Water Investment Africa 2009

Keynote Address

Is Water the Next Oil?

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What is depleting our resources?

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 cubic kilometres[1]. Of this a staggering 97.5% is saltwater found in the sea. The remaining 2.5% of the global water reserves (35 million cubic kilometres) is fresh water. This total volume (35 x 10^6km^3) 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 km^3, which is shared with aquatic ecosystems, and this amounts to less than 1% of all freshwater resources on the entire planet[2]. This is a staggeringly small number.

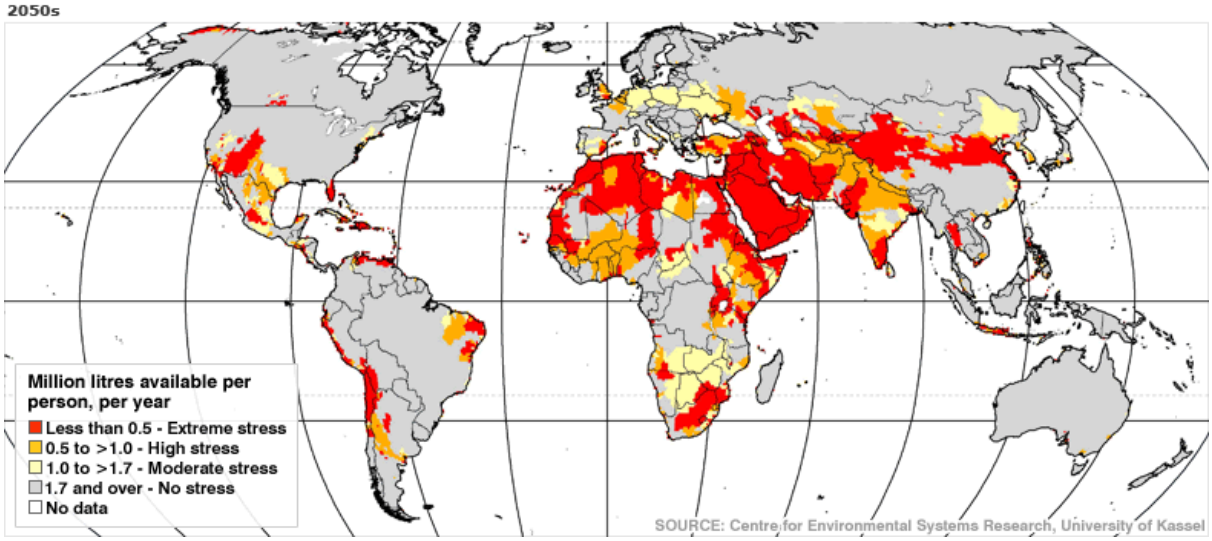
If one homes into the population element and links that to water availability, then a truly terrifying picture starts to emerge. Work done in the late 1980's by a famous Swedish hydrologist named Prof. Malin Falkenmark[3] developed what can be thought of as a Water Crowding Index (WCI). This is an indicator of the number of people dependent on a standard unit of water (1 million cubic metres or 1 x 10^6m^3) 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. Prof. Peter Ashton, a highly respected 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 river 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.

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 Water Crowding Index (WCI) for each basin (Ashton *et al.*, 2008[4]).

Basin	2000			2025		
	Population ('000s)	Available Water	WCI	Population [High]	Available Water	WCI

		($10^6 m^3 yr^1$)		**('000s)**	($10^6 m^3 yr^1$)	
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

This is shown graphically in the map, which shows global trends for the year 2050. Note that the Limpopo and upper reaches of the Orange River basin in South Africa are projected to become as water stressed as the Middle East North Africa (MENA) region.



These are serious numbers indeed. In a nutshell, South Africa is at the very tipping point of environmental constraints to future economic growth and thus social stability. The concept of a tipping point needs to be understood by the audience. Ecosystems perform in a 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 past observations. This is true up 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 a "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[5]. 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[6].

Water, by virtue of its growing scarcity[7], 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 NGO's and trades union resist this notion), because ultimately the laws of demand and supply will prevail and the scarcity will determine the value; but because it is a flux, this will drive recycling and reuse, which is simply impossible in the case of oil. The sooner that progressive governments realize 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 wellbeing 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.

How do we preserve water for future generations?

The problem is that water is a flux, but we manage it as a stock, and so 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 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 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 mobilize political support for change. The most likely drivers for this in my professional opinion are as follows:

- 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[8].
- The emerging issue of endocrine disruption, specifically as manifest in babies being born with both male and female genitalia arising from the use of DDT to control malaria in Limpopo[9] has the potential to become a storm of public protest if left unmanaged.
- The current failure of 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, in my professional opinion, 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:

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 the 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 waste water 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[10]. In Brisbane a different but equally useful approach is underway[11]. Similar thinking is currently taking place in California[12]. This approach has considerable scope in South Africa and I am actively championing it. This will manage water as a flux and encourage reuse and recycling.

Our 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 Basin, this figure is just over 3%, which means that around 97% is lost to evaporation. The total storage capacity of all dams in the Orange Basin is around 270% of the actual flow of the river[13]. 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[14], which transforms the AMD 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 and so I encourage the President to strengthen these efforts given their urgency.

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 entity will have to be considered for the management of sewage works, managed like a franchise operation would be 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, specifically 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[15] 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.

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[1] See **Shiklomanov, I.A.** 1993. World Water Resources: Modern Assessment and Outlook for the 21st Century. In **Gleick, P.H.** (Ed.) 1993. *Water in Crisis: A Guide to the World's Water Resources*. New York: Oxford University Press.

[2] See **Gleick, P.H.** (Ed.) 1993. *Water in Crisis: A Guide to the World's Water Resources*. Pp 80-91. New York: Oxford University Press.

[3] See **Falkenmark, M.** 1989. The Massive Water Scarcity now Threatening Africa: Why isn't it Being Addressed? In *Ambio*, Vol. 18, No 2; 112-118.

[4] See **Ashton, P.J., Hardwick, D. & Breen, C.M.** 2008. Changes in water availability and demand within South Africa's shared river basins as determinants of regional social-ecological resilience. In: **Burns, M.J. & Weaver, A.v.B.** (Eds.) *Advancing Sustainability Science in South Africa*. Stellenbosch: Stellenbosch University Press. Pp 279 – 310.

[5] See **Turton, A.R.** 2007. *Can we solve Tomorrow's Problems with Yesterday's Experiences and Today's Science?* Des Midgley Memorial Lecture presented at the 13th SANCIAHS Symposium, 6 September 2007, Cape Town.

[6] See **Walwyn, D. & Scholes, R.J.** 2006. The Impact of a Mixed Income Model on the South African CSIR: A Recipe for Success or Disaster? In *South African Journal of Science*. No. 102. Pp.239-243 for a sobering discussion on the reality facing South Africa.

[7] See http://dailyreckoning.com/the-end-of-cheap-water/ for an interesting insight.

[8] See **Coetzee, H., Winde, F. & Wade, P.W.** 2006. *An Assessment of Sources, Pathways, Mechanisms and Risks of Current and Potential Future Pollution of Water and Sediments in Gold-Mining Areas of the Wonderfonteinspruit Catchment.* WRC Report No. 1214/1/06. Pretoria: Water Research Commission; and **Turton, A.R.** 2009. South African Water and Mining Policy: A Study of Strategies for Transition. In **Huitema, D. & Meijerink, S.** (Eds.) *Water Transitions*. Netherlands: Edgar Elgar.

[9] See **Aneck-Hahn, Natalie H., Schulenburg, Gloria W., Bornman, Maria S., Farias, Paulina & de Jager Christiaan.** 2007. Impaired Semen Quality Associated with Environmental DDT Exposure in Young Men Living in a Malaria Area in the Limpopo Province, South Africa. *Journal of Andrology*, Vol. 28. No. 3: 423-434; and **Bornman, M.S., Delport, R., Becker, P., Risenga, S.S. & de Jager, C.P.** 2005. Urogenital birth defects in neonates from a high-risk malaria area in Limpopo Province, South Africa. *Epidemiology*. (16)5. S126 – 127.

[10] See http://www.watercorporation.com.au/M/mar_background.cfm for information on the Perth groundwater replenishment trial.

[11] See http://www.westerncorridor.com.au/home.aspx?docID=1.

[12] See http://www.gwrsystem.com/. This won the Stockholm Industry Water Prize recently, which is an indicator that it is a world-class project.

[13] See **Ashton, P.J., Hardwick, D. & Breen, C.M.** 2008.

[14] See **Naidoo, B.** 2009. Rising Tides: Massive Acid Mine Drainage Project Stimulus for Local Beneficiation, in *Creamers Mining Weekly*. July 31 – August 6. Pp 8 & 9.

[15] See **Oberholster, P.J., Botha, A-M. & Grobbelaar, J.U.** 2004 *Microcystis aeruginosa*: Source of toxic microcystins in drinking water. *Africa Journal of Biotechnology* 3: 159-168; and **Oberholster, P.J. & Ashton, P.J.** 2008. *State of the Nation Report: An Overview of the Current Status of Water Quality and Eutrophication in South African Rivers and Reservoirs.* Parliamentary Grant Deliverable. Pretoria: Council for Scientific and Industrial Research (CSIR).