The State of Water Resources in Southern Africa: What the Beverage Industry Needs to Know

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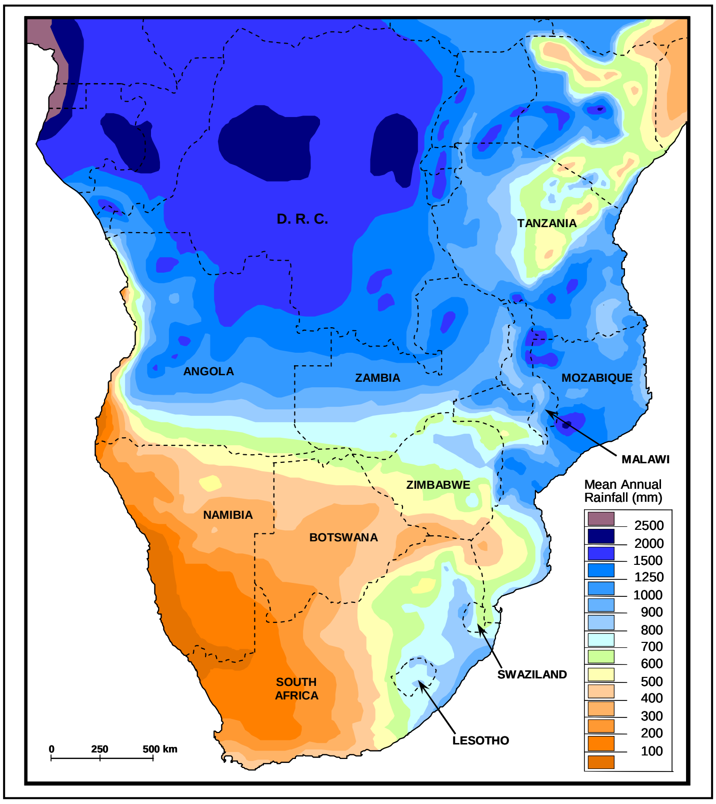
Current State of Freshwater Resources in the Southern African Region

Water is a strategic natural resource which, by virtue of its fundamental physics and chemistry, is fugitive in nature. This means that unlike any other natural resource (gold, coal, oil and iron ore), it is not a stock, but rather a flux. These two fundamental elements of water – the fact that it is a **flux** and that it is **fugitive** in nature – means that it is "special", so **if managed correctly it can become a renewable resource**.

The volume of water on earth is a constant over time, but the physics of the earth dictate that it is available at any one time in three forms – solid, liquid and vapour. The distribution of water is determined by physical elements which combine to be called the "hydrological cycle". It is this hydrological cycle that determines the spatial and temporal distribution of water across the Southern African region. Map 1 shows the distribution of precipitation across Southern Africa. From this image it is clear that the spatial distribution of precipitation is not even, with a steep gradient from north to south and from east to west, leaving the four potentially most economically diverse countries – South Africa, Botswana, Namibia and Zimbabwe – all on the "wrong" side of the global average of 860 mm/yr^{-1}.

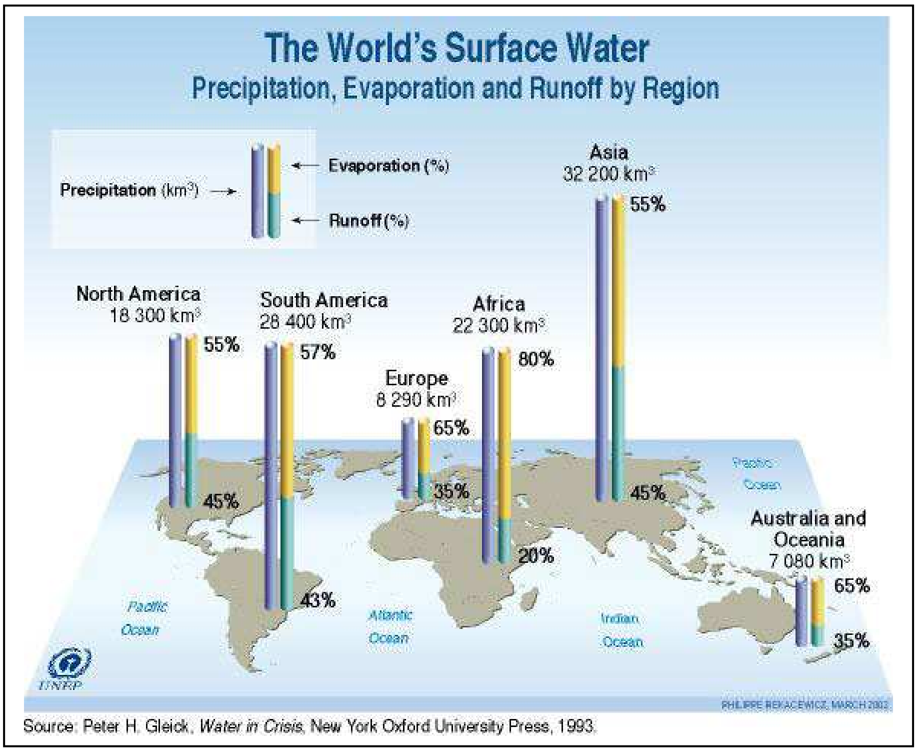


Map 1. Spatial distribution of Mean Annual Precipitation (MAP) across Southern Africa (courtesy Prof. Peter Ashton).

From this it is evident that **water availability is a limiting factor for future economic growth and development unless the management of the resource-base is conducted in a responsible manner that is informed by a robust scientific process**. Arising from this fundamental fact there are three distinct elements that make the business risk associated with the management of water assume a peculiar strategic profile that is not consistent with other parts of the world. These are:

Strategic Fact No 1 - The MAP: MAR Ratio

As a result of the peculiarities of the hydrological cycle in Africa, the ratio of water that eventually becomes a river (Mean Annual Runoff abbreviated as MAR) arising from water originally falling to earth as precipitation (Mean Annual Precipitation abbreviated as MAP) is the lowest in the world as shown in Map 2.

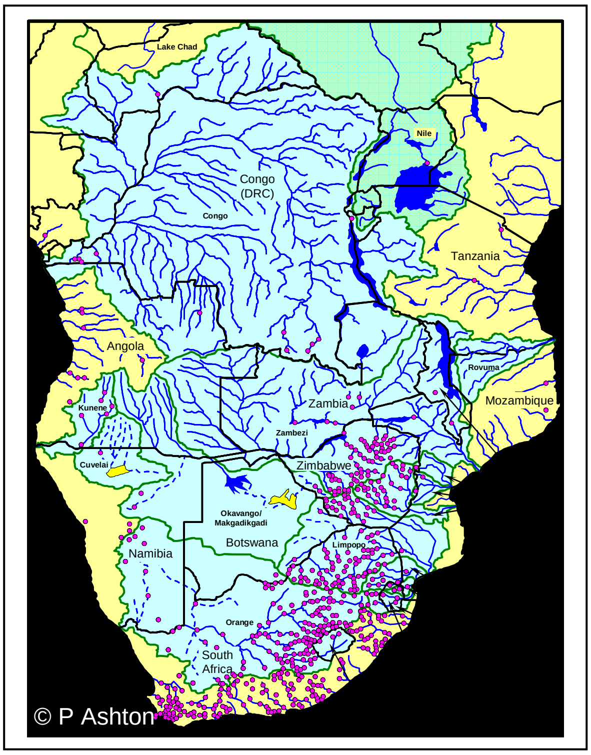


Map 2. The conversion of water falling as rainfall (MAP) to water finally ending up in rivers (MAR) leaves Africa with the worst ratio in the world (UNEP).

It must be noted that the figures shown on Map 2 are a continental average. When comparing this to the precipitation patterns shown in Map 1 it is evident that the central portions of the continent are extremely well-watered, which means that the semi-arid areas (typically those found across Southern Africa), have a much lower conversion ratio. In fact, the conversion ratio of MAP to MAR in Southern Africa is on average a paltry 10%, but this occurs in a range from near zero to around 15% in specific river basins. **It is this poor conversion ratio of MAP to MAR that is a fundamental development constraint in Africa**, giving the continent a specific risk profile that is generally misunderstood. It is this aspect that has given rise to the World Bank referring to development in Africa as being a "hostage to hydrology". It is also for this reason that Global Climate Change is such a serious issue for the region, because even small perturbations in the current distribution of moisture from the Inter-Tropical Convergence Zone (ITCZ) down to South Africa, Namibia, Botswana and Zimbabwe, can cause major shifts in this final conversion ratio (a phenomenon known technically as non-linearity). **This translates into uncertainty and consequently risk that needs to be appreciated and managed** if industrial development is to be viable and thus sustainable over time.

Strategic Fact No 2 – Centres of Economic Development

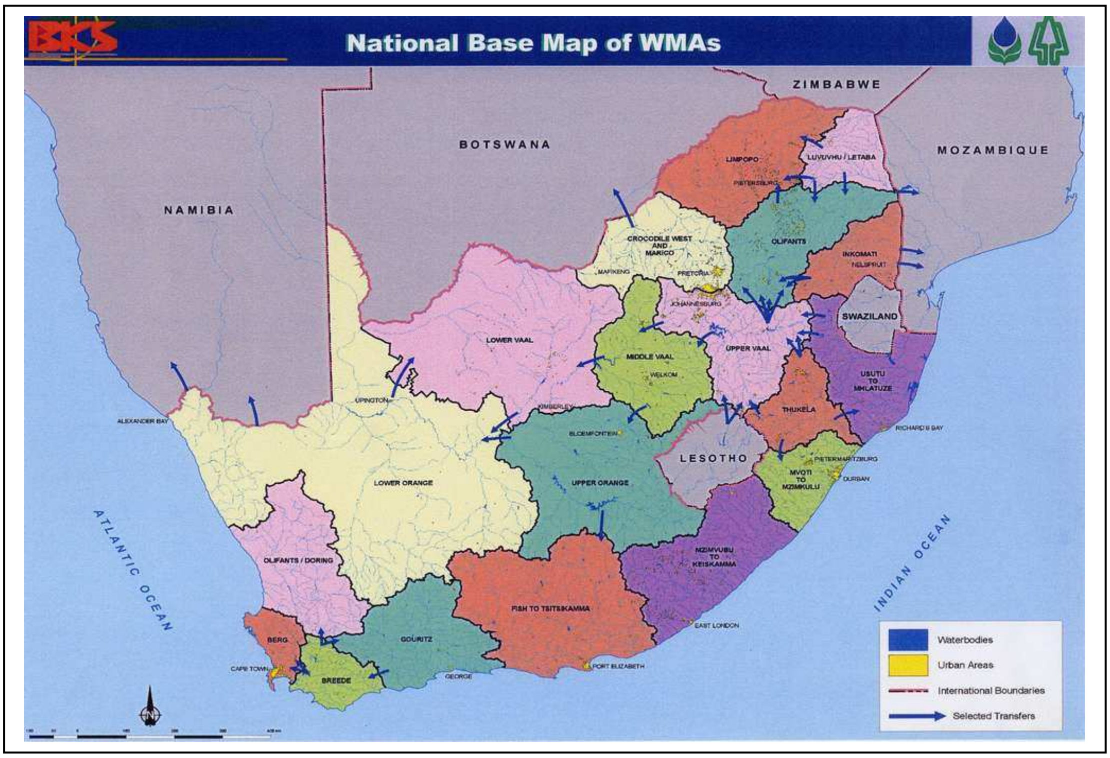
Given the specific pattern of precipitation across the Southern African region, there is another peculiar driver of risk associated with water resource management. Most of the early industrial development in the region was driven by mining, which means that the geographic location of the centres of development was not dictated by water availability. Stated differently, the natural drivers of development were access to mineral deposits, some of which are associated with geological features occurring on or near to watersheds. **Arising from this has been a peculiar developmental pattern where large cities or centres of development are located on watersheds**. Thus we have Johannesburg, Pretoria, Bulawayo, Harare, Gaborone, Francistown and Windhoek, all located either on, or very close to, major watershed divides. This is totally at odds with the rest of the world, where most major centres of development are located on rivers, lakes or the seashore. One of the consequences of this is that the major towns associated with mining were never designed to be permanent or sustainable. So one of the elements in the risk profile is associated with the need to manage a transition from a non-sustainable extractive industry (mining) into a sustainable industrial-based local economy centred on existing cities. This is a highly complex problem that is not yet fully appreciated by all key decision-makers.



Map 3. Distribution of large dams across Southern Africa as an element of the management of the high assurance of supply level needed to sustain economic development in a water-constrained region (courtesy Prof. Peter Ashton).

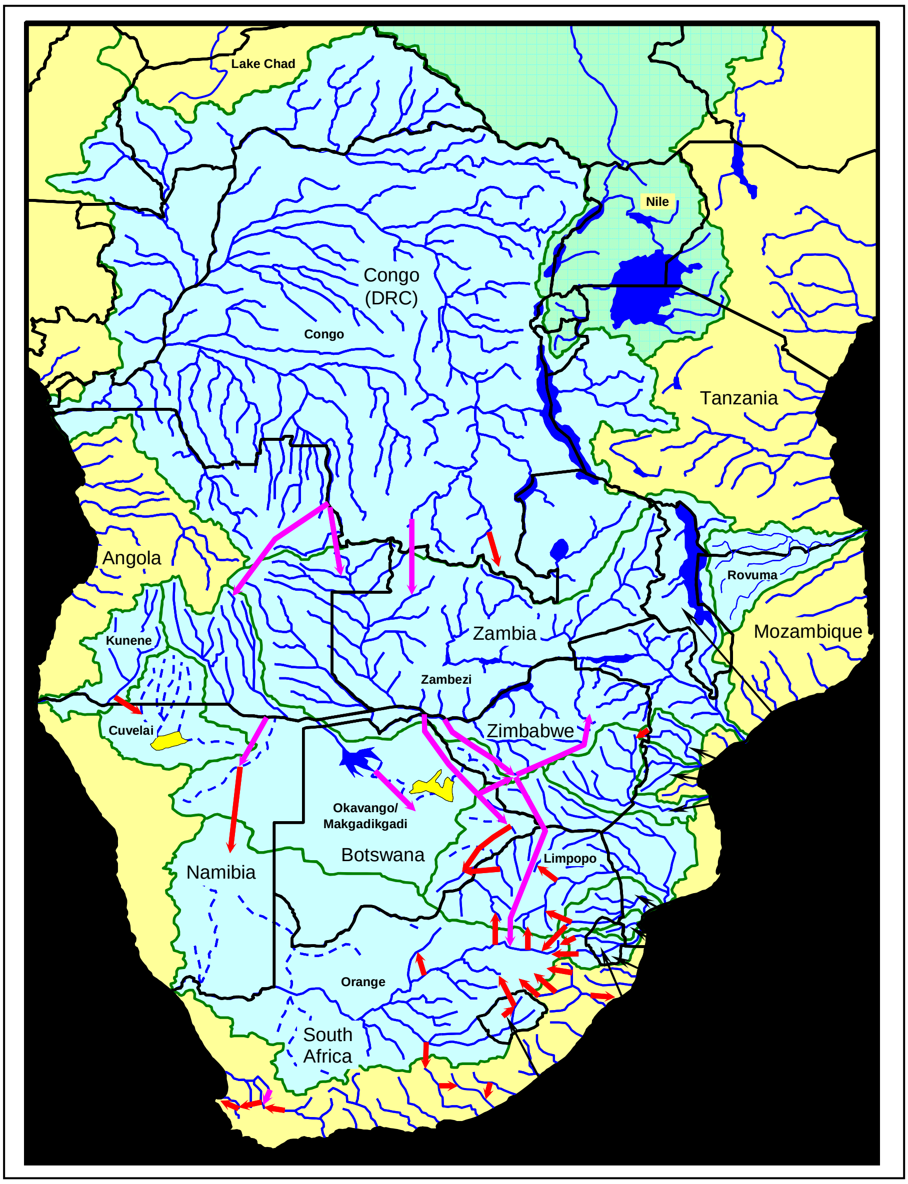
The way that the problem has been managed to date is to develop hydraulic infrastructure such as dams, pipelines and Inter-Basin Transfers (IBTs). The best example of this is the Gauteng area that houses around 25% of the total South African population and generates around 10% of the economic output of the entire African continent. This level of economic output is 100% reliant on IBTs (with some minor exceptions – Tswane does have access to some groundwater for example, but also receives a lot of the sewage return flows out of Johannesburg). Map 3 shows the spatial distribution of major dams across the Southern African region, with the densest population of infrastructure being found in South Africa and Zimbabwe, closely associated with the economic potential of those specific countries.

This massive investment in hydraulic infrastructure has established the high assurance of supply needed to attract and sustain the industrial partnerships needed to drive sustained economic development in the region. It is therefore instructive to note that the IBT system in South Africa is highly developed as shown in Map 4. This comes from the decision to manage water as a national-level strategic resource, rather than as a local-level resource, taken after the findings of the *Commission of Enquiry into Water Matters* tabled its final report as long ago as 1970. This has major implications for the economic development of the entire Southern African region and is an example of what the World Bank calls overcoming the constraints imposed by being "hostage to hydrology". The challenge facing the Southern African Development Community (SADC) is how to manage water at the regional level for maximum benefit to all of its Member States.



Map 4. Major Inter-Basin Transfers in South Africa sustain the national economy and mitigate the constraints of what the World Bank calls "difficult hydrologies" (courtesy of DWAF).

It must be noted from Map 4 that some of the water arising from this infrastructure goes from South Africa to neighbouring states, sustaining local economic development in southern Namibia and around Gaborone in Botswana. Significant new IBTs are being mooted to create a stable water supply platform within SADC in future (see Map 5).



Map 5. Existing (red) and planned (purple) Inter-Basin Transfers within the SADC Region designed to establish the stable water supply infrastructure needed to create sufficient assurance of supply on which future industrial growth and economic development can be built (courtesy Prof. Pete Ashton).

Strategic Fact No 3 – Management of Return Flow

As a direct result of the interaction between Strategic Facts No 1 & No 2, we are confronted by a third issue that is somewhat unique to the Southern African region. **Given that the centres of development are mostly on watersheds, the management of effluent return-flows becomes a critical issue.** Stated simplistically, these major centres of development are located upstream of their water storage infrastructure, or crudely put, their sewage flows naturally into their drinking and industrial process-water. For this specific reason the management of return flows becomes a major challenge, compounded by the fact that **we have reached the point where our developmental demands are outstripping our capacity to supply water at the necessary assurance of supply level to sustain industry**. For example, the National Water Resource Strategy in South Africa determined that by 2004 (using data from 1998) around 98% of the total national resource had been allocated, with a number of Water Management Areas (WMAs) being over-allocated by as much as 150%. It is also significant to note that historically it is not water scarcity that has threatened major irrigation-based civilizations, but rather a salts build-up. So the critical risk that needs to be managed is the build-up of salts, nutrients, cyanobacteria, heavy-metals, endocrine disruptors, carcinogens and radioactivity in rivers arising from the unregulated use of that water for industrial activities.

What are the Strategic Challenges to the Beverage Industry?

From this brief assessment it is evident that **there are three clusters of challenges that strategic-level managers will need to understand** if risk is to be mitigated and economic viability is to be ensured. These are as follows:

Cluster 1 – Managing Industrial Inputs

We can expect to have increased risks associated with water as an industrial input. These risks include (but are not restricted to) the following:

- Reduced water quality as a result of the **loss of the natural dilution capacity** of rainfall events driving stream-flow, which **will include a gradual increase in a range of salts, endocrine disruptors, cyanobacteria, carcinogens, heavy metals and radionuclides.** This will require increased investment in upstream water treatment plant in order to maintain a product of acceptable quality. This will impact on bottom-line profits.

- **The reduced assurance of supply** as infrastructure investment is either outstripped by demand, or stunted as a result of insufficient investment in maintenance, **will translate into the risk of unproductive down-time for industrial plant**. This will require investment in bulk upstream storage needed to maintain the assurance of supply level consistent with efficient industrial processing. Lessons being learned from the current electricity crisis will be valuable in this regard.

- **The increased cost of water** as economic incentives are introduced by regulatory authorities in an effort to improve overall efficiency of water-use **will impact on bottom-line profits**. This will require investment at the level of the factory designed to get the best possible yield from each unit of water used as a production input. This is known as End-Use Efficiency and it will need to be managed at the level of the individual production unit. The arising comparative advantage of individual corporations will be driven by the effectiveness and appropriateness of management interventions to this end.

Cluster 2 – Managing Industrial Outputs

We can expect to have increased risks associated with water as an industrial output. These risks include (but are not restricted to) the following:

- **Increased pressure on end-of-pipe water quality standards** as part of a water use licence application is to be anticipated. This **will result in increased investment in effluent treatment systems**, which in turn can impact on bottom-line profits. In this regard it must be remembered that effluent return flows from one industrial activity, will become inputs to another industrial (or social) process downstream, so in essence it is the need to manage water at a higher level of scale that will dictate the exact monetary impact of this driver.

- **All industrial outputs will become relevant, because air quality, specifically where sulphur dioxide (SO) and hydrogen sulphide (H_2S) is a factor, will also need to be managed to tighter standards.** Sulphur dioxide forms acid rain, reducing the quality of water far removed from a specific industrial hub, which is likely to become a key focal point of regulatory authorities. Again this is driven by the loss of natural dilution associated with a "closed" water resource-base (closure occurs when demands for water exceed the naturally available supply necessitating some active management intervention).

Cluster 3 – Creating an Enabling Environment for the Future

This is a complex cluster in which we can expect to have increased risks associated with the need to manage the unintended consequences of past practices on the one hand, while driving water use to unlock the efficiencies or benefits associated with higher levels of scale on the other. Part of this cluster will be Sectoral Water Efficiency (moving water from an economic sector with a low efficiency – typically agriculture – to an economic sector with a higher End-Use Efficiency). These risks include (but are not restricted to) the following:

- **The development of an effective mine closure strategy at national and regional level.** Current trends indicate that mine closure is associated with uncontrolled decant of water from the mine void. This water is highly contaminated, with a low pH (around 2 – 3.5) and a high sulphate (SO_4^{2-}) content, also containing a complex cocktail of heavy metals and radionuclides. While this is specific to the mining industry, given the loss of dilution and the fact that centres of development are generally upstream of water storage infrastructure, this has the potential of severely degrading the national-level resource and impacting on a wide range of downstream users. **Left unmanaged this will reduce the potential value of the water-resource as a strategic regional flux by reducing it to the status of a nationally-depleted stock.**

- **The development of an effective waste management strategy capable of integrating various elements at a national level to protect the resource.** Included in this are a national-level endocrine disruptor, heavy metal, radioactivity and cyanobacteria monitoring program that will need new partnerships between research-based organizations, corporations and government.

- **Substantial investment will need to be made in water treatment processes that reduce return-flow discharges of nutrients, salts and endocrine disruptors by orders of magnitude.** This will not be driven from overseas as in general Western industrialized-nations have not lost their dilution capacity and so the engineering design parameters are not cognizant of this need. This will mean the need to forge new partnerships between industrial, financial and research-based institutions and will place heavy demands on the science, engineering and technology-base of the entire Southern African region.

- **The policy processes associated with the need to unlock benefits and values arising from optimizing water use at higher levels of scale will create new partnerships between industry and government.** The need to unlock the real value of seeing water resources as a regional flux rather than a national stock will pose severe challenges to supra-national groupings like SADC. Central to this will be the need to invest heavily in policy-harmonization processes that balance sectoral needs at the national level with national interests at the regional level in an optimization equation of greater complexity than is currently the case. This is likely to drive new partnerships between industry, government, research organizations and donor agencies, placing a new burden on political and institutional organizations. This will also place a major burden on the science, engineering and technology-base of the Southern African region, specifically where this interfaces with government.

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