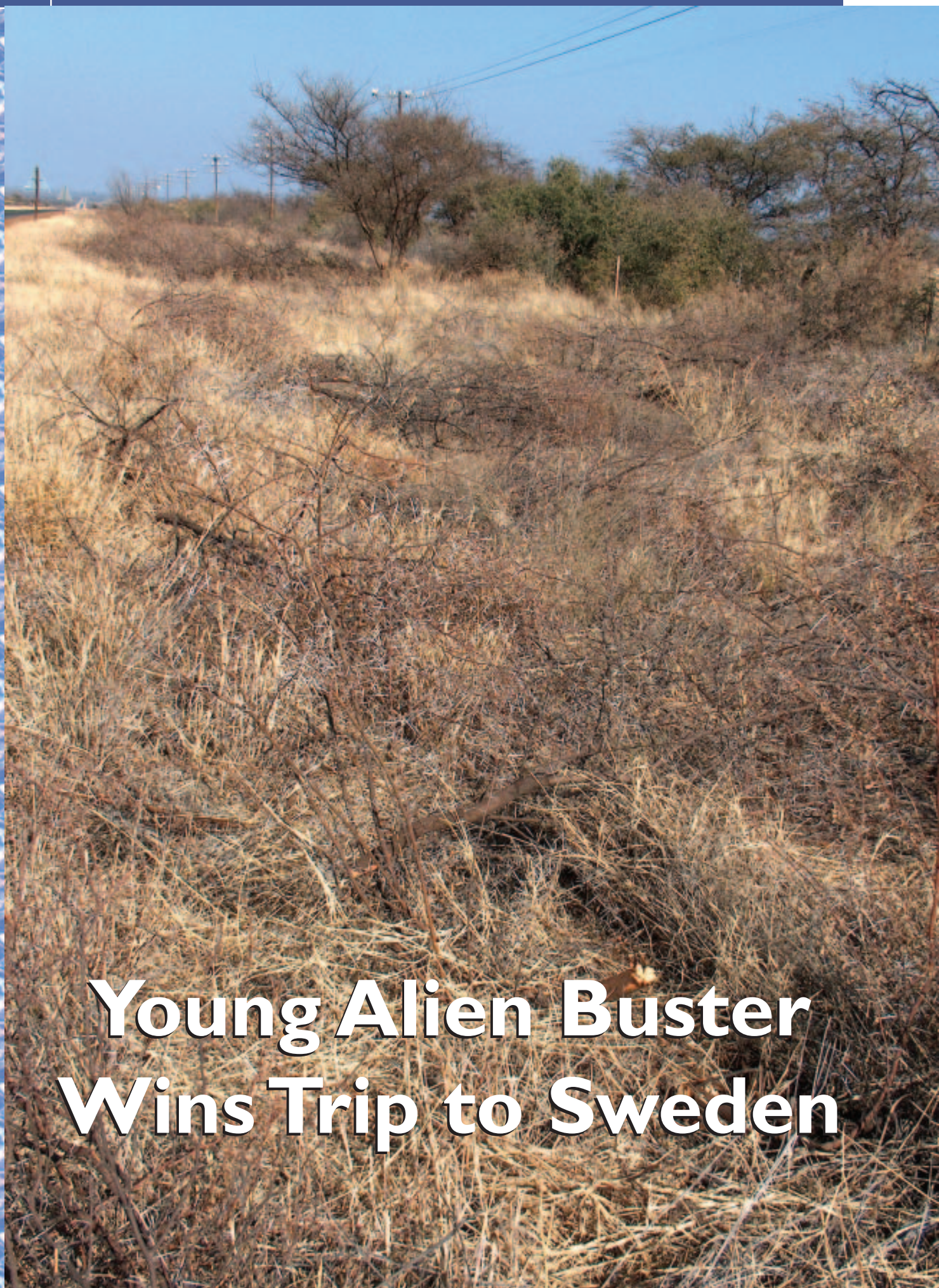


Young Alien Buster Wins Trip to Sweden

"The greatness of any nation is measured by the way it celebrates its children and their achievements."

This saying was quoted by the Minister of Water Affairs and Forestry, Ms Buyelwa Sonjica, when she announced the winners of this year's South African Youth Water Prize at the Kathu High School in the Northern Cape. She said it was a privilege to witness the rise of a generation of young people "who will make South Africa stand shoulder-to-shoulder with other great nations of the world".

The national winner of the 2004 competition was Jacques Deacon, a grade 12 learner, from Kathu, with his invention, "Alien Buster 1-2-3". Runner-up prizes were won by Nokuthula Dubazane from KwaZulu-Natal for an environmental study on water, water pollution, wastage and sanitation in and around Ladysmith; Dean Butler from Mpumalanga for an investigation into the use of partially recycled sewerage water for crop irrigation; and Kirsty van den Bergh and Niveshni Maistry from Gauteng for their innovative design of a rural water purifier.

In her address Minister Sonjica stressed the importance of science and said South Africa's leaders and educators had a duty to encourage young people to study science "and especially studies in water for sustainable development – as water is central to the country's economic activity".

She said the South African Youth Water Prize formed part of the Department of Water Affairs and Forestry's School based water and sanitation education programme called the "2020 Vision for Water".

"The 2020 Vision for Water programme seeks to empower the youth with knowledge and water management skills and will enable them to participate in integrated water resource management and other environmental programmes.

"Through the 2020 programme our children learn about water and sanitation at an early age and on a daily basis. We are therefore instilling the values of water resource management into the future generations. These young people will in turn transfer this knowledge and skills to their parents and communities at large. Children are better placed to change the mindset and educate their parents that water is not only a gift from God, but also a scarce resource that should be conserved and protected."

Photo: Reuben Standers

The finalists in the 2004 South African Youth Water Prize. From left: Jacques Deacon from the Northern Cape, the overall winner who represented South Africa at the international Stockholm Junior Water Prize competition in Sweden with his invention, Alien Buster 1,2,3 – a device used for eradicating alien invasive plants; Niveshni Maistry and Kirsty van den Bergh runners-up from Gauteng, Nomxolisi Matyana, Director of the Department of Water Affairs and Forestry's 2020 Vision for Water programme, Nokuthula Dubazane, runner-up from KwaZulu-Natal and Dean Butler, runner-up from Mpumalanga.

CAREERS

The Minister said the 2020 Vision programme was used to stimulate the interest of youth in water resource management careers as well as promoting science, technology and research, and referred to the Water Research Commission's career guide – *Water @ Work* – which she recently launched in Grahamstown. She said this publication would "guide learners

The newly published career guide – Water@Work – available from the Water Research Commission in Pretoria.

Left: *Invasive Prosopis trees tend to form dense, impenetrable thickets that render the land useless for normal farming practices.*

Jacques Deacon, winner of the SA Youth Water prize, demonstrating his Alien Buster 1-2-3.

Labourers "fighting" invasives with the Alien Buster 1-2-3.

on the selection of careers in water resource management as well as within the water sector broadly".

Referring to the South African Youth Water Prize competition, the Minister said it was usually preceded by the provincial and national competitions and "culminates in the International Junior Water Prize, held in Stockholm, Sweden, annually.

"In this competition the learners identify water and sanitation related problems in their communities. The challenge for these young people is then to come up with solutions and innovations to solve those problems. This is what the South African Youth Water Prize is all about," she said.

ALIEN BUSTER

One of the most important water related problems for the community of the Northern Cape, where Jacques Deacon, the 2004 SA Youth Water Prize winner, lives, is the growing infestation of alien invasive vegetation, especially Prosopis trees and their adverse effect on the scarce water resources of the area.

The Northern Cape is the driest province in South Africa with a mean annual rainfall – at a quaternary catchment scale – of 226 mm and a mean annual runoff of about 4.5 mm. This lack of rainfall makes the province very dependent on ground water.

Today, groundwater resources in the province are threatened by alien Prosopis invasions which closely track underground water aquifers and suck the earth dry.

Jacques says the Prosopis trees have a deep and extensive root system that can reach water tables of 12 to 18 m and deeper. (The longest roots measured in the Arizona desert in the USA were 53 m). A mature Prosopis tree can use about 60 to 100 litres of water on a hot day, while water use per hectare, with dense stands, is estimated to be nearly a million litres per year.

PROPAGATION

He says until the 1960s government agencies actively encouraged the propagation of Prosopis trees, commonly known as Mesquite (or Suidwesdoring or Peulbome in the local language) in the arid northwestern regions of South Africa to provide shade, wood, fuel and animal fodder to farmers.

Great benefits were derived from these plantings and the campaign was thought to be a success. Unfortunately, the invasive potential of Prosopis trees –with their deep root systems, massive seed production and the absence of any natural insect enemies in South Africa – was not taken in to consideration and soon Prosopis became widely established throughout most of the drier regions of the country.

In the Northern Cape the first real notable invasion of Prosopis started after heavy rains in 1974. Since then, more than 1.8 million hectares of land have become infested.

Water is instrumental in the long-distance dispersal of Prosopis pods and seeds along seasonal water courses. From here the plants are spread onto the surrounding plains by domestic stock and wild animals feeding on the pods. Studies showed that for every one kilogram of pods eaten by sheep about 1 300 seeds are distributed. The trees tend to be multi-stemmed and form dense, impenetrable thickets that render the land useless for normal farming practices.

WORKING FOR WATER

The Department of Water Affairs and Forestry, through its well-known Working for Water programme, is leading the campaign to clear South Africa of invading alien plants. However, Jacques, with his prize-winning invention, Alien Buster 1-2-3, decided to add a little bit of impetus to the programme.

"The Alien Buster could be an important tool in the fight against invasive plants, especially Prosopis, and help save our scarce water resources in the area," he says.

Jacques' apparatus is a simple, easy to handle, multi-purpose, effective device, to eradicate alien Prosopis, by mechanical, biological or chemical means. It consists of a long pipe of adjustable length with a hook and a locking device at the one end and an umbrella at the other.

Mechanically, the Alien Buster can be used to harvest Prospis pods by hooking the apparatus onto a branch and then vigorously shaking the tree until all the dry, ripe seedpods drop to the ground.

Jacques says the umbrella protects the operator against the falling pods,

as well as against dangerous thorns, insects and snakes that often get shaken out of a tree.

Gathering Prosopis pods prevents the distribution of the seeds, while the treated and grounded pods make excellent animal feed that can fetch prices of R250 to R750 per ton.

For chemical control of the trees, Jacques plugs in the Alien Buster's nozzle, extension pipe and pump to spray herbicides on top of the trees.

He says in the Northern Cape chemical control of Prosopis trees involves the cut stump method – cutting down the trees and the then treating the remaining stumps with a mixture of the herbicide and diesel. This method, although effective, often leads to regrowth.

In his experiments with the Alien Buster, using a foliar herbicide application method, Jacques found that one week after he sprayed the tree with the herbicide Touchdown, the leaves turned yellow and started to drop. After three weeks the tree was completely dead. The tips of the branches were dry and could easily be broken off.

Once again, the umbrella protects the operator from poisonous sprays and dripping herbicide.

An area cleared of invasive vegetation and restored to its original condition.

The Department of Water Affairs and Forestry, through its Working for Water programme, is leading the campaign to clear South Africa (including the Northern Cape) of invading alien plants.

For the biological control programme for Prosopis two bruchid host-specific seed-feeding beetle species from the south-western USA, *Algarobius prosopis* and *Neltimius arizonensis* have been released in South Africa. These beetles can destroy up to 90% of seed embryos, but levels of damage are often minimal because livestock and game ingest most of the seeds soon after the pods fall to the ground, usually in January and February, and before the beetle larvae are able to fully colonise the pods.

Jacques' Alien Buster also has a biological control device for the release of seed-feeding beetles. He says his experiments showed that it was much better to release the insects in the top of the tree where they could fly straight to the seedpods and start working.

"A few insects were released near the ground on the stem of the tree and they were immediately attacked by ants. Only about 10% were able to escape and reach the top of the tree."

For the future, a research programme into the development of a myco-herbicide for Prosopis is in progress. This herbicide uses a suspension of fungal diseases spores to kill plants.

Jacques has employed two labourers to assist him with testing his Alien Buster in the field, showing that the use of the apparatus could be an important tool to create work for untrained, jobless people.

He now wants to adapt the Alien Buster (making it 1-2-3-4) by inverting the umbrella and fix it just below the hook. This will make it suitable for fruit farmers who could use the apparatus for harvesting nuts, avocados and pawpaws.

With all those newly won prize money safely in the bank that should be no problem for Jacques!

There's Life in Groundwater

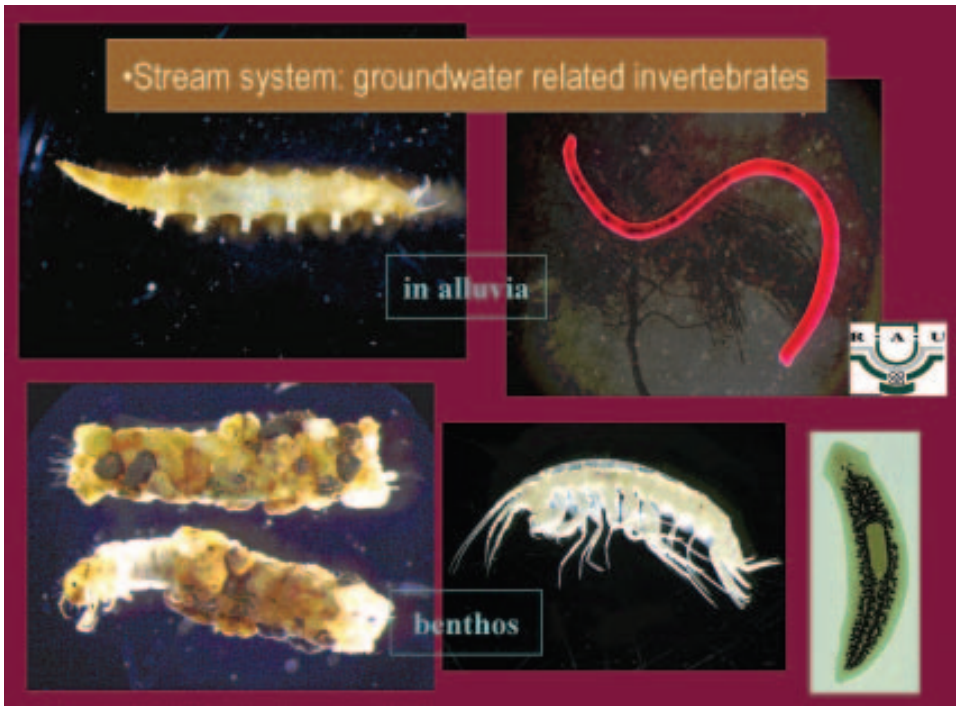
In bodies of water beneath the surface of the Earth, are living organisms that need to be protected. It has taken dedicated scientific research and state-of-the-art technology to shed light on these organisms. Edith Webster reports.

Sayomi Tasaki, a freshwater invertebrate zoologist-research scientist based at the Rand Afrikaans University (RAU) and focusing on groundwater ecology, working with the Water Research Commission and affiliated to the Department of Water Affairs & Forestry, abseils into a cave to investigate groundwater fauna.

Modern technology has enabled scientists to discover thriving communities of tiny living organisms in groundwater beneath the surface of the Earth, including aquifers in parts of southern Africa. And, as subterranean karst wetlands are defined as groundwater-dependent systems (Ramsar Convention, Iran 1971), these ecosystems should be protected.

Blind amphipod (a 4 to13 mm stygobite) found in the Koelenhof Cave - Kromdraai Conservancy. Stereodigital Photograph: Sayomi Tasaki. Courtesy: RAU, Department Of Zoology

Dr Heather MacKay, research manager at the Water Research Commission (WRC), says scientists, already armed with knowledge of the unusual animals in aquatic habitats, are focusing on the small fauna (micro-organisms and invertebrates) living in aquifers. Sometimes these organisms occur in small fractures within rock strata or in the interstitial spaces within shallow, unconsolidated rock just beneath the streambed – the hyporheic zone.



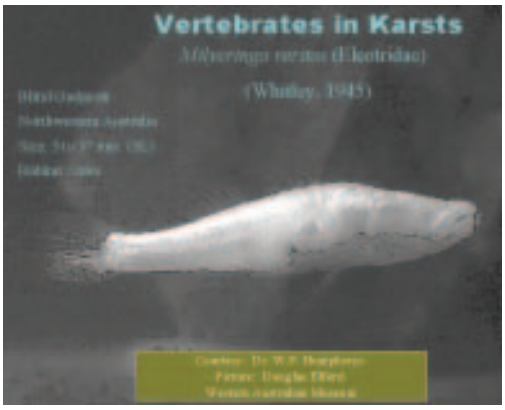
Pictures of groundwater-related invertebrates found in Gauteng stream systems

"Amphipods, for instance, are sometimes found when a borehole is drilled. They appear at various depths within the borehole water – there are usually greater concentrations at the bottom of the borehole – having migrated there via fractures or spaces in the rock," she says.

"Drillers have often noted this as a curiosity: occasionally small animals would be found in water brought up from the borehole."

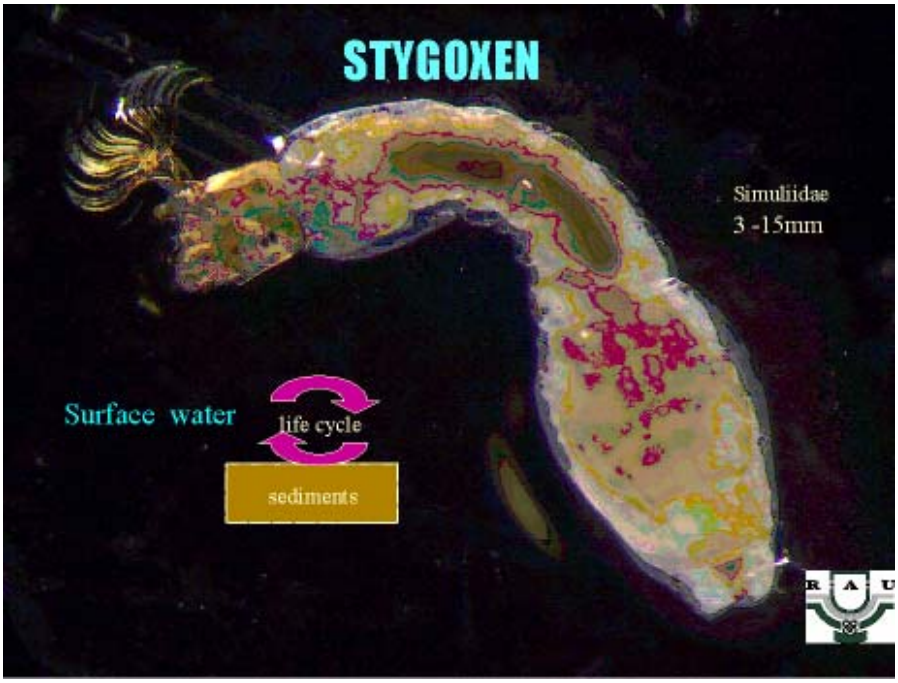
But, as they are living organisms, they are not merely a "curiosity", even though their linkages with and importance to other aquatic and terrestrial ecosystems are not yet well understood at all.

According to Dr MacKay many of these underground aquatic habitats are very sensitive to impacts such as pollution seeping down from the land surface as a result of, for example, agriculture, urban development or over-abstraction of groundwater.

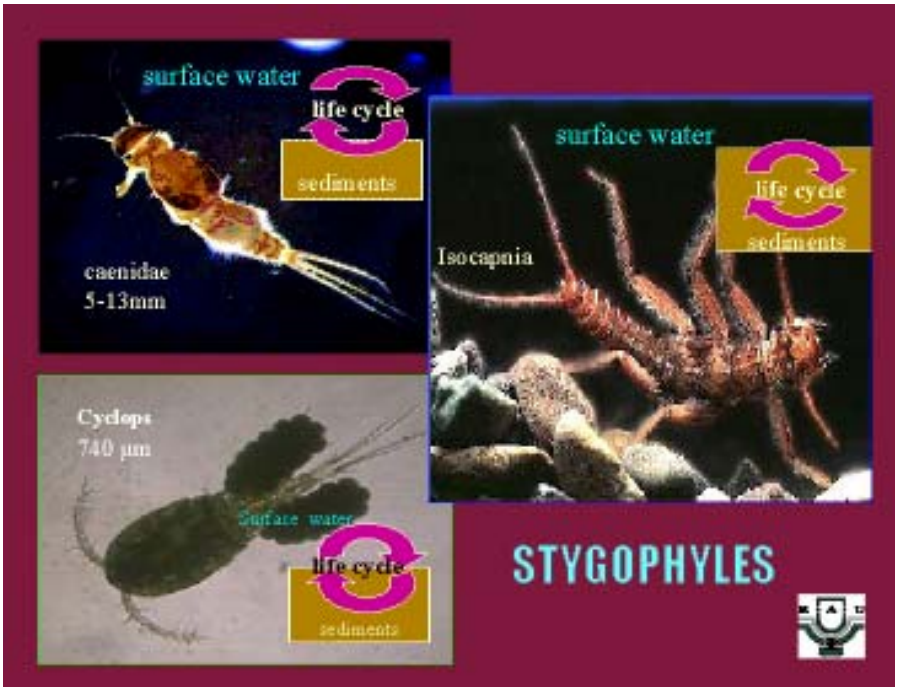


The Blind Gudgeon found in caves in Northwestern Australia

Now, using sophisticated technology, such as a video camera that can be dropped down a



STYGOXEN - a group of animals occurring accidentally in groundwaters



STYGOPHILE - a group of animals living within surface water-groundwater interfaces (benthos, alluvia, interstitial)

borehole, organisms are being closely monitored in underground ecosystems – they simply couldn't be reached before scientists were availed of state-of-the-art equipment.

Sayomi Tasaki, a freshwater invertebrate zoologist-research scientist based at RAU, focusing on groundwater ecology and working with the WRC and the Department of Water Affairs & Forestry, has found various groundwater-related invertebrates (scientifically referred to as stygoxen, stygophyle and stygobite), including the blind *Sternophysinx* amphipod group, in the area around The Cradle of Humankind (the Kromdraai Conservancy region).

The *Sternophysinx calceola*, which does not have eyes, senses movement by detecting sound waves via phonoreceptor appendages on its antennae. It has thus evolved to survive in groundwater habitats devoid of light.

"In South Africa, these eyeless crustaceans can be found in water up to 170 m below ground," says Tasaki.

"These stygobites are aquatic animals totally adapted to live their entire life cycles in absolute darkness, below ground," she explains.

"Because of the fine nature of their evolutionary development, they are extremely well tuned to their environments, becoming a sort of natural indicator of system integrity."

Tasaki says studies of such fauna can, at least, reveal the composition of aquifers and, thereby, provide important information that can guide efforts to protect aquifers from pollution and over-utilisation.

Ongoing studies of stygofauna continue throughout the world. In northwestern Australia, scientists have found blind fish (completely devoid of skin pigment) in the Cape Range and Barrow Island. Some European countries are using meiofauna (minute stygal invertebrates) in their studies of the

hyporheos – the transactional zone, or interstitial waters, between streambed sediments and groundwater.

"Stygal communities actively participate in the food chain; consuming and being consumed; they reproduce, interact and react in accordance to fluctuations in the composition of the system," Tasaki points out.

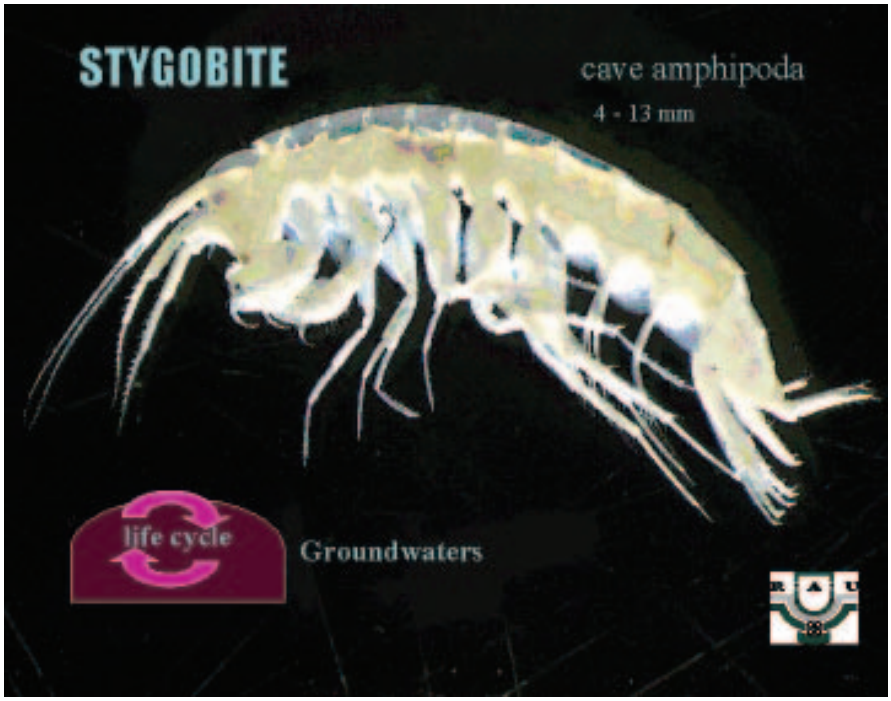
"All subterranean fauna, therefore, deserve consideration as each group has a different role in terms of its interrelationship with the broader environmental system."

Tasaki is studying groundwater-related invertebrates in order to provide a better understanding of catchments and, thereby, make a valuable contribution to water management in South Africa.

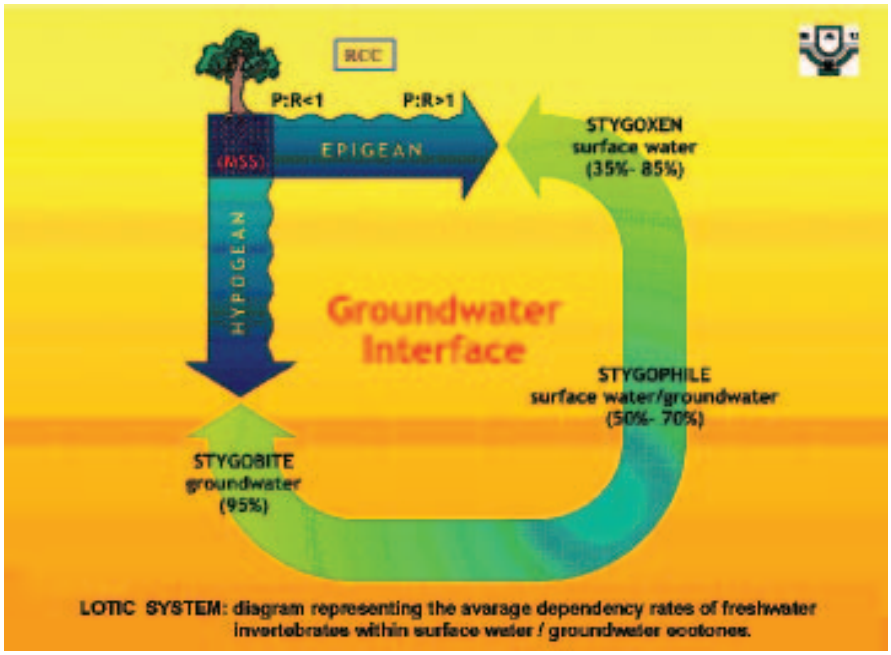
Her research is

- identifying links and pathways for ecological processes between surface water and groundwater systems,
- refining the understanding of these systems in order to support conservation and protection of groundwater-dependent ecosystems,
- potentially providing a water quality assessment model using groundwater invertebrates,
- assessing the quality of groundwater discharge, and
- detecting the occurrence and transmission of organic pollution in aquifers.

For more information, contact Sayomi Tasaki at RAU's Zoology department, (011) 489-2441.



STYGOBITE - group of animals entirely adapted to live in subterranean aquatic systems



LOTIC SYSTEM - representation of fauna classification and average groundwater dependency rates in a lotic system

Seterodigital pictures: S. Tasaki
Design of slides: H. Hoets and S. Tasaki
Department of Zoology - RAU

FOOD FROM USED WATER

Making the Previously Impossible Happen

The lack of gardening activities in so many rural villages is distressing. There is more than enough ground available, swept clean and baking in the hot sun. But who can grow vegetables without water? Finding water, carrying water, waiting for the turn at the tap dominates village life.

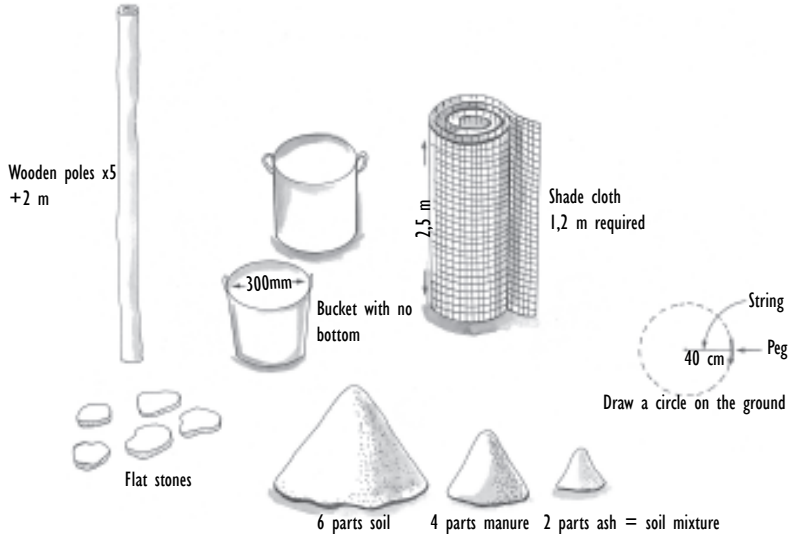
In a recent speech the Minister of DWAF identified explicit targets on which government will focus:

- The Department will ensure that in the next five years, all households will have easy access to clean running water.
- By December this year, the Department will provide clean and potable water to the 10th million South African since 1994.

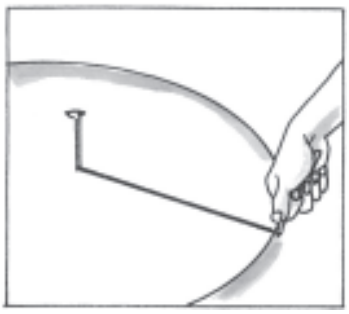
MAKING THE MOST OF THIS NEWFOUND SOURCE OF WATER

Of course this precious water is not intended for gardening and, in many cases, still has to be carried from the nearest standpipe in plastic containers. Despite this, many households have shown that this newfound source of water can be used for growing vegetables successfully. They save the water that has been used for washing clothes and utensils and feet, so-called grey water, and use it for gardening.

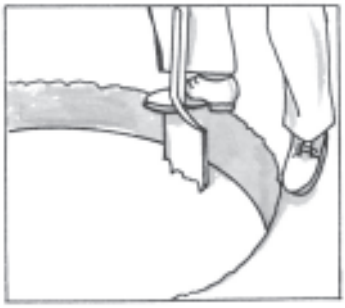
One of the most innovative and user-friendly ways of doing this is the "tower garden". It is not a new idea and South African developments are derived from what was seen in Kenya by a small group of people on a visit to assess treadle pumps. Vegetables are grown in a column of soil that fills a bag. Each day the available grey water is



Materials required for building a "tower garden".

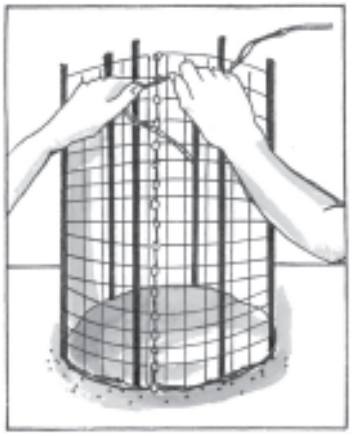


Mark out the circle - 40 cm for 2,5 m wide shade cloth.

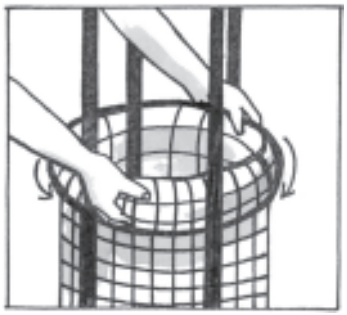


Dig out the bottom layer of the tower.

Plant the side poles or droppers firmly into the bottom.



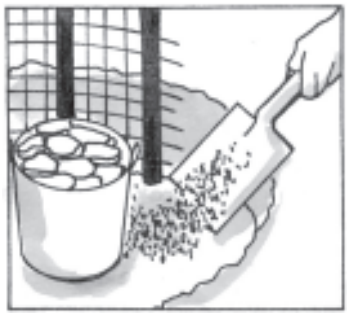
Wrap the shade cloth around the poles and tie the ends together to make a cylinder.



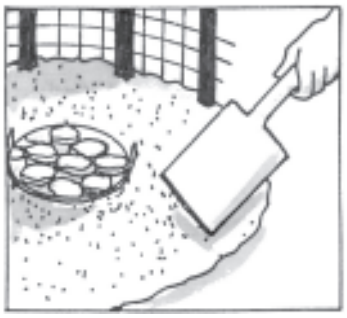
Roll the sides of the shade cloth cylinder down out of the way before filling.

Place the bucket (bottom removed) on the ground in the middle of the tower.

Pack stones carefully in the bucket to make sure that the water does not run through too fast.

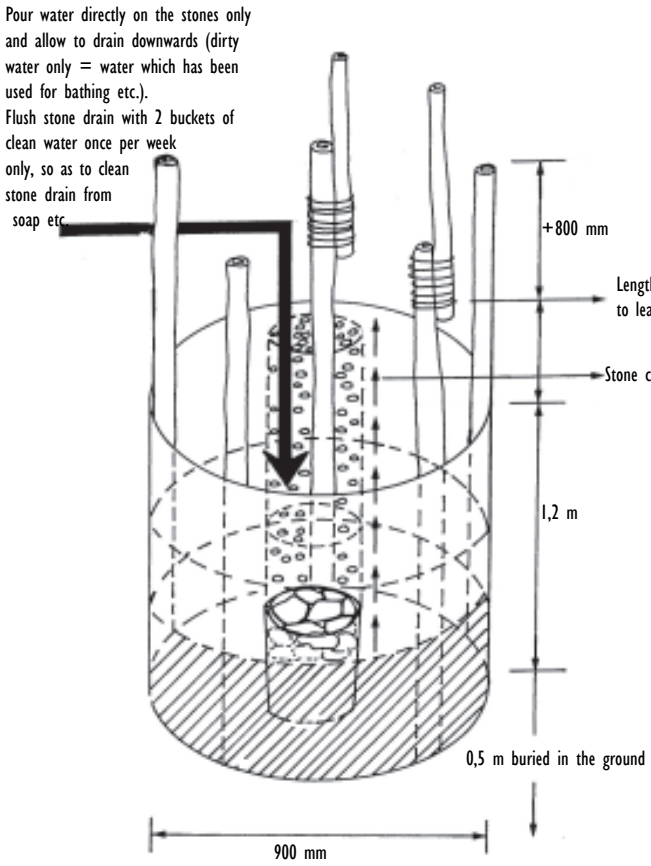


Backfill around the bucket with the soil mixture.



Dampen and smooth soil but do not compact.

Pull the bucket partially out, leaving the stones in position. Fill the bucket again with stones and backfill with soil. Repeat for each layer.

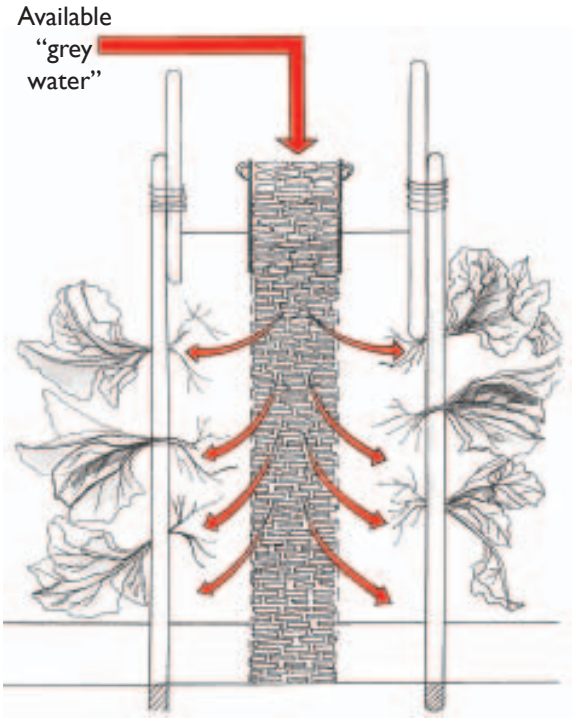


The final dimensions of the Tower Garden.

poured into the bag and the vegetables are planted in holes cut in the sides of the bag itself. The results speak for themselves but like all irrigation the user must master the tricks of the trade, nothing is as simple as it appears at first sight! Initially the housewives were sceptical, they didn't believe you could grow good vegetables successfully with soapy water! The answer to this problem is to clear the system out by pouring two buckets of clean water into the column each Saturday.

WHAT VEGETABLES CAN BE GROWN?

What vegetables can be grown? The towers are ideal for leafy crops typically the various varieties of spinach that are planted through the holes in the side of the shade net cylinder. Ideally the holes should not be one above the other but should be staggered diagonally providing more space for root development. Tomatoes and onions can be planted in the top layer and if crops require trellising this can be provided by extending the vertical uprights and joining them with wire or string. Where possible companion crops should be grown to facilitate biological control of diseases and pests, garlic and onions are useful in this regard.



The shape of the filling material in the stone column is very important for the even distribution of water through the soil in the tower.

An unexpected benefit is the way in which the vegetables have thrived in severe heat wave conditions that have proved too much for conventionally planted gardens. The reason for this is not quite clear. It may be the free air circulation, lower soil temperature or the better moisture status of the soil. It is not claimed that towers will be able to provide all the food a family needs but the contribution made to nutrition and eating pleasure is very considerable.

THIS IS LAZY GARDENING

Once people have become familiar with the towers they prefer to position them right at the back door so that it is easy to pour the wastewater into the tower. It is difficult to predict how much water will be required, only time can tell. If water forms a puddle around the bottom of the tower it is an indication that too much water is being applied and the obvious answer is to make a second tower! One of the main attractions of the method is that little labour or attention is required and this appeals to all busy housewives.

MAKING UP THE TOWER

The way in which the tower works is simple. The soil is contained by the shade cloth "skin" and surrounds a central stone packed drain. The purpose of the stones is to control the

Each day the available "grey water" is poured into the bag….

and the vegetables are planted in holes cut in the sides of the bag.

flow of water so that the soil in the tower is kept at the right water content for growth. The soil mix provides fertility.

The upright poles are not critical. Branch trimmings or fencing standards are suitable and where crops such as tomatoes are planted in the top layer of soil, extensions can be wired on to provide trellising. The selection of the cloth that forms the sides of the tower is, however, critical. All sorts of materials were tried initially in South Africa. In Kenya nylon gunny bags were used but were found to only last about two years. In South Africa sacking, as shown in some of the photographs, did not last the season. Black plastic sheets deteriorated rapidly in the sunlight. Shade netting proved to be far more durable but it was important to use nylon string or fishing line to join up the ends of the shade netting to form a cylinder as shown in the diagram.

Filling the tower with the soil is an art. The soil should be dampened to provide cohesion but not compacted. The water must be distributed evenly throughout the soil mass and will not penetrate the compacted areas. Similarly the stone filling is critical. When the first attempts were made in South Africa round stones were used and the water simply ran down the centre of the tower and did not filter through evenly into the soil mass. Packing flat stones, or building rubble, carefully solved the problem. It is possible to use smallish round stones provided they are so arranged and packed so that satisfactory water distribution is achieved.

The soil must be fertile and retain moisture and it has been found that a mixture of six parts of soil, four parts of manure and two parts of wood ash is satisfactory. It is likely that people will be able to develop appropriate soil mixtures utilising locally available material but experimentation will be required.

Tower gardens are in their infancy in South Africa but have the potential to make a real difference in areas where extreme climate and adverse circumstances have lead to household vegetable gardening being considered out of the question. The initial examples are in the Ndonga area near Queenstown in the Eastern Cape and there are two areas in Limpopo Province, both subject to hot arid conditions. One is the Nzhelele valley north of the Soutspansberg and the other Makuleke in the north east of the province.

Further information can be obtained from Johann Adendorff at (014) 717 3336, cell 0828594896 and Chris Stimie at (012) 842 4103, cell 0824694535.

The assistance given by Johann and Marie Adendorff, Chris Stimie and Gerhard Nel in providing information and photographs is gratefully acknowledged.

Wetland Plants - Dr Jekyll or Mr Hyde?

Wetland plants are often considered problematic but research now proves otherwise. **Edith Webster** reports.

Wetland plants are not entirely villainous vegetation – ongoing research into the biology of these plants, as well as conservation efforts, prove we couldn't survive without them.

So says René Glen of the National Botanical Institute in Pretoria.

"Wetland plants are often considered to be problem plants, growing in wet, smelly places that are ideal breeding places for mosquitoes," she explains.

"They are also often referred to as aquatic weeds, which depicts infestations of unwanted plants, causing severe economic losses."

But, continues Glen, "aquatic weeds" are not all bad – these plants (including *Potamogeton* species *pectinatus*, *crispus* and *schweinfurthii*) point out the most prolific bass fishing areas in South Africa, for example.

"Juvenile bass crowd under the thick weed beds to hide from predators while adult bass hide among the weeds to ambush prey.

"The weeds provide homes for insects, which in turn attract small bait fish attractive to feeding bass."

SUPERMARKET

In the USA, the common "cat tail" (*Typha latifolia*) is considered "the supermarket of the swamp" as the pollen can be used as a flour substitute, the flowers for stuffing pillows, the leaves for weaving baskets and mats, and the rhizomes, which contain as much protein as rice and more carbohydrate than potato, can also be ground into flour, and eaten whole, raw, boiled or roasted.

The South African equivalent "bulrush" (*Typha capensis*) is also benefi-

cial in that it prevents soil erosion, acts as a filter system or breaks the force of water, especially during floods.

"No doubt the most important property of *Typha capensis* is that it is a food source and/or shelter for several wetland animals thereby enhancing the biodiversity of any wetland," says Glen.

"Sadly, these positive 'Dr Jekyll' characteristics are overshadowed by the negative 'Mr Hyde' characteristics, such as vigorous growth, that block waterways."

Nevertheless Glen proposes: "Should we not be concentrating on how to use this potential food source to alleviate some of the starvation in this country instead of trying to find ways of eradicating this plant from wetlands?"

WATERBLOMMETJIE

Take the "waterblommetjie" (many South Africans may be familiar with this plant, scientifically known as *Aponogeton distachyos*). It is often cooked in a "bredie" or stew. This plant is valuable as a food source, it keeps water clean, it is home to (and protects) various creatures, and it can be grown commercially. Unfortunately, in Australia, waterblommetjies have been introduced as an attractive pond plant – where it has lost all its "Dr Jekyll" attributes and changed into "Mr Hyde", Glen points out.

"All these wetland plants only become a problem when they grow in polluted water or are introduced into foreign habitats," she says.

"In the novel *Dr Jekyll and Mr Hyde*, during the day Dr Jekyll was an extremely helpful and kind medical practitioner but at night he drank 'potions' that changed him into a barbaric, unkind person," Glen explains.

"Likewise, wetland plants react to the 'potions' people put into the wetlands and then become uncontrollable, as did Mr Hyde."

Glen wonders: "Is it not time we stopped blaming the plants and enforced better management programmes instead?"

Waterblommetjies are often cooked in a "bredie" or stew.

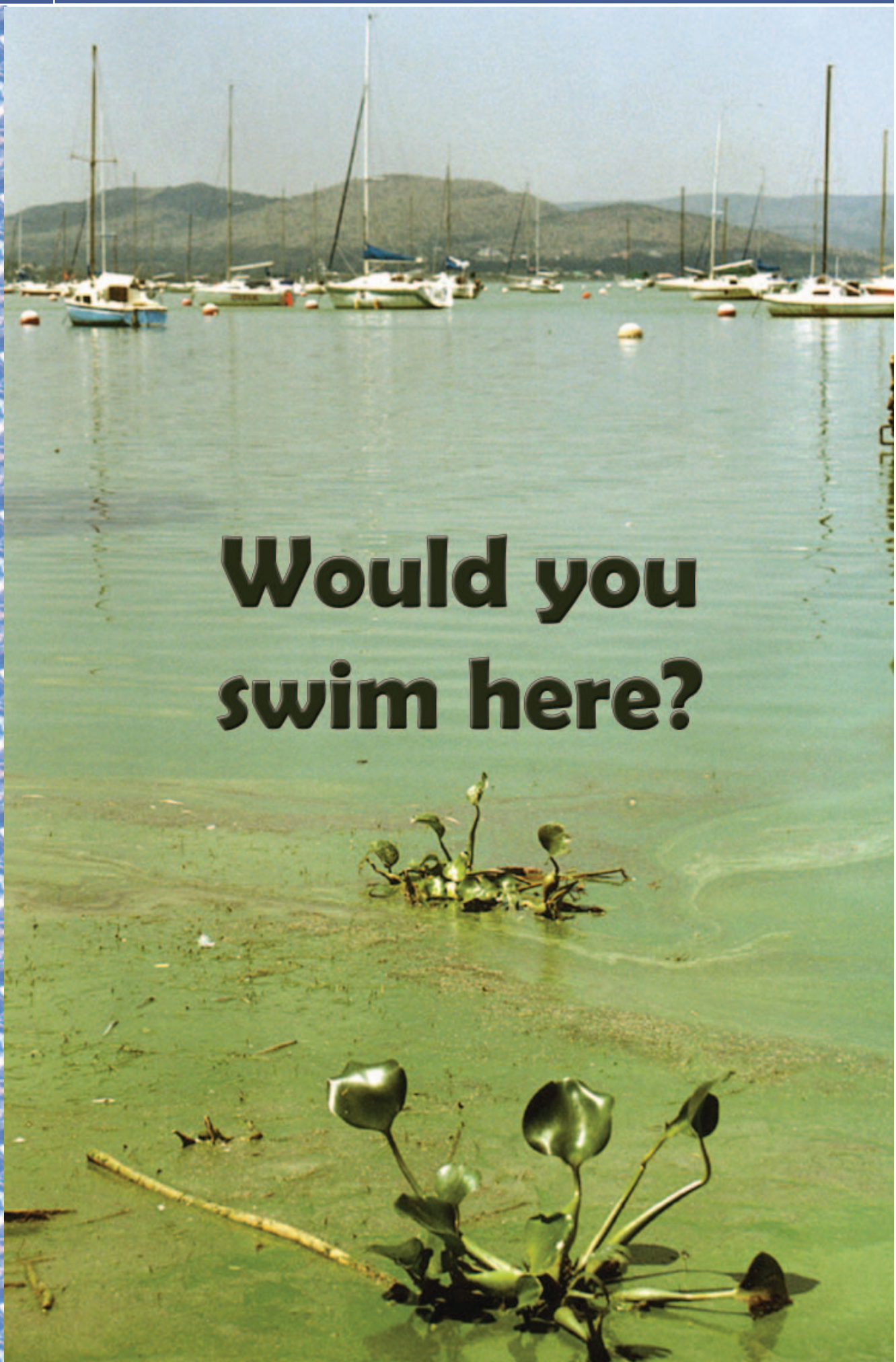
Examples of aquatic weeds

Potamogeton pectinatus

Potamogeton schweinfurthii

Potamogeton crispus

Potamogeton schweinfurthii


Would you
swim here?

In March this year, Hartbeespoort Dam experienced one of the worst algae blooms in its history. Some three hectares of water close to the dam wall were covered with a 30cm-thick sludge of rotting toxic algae, releasing smelly gases and necessitating an emergency clean-up operation. It was just another episode in the ongoing controversy surrounding what has become one of South Africa's most popular recreational dams and elite country settlements.

By Sophia Dower

Without a doubt, Hartbeespoort Dam has a reputation for being one of the filthiest dams in the world. But does it really deserve all the bad press its getting? Yes and no, says Carin van Ginkel, specialist scientist at the Department of Water Affairs and Forestry (DWAF) in Pretoria.

"More than any other dam in the world, Hartbeespoort suffers from massive seasonal growth of cyanobacteria (previously known as blue-green algae), which accumulates on the dam surface and rots in the sunlight. It releases offensive odours and often looks and smells like raw sewage - but it's not. The sludge is caused by the natural biodegradation of the cyanobacteria, and not human excreta."

Cyanobacterial blooms such as the one in April not only affect the taste and smell of the water supplied to local residents, the foul smell around the dam wall also puts off prospective buyers looking to purchase upmarket homes in the area.

Understandably, it has residents up in arms. Unfortunately, there's no easy solution.

THE ROOT CAUSE

The source of the huge outcry is tiny – a minute cyanobacteria called *Microcystis*, which, through a process known as eutrophication, develops to massive concentrations. Eutrophication is a natural process through which normal nutrient levels in the water are raised, but it is enhanced by human activity in the dam's catchment area. Coupled with other environmental factors such as low rainfall and warm, windless weather, this influx of nutrients leads to rapid and excessive growth of cyanobacteria and aquatic weeds.

Ironically, the cause of the stink is Mother Nature's way of absorbing and removing excess nutrients from the water. However, in attempting to rectify the problem, nature has created another – one that is proving extremely difficult to resolve.

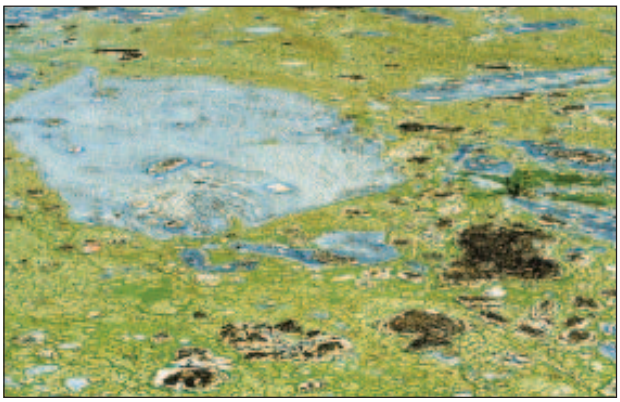
"Hartbeespoort dam is effectively a massive nutrient trap," says van Ginkel. "Approximately 16 sewage works and many industries discharge wastewater effluents from the high density Johannesburg and Pretoria area into the Crocodile River, the main river flowing into the dam. The aridity of South Africa and the historical Water Act enforced companies to discharge all effluent wastewater back into the rivers. All these companies are required to comply with strict water regulations and, since the promulgation of the National Water Act in 1998, are monitored by DWAF to ensure that they do so. Nevertheless, more than half of the water flowing into the dam is phosphorus and nitrogen-rich."

The release of wastewater into catchment areas is widely practised across the world, and is controlled locally by South Africa's new Water Act. So why is it a problem at the Hartbeespoort Dam?

"Much of the nutrients are trapped in the sediments at the bottom of the dam and remain inactive for extended periods," explains van Ginkel. "In summer, however, different thermal layers form in the water column. The deeper layer becomes anaerobic (oxygen depleted). Under these conditions phosphorus is released from the sediments. This process is known as internal loading. When mixed into the upper layers of the water, these nutrients boost algal growth. The cyanobacteria are able to regulate their position in the water column for optimal growth. During a cyanobacterial bloom of *Microcystis* the cyanobacteria form dense accumulations, which then floats to the surface. Once exposed to sunlight, it starts to decompose, and toxins that are normally bound inside the algae, are released."

Van Ginkel adds that the problem is not unique to Hartbeespoort, and occurs in about 20% of South Africa's monitored reservoirs. But for unknown reasons, nowhere else do these "hyperscums" produce so

With water-front properties starting at well over a million Rand apiece, DWAF is under increasing pressure to find a long-term solution to Hartbeespoort's algae problem.



As the cyanobacteria dies, it changes to blue-green and then to black-brown, forming a crust on the surface which looks - and smells - like raw sewage.

A typical cyanobacterial bloom initally looks like pea-green soup. Once it reaches the surface it is blown by wind into smaller inlets, where it accumulates and dies off.

rapidly or in such vast quantities.

"According to a recent DWAF eutrophication survey and prioritisation of monitored dams, Hartbeespoort is not the worst case in terms of its nutrient and algal biomass levels. However, it has relatively clear water that allows more light and heat penetration, which also contribute to algal growth."

SO WHAT'S THE FUSS?

The appearance and smell of the rotting cyanobacteria has led to a number of reports from concerned residents to DWAF that raw sewage is spilling into the dam. This is denied by both DWAF, private consultants and the industries operating in the area.

Petrus Venter, Deputy Regional Director: Water Resource Management of the North West Province, explains that a typical cyanobacterial bloom initially has the appearance of green pea soup. "Cyanobacteria on the surface is blown by wind into smaller inlets where it accumulates and dies off," he says.

"As the cyanobacteria dies it changes from white, to blue-green, and then to black-brown. It then forms a dry crust on the surface which is often mistaken for raw sewage." What happens to the dying bacteria is the same process that applies to a sewage treatment works, namely biological breakdown of organic matter. In this case, however, the organic matter consists of cyanobacterial accumulations.

Another concern voiced by visitors and residents, is the incidence of cholera. But, as Venter explains, there is no relationship between the algal growth and cholera. "The Department tests the dam water every two weeks and so far, no cholera has been detected." Additionally, because the cyanobacteria and phosphorus doesn't penetrate through the sediments, its presence in the dam does not affect local groundwater supplies.

In that case, what's the fuss all about?

"Cyanobacteria can potentially be dangerous to both humans and animals due to their ability to produce toxins. The effect depends on the amount that they ingest or come into contact with," says Venter. "Mostly animals are affected, as they drink the cyanobacteria clumped around the shoreline. The greatest effect on humans is that of the powerful, unpleasant smell. Exposure to the cyanobacteria can also cause gastro-enteritis, skin irritation, nausea and skin lesions. Contact with it is best avoided."

Besides the more obvious inconveniences, the dominance of the cyanobacteria wreaks havoc with the ecosystem in the dam. The decomposition of the cyanobacteria hyperscums depletes oxygen levels, and

(Top) When excess nutrients are released into the water, they boost algae growth. This forms dense accumulations and floats to the surface.

(Left) While cyanobacteria is not unique to Hartbeespoort, nowhere else do these "hyperscums" produce so rapidly or in such vast quantities.

The rotting algae is potentially dangerous to both humans and animals. It also gives off noxious fumes - unfortunately for the Hartbeespoort restaurant outside which this signpost appeared.

– under high temperatures – causes the nitrogen to form ammonia and methane, which can be very toxic to fish and birds. A number of fish and bird kills have been reported at different parts of Hartbeespoort Dam over the years.

TREATMENT OPTIONS

Ironically, the cyanobacteria that's causing all the stink is Mother Nature's way of absorbing and removing excess nutrients from the water. However, in attempting to rectify the unnatural balance of nitrogen and phosphorus, nature is creating a new problem – one that, in this case, is proving extremely difficult to resolve.

Venter explains that a number of treatment and management strategies are used worldwide, although many are not feasible for implementation at Hartbeespoort Dam for cost or practical reasons.

- "Problem" dams can be drained and the sediment dredged. However, draining a major water source is not an option in a country as arid as South Africa.

HARTBEESPOORT – A 30-YEAR-OLD PROBLEM

Originally built for irrigation purposes, the construction of Hartbeespoort Dam served as a job creation scheme to help alleviate the tremendous poverty that prevailed after the First World War. Today Hartbeespoort is the main water supply for some 139 000 households in the Brits and surrounding areas.

When it was filled, the dam was classified as a pristine dam. It was only in the 1970s that cyanobacterial blooms became a problem. The dam's growing popularity as a recreational area, plus the rapid urban developments upstream, soon led to higher nutrient levels in the water – nutrients commonly found in fertilisers, industrial wastewater, sewage effluent and products such as soap and washing powders.

In 1970, the dam was raised by 2,44 m to increase the gross capacity to 205 million m^3. When full, the dam's shoreline is over 56 km long, and the surface area is 2 062 hectares. The dam has a catchment of 4 112 km^2, which is drained by the Crocodile River and its tributaries, the most important of which are the Jukskei, Hennops and Magalies rivers.

Nor does this tackle the root of the problem – nutrient-rich water inflows.

- Dam water can be aerated by feeding air through pipes along the dam floor. This mixes the water and increases oxygen levels, inhibiting cyanobacterial growth. This method has been tested elsewhere in South Africa, but with limited success.
- Chemical additives, such as iron or aluminium sulphate, or copper, prevent the phosphorous from being released or "seeping out" of the sediments. While these additives have no impact on crop irrigation, they could pose a problem for domestic uses.
- The creation of a wetland or pre-impoundment dam could filter nutrients out of the water before it reaches the dam. This is an option that is being considered for the Hartbeespoort Dam.
- Bio-manipulation involves analysing the impoundment's ecosystem and removing any natural elements that somehow contribute to the release of phosphorus from the sediment; or adding elements that absorb the phosphorus or control the cyanobacterial growth. One option is harvesting surplus fish, such as carp, which is a bottom-feeder that disturbs the sediment to such an extent that phosphorus is released from the sediments.
- Physical removal of the cyanobacterial scum is the most successful management option used to date. In April, two private companies were contracted by the department to clear the surface of the rotting biomass. This involved pumping the algae through pipes over the dam wall to a safe dry area on the northern side, where it was treated to mitigate the odours and accelerate the natural decomposition process. The clean-up was coordinated by ENVIROKONSULT, a local private company of environmental scientists, and HAZMAT (Enviroserv) which handled the mechanical removal of the dried cyanobacterial scum.

"In a nutshell, we need to find a long-term solution that suits all the different people who currently benefit from the dam," says Venter. "The users and their varying needs – from irrigation to recreation to domestic use - limit our options. Therefore, they should all play a part in finding the solution."

MAKING PROGRESS

The Hartbeespoort Water Action Group (HWAG) was formed in 2000, comprising members of the Department and the local community. HWAG has been quite active in obtaining funds, both from government and from some of the companies operating close to the dam. This funding has yet to be put to good use.

Venter explains that the Department is working with HWAG to appoint a private consultant to put in place a long-term business plan with sustainable water management and rehabilitation strategies.

"The group has formed a Section 21 company, and will be implementing levies on local industries and residents, which can then be used for problem management." At this stage, however, promises have been more forthcoming than hard cash, and Venter says progress is slow. "Some equipment has been bought with a view to handling fast, effective clean-ups such as the one in April," he says. "But much-needed finance is still outstanding – as is commitment from many of the larger property developers in the area."

To date, however, both the department and local action groups can boast a number of achievements:

- DWAF has instituted measures to limit the discharge of phosphorus into surface water. Specific standards (1 mg/ℓ ortho-phosphorus) were introduced in 1985 and have been managed ever since. Some treatment works already comply with a standard of 0,5 mg/ℓ ortho-phosphorus.
- Dam water and rivers up and downstream are regularly monitored for the presence of pollutants and cholera.
- DWAF has developed, and manages integrated resource and wastewater management plans, and conducts regular general inspections. It also facilitates clean-up actions and preventative measures.
- Residents and visitors to the region participate in projects to eliminate algal growth, such as the skimmer project which traps and removed algae from the water surface with nets.
- Cyanobacterial bulldozing takes place to move solid scum away from the shoreline, and a floating weir has been installed to separate certain parts of the water, to enable a process of phosphorus removal.
- An ultrasonic algae killer has been installed in an experimental project during the year 2000 cyanobacterial bloom in the Leeuspruit section of Hartbeespoort Dam.
- General public awareness and education campaigns have been launched, aimed at residents and visitors.

For more information:
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Petrus Venter, (012) 253-1093
***Hartbeespoort Water Action Group*: (012) 253-2796 or at www.hwag.co.za**
***ENVIROKONSULT*: Kobus du Plessis, (012) 349-1793 or info@envirokonsult.co.za**

Musa Will Not Drink Water From That Stream Again

Musa Nzimakwe was 18 years old when he contracted cholera two years ago. He had just finished his electrical engineering exams at a technical college in Durban, and had gone to his rural home between Margate and Post Shepstone in late November. One week later he was seriously ill with cholera. Louise Torr tells the story.

In Durban Musa has access to clean, piped water. At his rural home, domestic water is obtained from a stream, which is supplied by a spring. This stream runs through Musa's homestead, and at places the water is stagnant. Sometimes the water is yellowish green, with frogs, but this is the water that his mother and rest of the community collect for domestic consumption. Until recently people used the bushes when they needed to defecate.

Musa had been helping to build a fence, and used to drink water straight from the stream whenever he felt thirsty, which is what everyone does in that area. In addition, Musa is a soccer player, and whenever he came home after playing, he would drink plenty of water from the stream. His mother, sister and two brothers did not get ill because they did not drink as much as he did – also in Durban he was used to drinking water that was safe. His family was very worried and confused when he became ill, and they gave him plenty of water to drink, but it was water from the same stream.

Soon Musa began to lose his appetite. Three days later he had diarrhoea, but he did not go to the clinic as he thought it would pass. He felt terrible – everything he ate passed through him – he had diarrhoea and vomited, and could not keep anything inside. The makeshift toilet was far from the house, and he needed to get there about 15 times a day. Sometimes he could not get to the toilet in time. His mother brought a bowl to wash him. He felt terrible and began to lose hope. He lost a lot of weight and his mother had to carry him to the clinic.

By the time he got to the clinic, he had no energy. He was given glucose, and a letter of admission to Port Shepstone hospital. He stayed in hospital for a week, and was on an intravenous drip for a few days.

HOW TO TREAT AND PREVENT CHOLERA

When people have diarrhoea and lose a lot of fluids, it is important to give them a sugar/salt solution to drink as often as they can. This home solution stops their bodies from drying out. To one litre of clean water, add 8 teaspoons of sugar and half a teaspoon of salt.

We can all work hard to prevent cholera if we:

- Make sure that human faeces do not get into the water that we drink.
- Make drinking water safe. Add one teaspoon of Jik (or other bleach) to 25 litres of water. Let it stand overnight, or for two hours at least, to clean the water properly and to kill the cholera germs. Water can also be boiled to make it clean.
- Wash hands with soap after going to the toilet, and after changing a baby's nappy.
- Wash hands with soap and water before preparing or eating food.

Illustrations supplied by SANTAG (KwaZulu-Natal Sanitation Task Group). Artwork by Hildegarde van Zyl.

Make drinking water safe:

- **Add one teaspoon of Jik (or other bleach) to 25 litres of water.**
- **Let it stand overnight, or for two hours at least, to clean the water properly and to kill the cholera germs.**

Make a home solution for people who have diarrhoea:

- **To one litre of clean water, add 8 teaspoons of sugar and half a teaspoon of salt.**

Give this sugar/salt solution to people with diarrhoea to drink as often as they can.

Thereafter he was given healthy food, plenty of liquid and fruit. On the seventh day, he was much better and discharged.

CHOLERA

People know that cholera is bad, but Musa thinks that they are not aware that cholera is caused by bad sanitation habits. Since last year the uGu District Municipality has supplied toilets to this area, badly affected by cholera, but this has not been accompanied by an education campaign. No workshops have been held to educate people about the connection between bad sanitation, contaminated drinking water and cholera. People are still drinking unsafe water from the stream. They do not realise that it has to be purified – they generally do not boil their drinking water, nor do they cleanse it with Jik. Earlier this year, handpumps were installed in the vicinity, but people still use the water from the stream because they have to walk too far to collect water from the handpump.

It seems that people in the area seem to know more about the ways that HIV/AIDS is spread than they know about how cholera is contracted. But they show the same indifference, and do not take precautions.

Musa, however, learnt the hard way. He will not drink water from that stream again.

CHOLERA CAN SPREAD DURING SUMMER HOLIDAYS

Over the past few years KwaZulu-Natal has been hit by outbreaks of cholera during the December holidays. The disease can spread easily with the movement of people during the summer holidays, because people spread the disease.

Not everyone will get cholera. People with clean piped water will not get cholera, but those who do not have clean, safe drinking water can get cholera if the water is infected with cholera germs. These germs are found in human faeces. Communities can easily get cholera in areas where the toilets are badly constructed, and the human waste can contaminate their drinking water. If they defecate in the bushes, their faeces can wash into the river when it rains. If the water is made dirty by human faeces, the cholera germs will grow and spread.

When heavy rains fall and the weather is hot, cholera germs can grow and spread very quickly. When the weather gets cool and dry, these germs can stay sleeping in water for many years. They will grow again when it gets hot and spread when the rivers flow after rain.

People who drink infected water and get cholera, suffer from diarrhoea and vomiting. If the body fluids that they lose are not replaced quickly enough, they can die. During last year's cholera epidemic the Health Department helped to stop people from dying of cholera. People in cholera areas were given Jik to clean their water, and clean water was brought to cholera areas. Emergency clinics or rehydration centres were set up, where people with cholera were given extra fluids to replace those lost from diarrhoea and vomiting.

That I cannot say

by Rosamund Stanford

Bulu was walking round and round under the old oak tree pushing a pole. The other end of the pole was tied to a bunch of cowhide strips, suspended from a high-up branch. The little girl's eyes were on the still hairy hides. They were twisting, twisting, twisting, and growing a big lumpy bulge. As the bulge got more knotted the pole pulled Bulu's arms up and up, until they were above his head.

You know, said Bulu without looking at her, when your grandfather passes on, the buck are going to die. That herd of rhebok up there on the mountain are going to die, it will take some time, but that is what will happen.

Why will they die? asked the girl.

That I cannot say, said Bulu.

Bulu was very old and very hard to talk to. The little girl wanted to ask more but she felt unable. He had such deep dark lines in his face, and he was filled with sorrow. His sons, whom he'd raised with great care, had become cattle thieves. He said such a thing was almost enough to make him join the mission people, although not quite enough.

Get out of the way! he suddenly shouted. The little girl scattered. The pole came wildly smacking and bouncing down as the knotted riempies unwound.

Then Bulu started again, trudging round and round. My mind is like the hide of this cow, said Bulu, if I put my sinews into it and twist it up, it becomes unruly, like the water snake when it has been angered. Maybe, as they say in that church that has been built over there, I will go to hell, but there is nothing else for it.

That was very frightening for the girl. Now she was thinking, not only will Bulu one day die, but also her grandfather would die, and all the buck on the mountain too. She felt the presence of doom.

Knowing how she felt, Bulu for the first time looked straight at the girl. Not now, he said, because it is not yet the time, but when you are older, you will have to come back here no matter how difficult that will be, or how inconvenient. But come with me now I will show you something before I die.

The girl followed Bulu up into the hills. You see, he said, when they reached the heights where there was a covering of grey-green isidwadwa shrubs; the goats are destroying the grass, eating even the roots. And the cattle, he shook his head, they are thin long before the frost. And here, this spring, which is the one that sends water down to the homes below, is becoming weaker. We do not know why, but I alone have been speaking to the water snake, no one else hears him anymore. He says this mountain is shrinking from him, in shame.

The shame is on account of being left naked. No mountain wants to be without cover, but that is happening. For the first time Bulu smiled at the girl. You, he said, and me, we can put on clothes in the morning and take them off at night, but not the mountain.

They walked along the ridge and down a slope until they sighted the small herd of rhebok in the distance. There they are! said the girl, excited, because they were a rare sight for her eyes.

Now we will follow them, said Bulu, but from a distance. For nearly an hour, the two of them walked quietly behind the herd of buck. They are going, said Bulu, all the way from up here on Inungi mountain, right down down the foothills and into the valley of the Umzimvubu.

When the buck reached the Umzimvubu, the girl expected that they would drink, but no. Instead they trailed along the bank, going south with the bends of the river. They stopped at a place where the water was spreading wider and

shallow enough to wade through. One by one each buck made a small jump into the flow. With their heads held high, half wading, half swimming, they made their way to the middle of the river. Then their backs rose out of the water; there must have been a mound or a rock just beneath the surface. Standing on this they lowered their necks into the river and drank. Then one by one they returned to the bank.

All that way, said Bulu, and they could have drunk anywhere along the river. In fact they could have drunk from the stream up on the mountain. Maybe you, on those short but sturdy legs of yours, would walk such a way, from the top of the mountain to here, if there was coca cola in that water. Now you are teasing me, said the girl.

Soon after that Bulu died and the girl's grandfather died too. The family moved to the city where she was sent to school.

For the first few years the girl was alright. But as the pages and pages of facts began to mount she'd ask her brothers: How can a person remember all these things about an animal or plant, or a river without seeing it ever? The girl was scolded, she was sent for counselling, she was sent to a psychiatrist. When the psychiatrist asked her why she was refusing to learn her work she replied: There's no picture, no story to help me hold the bullet lists in my brain. I want you to take these pills, he said, they will help you remember.

I don't want pills, said the girl, I want to smell the Umzimvubu again, the water in these taps is disgusting.

The psychiatrist told the girl's family: Without medication I see little hope. It's clear as crystal that she is deluded; we all know that our city water it is absolutely sterile, you can even smell the chlorine.

Now the girl was back. Her brothers had brought her to visit the place of their early childhood. They searched for the mountain spring, but it had dried up, as Bulu predicted that it would.

Then they went down into the valley to Bulu's huts. They were long deserted. There were goats all over the place and a few cattle, bony as skeletons.

They went to the river. If only I can find the place that Bulu showed me, said the girl. I have to find the buck first. Walking around they asked whoever they came across: Have you seen any rhebok? Some people who were herding their thin cattle, said they'd last seen a small herd over there or over there, but that it was some time ago. Nobody was sure whether the buck were still around. One person said he'd heard gunshots on the mountain, and that maybe the whole herd had been hunted out. Another one said dogs had eaten the buck.

Then the girl and her brothers met a man who was tall and ropey-looking just like Bulu, but younger. You must be one of Bulu's sons, said the girl. Yes he said, they released me from prison only yesterday and I've been walking walking walking, but I no longer have a family to return to.

The spring on the mountain has dried up, said the girl. That is what my father said would happen, responded Bulu's son.

Because it was summer the Umzimvubu was swollen with earth-red water. We will never be able to find the place where the buck drank with the water so full and muddy, said the girl.

You must wait then until the rains subside if that is why you came all this way, said Bulu's son. That could take months, said the oldest brother in consternation. It's too bad, said the girl, I'll just have to wait as long as it takes. What about your schooling? asked the other brother, you will fall behind. It would make no difference if I went back now, she answered, there's no room in my brain.

Your head is too tight inside, said Bulu's son. The remedy for that is known only to the water snake. He is the one who can unravel the tightness of mind that won't allow new things to enter.

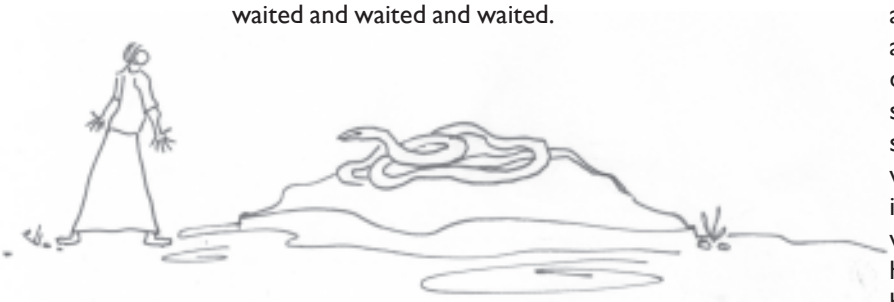
You can't stay here, said the brothers, everything's changed: look at the veld, look at how the huge old ironwoods have been hacked away. And in any case you can't drink the water of the Umzimvubu anymore, there's an enormous unserviced settlement ten kilometres upstream,

you'll have cholera in no time.

I'll stay, said the sister, Bulu's son will look after me: won't you?
I'm known as a cattle thief, he replied, but you are welcome to one of my father's huts.

For four months the girl waited. Then when the grass had broken into little white pins, the water of the Umzimvubu got shallower and clearer; and because it was late summer the snakes spent as long as possible heating up their bodies in the sun.

Then one morning next to the river the girl met the water snake. It was big and long and brownish black, almost invisible, as it lay coiled on a hot black rock.



The girl froze. The next step of her bare foot would have stood right on the snake had she not caught the glint of its eye. Her foot jerked back. Her mouth went dry, as if she'd bitten into a green banana. Her legs were trying to run her away, but she was torn in two, because her mind was saying: this is your chance; you came here because school or some other thing was squeezing your brain, now is your chance.

The girl forced her legs to be still. She faced the water snake.

I see your legs are still running inside themselves, remarked the snake. I see you are being torn apart. Follow me.

Uncurling itself the snake slid across the hot rocks and down into the grass. The girl followed it through grass and bush and deep red dongas. Then the river widened out and the water looked a bit shallower. This is the place, thought the girl, the place where the rhebok came to drink.

You are right said the snake. Now we must wait. So they waited, but soon it was dark and nothing had happened.

You will have to find me again tomorrow, said the snake, I will be back on the same rock. It slid into the water.

In the dusk the girl made her way back along the river, she went as slowly as a creeping creature so as not to injure her upright bones.

The next day as soon as it became light she walked back to the black rocks. There was no snake. She waited and waited and waited.

Then a movement caught her eye. It was the snake gliding up the rocks.

Again she followed it along the bank to the place where the river was slightly wider and shallow enough to wade through. They sat all day there. Nothing happened. The girl felt thin and hungry and very thirsty. She lay on a flat rock and sucked water up like a cow or an antelope.

The snake disappeared without saying a word to her, so again she walked very slowly back to Bulu's huts.

What was she to do? She spoke to Bulu's son: I have followed the water snake today and yesterday and waited and waited, I'm sure it's the same place that Bulu took me to, where the buck drank.

Bulu's son was unable to hear her because he was vomiting his guts out. For days he'd been unable to keep anything in his stomach. He'd heard that many people along the river were throwing everything up in the same way. The girl didn't know what to do to help him. They knew it was the water making everyone sick. If only the spring on the mountain hadn't dried up, she said. She boiled pots of water for Bulu's son, and he drank and drank. Then he said: maybe it is better that we all live in prison, at least there we are fed, and the water does not make us die.

Again the next day the girl went to find the water snake. For many hours she sat on the rock, but there were clouds passing over the sun, and every time another cloud darkened the sun her heart sank. Maybe winter has set in and the water snake has gone into hibernation, she thought.

Then she thought: but what is the point in any case, I must truly be mad, those teachers were right, if anyone saw me here spending my days sitting on a rock like a primitive person waiting for a snake, they would say yes indeed this is madness. This was a terrifying thought for the girl. She could neither get up and leave nor stay where she was: what was going to happen? What can happen if you can neither stay where you are nor leave?

It was then that she noticed that the snake was on the rock, as if it had been there all the time and she'd been unable to detect its presence. But what was happening? It was writhing and swelling. Its skin

was beginning to burst. A slow tear was splitting along the length of the snake's body.

Now, said the snake, take my old skin and grind it up with a stone, then walk along the river bank and you will know exactly which place in the water to throw it. That's all you need to do, nothing further. I will be gone now. With its golden-brown skin, like the skin of a young snake, it slid off the rock and disappeared into the running water.

The girl picked up the skin, which was thin as plastic and slightly translucent. She crumpled it into one hand then began to follow the river as she'd done the two previous days. She saw a round rock, the size of her hand, which she picked up and took with her to the place where the river widened out.

There, she sat down and ground up the water snake's skin. Then she gathered up every bit, every scale in her palms and stepped to the water's edge. This was the place she knew; but her hands wouldn't open, they were afraid to let go of the snakeskin. As long as she held it in her hands she could hope: but what if she let it go and that was the end of that, what if she never found whatever it was she'd come back for? What if she went back to school and was still unable to store more than three facts in her tight brain?

She found herself weeping: this was the first time that she'd allowed her tears to flow since returning to the place of her birth. But after only five sobs the girl took in a very deep breath. These tears, she said, will have to help me: I will not shed them for no good use. She stood up and flung the crushed water snake scales into the stream.

As she did this, she heard a soft sound like hooves on rooigras. She looked up and there was a small herd of rhebok. She remained absolutely still, as still as the snake had been when she had failed to detect it on the rock. The buck reached the bank, then one by one they made a jump and entered the water. First they swam out a bit, then they allowed the current to take them slightly downstream, to a place where the water was swirling like a knot in a tree. There the buck rose out of the water; they were standing on a rock or a mound, with just their lower legs covered. One by one they bent down and sucked up water from the river. Then they swam back to the bank.

When the rhebok had gone the girl took off her clothes and waded and swam to the same place. Just under the water was a large rock where she rested, looking into the river on the far side. The water there looked as if it had rust in it and smelt slightly sulphurous. She put her face in and let her eyes look down into the river. She felt with her arms. Under the river there must be a spring, she could feel the bubbling coming up.

The next day the girl returned with empty two-litre coke bottles. She swam to the same place, then she dived to the bottom of the river. Spring water was welling up from a hole. She filled the bottles, trying as best as possible to keep the river water out.

Then she took the bottles back to Bulu's huts. At first when she drank this water, it tasted awful, but soon she wanted nothing else to drink or eat. For five days she took in nothing but the water of this underwater spring.

On the fifth day she began to feel that her tight brain was softening, and the knotted rope in her belly was turning into a thousand flowing strands all moving together, it was as if all her energies, instead of zooming this way and that way like taxis in rush hour, were just meandering like water or thin strands of cloud on a breeze.

The girl breathed freely again. She said to Bulu's son. I'm going back now. I think those buck were the same ones that came down from the mountain when your father was still alive, the snake allowed me to slip back to that time. Before I go I will show you the place under the Umzimvubu, where the water is still full of life.

(The author can be contacted at mindys@global.co.za)

Tshepo Maeko: Rooted in Africa

Tshepo Maeko is a young man with both feet firmly planted on South African soil.

As a Master's graduate of the University of Pretoria's Department of Plant Production and Soil Science, Tshepo has the kind of talent and passion for his subject that could open international doors. But, he says, he's not going anywhere just yet.

"Global experience would be great, but as an irrigation management specialist, I think there's a lot of work to be done here first," he smiles.

Most recently, this has involved the practical research and testing of a new irrigation management device, the Wetting Front Detector (WFD). Originally, WFD was developed by Professor Richard Stirzaker at CSIRO in Australia, the commercial product is expected to be available on the local market towards the end of this year. Tshepo has played an integral role in the fieldwork conducted at the university, which has since led to the patenting of the product in South Africa.

The detector – an affordable irrigation management tool – addresses what Tshepo describes as a major

challenge facing the South African agricultural industry. "There is a huge resource gap between big commercial farmers and small-scale producers," he says. "For example, the new water laws mean farmers have to be far more knowledgeable about how they use and manage water for irrigation. But most irrigation management products and technologies in the market are complex and costly, and far beyond the reach of small-scale farmers. The Wetting Front Detector is a very simple, user-friendly and highly effective product that could cost less than a tenth of other irrigation management tools."

Tshepo explains that the detector enables farmers to monitor the depth of water penetration into the soil during and after irrigation or rainfall. The design is simple enough that anyone can use it without having to understand the science behind it.

"With this kind of information, farmers can quickly establish whether they are over- or under-watering, and can adjust the amount or regulate their irrigation accordingly. It also helps farmers to learn from previous irrigation patterns, and use this experience to make future decisions. By not over-watering farmers also prevent the leaching of nutrients in the soil."

SCIENCE AND FARMING

It's not often that students get the chance to see their research in practice, and this quietly-spoken 23-year-old agrees that it has given him valuable new insight into the role of science in agriculture.

"Many people don't really appreciate the real value of science in farming," he says. "In terms of an academic career, farming is often classed as 'dirty work', but – as any water professional or agriculturist knows – there is a lot more science behind it than you think. In South African agriculture, science seems to have a very low profile. It's time we gave it more credit."

Tshepo's fieldwork has also taught him that "science and technology" is more about people than it is about laboratories. "Good technology is useless without good communication," he says. "By working side by side with the farmers to establish their real needs, and by communicating our progress, we have been able to make a real difference in their lives. We need more effective communication between farmers, scientists and various organisations. Successful water management in South Africa depends on it."

HOME TOWN

While Tshepo's recent experiences may have "unleashed" his research capabilities, the university's experimental farm is many miles from his home town, and he is quick to credit his parents for making his journey to academic excellence possible.

Born and raised in the rural village of Ga-Modjadji, north-east of Tzaneen, Tshepo attended the local primary school before his parents sent him to Tshebela High, a boarding school near Pietersburg (now Polokwane). Having discovered a passion for science, agricultural studies and geography, he matriculated in 1996 and completed his degree at the University of the North, before enrolling for his Master's in Pretoria, in 2001.

"I have a great deal of respect for Tukkies as a scientific and agricultural research institution," he says. "What South African learners need is good mentorship, and I have been lucky enough to have it. I have been blessed with the guidance and tutorship of people like the department's Professor John Annandale, and Dr Martin Steyn, who I have worked with on a daily basis. Fellow researcher, South African-turned Aussie, Professor Richard Stirzaker, has also been the wind beneath my wings. They have all made it simple for me."

One of Tshepo's long-term goals, ("apart from making loads of money and establishing my reputation as a scientist", he laughs), is to improve general awareness of the importance of irrigation management in South Africa.

WATER USE

"Despite our erratic rainfall and strict new water regulations, there is still vastly inefficient water use in South Africa. Greater awareness of the importance of irrigation management will lead to a more productive agricultural sector, sustainable crop production and therefore food security for a very large segment of the population. It will also allow us to build up a strong scientific basis for meeting the needs of local farmers."

Tshepo backs this up with a refreshingly positive view of the future of local agriculture. "With the training and capacity building that is starting to take place, we can expect to see many more young people entering the market, who are well-equipped to give South African farming a boost," he says.

If they're anything like Tshepo, the industry has a lot to look forward to.

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 eight 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.

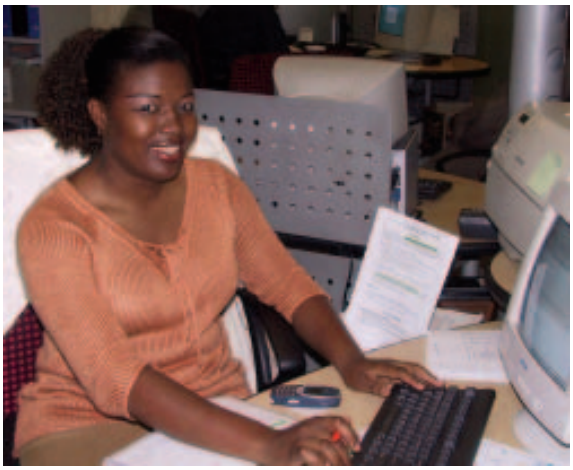
The project is still in its infancy, and the trees are now 1.6 m tall, but will not grow much this winter because they lose their leaves and become dormant. A small-scale dairy farmer, Simon Mbhele, is involved in this project, and the results will be extended through him. After the experiment, the results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

Olivia's Rise from Street Sweeper to Manager

Lebo Moncho reports



Olivia Radebe's brief career reads like a fairy tale. Recently promoted to Manager: Environmental Projects at Pikitup, Olivia's story is an inspiration to many young people struggling to get their careers off the ground.

Like many other youngsters, Olivia finished high school with great ambitions. She wanted to become a medical doctor, but due to circumstance was unable to register for the degree. Instead she enrolled at Pretoria Technikon where she began a Diploma in Environmental Engineering. By her own admission this was an unusual choice for a girl from Dobsonville, but as she says that is what was available at the time and she was determined to go to tertiary school.

As testament to her commitment to better herself, Olivia also interned in an Experiential Training programme at Sasol.

In 1999 she was forced to drop out of school and the Sasol programme. No one in her family was working and she could no longer afford her school fees. She went looking for employment.

Again circumstance played a hand. She was told Pikitup was looking for street sweepers at the Selby depot. Selection was a simple process. All applicants put their ID documents in a bucket and those that were drawn out got the job.

Olivia remembers her feelings about getting the job as a night street sweeper. "I was relieved to get a job. But I never thought that I would end up as a street sweeper. In life you set standards for yourself and this is not what I wanted for myself. But my mother said when money comes it doesn't say where it comes from. On the other hand I made good friends with the various people I met on my route which made the experience bearable."

With very clear ideas about where she wanted to end up in life, Olivia was determined to turn her life around – circumstance or no. A year after starting at Pikitup her appointment was upgraded to full time which allowed her to re-register at Pretoria Technikon to complete her Diploma.

"I traveled to Pretoria by train every day," says Olivia. "In the day I went to school and at night I swept the streets of Johannesburg. It was a tough time. I would study and sleep on the train but it was worth it."

As a result of her sacrifices she graduated in 2001. She was also promoted to a position at Pikitup head office as a Community Education Facilitator. In 2002 she completed her B.Tech in Environmental Management and the following year enrolled for her master's degree which she is currently busy with.

OPPORTUNITY AND WILL

When asked what she credits her success to Olivia is quick to respond, "Opportunity and will. You are the captain of your own ship. Your attitude determines your altitude. So grab what is available and make use of it."

She even sees value of having been a street sweeper in her current job. "My job now is very community-based. So being able to talk to anyone and having first hand understanding of what happens at street level is very helpful."

Olivia is also grateful for the assistance that Pikitup has given her along the way. The company helped finance her B.Tech degree. She also values the exposure she received at International Association of Impact Assessors (IAAIA) conferences which she attended through Pikitup.

Her family has also been a source of strength. Her younger brother is her biggest fan. He is always bragging about her and her accomplishments.

With so much under her belt at 27 years old where does she want to end up? "Ke batla ho ba MD!" she says with a laugh. Somehow, one can see it happening.