Water and Ethics

WATER IN CIVIL SOCIETY

Arid African upstream safari: a transboundary expedition to seek and share new sources of water

Kader Asmal

UNESCO International Hydrological Programme

World Commission on the Ethics of Scientific Knowledge and Technology

Water and Ethics

WATER IN CIVIL SOCIETY

Arid African upstream safari: a transboundary expedition to seek and share new sources of water

Kader Asmal

UNESCO International Hydrological Programme

World Commission on the Ethics of Scientific Knowledge and Technology

Series on Water and Ethics, Essay 3

Published in 2004 by the United Nations Educational,
Scientific and Cultural Organization
7, Place de Fontenoy, 75352 Paris 07 SP (France)
Composed by Marina Rubio, 93200 Saint-Denis
Printed by UNESCO

ISBN 92-9220-018-6

Preface

This essay is one of a series on Water and Ethics published under the International Hydrological Programme of UNESCO. A Working Group on the Use of Fresh Water Resources was established under that programme in 1998. Preliminary drafts on fourteen aspects of this topic were prepared under the guidance of this Working Group.

An extended executive summary was prepared by J. Delli Priscoli and M. R. Llamas and was presented to the first session of the World Commission on the Ethics of Scientific Knowledge and Technology (COMEST) held in Oslo in April 1999. At the latter meeting, COMEST established a sub-commission on the Ethics of Fresh Water under the Chairmanship of Lord Selborne. The first meeting of this sub-commission was held at Aswan in October 1999. A 50-page survey by Lord Selborne on the Ethics of Fresh Water, based on the above meetings and documents, was published by UNESCO in November 2000.

Since then, the original draft working papers have been revised under the editorship of James Dooge and published on CD ROM as an input to the Third World Water Forum held in Kyoto in March 1993. These are now being published in printed form as the first fourteen titles in a series of Water and Ethics

These essays are written from the point of view of experts on different aspects of the occurrence and use of fresh water who are interested in the ethical aspects of this important subject. They do not purport to be authorative discussions of the basic ethical principles involved. Rather, they aim at providing a context for a wide-ranging dialogue on these issues between experts in diverse disciplines from the natural sciences and the social sciences.

James Dooge
John Selborne

This publication takes the form of a description of an arid African upstream safari in the form of a transboundary expedition to seek and share new sources of water.

Kadar Asmal was Minister for Water Affairs and Forestry in the government of Nelson Mandela. As such, he was responsible for a fundamental rewriting of Water Law in South Africa and a major reform of the water distribution system. He is currently Minister for Education.

Contents

1. Cross-border co-operation

1.1 Introduction

They say no new frontiers remain left to be discovered, but let me tell you a true story about one recent and ongoing expedition that suggests otherwise. It began seven years ago in the heady dawn of a new African democracy, the kind in which a formerly imprisoned 'terrorist' is elected president, and a formerly exiled legal academic specializing in human rights is asked to manage rivers in one of earth most water-stressed regions. I had barely come to grips with such novel concepts such as that 'groundwater' refers to 'underground water,' when I received a call from Roberto Kostley-White.

Roberto was my counterpart across the border in Mozambique, another new African democracy emerging from domestic strife and a legacy of post-colonial inequity. As the Minister of Water and Public Works, he is a soft-spoken man whose gentle and charming demeanor masks an indomitable will. I did not hesitate to accept his invitation 'to come to my country and visit our rivers.'

After quickly checking an atlas, I discovered that no fewer than seven of Mozambique's rivers originate in South Africa, including the critical Komati, which flows to its capital, Maputo. The atlas showed all these rivers as solid thick blue ribbons, indicating year-round flows, gushing downhill through productive industrial, urban and agricultural areas. So I assumed Roberto might have wanted to draw my attention to an issue of water quality, perhaps some kind of *apartheid*-era river pollution that could be cleaned up – like Dublin's river Liffey where I had spent many years as an adult – through strict law enforcement and fines.

I arrived in Maputo, an expanding port city of 2 million on the Indian Ocean, and Roberto and I embraced in a greeting. After some small talk, we got into a car and headed dozens of kilometers inland toward the Lebombo Mountains. We drove over an hour until paved roads turned to potholes and then dirt and soon we got out and walked on through brown, dry, thick riparian vegetation, sweating profusely in the heat. Eventually we arrived at a 150-meter-long bridge and stepped out to the middle of it. Said Roberto, 'Welcome to the Incomati,' as the Komati becomes in his country. I looked around but could not make it out. Then, suddenly, it was all around me. The good news: I could see no pollution in the river. The bad news: I saw no water in it either. The bridge spanned nothing but a deep, wide ribbon of sand, white and barren, dusty in the lacklustre breeze. I was stunned, and turned to Roberto, taking him by the arm.

'This cannot continue like this,' I vowed, rather impulsively.

My outburst would not go unnoticed. 'Noble sentiments,' sniffed skeptics outside South Africa. 'Rash promises,' grumbled career water officials within my country, who knew me better. Roberto said nothing. He was not bullying or casting blame, for it was a problem we shared. Nevertheless, just as I was accountable to my voting constituents, he was accountable to his, and so he seized the opportunity to show – deftly, clearly, gently, graphically and without panicky accusations – the classic point of view of the downstream water-dependent neighbor.

That day over the empty streambed was a rude awakening. But it was neither the first nor last shock to my assumptions after 27 years in rainy Ireland moving back to my arid native land. I remained ready to stand by my instinctive, heartfelt promise, rash or otherwise. True, I readily concede that at the time I had no idea how much intense pressure is brought to bear upstream on the Inkomati, which is a microcosm of all my country's rivers. Nor did I register that when I inherited my rivers portfolio, I also inherited seven major dam projects proposed or under construction in that very catchment. Delivering on my promise was not going to be easy. Though they may meander lazily and cascade casually and splash and gurgle and eddy – every single South African stream is drawn back taught as piano wire, with the human allocation and demand screws turned each day to the snapping point.

1.2 The shared challenge to overcome

The Inkomati system however is not just stretched thin; it is one of four drainage basins that stretch across borders. My commitment to Roberto that day was a personal one, sealed with a handshake. But its spirit was embodied in a firm set of obligations established between neighboring countries inscribed in international law under the Helsinki Accord. As two responsible complying democracies sharing the same river basin (in this case Inkomati River catchment), those rules compel us to ensure fair water allocation. As the upstream country we must release 'a reasonable proportion' to our neighbors. Previous undemocratic regimes might ignore those rules, or evade the meaning of 'reasonable,' but we could not, and would not.

Quite the contrary, South Africa and Mozambique have since that day become co-signatories to the Southern African Development Community (SADC) Protocol on Shared Rivers, which reinforces the Helsinki Rules in a regional context. We recognize our mutual dependency upstream and downstream of each other as, for example, Lesotho rises upstream of South Africa; Namibia stands upstream of Botswana on one river and downstream from it on another; and the mighty Zambezi drains and flows through seven SADC nations.

Unfortunately two even higher powers, the laws of nature and gravity, were at work in this particular case: the dry Inkomati was not miraculously going to fill on its own

or from downstream. And so I turned my attention even further inland, to the West. I began looking upstream, scouring surface water from river to primary streams to dam to tributary to brook to the Inkomati's origins in the fickle thunderclouds above, all exclusively within South Africa's borders. I began searching – like some modern day Dr. Livingston – for 'The Source'.

Not the geographic source of the Inkomati, which had been charted centuries ago. No, by exchanging pith helmet and panga for pen and paper, it would be my post-colonial, newly democratic 'adventure' to discover new sources and supplies (and demands) of *water,* a far more strenuous task, and a frontier that we simply had to explore. Though at the start, many were reluctant to join our intrepid voyage. Nay-sayers were then, and some remain today, prepared to say these water 'sources' could not be found, or even if found would never be enough. From their armchairs they made a tempting case that: water is essential to economic growth, to people and to biodiversity, and that rather than scale back its allocations, South Africa in fact should quickly *increase* even *more and more* water from the Inkomati tributaries for domestic consumption, industry, agriculture, forestry and tourism – and not necessarily in that order.

And what, I asked, of Mozambique's legitimate claim? What of those 6 million South Africans without access to nearby safe tap water, and 21 million without sanitation? What of the legitimate claim of the natural river ecosystem itself on which our lives depend? Well, they shrugged, these ideal interests must be sacrificed for higher, realistic, immediate priorities. Water allocation of rivers that cross borders is a cold zero-sum geopolitical game, in which wealthy upstream users benefit at the expense of poorer downstream users. It is a bitter world, they explained, but global *realpolitik* is such that we face an inevitable downward spiral whereby water demand leads to water scarcity leads to water stress leads to water wars, in which case we should fortify ourselves for the dog-eat-dog clashes to come.

Really? I for one was not prepared to accept this. We have all heard this future 'water war' scenario so frequently, so prominently, and for so long that we have come to accept it as Gospel, accompanied by sabre-rattling along the Mekong, the Euphrates, the Nile, and even, most recently, even along the Rio Grande. Based on these unethical 'realistic' attitudes, scarce-freshwater-as-a-divisive-force becomes self-fulfilling prophecy. It is seen as not only a heavy wedge driven to split sovereign national borders, but also a riparian axe that splinters people *within* a nation by class, tribe, sector, race or gender. Some say Southern Africa is most at risk: 'water scarcity and the concomitant reliance on shared rivers can be a potential source of conflict at various levels.

Yet today, seven years after we stood on that bridge, I am writing in an unprecedented era of ongoing democratic peace and prosperity. Mozambique is growing at

a 11.7 percent. The fences are coming down between our nations, quite literally. The Maputo corridor is crowded with economic development. There is water flowing in the Inkomati Basin, yet it is being tapped more than ever. Mozambique is exploiting the river. Farther upstream, Swaziland is exploiting the same river. Farther still, South Africa is very much exploiting the river. Rains are not enough to explain away this phenomenon; we are living again through a drought-prone, *El Niño* year. If, as some claimed there are indeed no new sources of water, and Mozambique is demanding more, and water scarcity allegedly leads to conflict, why are we not engaged in a horrific three-way water war?

Some observers readily offer logical theoretical answers, ranging along the lines of 'virtual water' or 'thresholds of relative scarcity' or 'expense and risk aversion' or some other 'hydro-political' explanation. As a former academic these models fascinate me in their retrospective explanatory power, and I do not dismiss any of them. At the Stockholm Water Symposium (Asmal, 2000) I entered the global fray building on their careful analyses, emphasizing the carefully researched historical fact that there has not been a true water war in the past 4,000 years, and even that was not clearly over water (Wolf, 1998). Yet as a politician dealing with messy, urgent and fluid day-to-day needs, budget shortfalls and bureaucratic infighting, these specific theories are not always seen to be of immediate practical value.

1.3 The role of expedition guides

I would be delighted to offer my own self-serving answer: that Roberto and Mangangwa BeMollali of Swaziland and Minister Kasrils and I have single-handedly averted water war through brilliant tactical planning matched by incisive strategic interventions and deliberate multilateral micro-management from our central bureaucracies. Alas, that might be stretching things a wee bit. The truth is I really can't offer an all-encompassing, irrefutable explanation why we've not spiralled into water war hell, and why we're less likely to do so with each passing day.

What I *can* put forward, however, is an in-depth look at the forces emerging within and between a single critical Inkomati catchment over those seven years, starting from its mouth at the Mozambique border to its source 2,130 meters high in the Eastern Transvaal Drakensberg Escarpment. I offer, in short, the emerging and revealing results of my arid, South African upstream safari that set out seven years back to seek new sources of water.

Luckily I was never alone, but would be accompanied (and in most cases, admittedly, led) by rotating bands of loyal, dedicated, experienced, ethical and indefatigable guides; these field scientists, staff aides, policy analysts and water-trackers would help me negotiate this political *terra incognita*. In Livingston's day they'd be

called my 'expeditionary force.' Today they would be called 'Civil Society,' and as we shall see I could not have ventured far beyond my office, let alone to push the frontier of new water sources in rough and unfamiliar terrain, without their invaluable assistance.

For in seven years the openness of our new democracy allowed my guides and trackers – that is, modern civil society: to breathe; to take root and flourish; to fill the power vacuums that grew with the collapse of apartheid; to act as a powerful glue between the engines of the private sector and decisions by local and national and provincial government; and to remain in the field to ensure progress continues. Within civil society I include a wide and evolving range of groups, large and small. These include irrigation boards, catchment management agencies, water user associations, university research programs, health outreach, NGOs, environmental and wildlife trusts, social advocacy groups., women's empowerment societies, industry trade groups. And so forth.

Each individually and all collectively helped ensure that, for the first time we took a fundamentally different approach to water, as our equal and long-term partner rather than as our mistress or adversary. Textbooks dryly call this 'riparian sustainability.' Put with a bit more flair, in means: Ask not what fragments we each need from our river, but what integrity each of our rivers needs from us.

That this partnership has been forged during fiscal and water scarcity, and within and between free young nations learning to stand on their own, is telling. It suggests that, far from becoming a negative force of trouble and strife, the increasing pressures of water scarcity – even, I will venture, of water *stress* –may be one of the best and most ethical forces that can happen to a democratic people.

That is, I realize, a rather provocative hypothesis to substantiate. But I do not write it merely for the sake of argument; too much lies at stake in terms of political will and priorities. In this essay I admittedly lack the scope or time or experience to back up my hypothesis with a sweeping global analysis encompassing all nations, or make the regional case encompassing all Southern African rivers. Nor do I wish to be accused of wishing drought upon all other nations. So let us only consider the role of South African government, business and civil society in one critical tributary to the Inkomati River: the Sabie-Sand River Catchment. This catchment covers some 7,096 km^2, of which 659 km^2 falls within Mozambique.

I choose this catchment because it offers a cross section of South Africa's extremes in society, because of its wide range of water-linked economies, because of its diverse water pressures, and because, looking close, it reveals perhaps the most ecologically important and politically-stressed river in the nation, plunging 2,000 meters in a short distance from cool afro-montane highlands to tropical lowlands while passing through the nation's most rapidly developing region. Join our 'expeditionary force' on

a wilderness, rural, urban, industrial, agricultural and even sanitation safari. Walk with us against the current – literally and figuratively – as we try to overcome the ethical and practical challenges of finding and sharing new sources of water to meet ever-increasing local demands. As Livingston might have said, 'Come lads (and lasses), onwards and upwards!'

2. The lower Sabie catchment

2.1 Kruger Park (111 km)

Distance from the sea: 111 km by river
Elevation: 100 meters above sea level
Rainfall: 400 mm per year
Temperature: 25°C
Terrain: Bushveld vegetation on underlying Rhyolite rock formations
Land use: Wilderness

Our expedition starts at the South African/Mozambique border, in a narrow gap of the Lebombo Mountain Range, looking west up the Sabie River into wilderness. If ever there was a stretch of watercourse where the Inkomati tributaries should be safe it is here, enclosed within the protective human- and animal-proof fences surrounding the 19,485 km^2 Kruger National Park. And to a certain extent the flowing waters are safe, from humans and for plants and animals. All life in this park – an area larger than Wales – has been shaped over the millennia by Kipling's 'jungle law of tooth and claw,' also known as Darwin's 'survival of the fittest.' But above all is that supreme law: the governing force of water. For not only do species compete with each other for food, they compete for water. Water scarcity dictates that only those plants and animal species that adapt their biology and behavior to the most efficient, energy conserving use of water can and do survive here over the millennia.

More than survive, indigenous plants and animals *thrive*. For they have been sculpted by the powerful hands of drought and flood cycles, by extreme heat and sudden frost, by competition and adaptation. Far from simplifying and narrowing the range of biodiversity, water scarcity has created in Kruger a rich and complex tapestry which is economically lucrative.

If the colorful cloth on the Kruger tapestry are its mammals and birds and fish, and the underlying threads are its vegetation, then the loom holding it all together is the hydro-geologic foundations, rock and above all, flowing water. The Sabie River's

dense riparian flora and fauna arguably form the prime habitat of the entire park, and are indeed the most biodiverse rivers in South Africa in terms of both indigenous fish and insects (Davies and Day, 1998). To the casual observer, like me, there is neither rhyme nor reason for why certain plants and animals appear where they do when they do. But after some research, and the instructive help of our civil society expedition guides, one sees how the presence of surface and groundwater often predetermines what you will see, how much will reproduce, where you will find it, how fresh its spoor (tracks and dung) is, when it will drink, why and how often.

Walking upriver along these lower reaches of the Sabie, for example, lava cooled above ground and so eroded onto a floodplain down into fine, dark basaltic soil called 'sweetveld,' which retains water, traps nutrients and allows a profusion of grasses and nitrogen-fixing small leafed legume trees like acacia. These attract grazers like buffalo, zebra, wildebeest and their predator, lion. Further upstream, we find where magma cooled underground forms light, alkaline, grain crystals which easily drains water, leaching nutrients from poor soil, called 'sourveld,' and allowing only large-leaf trees like bushwillow and hardy, barely palatable grasses to generate their own food. These attract browsers like impala, bushbuck, duiker and their main predator, leopard.

In between, here and there, we come across wet seep lines (marked by wild sage, silver cluster-leaf, weeping wattle, herringbone and gum grass) and within the streams (wild date palm, phragmites, sorghum, or jackalberry) where trapped or flowing water determines still more unique plants, herbivores that devour them, and predators that dine on them *in turn*.

By understanding how water moves across, through, under and up from the ground the Kruger's guides and rangers and concessionaires increase the odds of finding what tourists pay money to see – especially the Big Five — and then interpret what is happening. For example, we learn how Cape buffalo love water to drink and wallow and why they will most likely be found in a shady wetland or swamp during the heat of the day. Odds are they then graze (ideally on sweet guinea grass) their way en route to a spot downwind in an open grassy airstrip where they can better smell lion and defend each other at night, moving back down in the morning. A timeless migration.

Alas, no park is an island unto itself, not while rivers are involved. Even before a fence was erected around it in the 1960s, the Kruger Park's streams grew increasingly degraded and desiccated due to human pressures both upstream and *within*. Let's look at how those pressures arose, and how we are trying to deal with them. Twenty one kilometers upstream we come to the first signs of human habitation: three weirs and dams surrounding the beautiful, comfortable and large Rest Camp at Lower Sabie.

2.2 The user pays (139 km)

Kilometers from the sea: 139
Precipitaiton: 450 mm
Altitude: 135 meters above sea level
Terrain: Sweet low bushveld on basalt
Predominant land use: Tourist facility

Kruger is for wild animals, including humans who, as Freud noted, 'have never been domesticated.' Thus the meeting of people and animals in Kruger is understood as an overwhelmingly positive economic generator. Eco-tourism is relatively light on the landscape. Resource 'use' is for the most part non-consumptive and recycled. The area between the Sabie and Crocodile attracts 900,000 visitors a year, many of them paying in foreign currency and yielding immediate and long-term profits in Mpumalanga and Northern Provinces. But even where they 'shoot only photographs and leave behind only tire treads,' relatively affluent tourists do place demands on the Inkomati, both directly and indirectly.

At an immediate level, holidaymakers use water, *lots* of water. They use it to drink, wash, launder, bathe, cook and flush. That is putting it bluntly, but the cumulative affects are like inserting an unstable, temporary small middle-class city in the heart of this wilderness reserve.

Ah-ha. This might prove our first new source of water. To find out, we conducted a fascinating and immensely practical experiment upstream in the Park to get at a small part of the problem (Preston, 1994). In contrast to some high-end resorts that cater to overseas clientele, the average Kruger Rest Camp visitors are South African, who stay an average of two nights. In winter they use an average of 148 litres per day, rising in the heat of summer to 156 litres. That adds up to, conservatively, some 130 million litres of water per year withdrawn from Kruger's rivers.

There are spikes in the averages among these holidaymakers. Even among those groups of six who stated on the record, 'I am concerned about water conservation in Kruger' some used the equivalent of 27 full baths of water (4,000 litres) in a single day. Since they paid so little, the majority of these visitors did not know how much they used either at home or on holiday, where they paid nothing.

Against that 'control' sample, we offered an alternative. Visitors in an experimental group at the Rest camp were given a reduction in the cost of their accommodation unit, but had to pay for their own use of water. With a data-logger, they could see at any time how much water they had used, and with dual-flush toilets and low-flow showerheads it was easier for them to conserve. This group averaged 38 litres per day in winter and 44 litres in summer, a 74 percent reduction. Our expeditionary force

takes out a tablet and writes down our first discovery of new sources of water, perhaps 90 million litres per year. Appropriately, the source lies in conservation, which is what Kruger is all about.

That first bold undertaking – it takes courage to allow researchers to experiment with the economic lifeblood of a business – is one we must continue to build upon. Compounded throughout the vast private reserve and park system, the stark results show how far we might substantially reduce the direct tourist pressure on Kruger's precious rivers. The lesson civil society taught us is how flexible and adaptable the human animal can be when water scarcity demands it. But as a species, we can't hold a candle to other animals we encounter further upriver.

2.3 Indirect impacts (177 km)

Kilometers from the sea: 177
Precipitaiton: 450
Altitude: 155 meters above sea level
Terrain: Undulating bushveld
Predominant land use: Conservation of wildlife

Leaving Lower Sabie Rest Camp, feeling rested, fed, washed and energized for the march through the bush, our expedition continues along some of the dirt back roads winding to the West. While paralleling and traversing several tributaries to the Sabie, we come across thirteen artificial water constructions, ranging from Nhlotini water point on the N'watimhiri River to Mestel dam on the Phabeni. What's going on here? Checking with our guides we learn that in fact throughout the Kruger Park there are no fewer than 356 boreholes, some with windmills others with engine pumps. And there are 132 dams on small tributaries. It seems tourism has also had an indirect impact on the Inkomati tributaries themselves, re-shaping and pumping and damming them for the 'benefit' of animals, including those animals who watch from cars.

Recall the timeless migration of elephants, zebra, wildebeest, hippo and buffalo? Well, two things have changed that. The first is fences; after installing them four decades ago it was argued that since humans blocked off the migration to natural water sources outside the fence, humans needed to install new artificial water points inside it. This was done to provide habitat and wallows and to keep the animals from dying of thirst. The second, less altruistic force, is that we humans *Ecotouristicus safariensus* are a rather impatient species. With just two days to spend in the Kruger, people understandably don't always feel they have time to read and learn and seek and follow clues to such migrations. With hungry restless kids in the back seat, the

average tourist is in no mood to wait. On their behalf, parks and private reserves share responsibility for artificial short-cuts: boreholes. Based on the principle 'if it pays, it stays' ecotourism's good intentions lead to decisions that 'since animals are drawn to water where guests can easily see them, we should dam and pump more water in more places so more tourists can see more animals.'

Both reasons seemed logical enough at the time. But with the profusion of artificial water holes in the late 1960s, no place in Kruger was left untrammeled by grazers like zebra and wildebeest, which denuded grass everywhere, exposing all nests and newborns; among other distortions the sable went nearly extinct. Artificially pumping up from deep aquifers disrupts seasonal migrations in a different way, and confuses animals' sense of food security, since ordinarily water means grass; in drought years thousands of eland and red hartebeest trekked confidently to waterholes, only to die of starvation. Hippos left their happy wallows, forced to walk farther and farther in search of grass that could not grow. Elsewhere, wildebeest died trapped against fences, smelling water in the distance.

Gradually, bravely, reluctantly, private reserves and parks have in the last decade begun to drain and remove some of these artificial water holes and roads, exchanging short-term cash flow for long-term stability. Indeed, after the 2000 floods damaged dozens of weirs, the Park managers decided rather than repair them, to remove some entirely. They even involved Special Reconnaissance Forces armed with explosives to do the job right.

As artificial water points vanish, fewer but wilder animals work harder for natural water while fewer people must work harder for natural photos. And what can we learn from these animals? If nothing else, we can learn how to adjust and adapt. As Kruger's animals again work harder and thus more efficiently for water, their adaptations astound. In drought, 'pure carnivores' like cheetah will eat melon to get water locked inside; 'pure insectivores' like yellow mongoose will eat succulents. Tree rats urinate on their nests to keep up humidity level. Jackals and monkeys lick settled fog. Herbivores feed at night when relative humidity rises and water concentrates into leaves and grasses; even dead grasses increase 30 percent of weight after dark.

Perhaps no adaptations can teach us more about adaptation than the patterns of two particular pachyderms. Humans aren't the first to use 'divining rods' and bore down in arid regions. In dry river beds like the dongas that lead into the Sabie, elephants can sense – from the smell, vegetation, taste, or soil moisture – where to dig for water closest to the surface (the flip side is they may also tear up leaky underground water pipes or sewerage). That groundwater does not evaporate. Scooping with trunk it may create a deep narrow hole exclusive to other snorkel-sipping elephants. Or with feet it may scrape a ditch, drink its daily 50–200 litres, then move on, allowing other animals to slake their thirst.

Our expedition has almost reached the fence. 'Rhino territory' whispers one of our guides. The black, or hook-lipped rhino is meant to be more aggressive than the square lipped or white rhino, but both will drive our expedition up trees. Both are also extremely rare and the more we learn about these relics from an earlier age the more we can admire their tenacity, endurance and above all, its relationship with water.

Rhinos don't sweat. They don't have huge ears to cool blood vessels like elephants. They are the pioneer pachyderm trailblazers, crashing through brush once a day to drink, wallow and cool down, never trundling more than 3 km from water. To conserve energy other species (including humans, long before there was a need for protected Parks) will then use their fresh paths.

Like hippo, a rhino is territorial and will scent-mark and dung-mark its boundaries, patrolling the area as it feeds, intolerantly possessive of its food and its female; the bigger, healthier one will drive off the subordinate. Yet unlike hippos, rhino are *not* possessive of *water*. They must frequently cross eacFkanh other's territory for water to drink or wallow, taking turns. These territories can lie so tight-knit together that retreat is blocked by a second or third territory. If two rhino fought every time they tried to drink the species would quickly have driven itself extinct long before the arrival of horn-seeking poachers. So it developed a ritual where two will touch horns, measure each other up, and then step back. The one seeking water will adopt a subordinate posture, temporarily asking permission, and the other will invariably grant him access to and fro (until it is his turn). It is an ancient unwritten code – that sounds eerily like the Helsinki Rules governing water use between nations.

Rhino are not bright or altruistic. They are as irascibly territorial as humans, if not more so. They display their lateral bulk and large horns like nations display weaponry and economic might. Still, they must be onto something that has allowed them to endure over the millennia: by replacing self-destructive aggression over water with its own way of avoiding confrontation, they share access reciprocally, reduce needless casualties, and conserve their energies for gentle and productive tasks like sleeping, eating and mating.

Now at the Western fence, our 'wilderness' safari is over. Time to depart. We cross through the electric fence gate to more complex and difficult territory, to learn if humans upstream, that other wild species, can use the rhino's example, living where rhino once lived, walking over well-worn paths to water it made then left behind for us to follow.

2.4 The former homelands (189 km)

Distance from the sea: 198 km
Altitude: 175 meters above sea level
Precipitation: 470 mm
Terrain: Highly impacted bushveld
Predominant land use: 'Rural' villages with domestic subsistence production

Upon those bygone rhino paths outside the fence, some two million people now shop and work and walk and drive and eat and play and drink and sleep and dance, all within 50 kilometers of the western boundary of Kruger. The overwhelming bulk of these live in near-poverty in the former apartheid era 'Homelands' of Lebowa, Gazankulu and Kangwane in the middle Inkomati tributaries. I can't begin to go into the horrors of apartheid they faced through history, nor all the challenges these people overcome on a daily basis. Let our expedition seek only their relationship with water today – more specifically in terms of the force of shared water, increasing access to water, water consumption, productive use of water, and water supply and harvesting.

Let us further narrow our focus to those 500,000 poor living within a single subcatchment. The Sand River is to the Sabie what the Sabie is to the Inkomati: its main 1,910 square kilometer tributary, gradually branching northwest as our expedition moves upstream against the current that flows under the Kruger fence.

2.5 Shared water

For better or worse, for much of its history these vast fences were erected – like a fortress of conservation – as much to keep hungry and thirsty people out as to keep hungry and thirsty wild animals in. That Kruger fence-line embodies the legacy of divisive, segregationist policies that involved forced removals between the 1930s and 1980s, and decreasing autonomy of tribal structures (Carruthers, 1995). The fence is a classic division, found throughout Africa's wildlife areas: Inside, as we have seen, are relatively healthy, intact systems, generating economic profits for and by the affluent, white and mobile. Outside lie densely populated, underdeveloped, impoverished landscapes, with resources burned and devoured by poor people struggling just to survive. The inevitable drawback to the division is that by turning its back on its neighbors, those outside grew bitterly resentful and turned against Kruger.

One would think that competition over scarce resources would exacerbate such

tensions, and no resource here is scarcer than water. But in fact, the shared rivers and tributaries flowing under the fences became the only real indication that the economic, environmental, social and political futures of both sides were inter-dependent. Water scarcity began to bring historically divided people, however mistrustfully, closer together in what some call 'a marriage of convenience' (Alpert 1996). The attempt to integrate water conservation and water development is, perhaps, the inevitable result of the failure of either to succeed on its own.

For by the 1990s the declining health of rivers like the Sabie could not be ignored (CUSTOS, 1994). Having seen how rivers are the lifeblood to the Kruger, and Kruger is arguably *the* critical economic lifeblood in the entire catchment, providing direct and indirect benefits to all, the threat to these rivers was a threat to all. Kruger's proximity below the Homelands was, ironically, in the same position as Mozambique below South Africa: a water-dependent landscape dependent on neighbors farther upstream who didn't see the impact of their consumption on the rivers they shared. We have since made that link, on paper, in a concept called the Ecological Reserve.

The Ecological Reserve is a complex equation, measured in quality and quantity of water to maintain natural ecosystems. Put another way, it forces us to ask, and answer, 'how much water do the Inkomati river tributaries need?' While we have begun to answer on paper, it is more difficult to make the concept work in everyday practice, where human survival outside the fence competes with animal survival inside it. To make that transboundary link, Kruger, and some of the progressive private reserves bordering it, have since the mid-1990s, begun to reach out over, under, and through the fence.

Odds are, the first hands they reach belong to a thirsty female. All people in every 'homeland' have been abused, neglected and isolated for decades. But throughout homelands the most desperate, hardest working and most historically disadvantaged are its women. While leading single-parent households, women upstream of Kruger live not only on the minimum standard of pensions, but even less than the 25-litre-per-day minimum standard of water. Coming into office, our first priority as an Administration was to try to better their lives by improving access to water, and eventually recovering costs at rates they can afford. That nationwide undertaking brought me closer to understanding the water situation in middle tributaries of the Inkomati. Yet rather than take a broad boilerplate look at how the government may (or may not) have helped them in seven years, let's take a closer look at how women in one village are helping themselves, taking the water initiative into their own hands, and forging links between and within civil society under the new democracy.

Finding Welverdien 'A' Village takes some effort, veering off the smooth asphalt tourist highways out of Kruger at Orpen Gate. Twenty kilometers outside the fence stop. Veer off south down an unmarked dogleg across a cattle guard onto a rutted dirt

track that winds through the area. While its population density rivals Belgium, the AA and tourist maps show this whole District as blank. Rolling through dozens of incongruously named villages – Champagne (67% unemployment), London (pop. 1,923) Croquet Lawn (average household income: US$ 57 per month) – we pass dozens of men en route to migrant labour work (or to seek it). We pass hundreds of waving children wearing clean school uniforms. And we pass the women. Thousands of women. They emerge through low doors of small cinderblock houses and orient themselves like a compass needle toward whatever place offers the best chance of encountering water.

That chance fluctuates from hour to hour. Despite high stakes and long distances the odds of success range from coming up dry, to finding a dribble (in 'Merry Pebble Stream' village the sole communal tap trickles out 1.5 gallons per hour), to waiting hours for a turn at a crowded spigot. Yet the task can't be avoided. So they laugh, sweep their hard dirt porches, shiver themselves warm then grab empty buckets.

'Not buckets,' corrects Kgaugelo Morale, 39, when you finally arrive at her two-room house. 'They're called *sturuturu*.' As our new communal lands safari guide to this water scarce territory, she shows how to arrange three of the 25-litre sealed plastic (far superior to metal or clay) containers in a neighbor's wheelbarrow, how to push it without bouncing them off (not easy, empty or full). With time, she could teach our expedition how to balance water on our heads, although that method, she warns, is slow, heavy, outdated and inefficient.

Understanding her labor on the Inkomati tributary has broader and deeper political implications. In 1994, fetching water was a task shared by more than 2 million women in South Africa alone, or 200 million women worldwide. Calculating an average 50 litres per trip it means that each year the world's women – and they are almost all women – carry 3.65 billion cubic meters of water each year, by hand. That's twice the storage of Africa's Lake Kariba Dam.

3. The role of rural women

3.1 Access to water

Kgaugelo leads us northeast up a dirt path from the home where she lives with her sister Tshegofatso and their children. She's bound for a neighboring village further upstream, where a tap has been installed. But, she says, 'I don't know if we will find water at this place where we're going,' a reminder that installation is one thing, follow-up and ongoing maintenance quite another.

On paths this side of the Kruger fence, chickens, dogs, goats and cows have

replaced guinea fowl, hyena, impala and buffalo on the other. Two women with log mortars and pestles vigorously pound corn into meal in their front yard. This region, like so many former homelands, defies easy classification, for it has neither urban density, nor suburban mobility, nor rural agricultural space, nor the dependable water services in all the above. But the women did not choose it; they simply adapt survival strategies, finding and using water however best they can.

Minutes later we stop. Something seems amiss. After two miles Tshegofatso has set down her wheelbarrow and turned with an anxious look. 'No one has passed us in the opposite direction,' she points out. True enough. By this time of the morning we should have seen at least one woman and/or child returning home with full loads of water. Kgaugelo considers this and squints ahead. She thinks she sees women in the distance heading for the same destination, and offers, 'Maybe people are starting late because it is cold.' Her daily quest for water becomes an act of faith.

Not faith in man, however, but *despite* him. I was privileged to chair the World Commission on Dams, a multi-stakeholder task force to look at the performance of dams and water development to better chart the future. What we found, among other conclusions (WCD, 2000) is that, all too often, powerful men in international institutions have such sympathy for Kgaugelo's drudgery that for decades they have tried desperately to expunge water fetching off the face of the earth. This is a noble undertaking, one in which they raise and spend US$ 40 billion each year on her behalf. They then pay 80 cents of every aid dollar to themselves or to other white male international engineers and consultants to write reports or design centralized water schemes that primarily benefit factories and crops which men own and where, predictably, more men work.

That's not to say women's needs are utterly neglected. But of the 20 cents left that trickle down to rural water aid, not much remains for training, upkeep and operation. Men hold even these posts, without a stake in their success. The result? Kgaugelo's nearest (half a mile) manmade borehole hasn't produced water for months due to a faulty machine the male mechanic hasn't come to repair. Another borehole fails to pump because men took its diesel for their own truck engines. A third electric generator sits silent since a gang of five men stole its copper wires (The gang's now down to four after one was recently electrocuted attempting a similar heist). The previous night in a neighboring village several young men stole 47 faucets off pipe ends (arrested when they tried to fence them); another group ripped the engine off a borehole, irreparably damaging the pipe in the process (they remain at large). And the tap where we're bound? 'Yesterday no water came when you turn the handle,' Kgaugelo says. 'For some reason the man paid to be in charge of the pump decided not to come turn it on. He just went away somewhere.' Hence the understandable edge in her voice when she speaks of the contrast between priorities of women

grasping water and men grasping power. Her only child softens her edge, a son who in a few years will be old enough to help carry water. But one day in his early teens he too will refuse. 'What can I say to him,' she asks with a shrug. 'If he continued he would be teased; fetching water is not something men do unless they are alone.'

3.2 Water consumption

Such is the deep cultural tradition that Kgaugelo was born into, the burden of which governments like our own try to ease by bringing water closer to home. Until then, the world is what it is; a South African woman today carries water because she has always carried water since .... Genesis doesn't say how Adam and Eve got water once evicted from *their* Garden's waters. We can only suppose, for they must have done something within three days or perish of thirst.

Adam: 'Look, I was perfectly content drinking from the streams now denied us. If I have to get bread through the sweat of my brow, you have to fetch water.'

Eve: 'Hold on. I don't see that anywhere in His contract. You get your *clothes* dirty to require washing (3 litres a day). Your house needs cleaning (1 litre a day). So do your dishes (2 litres) and cooking and drinking (3 litres) and – phew, that sweat is coming off more than your brow. You need a bath (16 litres per day)!'

Officials consider those 25 litres per person per day – roughly two flushes, although flush toilets are notably *not* part of the equation, as we will see later – as the Basic Human Needs Reserve (BHNR). The BHNR is the human counterpart and complement to the Ecological Reserve, and one of the advantages of a late-maturing democracy. We were able to look at best practices of all countries, and then go one step further. Thus under our new constitution, South Africa, alone among all nations, reserves and guarantees access to that basic amount as a human right. Under the 1997 Water Services Act (WSA) and 1998 National Water Act (NWA) we aim to tackle the need for sufficient domestic water for all urban *and* rural populations. In the process, our government has attempted to install a street tap within 200 meters of all 14 million citizens who had no fresh water access in 1994. I'm unabashedly proud to say, on behalf of my successor, Minister Ronnie Kasrils, that our nation is already halfway there.

Yet there is only so much a government can do without civil society. An informal water 'law' – of diminishing returns – makes connecting the next 7 million to water take longer than the first. That's where women like Kgaugelo come in. For the words articulated in the official Water Act become a powerful tool, stronger than a wrench, to speed up progress. The tool comes in the form of new women's pressure groups emerging in these very Inkomati tributaries.

As rural women learn their right to access water in proximity to home, they grow

restless. They speak up for the first time in their lives. By word of mouth and photocopies, they spread news and knowledge of the law through villages faster than rumors that a tap is working. In early 2002, after a group of women were forced to wait 24 hours at a tap to serve 8,000 people – some sleeping overnight against their sturuturu – Kgaugelo began to organize a woman's empowerment circle in the local 'Community Development Forum.'

The meetings are not exclusive, she says. They're aimed at solving problems and networking. 'Men are welcome to sit in and take part. But men do not feel the water problem as we do. They don't do enough. Men are not the ones waiting for hours and carrying the water.'

The world is (mercifully) not a perfectly regimented and ordered place. And there are unforeseen wrinkles and links between the Ecological Reserve and the Basic Human Needs Reserve that are still being worked out. One is the calculating the informal use of water from rivers. En route to water, our expedition descends into one fourth-level tributary, the Banana River. Here our wheelbarrow drags in the dry, deep sand, reminding us of the Inkomati below the bridge in Mozambique. An old woman here recalls how, when she was a child, it flowed regularly, down through a fence into the Manyaleti and later the Sand. Back then women didn't have to collect water in long distances for anything but cooking. They could wash everything else in the river, together, as a clean fresh current swirled past. Today a woman is digging in a three-foot deep well, scrubbing her clothes with a few pints of dirty water. This damages the resource for her and for all; through better water reticulation systems, we can ensure at least 25 litres for consumption while protecting the integrity and function of river ecosystems and water resources.

Another challenge is finding the right 'price' or cost of water. As we follow Kgaugelo crossing from one local boundary to another, questions of jurisdiction and accountability arise. 'Do other villages resent that you come to take 'their' water?' I ask.

'Not if we come on foot,' Kgaugelo replies. 'They may need to use our water someday if theirs does not work. But if you come in a car they will turn you away, or make you pay.'

'Pay what, money?'

'Yes,' she answers, puzzled at the question. Then she lays it out. In some villages you informally contribute 5 rands (55 cents) for diesel for a borehole that doesn't come supplied. Or you pay someone 0.50 Rands for a full sturuturu. Or you pay 50 Rands (US$ 5.50) to water vendors who deliver three (225 litre) drums. 'Sometimes it's easier. More secure, especially if you're sick or can't get out.'

Eating up a tenth of their average household pension or income, these rates seem mildly obscene. What's more, here they pay roughly five times as much for water as

rates that urban residents do. Perhaps most revealing, however, is the extent to which an informal water vendor system exploits where government and civil society has yet to deliver. Many casual observers – again like myself when I first took office – equate 'Third World water privatization schemes' with the nefarious agendas of multi-national conglomerates. They imagine how industrial giants are poring over maps, carving up continents like their geopolitical colonial predecessors, snapping up water rights and water systems from incapable governments, plotting control and provision of water delivery and charging high rates to those who can least afford it.

Perhaps some are. But while berating such plots we overlook how a vast network of small, one-or-two man (and they are invariably men) operations are quietly doing exactly the same thing beneath the 'anti-globalization' radar. They work out of the back of a truck. They promise drinkable water. They meet local demand. They maneuver in an unregulated, unregistered, unmonitored, tax-free black market and turn quick profits.

In the course of our expedition, I reflect on this inequitable system. Rather than crush it or sweep it aside, governments must work with civil society to ensure any and all forms of water vending are made accountable, equitable, safe, clean and affordable. For Kgaugelo, many hours wasted fetching water could be invested in generating income. Her water consumed could be invested in making her ventures grow. But doing so involves a quantum leap from 'consumptive uses' of water to 'productive uses' of water.

3.3 Water use

My successor, Minister Ronnie Kasrils, has pioneered a bold new policy, a difficult compromise between global imperatives and local realities. It aims to sort out those who for whatever reason *won't* pay for water services, and those impoverished millions who simply *can't* pay. It is South Africa's 'free basic water' policy, which allows a free quantity of 25 litres per person per day, and then charges a steeply graded price for consumption thereafter. When first introduced it seemed heresy to the World Bank and IMF, but has since been praised by liberals and conservatives alike, garnering favorable mention during the recent WSSD from unlikely supporters.

Yet it is only part of the equation. Again, civil society in this catchment is breaking new ground with work that indicates the standard 25 litres for water and hygiene may not be enough to lift people like Kgaugelo out of poverty. That minimal amount may be enough for *consumptive* use, but it does not allow her to use water for *productive* use – that is, to use water to generate profits and improve her quality of life.

If she is only ensured 25 litres free, her desire to get ahead requires makes her cut into basic consumptive use for other purposes. She may use 'grey water' from bathing

to water fruit trees and subsistence gardens in the yard. Or use clear water from a well to drink or boiled for tea. Salty water from a bad borehole washes dishes and the house. Any water left over after gross consumption becomes profit. In other words that means that only if she skips a bath five days in a row, she'll have 90 extra litres that could be invested in, say, home brewing traditional marula beer to be sold at a profit. While efficient, this self-deprivation undermines the hygienic purpose of the policy.

'Water is life,' says Kgaugelo. 'Our woman's empowerment group discusses ways to raise money to pay for it.' Invariably the most common low-level income generating activity depends, in turn, on water. Construction, brewing beer, hair salons, fruit trees, vegetable gardens and livestock are impossible without it. Perhaps more than any other factor, including education, the level and reliability of access to freshwater determines whether women like Kgaugelo stay on or get off the poverty-survival treadmill.

One women's bread-baking operation nearby failed after months of growth. It had skilled labor, flour and ovens. But it lacked steady water delivery to meet demand, and could not afford to pay other women to fetch it. An impressive recent local study (De Mendiguren and Mabelane, 2001) documented that on average people in villages who reliably get 25–40 more litres of freshwater a day generate 2.5 times more income (US$ 63 per year) for productive uses than those who don't (US$ 25 per year). These water-dependent businesses primarily involve women, and they can apparently make a little more free water go a very long way. Says Kgaugelo, 'Even traditional beer. Yes. It is the women who make it.' She pauses. 'The men drink it.'

3.4 Water supply

But where will that additional supply of productively used water come from? Dams upstream, perhaps. Bulk water supplies. Reticulated pumping schemes. But these provide water only if everything is functioning perfectly, and people upstream use less – two ideals which, as we have seen and will see, don't always occur.

After an hour of walking, our expedition turns left down the main dirt street of the village. We look up. There it is in the distance, the holy grail of our expedition's pilgrimage: the communal water point. At the risk of gross gender-alization, it seems that throughout history the designs involving water transport have sprung primarily from the inventive minds of men; water wheels, suction pumps, internal combustion generators, boreholes, hydro-turbines, aqueducts., plastic PVC piping, duct tape, porcelain flush toilets, concave arch ferroconcrete dam walls with massive inter-basin transfer schemes. Typically these designs seek ways to 'harness' rivers and underground aquifers to 'liberate' civilized man from what drudgery he hasn't already

foisted off on his wife. All seek to bring water from farther and farther away (until, in the most exalted projects, water actually flows uphill) and we are duly grateful to these men for such convenient symbols of 'development.'

But that masculine ego may also genetically incline toward the most complex, vainglorious, intricate and expensive technical designs. The more parts, distance and money involved up front, the greater the odds of something going wrong later on. We have seen how that can lead to stolen fixtures, wires, and pipes; illegal connections; 'missing' parts; bribery and corruption etc. Just upstream on the Mutlumuvi river, the award-winning Zoeknog Dam was designed to be one of those engineering wonders constructed in the waning days of apartheid on behalf of upstream irrigation citrus, rice and coffee farmers. But ten years ago, before the politicians could cut the ribbons and when the dam as only 30 percent full, water broke through the dam walls in a monumental disaster. It seems the construction was faulty because hundreds of thousands of cement bags 'went missing' and unreported by the contractor.

Rather than build more and more dams and systems, South Africa has tried to focus its capital works programme on existing infrastructure: plugging leaks (which in some areas lose 30 percent of water through reticulation) and ensuring greater accountability in where the water goes. It has helped set up community-based Project Steering Committees, with civil society and elected officials to provide local oversight and decentralized responsibility. The potential here for 'new' sources of water are huge. Yet with men in power – local or national – there's not always much glory or profit in rectifying problems or seeking a simpler, cheaper approach. Especially if women are willing to find water regardless of what men design.

Increasingly, they aren't. In a subtle process emerging beneath the surface of South African politics, women like Kgaugelo are starting to flex for political power, to put other women in charge of the borehole generator switches, to let women oversee the delivery of bulk water supplies, to approaches water transport from fresh female angles. It seems the currency of water has a gender, and in the new breathing room of civil society, that gender is no longer content with its subordinate position.

First, women organize people, both formally in committees and while waiting in line at water points. Kgaugelo's group involves 200 women, 20 per village from 10 villages. Their target: male politicians sitting on posts in almost all of the 36 ward councils of Bushbuckridge District. She insists the aim is simply to empower women and put water at the top of the agenda but acknowledges that hopefully this involves political casualties, vowing 'This year we're going to challenge men and push women in.'

Second, women organize ideas. One is a deceptively simple, portable, and repairable treadle pump kit that can be assembled for US$ 35–40 in parts from any hardware store. You can attach it to a dysfunctional borehole or broken pipe, and,

shifting weight from one pedal to another, draw water up 8–13 meters and pump at 0.5 to 2 litres per second. It bypasses engineers, banks, vendors, motors, mechanics, wires, diesel or ... men. Perhaps that's why it took a woman to design it.

Third, women organize rain. Not long ago corrugated tin or zinc roofs became all the rage in villages throughout Bushbuckridge (indeed throughout of Africa). A traditional thatch grass roof was labor intensive, wore out every 15–20 years and it was old. Metal was flashy and mobile and long-lasting and new. 'Thatch was what our grandparents used,' says Kgaugelo. 'Yes. The metal seemed like a higher class.' A status symbol among these US$ 55-a-month households. But after installation problems rose to the surface, literally. Tin roofs trap heat in the summer; thatch breathes. Tin conducts heat in the winter; thatch insulates. Not to mention the noise when rain fell in thundershowers.

3.5 Rainwater harvesting

But that noise gave some women an idea (and it is primarily women who champion, maintain and practice it): Why let rain escape, roll and seep off to a distant place we must fetch and carry back home each day? Why not trap it before it hits the ground? So they linked the pre-fab metal grooves to gutters, buckets, or ditches store for later. Thus 'rainwater harvesting' becomes part of the domestic architecture.

And public buildings become the models. Missions and non-profit organizations – notably here the Save the Sand Project (not coincidently chaired and run by females), have capitalized on the concept to help villages install larger rainwater-harvesting projects involving several 15,000-litre sealed and locked tanks in schools and other large-roofed public buildings. These act as a practical water buffer, add water security, but mostly raise awareness of alternatives and possibilities. It demonstrates how to break the culture of dependency that the people had grown used to under apartheid.

Past water projects (including rainwater-harvesting) failed because they were installed quickly *for* the people in Bushbuckridge villages, rather than gradually than *by* and *with* them. Locals now feel 'ownership' in a process of gathering or using water since they help decide where or whether to plan rainwater tanks, who would build and maintain them, and who would benefit.

Any such 'soft, warm and fuzzy' water projects that bypass government, central planning, and vast infrastructure financing is bound to have critics. Male critics. These critics point out, accurately enough, that for many months of the year rainwater tanks will harvest dry air. One response, as Kgaugelo scrambled to put out buckets *just in case* the clouds open up, may be to note that a glass half empty is also a glass half full.

So far the expedition's stururu is still entirely empty. As the expedition approaches we see the tap is not even dripping; the ground beneath is dry. Tshalafatso reaches out, grabs the handle. You inhale. This is the test of whether civil society and government are making water more ethically useful in communities. Never before have we anticipated water so intently. It is a long walk back, or on to the next village. She turns the handle. Nothing. Seconds later there is a cough, a sputter, a gurgle, and water. The gush spreads smiles across our faces; the splash reverberates through the village. We start filling and soon there are three, five, dozens of women waiting their turn in line.

Perhaps women can exercise more power up the political pyramid, focus attention on water, control the income derived from water's productive uses, and escape their burden. Kgaugelo even talks about running for office herself, maybe this year, if she can find time. Water scarcity stifled in the years when freedom was curtailed. But in our more open democracy, with freedom to assemble and speak out and unite, water scarcity has, by necessity, forged new links within and between people living in these former homelands. Government can't uplift them on their own, nor can they remain on the treadmill of barely existing. The emerging civil society organizations do not undermine existing political institutions, but do on focus water as a priority, and work with AWARD, WHiRL, SSP, etc. Wits Rural Facility, SUNRAE and others in the catchment to govern water more equitably, economically and environmentally.

Families like Kgaugelo's were forcibly moved here under apartheid and must continue to seek water on the catchment's driest lands. Like Eve they were evicted from, and sandwiched between two lucrative but now off-limits Edens: Upstream plantations use 58% of the rivers' water; downstream game farms and the Kruger demand another 36% for tourism. If nothing were to change, women in communal lands would be left 6% to seek, gather and use efficiently. If nothing changed, meeting the legitimate growing demands of people would mean the Sabie would cease to flow during most dry seasons (Davies and Day, 1998). Clearly, something upstream must change.

4. Intensive water use

4.1 Water and sanitation (217 km)

Distance from the sea: 217 km
Altitude: 800 meters above sea level
Precipitation: 700 mm per year
Temperature: 19°C

Terrain: Sandy loam and clayey soils overlying iron, jaspilite and granite
Primarly Land Use: Domestic households, urban

On the edge of booming cities like Nelspruit, Lydenberg, Hazyview or Bushbucksridge, we pause, not for water or food but to deal with the intestinal byproducts thereof. Put blatantly, some members of our expedition need to answer nature's call. How we do so, however, is becoming an increasingly thorny issue as we shape the Ecological and BHN Reserves in catchments like this.

Sanitation is not a word that trips lightly off the tongue. Nor is it a topic of dinner conversation that warms the heart. It rarely makes for exciting headlines or public ceremonies, and was not high on either the household or national agendas after the first democratic elections in 1994. Our own first order priority was getting enough fresh water to as many people as possible to wash and thus improve hygiene. Most of us assumed we'd take care of water-borne sanitation with flush toilets at some point in the not too distant future, when we could better afford it.

Yet after cholera outbreaks, awareness of worm infestations, and sewage leaking through the streets of our cities, that future became the present. People took notice. Recent revelations have begun to rub our collective face in the problem, demanding that we tackle the issue of proper sanitation head on, led, once again, by an intrepid group within civil society who did not shirk from the messy details.

The first unpleasant revelation our expedition came across is that when it comes to biological functions no man (or woman) is an island unto his bowels. Never mind abstract individual human rights; we are all equals in one tangible and less exalted respect. Regardless of race, gender, age, religion or how much we paid for our most recent meal, all of us living in South Africa combined release roughly 40 million litres of urine and seven million kilograms of feces each day into our beautiful country. If our collective guts were considered an industry, we'd rank among the top industrial polluters of toxic waste (never mind certain greenhouse gases like methane). Still we can't plug or shut down this human waste factory; it has to go somewhere, with or without water.

The second unsavory revelation is that water may take it the wrong somewhere. Sure, 21 million of us comfortable South Africans sit smugly enthroned, assuming that our daily emissions are swept away by traditional expensive waterborne flush toilets, pipes, septic tanks and sewage treatment plants to become someone else's mess. But as has happened from Cape Town to Durban to Johannesburg, the old pipes rust. Gaskets fail. Connections leak. Plumbing ages, gets crowded, clogs, fails, backs up and those who built the system have retired, leaving few skilled workers to deal with the waterborne vector of disease infiltrating the water table above and below ground. From city sewers to home cisterns, the mess is increasingly our own.

The above might be amusing were it not for our third grim revelation: water brings life not just to Africa's charismatic 'Big Five' downstream in Kruger, but to *all* creation, including tiny intestinal parasites that cripple, weaken and kill us. Ironically, the water we use to get rid of these un-charismatic 'Microscopic Five' actually extends their lives and provides ideal breeding grounds. What's more, waterborne disease doesn't require a broken pipe to spread. All too often the only sewer is, like here in this catchment, the local creek: more than 18 million South Africans, three quarters of them rural, lack even a clean pit to squat over. Small muddy streams and puddles become deadly vectors. The results are predictable – intestinal worms in cities, death by diarrhea dehydration in the country – but so muted, poor, gradual and remote that it's hard to grasp. Imagine a bus filled with 100 small children careening slowly, silently off a cliff, twice a day, all year, due to waterborne deaths in South Africa alone. Twice as many, the survivors, hobble off with stunted growth or weakened immune systems.

This is an acknowledged disgrace (DWAF, 2002*a*), and one that I regret I was unable to resolve as Water Minister. I am trying to make up for it in my new Ministerial capacity, working with civil society in an initiative called Curriculum 2005 (Mbana, 2002). Yet education can only go so far: one in ten teachers teach students about proper hygiene in schools without toilets or taps, and one clinic in six lacks running water or latrines for the patient. Still, we have begun. South Africa hosted the world's first conference exclusively devoted to sanitation in June 2002 with a view to giving it a starring role in the World Summit on Sustainable Development (WSSD) two months later. That's not easy. But the economic rationale was as compelling as moral arguments. Studies showed that the returns on investment of improving water and sanitation together are three times higher than fresh water alone. Indeed, the Summit's most innovative press-grabbing social marketing came in the form of toilet paper with messages on the sheets, with some South African water experts being interviewed in the men's room, sitting in the loo.

It worked. Summit delegates indisputably succeeded in raising the profile and urgency of dealing with sanitation and fresh water together. The 'Johannesburg Declaration' splashed water and excreta all over the global map, so to speak, as it agreed to pledge hundreds of millions in aid funding to cut in half the billions of the world's population living without adequate sanitation by 2015. South Africa's recent white paper on sanitation enshrines 'sanitation is a human right, and municipal responsibility,' and allocates US$ 30 million a year to help municipalities eliminate the backlog (of bringing toilets to 18 million people) by March 2010 (DWAF, 2002*b*). At the same time it recognizes that water has economic value and that costs of using water at home and in the city will continue to rise.

What does this mean for Kgaugelo and the hundreds of thousands of others living

in the Sabie and Sand catchments without proper sanitation? In a dry, poor, water stressed nation with high unemployment and local governments thrashing about to stay afloat, the porcelain throne becomes a Mercedes in a land without gasoline or roads: a beautiful, comfortable, plush status symbol whose proud owner can't drive anywhere. Contractors cannot simply keep installing millions of toilets that no one has, or will ever have, the water or money to flush.

Nor is this dilemma limited to Southern Africa; meeting the WSSD sanitation target will require that the world invest at least 50%, or US$ 8 billion more each year in water-related infrastructure. In these places, money is as scarce as water. But *sans* flush, what's our viable alternative? Families must be given choices. But their answer, after reading the bottom line on the, um, *bottom line,* essentially depends on access to, and rising cost of, water. As the price of water rises and supply of water shrinks, and as this catchment lacks the money, infrastructure and capacity to install, maintain and treat effluent from flush toilets, savvy people may be turning more and more to a technology called 'dry sanitation' and 'urine diversion toilets in particular.'

This sounds more radical than it is on the ground. One well-known form of dry sanitation is called the Ventilated Improved Pit (VIP) latrine, born at the Blair Research Laboratory in Harare, Zimbabwe in the mid-1970s (World Bank, 2002). At first glance, you think: 'Just an outhouse.' Then you notice the long-drop is slightly off-center, and has a stovepipe, and vents on the front end, and a fine mesh screen. The revolutionary difference isn't that airflow makes it smell better; offensive odor is secondary. The magic is that contagious and breeding flies are diverted, trapped, excluded or confused. Over three months, researchers caught only two flies per day in the VIP latrine, versus 179 flies per day in a typical outhouse (Morgan, 1977). Counting flies each day for three months might seem droll if the consequences of these primary disease-vectors weren't so lethal.

Unfortunately Southern African VIP latrines still have, shall we say, a few flies in the ointment. They remain relatively expensive to those who need them most; the best functioning designs require brick, stone, cement, mortar and steel – materials that cost some families several months' wages, even in areas where they are available. While this can be overcome by donor aid and government subsidy, a second problem is that all pits, whether VIP or not, fill up. Fast.

When they do, they must be sealed over or emptied. Sealing requires installing another new VIP latrine, doubling all the expenses and delays and complexities that go with it. The nation that pioneered its VIP has filled most of its first ones to the brim, can't empty them, and can't afford to build new ones. Zimbabwe is not unique in its toilet-economy challenge. Emptying VIPs anywhere requires special vehicles, including suction tankers, which get blocked by non-human waste, can't reach places without good roads, break down through overuse, and require water for

dilution like septic tanks (Holden, 2001). VIPs, it turns out, proved just one inexpensive alternative to the flush toilet or septic tank, which merely extends the disposal problem from minutes to years. It delays the need for water to carry waste away, but did not eliminate water use or take dry sanitation to the next, perhaps ultimate, level.

Sanitation's political pressures are greatest in catchments like this. At community meetings women here learn how South Africa's largest water civil society NGO, the Mvula Trust, has been piloting a new kind of toilet that did not require water, ever, or need to be hooked up to expensive sewage systems. It sounded strange, but with nothing to lose, volunteers abound. To ensure sustainability, such pilot ventures require some investment 'stake' by the household, either in money or labor.

A urine-diversion toilet looks like any other, but as the name implies it isolates urine into one container where it can later be used as fertilize, while feces fall into the pit below. A mixture of soil and ash is thrown down into the pit to help kill of the pathogens and dehydrate the feces, and can be composted for soil conditioner twice a year. The pedestal is made using a fiberglass mould into which a sand cement mixture is cast. The cost is 30 Rands (US$ 3.50) if made by the household.

On July 6, 2002 in the arid and poor Northern Cape, the provincial premier Manne Dipico endorsed dry sanitation as *the* solution in the eradication of approximately 25,000 buckets in the province. His endorsement recognized that the province has neither the water nor the financial capacity to sustain waterborne sewage for all its inhabitants.

The technology is, for the time being, most readily embraced by the poor. And among poor, most readily adopted by women. For them, the cultural and social barriers of urine diversion are lower than the risks of rape, disease, or public exposure – or the cost of fetching water. Women say they don't mind handling dry feces. Nor did Marietjie Meyer of the Northern Cape, in whose government-built house's flush toilet had no water or sewer. Indeed, it seems only men have a problem with this, as the women have been handling feces – wet and messy, their own or others – for years. Women take care of the babies before they are potty-trained, changing diapers. And they take care of the elderly, after the sphincter muscles weaken. Handling dry feces, these women say, is by comparison a vast improvement.

Urine diversion is but one technology that households must be given as an option, but as water grows scarce, and expensive, any drop beyond the 25 litres per day must be taken into account. Dry sanitation appears to be taking root. Given that since I met with Roberto on the Inkomati, the population of Mpumlanga has grown from 2.3 million to 3 million in 2005. That's 700,000 people who need to dispose of their waste one way or another, with or without water. If they can afford to use water, fine.

But if they want to save money and water, through some form of dry sanitation, decisions to *not* flush 50–100 litres per day adds up to more than 15 billion litres per year, in this sub-catchment alone.

4.2 Irrigated agriculture (254 km)

Distance from the sea: 254 river km
Altitude: 675 meters above sea level
Precipitation: 600 mm per year
Temperature: 21°C
Terrain: Plains with moderate relief
Primary Land Use: Irrigated agriculture

As our expedition continues, we must cross what is proudly hailed in signs as 'citrus country.' This country lies on another side of a divisive fence – irrigated farms and orchards upstream of communal lands, rather than downstream game reserves – but the contrast is just as stark.

Rural black former homeland dwellers like Kgaugelo struggle to squeeze extra water from their tin roofs, bathwater or dry creeks in order to irrigate their 100-square-meter vegetable garden or five fruit trees. Meanwhile, the white landowners, their neighbors upstream, growing citrus on 4,000-hectare plots are awash in so much water they don't always know what to do with it.

If that sounds like hyperbole, consider the fact that for most of the twentieth century, the South African government valued irrigated agriculture as the top, if not only, measure of 'productive' land and water use in the catchment. Water not diverted to crops was considered 'wasted.' Dozens of dams in the Inkomati catchment – including the infamous Zoeknog, which collapsed so spectacularly – were constructed for Afrikaner farmers who cleared land and stayed long enough to transform native bushveld trees like weeping boerbean, black monkey orange and jackalberry into ordered rows of guava, grapefruit and banana plantations.

Consider also the now-well documented affirmative action programs in the Lowveld area, such as the Afrikaner Broederbond which extended public favors and finance to other Afrikaner males, primarily in agriculture like citrus and sugar. In short, an inequitable agricultural situation emerged out of the political history of the region, with government encouraging farming, and apartheid locking in white ownership along rivers as the most favored land use, with concomitant riparian water rights, lavish subsidies and free water.

True, this blatant and water-wasteful favoritism did not always go unquestioned, especially during the dry or drought cycles that plagued the latter decades of the

century. The back and forth went like this: irrigation farmers' collective board would demand more permits to irrigate more water-intensive cash crops even as the region was heading into a dry period. The government would reluctantly but ultimately grant this. As a next step, not surprisingly the farmers then demanded more water, delivered from storage dams. Government would feebly suggest that farmers might have more efficient and productive use if there was some volumetric accountability. In other words, might they allow the government to measure water use and charge a small fee according to use? Outrageous! Came the response. Preposterous, said the farmers, who have resisted every attempt at water meters since 1952. And the government backed off hastily for even making such a rude suggestion.

To my mind, and those on our upriver expedition, the only thing outrageous and preposterous about this situation was that it lasted as long as it did. Our administration subsequently began to overhaul the rigged system in a way that did not favor or work unfairly against these farmers. Property rights are forever inviolate, and we must forgive and forget the past through truth and reconciliation. Yet neither could we continue to allow precious water being wasted so obscenely in this manner with no thought to competitive and more efficient downstream users, and public need and equity.

As a result, the new Water Act abolished the riparian system, which had been in place for two centuries. The Act meant that, in essence, no one could 'own' water, but all had the equal opportunity to 'rent' it for a certain period of time. This rent was structured with a system of licenses of between 5 and 40 years. These licenses do not discriminate against farmers – indeed many of them will be first in line to be considered in their application. And the farmer's interests represent a powerful political lobby.

But neither do licenses discriminate on the side of farmers against all others, as in the past. Any user may apply, individually or collectively, and merit will be the deciding factor. As outside analysts have noted, this change – from the old unmonitored, unregulated water ownership controlled by a few paying nothing to new rental opportunities for all, monitored and metered and paying according to use – opens up the possibly of more sophisticated markets in water allocation, which could encourage greater efficiency of water use. Black urban communities hold far greater power than white agricultural ones, and new, less predictable allocations will be made (Bate and Tren, 2002).

Naturally, the changes underway don't please everyone, especially those who have so grossly benefited in the past. Right now, irrigation agriculture is responsible for an estimated 55 percent of the water use in the catchment, yet it produces 7 percent of the revenue. These crops are indeed important, both to feed South Africans and for sale on the global market to earn foreign exchange. And agriculture is a use that encourages open space and soil conservation, so it has indirect ecological benefits.

Finally, in fairness we must not lose sight of the fact that farmers grow water-thirsty crops like almonds, sugar, cotton, citrus and maize because we as consumers are prepared to buy them. Indeed, 33 m^3 of water are required to produce food sufficient to keep one adult on a daily diet of 2,500 calories (Davies and Day, 1998).

So farmers argue that they need every drop. Perhaps food crops do need every drop. Yet subsistence plot farms in the communal lands downstream — often hand-watered and cultivated may be arguably more efficient and flexible, crop per drop, in the type and quantity and nutritional quality of food grown. And with vast economies of scale, much is lost in waste in the effort to get that drop to the right place. In vast irrigated agriculture schemes, our expedition passes central spray systems in which the only a third of water is used by the fields; the rest evaporates in the midday heat. Other systems pour water down rows, diverted from canals; these too lose water in the delivery, not to mention increasing salinity in the soils.

If the 'stick' in finding new sources of water from agriculture is the price paid by farmers, the 'carrot' must lie in new technology. The state cannot encourage efficiency by itself. Today the Departments of Water Affairs and Agriculture are working with civil society and landowners in the area (large, small and communal alike) to encourage micro and drip irrigation – those thin tubes which that deliver moisture directly to roots without evaporation losses – which can save up to 80 percent of water use. That adds up. Some estimates of potential savings by technological efficiencies range between 100 and 150 million cubic meters of water (IWMI, 2001).

But what happens to those millions of cubic meters? Ideally they can go back into the system, used for environmental flows and to meet the increasing demands of domestic consumption or productive use of water in the communal lands, by people like Kgaugelo. Or they can be used by the irrigation farmers themselves, paying more for more water. Again, the government must ensure the BHNR and ER, and encourage productive use by small and subsistence farmers; but the state – national, provincial or local – alone cannot and should not try to micromanage such uses; that is where our guides in civil society can and do step in to play an increasingly active role.

5. Water and vegetation

5.1 Wood vs. *water (297 km)*

Distance from the sea: 297 river km
Altitude: 1500 meters above sea level

Precipitation: 900 mm per year
Temperature: 17°C
Terrain: Gradual to sharp gradient
Primary land use: Plantation Forestry

Our safari is now approaching a dark, shadowy wood, literally. No matter which group branches off, as we continue up the Sabie's tributaries – the Sabane, Mac Mac, Phasa Phasa, Ngwaritsana, Marisane, Mutlumuvi, Sand, and Klein Sand – we invariably enter forest plantations.

Rolling up and over hills and ranges and escarpments, these neatly ordered monoculture groves of pine and eucalyptus extend as far as the eye can see. It always comes as a shock to the South African tourist, who has read reports of indigenous deforestation and fuel scarcity and aridity, and then driving toward Kruger passes through one of the world's greenest plantations. Nationwide, plantations like this rank 10th in the world in producing pulp, 22nd in paper and board, generates at least 3% of the GNP, and employ over 100,000 people (Water Research Commission, 2002).

Plantation forestry covers 10 percent of the catchment, and thus makes up the single largest land use in the Sabie-Sand River drainage. They replace and isolate indigenous forest (to tiny fragments in steep terrain) because these softwood pines and eucalyptus produce up to ten times as much veneer, saw timber, pulpwood, poles and matchwood per hectare as indigenous and hardwood species (DWAF, 1998).

But for our expedition these same substantial benefits present a sticky wicket. For plantation forestry grows best in upper catchments like this where the rainfall is high. Like anything growing fast, these trees require water. Tonnes of water. They are evergreen and ever- thirsty and put down deep tap roots to drink throughout the year, drying up creeks and lowering water tables several meter deep. This perennial thirst makes them perennial enemies of streams that no longer perennial because they are dried up by these plantations.

One estimate is that the forests have reduced runoff in the Inkomati Basin by approximately 207 million cubic meters per year (Le Maitre et al., 1997). That's one fifth of potentially available water in the catchment. Understandably, the plantation forests are fiercely resented, even hated, by downstream users like Kruger, private reserves, irrigation agriculture, industry and domestic urban and rural households alike. Plantation forestry's water use is one thing that brings these disparate downstream sectors together.

And guess where they focus their ire? Well, these particular plantations happen to grow on land owned by the national government and thus managed by the he Department of Water Affairs and Forestry: formerly under the leadership of yours truly. It is a classic case of our having to pit one scarce and valuable resource against

another. We need water. We need wood. It seems that expanding one curtails the other. With no way to sacrifice one for the other, our expedition set about to brokering a compromise.

First, we said: Enough is enough. We have stopped granting new permits for further afforestation. Our Stream Flow Reduction Activity (forestry) licenses are used as an incentive for foresters to work more intensively with less water on existing plantation-zoned lands.

Second, we minimized the acreage where plantation trees could put down roots and grow. We barred plantation forestry from zones where the highest water reduction took place: those thin riparian strips feeding streams and tributaries. We made certain that every existing permit is conditioned upon clearing a 50 meter wide riparian strip, on both sides of all streams. This not only improves water quantities and quality by preventing erosion in sensitive areas; it allows ecological recovery of indigenous flora and fauna. Every unnecessary or out-of-bounds plantation tree that is removed yields an average 200 litres per day that can be used downstream by people or by the river itself.

Finally, over the next five years we have begun phasing out plantation forestry where the potential water and indigenous life is more valuable than the wood. DWAF currently manages 12,000 hectares of commercial forestry in the Drakensburg Escarpment-Blyde area, inherited from the former Lebowa 'Homeland' Administration.

Much of the upper Sand River falls into this region, and is now in the process of being incorporated into a Nature Reserve; the area and adjacent indigenous forests will be transferred to National or Provincial Parks. It has been documented that rehabilitation and tourism development will provide more job opportunities than are currently available in sawmills.

Estimates of water that would be liberated through these steps vary, but based on 1,000 trees per hectare, drinking 200 litres per day, one might conservatively predict these new 'water sources'yielding two *billion* litres per day in the Sand River subcatchment alone.

5.2 The cutting edge (313 km)

Distance from sea: 313 river km
Altitude: 2,000 meters above sea level
Precipitation: 1,200 mm per year
Temperature: 16°C
Terrain: Rocky escarpment
Primary land use: None

That may sound impressive, but I always save the best for last. And as our expedition, meeting stiff resistance from steep slopes and gorges and koppies of this upper catchment, we need relief from our climbing. What we need, in fact, is someone who knows the ropes, literally. Someone who can help us clamber up and over these steep faces. In this unlikely place, we find dozens of such guides in our midst, thanks largely to new programs flourishing in South African civil society. In fact, one such group has been quietly pointing out potential new water sources all along our journey, starting in Mozambique and Kruger, but here, near the source, their water-work is most evident. Consider the following.

The lanky and quiet young man named Doctor has a license to kill and he's good at it. He has been equipped and trained with 3,000 hours of intensive experience to mete out death with surgical skill that allows no suffering. Part of an elite team of 19 others, he is employed by the government to seek and destroy those public enemies no one else can get their hands on, defending his country against a relentless foreign threat. The enemy is heartless, mindless. It is inhumane and will stop at nothing as it sneaks in, digging down, infiltrating past the dark gaps of trade regulations to cripple and bleed Southern Africa's economy. It respects no sovereign borders, no hungry or thirsty men, women and children, no rare wildlife and biodiversity. Its avarice already has taken over eight percent of the country, and will stealthily expand its domain at the rate of five percent a year if left alone.

But as our expedition reaches him, on a certain Friday in mid-October, 2002 Doctor is in no mood for appeasement. 'Eech, it is too hot,' he announces, seeking shade and chugging from a canteen. He is impatient to kill, get it over with, and then enjoy the weekend. It has been a long scorching week; the day before we watched him kill an average of eight victims per hour – young and old, fat and skinny – breaking only for lunch and a smoke. It was physically exhausting but rewarding beyond the 90 Rands per day he earns, and Doctor slept soundly.

Today, looking straight down the edge of the start of earth's third largest chasm, Doctor identifies his target on the canyon floor 100 meters away: an Australian, mindlessly guzzling on the banks of the Blyde River in full view of our expeditionary force above. Doctor smiles. While technically demanding, this kill looks like it could actually be quite fun. Nothing personal, the obnoxious foreigner just doesn't belong here, and should never have come in the first place. Time to get whacked. Within an hour Doctor has fixed rope slings around solid protruding rock. He has tested knots, fed it through his harness, and, joined by half a dozen other mercenaries on both sides of the canyon, jumps backwards off the edge to carry out the execution in the abyss below.

Which raises the inevitable question as our expedition looks on, mouths agape: some claim South Africa has a slight xenophobic streak running through its national

character, but isn't this carrying on a bit far just to eradicate *Acacia mearnsii,* the black wattle, a simple weed?

In fact it may not be going far enough, given the acute security risk posed by black wattle and 197 other documented species now officially classified 'alien invasive weeds' (Henderson 2002). Their crime is that, like biological treason, these species threaten to undermine the nation's fragile water supply, consuming 3.3 billion litres, or 7 percent of South Africa's water. That's not water used productively. It's wasted. Gone. Lost forever. Never mind inefficient farms, industry or households — invasive aliens like wattle are the fastest-growing water users in the country. Until, that is, they meet the likes of Doctor and other trained killers – another 17,593 trained killers, to be exact. For Doctor's surgical mountaineering team of 20 is merely the cutting-edge crew, the Green Beret or avant-garde of a national army founded under the new government seven years ago. This special army is all poor, almost entirely black and what was considered 'Coloured,' 54 percent female (often single mothers), one-quarter youths, and 2 percent disabled.

The campaign is called 'Working for Water' (WfW). With three quarters of its budget coming from a post-apartheid 'Poverty Relief Fund' it is the kind of national public works program that either warms the heart of liberals who look back with fondness on the glory days when governments rescued their nations from the Great Depression, or chills the spine of conservatives who feel nations barely escaped the clutches of that 1930s form of 'creeping communism.' In South Africa, people across the political spectrum who are familiar with WfW in principle or practice can't decide how they feel about it, partly because they can't keep up with it. The program keeps evolving, focusing, adjusting and tightening its structure even as it expands from 1995's pilot experiment with US$ 3 million in seed money, into a US$ 50 million budget, Africa's biggest conservation program, and arguably the most innovative weed-eradication effort on earth.

Like its enemy, this weed-busting juggernaut did not crop up overnight out of nowhere, but has met – and continues to meet – opposition from several directions both in office and in the field. It seems that despite President Mandela's endless assurances, post-apartheid white landowners remained jittery about their future 'my-house-is-my-castle' rights and commercial ventures. The pessimists among them were certain that doom was just around the corner. One can almost sympathize with their perspective when, suddenly knocking at their doors wearing smiles and bright yellow t-shirt uniforms, come organized state-sponsored teams of the nation's poorest blacks armed to the teeth with chainsaws and hatchets and pangas, talking about 'eradicating noxious foreign aliens' from the country. It is a measure of progress and trust and stability (and recognition of the invasive threat) than in just seven years, so

many white landowners are actively inviting armed black teams onto their land that WfW can't keep up with demand.

Still, without a scientific basis, WfW could become an ethically slippery slope: Who decides when a plant is 'good' or 'evil?' The case against weeds is not frivolous but carefully documented by researchers over the past decade. Narrowing down that recently published 'hit list' of the subcontinent's 198 'most wanted' has taken many long years because the issue is so highly charged, politically involving every acre in the nation, public or private property, and all residential or commercial landowners. Inhabitants of the capital Pretoria, popularly known as 'Jacaranda City,' were none too pleased to learn that their beloved, ubiquitous, purple-blossoming tourist-drawing trees are, ahem, invasive Amazonian aliens. What might be next, pansies and tomatoes?

To defuse tempers, WfW hastens to explain two critical words: alien and invasive. From Europeans colonists through today, 9,000 'alien' plants have been brought into the country, including ornamental roses and tulips, commercially valuable timber and grape vines, and nutritional staples as potatoes, sugar and maize. These are beneficial. Likewise, there have always been plenty of 'invasive' plants indigenous to the region that spread at any disturbance, including *Zyzyphus mucronata,* buffalo thorn. These indigenous invasives are natural, and eventually get checked by indigenous competitors and pests.

Yet the volatile unnatural combination of the two elements – both alien and invasive, like black wattle – can prove explosive, expensive and even deadly on several fronts, because they have no natural predators or parasites, and so are at a huge Darwinian advantage. Nature abhors a vacuum, but until the landscape itself can develop organic resistance to thirsty alien invasives, humans must step in as the sole natural enemy.

Furthermore, within the hit list there are, like a traffic robot, several tiers regulating reaction: roughly a third (red) are noxious and must be immediatly killed and removed; another batch (yellow) can't be sold, traded or planted, and the remainder (green) are tolerated if closely watched, controlled and contained. Wattle spreading accross 2.5 million acres, is in the red zone, earning it the death sentence.

On private land, new regulations makes that the owner's task; here, along the riparian zone of state land, it is up to WfW, and hence Doctor, who has by now descended half way down the sheer rock face on the north wall of the Canyon. He is gliding unhurriedly, but still at several feet per second, using an 18-month-old used rope that has 0.27 percent 'give,' while armed with a hatchet and jar of environmentally safe poison.

As its name implies, the driving force of WfW is water. Water scarcity and water depletion, to be precise. When President Mandela took over the reigns, we had to get safe tap water to tens of millions who lacked it. As we have seen downstream, this

need implied more dams, pipes, boreholes and other infrastructure. But we also inherited a legacy of a stagnant economy, deep unemployment, scarce public funds and a military budget bloated to control foreign and domestic 'terrorists.' There was no spare penny set aside for what seemed 'frivolous' issues as control of non-human invasive plants that were draining runoff before water could even reach said dams, pipes and boreholes. The time was ripe for a fresh, new nationwide public works programme.

In the past, it has been our experience that public works projects on water, aka a large dam, are among the most expensive investments a nation ever makes (WCD, 2000). But WfW carries an ironic footnote: In the 1930s, during the worldwide depression, poor jobless whites were employed en masse by the state to increase water supply through dams. Now, poor jobless blacks like Doctor are employed upstream to ensure tributaries continue to flow toward those dams, keep dams from being choked dry with invasive alien water hyacinth, and don't fill up with weed-eroded sediment.

Still, with scarce taxpayer funds, some sceptics of our expedition ask if invasive aliens drinking enough water to justify the cost of labor. They are. Think of a plant's evapo-transpiration along the lines of human sweat, breath and urine. Like humans, thirst varies on the individual's age, size, health, genes, and the seasons to which it must adapt. Aliens have proven, on the whole, far less genetically adaptable to aridity than natives. In several studies, almost all high, vertical-growing invasive aliens drink exponentially more than slow-growing, indigenous, low or bushy plants and grasses. And they drink more at the worst possible time: the long dry season. Sinking deep tap roots, these aliens so dramatically sop up and lower the water tables that shallow-root natives are left high and dry. And eventually dead.

Cut to the quick, I found that in contrast to indigenous shrubs and trees, which sip and retain a few dozen litres per day, the average American pine tree may gulp and 'sweat' 150–250 litres per day; Australian wattle or eucalyptus: 250–400 litres per day. That's ten times as much as a family like Doctor's (or further downstream, Kgaugelo's) may consume each day in their home, water that won't get there if this wattle remains. No wonder Doctor's risking his life in order to kill it; it's almost a matter of self-defense.

In this particular section of the Inkomati's tributaries, there are only a few dozen wattles. For now. But as a seed source for lower-lying areas, the wattle's rate of spread, carried downstream by wind or water, demands a pounding of policy now instead of reaching an incurable stage later, where landowners walk away from farms and property overtaken, sucked dry and barren by alien invasive *Chromolaena odorata,* or triffid weed. Alien invasives spread and grow at an average rate of 5 percent per year, a doubling in about 14 years (McQueen et al., 1998).

Our expedition's guides do the exponential math. A relatively healthy area like this may have, say 50 alien invasive stems per hectare (roughly the size of two football fields), reduce the runoff by 10,000 litres and cost US$ 11 to clear. Neglected 10–20 years, that hectare will be infested with several hundred stems, drinking 250,000 litres per day (one-third of the runoff), and costing US$ 120 to clear. Left two more decades, more than a thousand invasives will be highly infested in the hectare, drinking three quarters of the runoff and costing US$ 500 to clear. I multiply that by alien invasive weeds already spreading on 10 million hectares (CSIR, 1997). Gulp.

Starting in the late 1980s, enlightened South African hydrologists and botanists put their heads together and calculated the cumulative national impact. Alarm bells started to go off, at least in this academic community. 'We knew the threat, and had written about the dangers, but no one in the apartheid regime was listening,' sighs Brian Wilgren, one of these scientists on our expedition. 'It is a fact we academics find hard to face, but publication does not precipitate political action. Then came the miracle.'

With President Mandela, a window of water-source opportunity cracked open. Cabinet ministers were targeted, and Wilgren gave a shock-speech before a crowd that included ANC officials in 1994 that said, in essence: Yes millions of poor blacks deserve running water. Yes you can and should build all the dams and pipes and taps you need to satisfy their long-deprived thirst. But at the current rate of spread and infestation, by 2030, there will be no water left to fill those pipes or come out their newly installed taps.

A dedicated researcher named Guy Preston made a similar focused pitch in Cape Town, during hearings I was holding on an expensive proposed Palmiet Water Agumentation Scheme in April 1995. Recalling expensive mistakes such as Zoeknog I was looking for non-dam alternatives. 'Before building this dam and transfer scheme,' Preston argued, 'why not tap potential water through demand side management savings, and milk the entire river basin to meet our needs in ways that are efficient, equitable and sustainable?'

'What kind of ways do you have in mind?' I asked.

'Well,' Preston answered, 'central to efficient catchment management was the labor-intensive clearing of all these invading alien plants.'

It didn't take a genius to recognize the potential for putting two top ANC 'stars in alignment': combining the priority to create jobs/reduce poverty with the priority to eliminate threats to water security/economic growth. It took an opportunist, which I most certainly was. And so I seized the occasion (and 25 million public Rands that, according to my dear colleague Jay Naidoo were still available in the RDP), brought President Mandela and 10 other cabinet ministers on board, and Working for Water was born .

I cannot say ' ... and the rest is history' because WfW's is still evolving as an environmental programme that is steeped in developmental necessity. '2001/2 was the most challenging year,' acknowledges WfW executive committee chair Barbara Schreiner, 'one in which the maturity of the program has been tested. It has been through a prolonged debate over optimal institutional arrangements and staffing needs.'

There are WfW critics inside and outside the Administration, and not all criticisms are unfounded. Every blemish that arises in WfW – from fraud, theft, mistakes, drunkenness and sloppiness – is readily and quickly and prominently publicized. Curiously, though, these exposées arise not from external investigations, but from WfW's own annual reports, interviews, and press releases. It uses sunlight to self-disinfect emerging problems, or rather, to be consistent with analogies: WfW nips any bad weeds in the bud.

It also grows difficult to label the programme as bloated or inefficient. WfW has tangible achievements it can point to, beyond simple employment. At first our expedition was puzzled to learn that the program has reduced staffing from a 45,000-person high (0.1 percent of the country's population) to 24,000 last year, t o 17,5000 today. Then we learned that downsizing might be an indicator of streamlining and progress. The fact that WfW is now paying fewer people more money per person to complete hectare-linked contract work rather than daily wages, suggests that, rather than waning, WfW may just be hitting its stride, growing more effective and mature per person at its task of clearing invasives. To wit: in 1999, some 21,000 workers cleared 240,000 hectares; in 2001 17,500 workers cleared 608,000 hectares.

WfW embraces so much of our vision of the future for our country, weaving together the social fabric of our people even as it rehabilitates the ecological fabric of our watersheds. But of course, the proof of this programme's pudding is in the drinking. As Doctor whacks that Australian invader, I reflect that a programme can't clear five billion invading alien plants without people and nature taking note. Every few months there seems to be a story about a dead spring 'miraculously' coming back to life. Some refreshing new gripes are that there is *too much* water returning to some formerly dry creeks downstream of WfW projects. Here in this part of the upper Mutlumuvi Catchment (where Wfw just completed work) streams have started flowing for the first time in 60 years. Around Lydenberg, where WfW has cleared 2,000 hectares, the region has been hit by a series of minor droughts, is feeling the pinch of El Niño, and from April to September recorded the driest winter in 81 years; meanwhile the area's water levels have been rising to their highest in the past 30 years. These tangible riparian benefits – new water sources on the order of several billion litres per day – are now cascading, literally, downstream to other water users throughout the Inkomati basin.

5.3 Conclusion

With the help of Doctor and his crew manning the ropes, we reach the top of the escarpment at 2,130 meters. It is clear and cool and we can look back down the catchment from source to mouth. It seems the farther we rise in the catchment, the less efficient the use of water, the more monoculture and uniformity of land use, the more sources of water there are to be discovered and explored, and more equitably shared downstream. New Catchment Management Agencies are being established to determine that equitable use, and the Inkomati appears the first one ready to function. These CMAs will involve a continuous feedback system to allow for representative self-regulation by all interest within the catchment. This will, I suspect, turn up even more 'new' and potential sources of water – from ongoing alien invasive weed removal, to more responsive and innovated efficient forestry, to equitable water-wise farming on small and large plots, from productive and consumptive conservation by people on both sides of the Kruger fence. Water scarcity has brought our compartmentalized nation out from behind its walls; by necessity, it has forced us to integrate our needs and capacities through the glue of civil society. As demonstrated in this essay, water scarcity has made us a better, stronger, more ethical nation.

And further downstream? Mozambique continues to grow, and requires more water from the Inkomati and other basins flowing across our international borders. We now have appropriate forums for calmly brokering and resolving any potential conflicts or disputes over quality and quantity crossing the border. We are also 'exporting' some of our technology and techniques – including the WfW programme – across the border to Swaziland and Mozambique. I anticipate the 'water war' rhetoric will gradually fade, even as pressure on the basin increases and even as we face drought conditions together. Indeed, at the World Summit Minister Kasrils and his counterparts, including Roberto, announced a watershed accord (in both senses of the phrase) to manage the 'IncoMaputo' catchments across borders, allowing development investments to move forward and mutually benefiting all three national interests.

There is only a slight glitch. Right now it seems there is a potential problem that neither the Helsinki Accord, nor Roberto and I anticipated back when we stood above the bone-dry Inkomati River bed seven years ago. Where the Sabie 'rejuvenates' through the steep gradient of that gap in the Lebombo Mountains, it seems that rather than not enough water crossing the border, there is now increasingly *too much*. The usually low level of Corumana Dam inside Mozambique is now pushing back up into the Kruger National Park, resulting in reduced velocity of flows, damping of seasonal flow fluctuations and increased deposition of sediments. In short, thanks to

the dam and the new sources of water backing up behind it, South Africa is, for a few kilometers at least, suddenly the 'downstream' neighbor of this transboundary river.

Since changing Ministerial hats from Water to Education, I haven't spoken with Roberto in many months. That's too long. Perhaps it is time for me to call up an old friend and invite him 'to come to my country and visit our rivers.' I know he'll accept the invitation. And I know that, by working with civil society to manage shared waters, our countries will hammer out an ethical solution, together.

6. References

ALPERT, P. 1996. Integrated Conservation and Development. Projects: Examples from Africa. *Bioscience,* Vol. 46, No. 11.

ASMAL, K. 2000. *Water is a Catalyst for Peace.* Keynote remarks reprinted in Stockholm Waterfront.

BATE, R. and TREN R. 2002. *The Cost of Free Water: The Global Problem of Water Misallocation and the Case of South Africa.* Free Market Foundation

CARRUTHERS, J. 1995. *The Kruger National Park: A social and Political History.* University of Natal Press, Pietermaritzberg.

CSIR. 1997. *The Environmental Impacts of Invading Alien Plants in South Africa.* Division of Water Environment and Forestry Technology, on behalf of 10 RSA Departments.

CUSTOS. *Kruger's Rivers,* the National Parks Magazine, March 1994.

DAVIES, B. and DAY, J. 1998. *Vanishing Waters*. University of Cape Town Press, Cape Town, p. 369.

DE MENDIGUREN, J. C. and MABELANE, M. 2001. *Economics of Productive Uses for Domestic Water in Rural Areas*. Association for Water and Rural Development.

DWAF. 1998. *National Water Act No. 36.* Govt. Gasette, Pretoria.

DWAF. 2002*a*. *Sanitation for a Healthy Nation.* Framework for a National Sanitation Strategy.

DWAF. 2002*b*. *Sanitation White Paper*.

HENDERSON, L. 2002. *Alien Weeds and Invasive Plants*. National Botanical Society, Cape Town.

HOLDEN, R. 2001. *Position Paper on Sustainable Sanitation*. Mvula Trust, 21 November.

INTERNATIONAL WATER MANAGEMENT INSTITUTE. 2001. *Water Efficiencies in Southern African Irrigation*.

LE MAITRE, D. C., SCOTT, D. F. and FAIRBANKS, D. H. 1997. *Forestry in South Africa.* Department of Water Affairs and Forestry, Pretoria.

MBANA, N. 2002. The Worms are Turning. *The Big Issue,* Vol. 6, No. 63.

McQueen, C., Noemdoe, S. and Noshiph J. 1998. Working for Water Programme. In: *Best Management Practices: Alien Invasive Species*. Department of Water Affairs and Forestry, Pretoria, p. 51.

Morgan, P. 1977. The Pit Latrine, Revived. *Central African Journal of Medicine,* Vol. 23, No. 1.

Preston, G. 1994. The Effects of a User-pays Approach and Resource-saving Measures on Water and Electricity Use by Visitors to the Kruger National Park. *South African Journal of Science,* Vol. 90, pp. 558–61.

World Commission on Dams. 2000. *Dams and Development*. Earthscan, London.

WfW. *Best Management Practices: Alien Invasive Species, Proceedings*. Department of Water Affairs and Forestry, Pretoria, p. 15.

Wolf, A. T. 1998. Conflict and Cooperation along International Waterways. *Water Policy,* Vol. 1, pp. 251–65.

World Bank. 2002. *VIP Latrines in Zimbabwe, from Local Innovation to Global Sanitation Solution*. WSP, August.

Water Research Commission. 2002. *A Water Sector Case Study, No. 3,* Sustainable Forestry.