

Understanding Peak Water as a Risk
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Let me start with these two photographs.

On the right hand side, you have a classic South African photograph. This is a standard electricity generating unit, what we call a 6-packs of Eskom. And the river in front of it is the Olifants river. The entire river is artificial: it has been captured from Mozambique and pumped over the watershed divide and it is now part of the energy platform in South Africa. That will have to change after Peak Water.



On the left hand side, you can see a classic water sewage treatment plant. At the moment we call it sewage disposal work, and we treat it as “dirty water” and we throw it away, but this will also have to change after Peak Water, because it will become a “water recovery work.”

Introduction : Understanding Peak Water as a Risk and Opportunity

What has water got to do with energy and food? It is the main question in South Africa.

Because the Republic of South Africa (RSA) is a water-constrained mining-based economy with a specific history, these three seemingly disconnected items are intimately linked. In the next 3–5 years, the economics of water, energy and food will change the way we currently thinkAnd a new term will emerge – « Peak Water ». Some people already talked about Peak Water, such as P. Gleick.

This notion is based on the original idea of Peak Oil. Specialists think that we are going to reach Peak Oil by 2015. The main assumption of this peak oil model is that prior to the “Peak” the economy is demand-driven and the “Business Model ” is simply replicated. The big companies, founded 100 years ago, inherited the business model, and they just refined it. But after the “Peak” the economy is supply-constrained, and a subtle shift occurs. They cannot simply replicate the “Business Model” which has to be re-invented. We are going to see after the Peak a kind a new Industrial Revolution, with new ideas coming from brilliant “maverick” engineers, like Eiffel during the first industrial revolution when he built the Eiffel Tower. But big companies such as Anglo American have become risk adverse, and they no longer embrace risk. The executives have defined what is a perfect person and they just duplicate, clone it, and they are not allowed in their thinking to welcome the “mavericks”.

This means that the logic underpinning our national and regional economy, which is basically extractive and never been designed to be sustainable¹, will change in a fundamental way. What we are doing now is great for the last century, but we won't be able to continue in the same way.

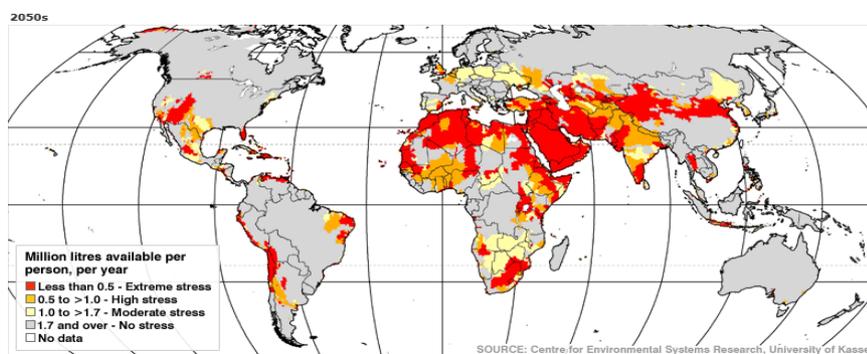
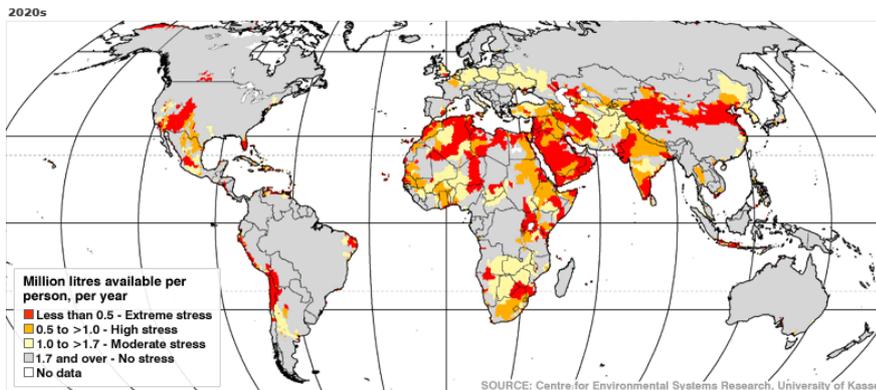
This will bring risk, and the risk is possibly going to be catastrophic, but it is also going to be an opportunity.

¹ I think for instance about the city of Johannesburg which is situated on a watershed, based on gold mining, and which ran out of water short after its foundation in 1886, and now rely on water coming from Lesotho

1/ Water Scarcity and the hydrosocial contract

1.1 The classical approach on water scarcity.

A classical approach of water scarcity is given by M. Falkenmark with the Water Scarcity Index. Water scarcity is related to population growth as much as it is related to environmental factors. Originally, it was calculated at the national level. The next figures are drawn at the river basin level.

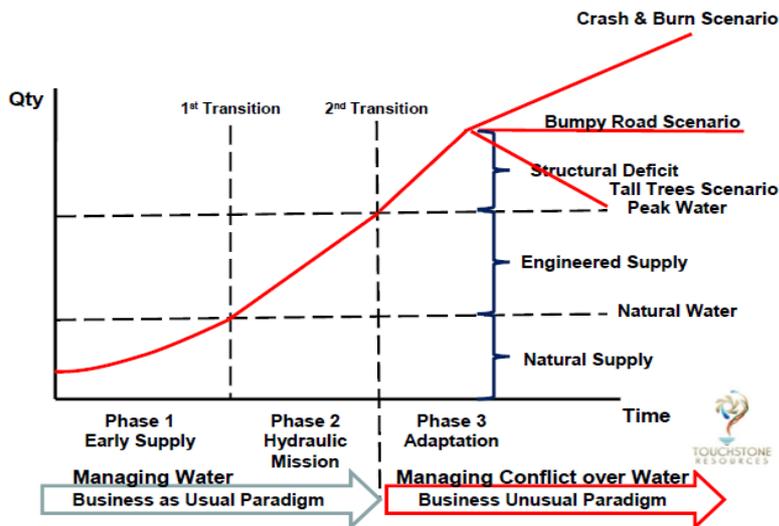


In the early 1990s, Southern Africa began to water stressed. In 2020, the Cuvelai and the Limpopo River Basin's both pass into extreme stress because of population growth. It is noteworthy that 80 % of the South African economy, which represent 18% of the total African GDP and 34 % of sub-Saharan GDP, take place in two river basins, the Limpopo and the Orange River. In 2050, the Orange River Basin will join the Limpopo as extremely stressed systems. In our lifetime, we are going to see a fundamental change : at this stage the most economically active portion of South Africa will resemble the Middle East and North Africa.

The question is : are we going to see failed states ? If you look at the map, you can see Somalia, a typically “failed state”, Kenya, which is also possibly becoming a failed state, Rwanda and Burundi. By the year 2025, 1.8 Billion people will be living in conditions of Absolute Water Scarcity (1,000 m³/p/a Falkenmark), two-thirds of the global population will be living under conditions of Water Stress (1,700 m³/p/a Falkenmark). When you are water stressed, that mean that you are vulnerable to droughts and floods. Southern Africa is highly vulnerable. But the South African government does not want to take this issue seriously, he believes that this is all propaganda. I try to show that is not a national issue, but a regional and global problem, and that I am not blaming any specific government. But I believe also that in a country where 25 % of the work force is unemployed, experimenting xenophobic violence, social stability will be a growing issue.

1.2 A new vision of the « Hydrosocial contract ».

I am getting back to Peak Water and its links with water scarcity. In 1999, when I was based in London and working with T. Allan, I was thinking to the Southern African situation and the link between water and development. I came to the conclusion that we can understand this link by studying two key points. The first step is to understand the natural endowment of water. In the case of South Africa, the endowment is very scarce. After the Anglo-Boer war, in less than a decade, we started to outstrip the local supply. And we went through the first transition, where demand starts exceeding the natural available supply, to second phase, “the hydraulic mission”, like in Spain, USA, Egypt, Turkey... which is a fairly universal concept.



The second line defined the water that you can engineer. In the 1999 version of the Hydrosocial contract model, I called it the water deficit line, and I changed it now to “peak water”. It underlines the radical change between phase 1 and 2 on one side and phase 3 of the Hydrosocial contract on the other side. When you go across the second transition, you arrive in a structural deficit situation. In the first two phases, the point is to manage water with “business as usual” paradigm. A paradigm is not neutral, it organises the way we ask question and give answers. During the phase 3, we will have to modify the paradigm, shifting to an “unusual business” paradigm, and we will have to manage *conflicts over water*. But during the first stages of third phase, we will continue to use phase two paradigm, going deeper and deeper into deficit, until a crisis happens. At this point, something has to change, and three scenarios are possible :

- “crash and burn scenario”, if we continue to do the same, leading to a catastrophic situation;
- “bumpy road scenario”, if the behaviour is modified, but slowly; big companies are adapting, but without a governmental big plan and strong leadership;
- « tall trees scenario », where you get visionary leader emerging taking the problem, and changing the way we deal with water, food, energy.

South Africa is now in an “experimental” situation, heading to crash and burn scenario (at worse) or bumpy road scenario (at best). As for example, for the first time in years, the RSA is importing food; it was until recent years a major regional exporter. And six month ago, there were the first riots in Mozambique after the war, induced by the rapid rise of prices of food, of water and energy. The water/food/energy nexus is becoming critically important in this “peak water” scenario.

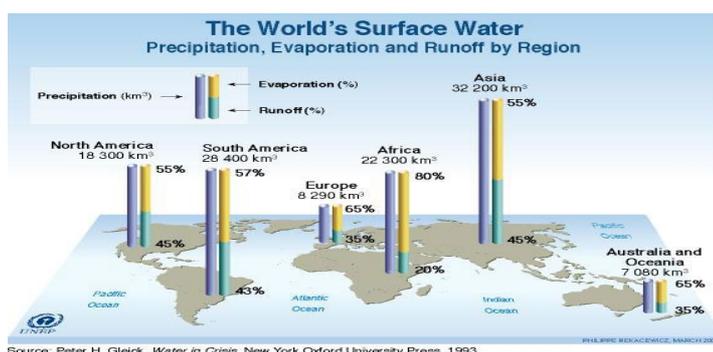
1.3 Shifting from “capturing stream flow” to “chasing evaporation”.

If you go a little bit further, you can see a fundamental problem in Africa : it has the lowest conversion of rainfall to runoff in the world, 20 %. Even Australia, which is a very dry continent, as a better conversion rate (35 %). Now Africa’s fundamental development constraint is the conversion of precipitation (MAP) to runoff (MAR)

In the case of South Africa, the mean annual runoff (MAR) to mean annual precipitation (MAP) conversion is a paltry 5.1% in the Orange and Limpopo Basins; and a meagre 3.4% in the South African portion of the Orange River Basin. But this meagre runoff is the hydrological foundation of our national economy.

The 1st Transition in the model is about to capturing streamflow in dams and chasing “blue water”, in order to get Assurance of Supply. The dams capacity in the RSA is now 2,7 time bigger that the mean annual water flow in the Orange.

After the second transition, we are now chasing evaporation or green water and managing social stability, by doing differently using for instance groundwater recharge. The objective is then to stimulate new ideas and “soft resources”.



Source: Peter H. Gleick, *Water in Crisis*, New York Oxford University Press, 1993.

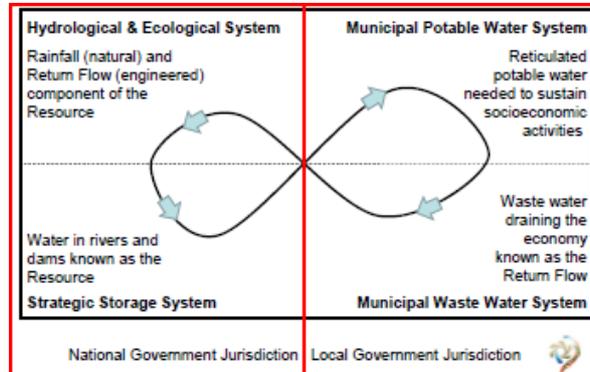
2 Water in the social economic metabolism.

2.1 Water in the economic cycle

The main problem that I will address now is that water is a flux that we manage like a stock. This is quite a difficult point to understand, and I will try to explain it with the next figure.

In the centre, you can see the symbol of infinity, water going around this cycle indefinitely.

You can superimpose 4 different systems.



1/ Hydrological & Ecological System. It consist of two components. The first one is Rainfall, and you can't change it (although it will change with global climate change). The second is the Return Flow (sewage water) which is the engineered component of the resource, and which in certain conditions (treatment) is able to go back to the resource.

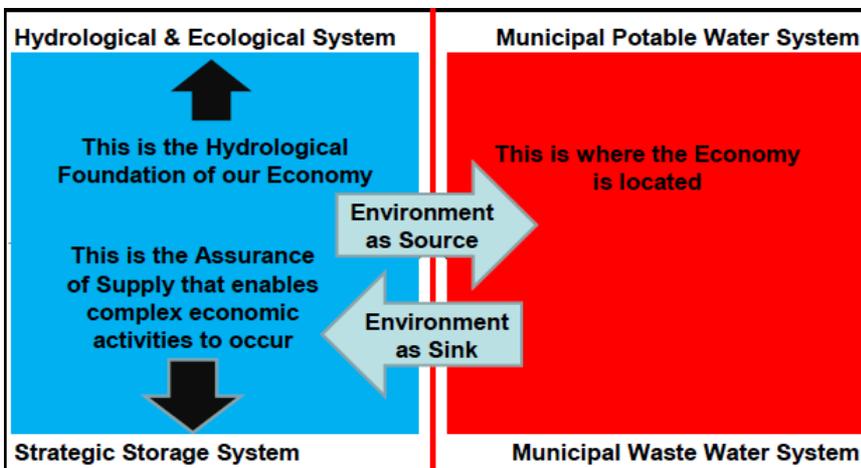
2/ Strategic Storage System : Water in rivers and dams known as the resource. South Africa is in the top 20 country for dam storage capacity in the world.

3/ Municipal Potable Water System : Reticulated potable water needed to sustain socio-economic activities. In the RSA, there are millions of pipes of different size, not well maintained and repaired, now leaking...

4/ Waste water draining the economy known which goes possibly back again to the resource as return flow. In the post peak economy, this fourth phase become more and more important. But it could be also very problematic. In the Limpopo province for instance, as there is absolutely no proper treatment of return flow, recent research shows that 10 % of the babies are born with both male and female genitalia.

1 and 2 are under National Government Jurisdiction, 3 and 4 are under Local Government Jurisdiction. And they did not talk to each other properly. The water boards, such as Rand Water Board, are active in the four sectors.

The national economy is based on the hypothesis of continuous economic growth, and without growth, in the capitalist paradigm, you have economic catastrophe and social unrest. This growth rely on the insurance of water supply. It sees the environment as a source and use it as a sink. On the other hand, the ecosystems are based on dynamic equilibrium. But at some point, this has to break, because you cannot have infinite growth based on a dynamic equilibrium system.



During the "hydraulic mission" phase of the hydrosocial contract, the main objective of the state as a dam builder was to dissociate the hydrological and ecological system and the economic system. It was very successful in South Africa,

and less in other African countries. The limited growth of Kenya for example, could be explained because it was unable to decouple its economy from the rainfall variability.

But now, in the post peak phase, this dissociation is not possible any more, and we are going to acknowledge the “recoupling” of the economic and hydrologic cycles. We are going to be more vulnerable. The environment as a source will become more expensive, and the environment as a sink will also evolve dramatically. As the Hydrological and Ecological System is overloaded by effluent, water will increasingly become a limiting factor as quality deteriorates and developmental aspirations cannot be met.

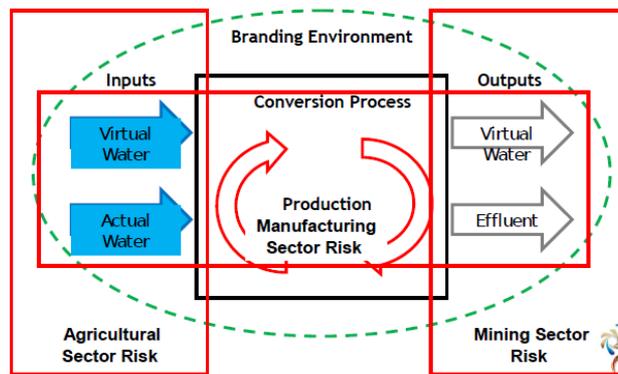
2.2 Understanding water as risk.

As shown in the figure below, in the actual phase of water increasing scarcity, it is not possible any more to dissociate the two sectors. A new business model will have to emerge.

Companies are transforming inputs in outputs. In the inputs, you have “virtual water” and actual water. In the outputs, you get virtual water (water embedded in the products) and effluent. SA Breweries has made study comparing beer processing in RSA and Czech Republic, for the same product and same process. It shows that for producing 1l of beer in SA, they need 340 of water, against only 80 in Europe. The reason is because in RSA you have irrigation water coming in, and that your effluent have to be more diluted as the stream flow is very low. Water is becoming a comparative disadvantage for the RSA.

The agriculture sector is at risk at the upstream side, and the manufacturing/mining sector is at risk at the downstream side.

Understanding Water as a Risk



2.3 Water and risk in South Africa

The situation is already tense in South Africa, and the prospects are quite dramatic, as shown in the next table for the four major river basins.

Percentage Increase in Water Needs by sector - 2025 (Ashton, 2009)

River Basin	Urban	Rural	Irrigation	Mining + Industry	Power Generation	Forestry
2000 to 2025						
Orange-Senqu	+ 77	10	7	10	+ 37	0
Limpopo	+ 146	+ 27	+ 9	+ 30	+ 26	+ 3
Incomati	+ 145	+ 3	+ 5	+ 5	0	+ 5
Maputo	+ 126	- 3	- 3	+ 1	0	- 4

The RSA is expecting a dramatic increase in urban sector demand for water in all basins. The Limpopo River Basin is faced with a 251% increase in demand by 2025, but it is already closed out so conflict is inevitable.

Some of the Inter-Basin Transfers currently sustaining the South African economy are alleviating the problem, but for the major basins the future is bleak.

The Berg river basin will experience a deficit of 508 MCM by 2025 in terms of High Scenario; desalination & recycling could be a solution.

The Mvoti–Umzimkulu system will experience a deficit of 788 mcm by 2025 in terms of High Scenario, along with huge problems related to dense population and important agro-business companies, such as poultry. Desalination & recycling could be a solution.

The Upper Vaal will experience a deficit of 764 mcm by 2025 in terms of High Scenario. Here, far from the sea, solution could be Reverse Osmosis & recycling.

And finally, only the Crocodile West & Marico will have a surplus of 335 mcm by 2025 in terms of High

Scenario..

At national level by 2025, the total water resource will be in a deficit of 2,044 mcm in terms of the High Scenario. But water is NOT a priority in the Presidency

In conclusion for this part, these are the risks Arising from Peak Water :

- Assurance of Supply will be the first casualty and in-house storage and processing will emerge.
- Pricing of water will escalate both upstream and downstream of the plant.
- Regulatory environment will change.
- Discharge standards will become more stringent.
- Comparative advantage will become relevant.
- Ingenuity (the capacity to re- invent core processes) will become the key driver.
- The normal Business Model will be adapted.

3. *The way forward.*

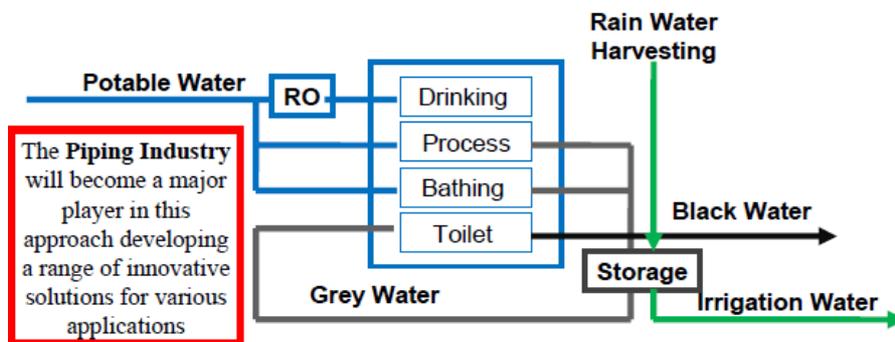
3.1 *Opportunities from Peak Water*

The second transition will also bring a set of opportunity. Here is a list of a few of them :

- Recycling technologies will become key.
- Both mine water and sewage flows will become a resource rather than an effluent.
- Phosphate removal will become key.
- Dual Stream Reticulation will evolve : we will not have on water quality one price.
- Different streams of different qualities at different prices at different levels.
- Reputational Risk will be mitigated by environmental branding. Big companies such SAB Miller of Anglo American already make massive advertising campaigns clean up their reputation.
- Green-washing will fail because sustainability will become a key board room issue.

3.2 *The “business unusual paradigm” : the dual stream reticulation.*

The Dual Stream Reticulation will be a key element of the Business Unusual Paradigm.



The Piping Industry will become a major player in this approach developing a range of innovative solutions for various applications. This system recognizes multiple sources of water, natural, municipal and commercial. This approach recognizes multiple uses for water based on different assurance of supply considerations. Water is treated like a flux – used at different grades for different purposes multiple times – and users become custodians rather than consumers

3.3 *The WEALTH model.*

We need a new national vision that is based on the WEALTH Model (Water, Energy, Agriculture, Leadership, Technology, Health). The core element is the water-energy-agriculture nexus, and we need to make strategic trade-offs between these elements. But for that we will need Leadership and Technology that we don't have at the moment. This WEALTH model could enable us to link our water, energy and food security strategies and thus lead to national well-being. If you focus on WEALTH then an emergent property is Health (human and ecosystem).

Conclusion

Water is a growing but complex source of risk to the national economy (referent object). The Old Paradigm (Business as Usual) of Externalizing Costs is no longer sustainable. The New Paradigm (Business Unusual) will need new thinking on:

New Water (Dual Stream Reticulation with WWTW's as a source)

New Energy (Hydrogen, Geothermal, Solar, Wind)

We need to merge three policy debates: National Water Security, National Energy Security and National Food Security. Sustainability in the New Paradigm will depend on reaching sensible trade-off's between these three strategic issue-areas.