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Is water the new oil?

Current knowledge and thinking around water issues will not be enough to solve South Africa's water challenges of the near future. So writes

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The simple truth is that human population growth is outstripping our supply of freshwater. The total volume of water on Earth is 1,4 billion km³. Of this a staggering 97,5% is salt-water found in the sea. The remaining 2,5% of the global water reserves (35 million km³) is fresh water. This total volume (35 million km³) is found in three separate forms: 68,9% is bound up in glaciers and permanent snow cover; 30,8% manifests as groundwater, soil moisture, swampland and permafrost; leaving the remaining fraction of 0,3% as water in rivers and lakes.

The result is that the only freshwater useable to humans is around 200 000 km³, which is shared with aquatic ecosystems, and this amounts to less than 1% of all freshwater resources on

the entire planet. This is a staggeringly small number.

If one homes into the population element and links that to water availability, then a truly terrifying picture starts to emerge. Work done in the late 1980s by famous hydrologist Prof Malin Falkenmark developed into what is now known as the water crowding index (WCI). This is an indicator of the number of people dependent on a standard unit of water (1 million m³), and has shown that a value exceeding 1 000 represents a reasonable upper limit that can be supported in a sustainable way within the current constraints of existing technology. To expect to survive above this limit thus becomes dependent on the levels of technology available in that given situation.

The value of 2 000 was seen to represent the 'water barrier' beyond which economic development was impossible in terms of the technology then available. Dr Peter Ashton, principal scientist at the CSIR, has produced a set of data that translates Falkenmark's findings into the South African situation as it exists in the four basins shared with other neighbouring states.

This is presented as Table 1, and it shows that in all cases the WCI was already above the critical 1 000 level in 2000, with the Limpopo being a stunning 4 219, over four times higher than what Prof Falkenmark considers to be sustainable and more than double what she called the 'water barrier'. When extrapolated to 2025 this becomes even more serious, with the Limpopo system approaching 5 000 and all of the others close to 2 000.

These are serious numbers indeed. South Africa is at the very tipping point of environmental constraints to future economic growth and thus social stability. To explain the concept of a tipping point: ecosystems perform in way that is reasonably predictable most of the time. This is known technically as linearity where two variables are known to be linked in a specific way, which means we can predict future behaviour based on various observations.

This is true to a point, beyond which non-linearity starts to occur. This means that the previous relationship between two variables is no longer relevant, because that relationship changes so fundamentally that predicting an outcome with any degree of accuracy becomes statistically more difficult (if not impossible). This is

referred to as the 'tipping point' because it is at this moment in time that change is so drastic that the future condition will differ fundamentally from the previous condition.

It therefore becomes technically impossible to solve tomorrow's problems with today's science that is based essentially on yesterday's knowledge. Taken one step further it means that any country approaching an environmental tipping point will need to develop a scientific capacity that differs fundamentally from what it already had, simply because the old science becomes somewhat irrelevant to the new circumstances.

Water, by virtue of its growing scarcity, is thus set to become the new oil, but there are also fundamental differences between the two. Water is a flux whereas oil is a stock, and this difference has major ramifications once we start to grasp them. This means that water will become commodified (even if most non-governmental organisations and trade unions resist the notion), because ultimately the laws of demand and supply will prevail and the scarcity will determine the value.

However, because water is a flux, this will drive recycling and reuse, which is simply impossible in the case of oil. The sooner progressive governments realise this and move to intervene in terms of legislation and regulation, rather than obstruction and denial, the better for national economic development and thus the well-being of all.

This is our challenge in terms of water investment – we need infrastructure,

but we also need intellectual capital in the form of new technologies and ideas – because as we upgrade our old infrastructure, we will also need to implement new processes that remove endocrine disrupting chemicals, microcystins and other contaminants like heavy metals and radioactivity from gold mining.

The problem is that water is a flux, but we manage it as a stock. Thus our solution lies in changing our management approach, and thus public perceptions to embrace this new reality. Being a flux it can be recycled, so in future effluent management will become as important as water resource management, simply because effective recycling will allow it for future economic growth. We therefore have to get the efficiencies right in order to remain competitive as a national economy functioning under conditions of endemic scarcity.

WHAT IS THE GLOBAL OUTLOOK FOR PRICING AND REGULATION?

Within the international water sector the Dublin Principles apply. These are expressly mentioned in the South African National Water Act. In terms of these principles water is a finite resource that has economic value and it therefore means that we have to manage it as such. This fails in practice, however, where major political pressures exist in the form of water as a human right, often underpinned by strong demands for free water.

This impacts on the financing of water infrastructure and unless this thorny issue is resolved, we are likely to remain in the

Table 1: Current (2000) and projected (2025) populations and water resources available (including water transfers) in the South African segments of the transboundary river basins with values for the WCI for each basin

Basin	2000			2025		
	Population ('000s)	Available water ($10^6\text{m}^3\text{yr}^{-1}$)	WCI	Population ('000s)	Available water ($10^6\text{m}^3\text{yr}^{-1}$)	WCI
Orange-Senqu	11 319.0	9 568	1 183	19 502.0	10 816	1 803
Limpopo	10 905.9	2 585	4 219	18 790.4	3 778	4 974
Incomati	1 122.4	723	1 552	1 933.8	837	2 310
Maputo	1 165.7	847	1 376	2 008.5	849	2 366

quagmire we currently find ourselves in. The way to change that is to work on public perceptions, because a changed public perception that free water today means no quality water tomorrow; or worse still, poor human health tomorrow, will mobilise political support for change.

The most likely drivers for this in my professional opinion are the following:

- The whole issue of acid mine drainage as it is currently unfolding in Johannesburg is driving a growing public awareness campaign. Associated with this is human health risk linked with radionuclide and heavy metal contamination downstream of gold-mining activities, the most notable being the Wonderfontein Spruit;
- The emerging issue of endocrine disruption, specifically as it manifests in babies being born with both male and female genitalia arising from the use of DDT to control malaria in Limpopo has the potential to become a storm of public protest if left unmanaged;
- The current failure of many municipalities to maintain their water care works in a way that is capable of returning quality water back into the hydrological cycle.

FUTURE SOURCES AND THE ROLE OF NEW WATER

'New water' is the best approach for South Africa and other water constrained countries in the SADC region. Two elements of this are likely to become critical. The first is sewage management, which as it now stands, is hopelessly inadequate if we are to have a reasonable chance of growing our national economy. Our current approach is to see water as a stock and then discard it once it has been used once.

The solution lies in seeing water as a flux and thus enabling reuse. This can best be achieved by moving sewage plants off the balance sheets of municipalities, where they currently reflect as a cost centre, onto the income statements of local authorities where they should

reflect as a revenue generator instead. The key to revenue generation is treating water to a level where it can become industrial grade process water and thus a valuable economic resource, rather than simply waste to be discarded.

The economics will drive this as potable grade water becomes more costly and starts to impact negatively on industrial processes needing water. This will see a new market for cheaper industrial grade process water and it will be in this market that revenues will be generated for wastewater treatment plants.

In Perth, Western Australia, an experiment is currently underway that will take processed sewage and inject it into groundwater aquifers where it will be stored for future use. In Brisbane, a different but equally useful approach is underway. This approach has considerable scope in South Africa.

South Africa's approach to strategic storage, which is currently done in the form of large dams, will also change over time. For example, in the Orange River basin, only 5% of the water that falls as rain eventually ends up as water in the river and thus useable to our national economy. In the South African portion of the Orange River basin, this figure is just over 3%, which means that 97% is lost to evaporation. The total storage capacity of all dams in the basin is around 270% of the actual flow of the river. Clearly we have reached the end of the dam-building era in the Orange, which is our most important national water resource.

Again, if we apply our flux thinking, then alternative strategic storage is likely to take place in a way that reduces evaporative losses. One method is to store water in aquifers in a process known as groundwater recharge, and I see this as becoming a major area of commercial interest in the near future. Another method is to store water in mine voids, which transforms the acid mine drainage problem from a mining issue into a strategic storage and national economic development issue instead.

This creates new water by reducing evaporative losses and if we get this right the numbers are massive – think of the 97% currently being lost in the Orange River basin alone – and then ask what we could do with only 5% of this as a useable resource? But this will need government support in the form of policy and legislation if it is to succeed.

TAPPING INTO NEW TECHNOLOGIES

Albert Einstein told us that the level of ingenuity needed to solve a problem exceeds the level of ingenuity that created the problem in the first place. This means that no single institution will be able to solve our national water problem. Partnerships, and only partnerships, will be needed.

I therefore see a new form of public-private relationship starting to emerge, building on the failures of earlier attempts at doing the same thing. Government will play a new role as regulator and legislator, enabling these partnerships to emerge. A new form of corporate identity will have to be considered for the management of sewage works, managed like a franchise operation would with skills and core processes being developed at the centre and then applied in the radial offshoots of the new entity.

The national science councils, especially the CSIR and Water Research Commission, will need to be invigorated for their role as technology generators, and where appropriate technology will have to be sourced from overseas. South Africa will have to become technology leaders in endocrine disruption and microcystin management, simply because our levels are so high that few other countries in the world are likely to develop the type of technology we need to survive as a viable economy within the severe water constraints we have.

*This paper was first presented at the **Water Investment World Africa 2009** conference, which took place in Gauteng in November last year.* 