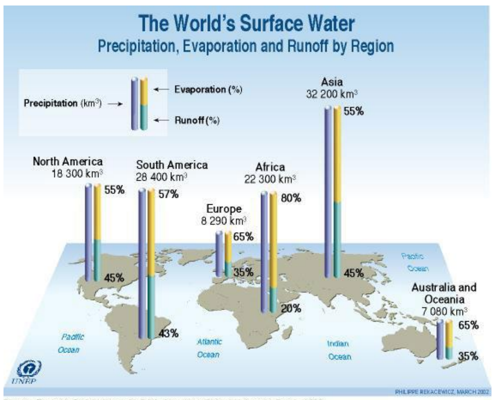
The Future of Water in Africa

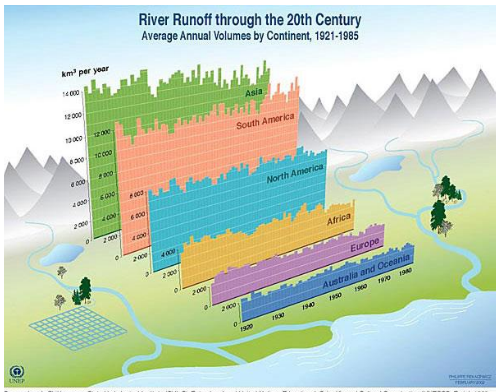
Understanding the Hydrology of Investment on the Continent

Dr Anthony Turton

If we accept that any economy has a specific natural resource foundation to it, then we can say that the investment case for continental Africa has a distinct hydrological element to it. Africa is unique globally, in that it has the lowest conversion of rainfall into runoff in the world. Rainfall is the origin of all water, and it plays a significant role in the production of food. But that is only a small part of the overall picture, because it is actually water in rivers that enables economies to grow and flourish. Managing water in dams is the infrastructural foundation of any economy in Africa because of a few unique aspects of hydrology.



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

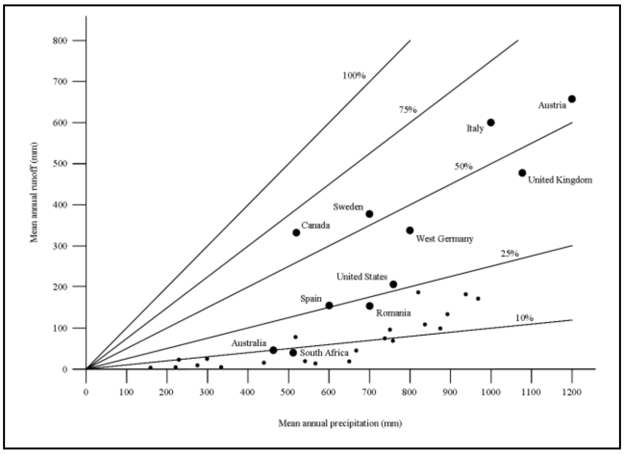


Source: Igor A. Shiklomanov, State Hydrological Institute (SHI, St. Petersburg) and United Nations Educational, Scientific and Cultural Organisation (UNESCO, Paris), 1999.

When compared to other continents, Africa only has a paltry 20% conversion ratio of rainfall into streamflow (water in rivers) as shown in the adjacent graphic. Note too that dry continents like Australia have a similar ratio to wet Europe, but nothing in comparison to the well-endowed Americas and Asia. The typewriter graph showing streamflow for all continents also reveals an interesting pattern with Africa at the low end of the global water distribution scale. This is only part of the picture however, because all rivers are not equal.

At continental level, Africa has sixty-four river basins that cross international political borders. It is significant that eleven of these African basins are endorheic and do not flow into the sea (Awash, Cuvelai, Daoura, Gash, Guir, Lake Chad, Lake Chilwa, Lake Natron, Lake Turkana, Lotagipi Swamp, Okavango / Makgadikgadi). The largest of these African endorheic systems is the Lake Chad basin, with the largest in the SADC region being the Okavango / Makgadikgadi, followed by the Cuvelai basin as a close second. This drainage pattern is unique where 15% of the river basins (expressed by number and not geographic size or magnitude of the hydrological flow) do not flow into the sea.

If one takes the Southern African Development Community (SADC) portion of Africa as an example, then this fact becomes patently obvious. The SADC region covers fourteen sovereign states, two of which are islands. The twelve mainland African states are linked by twenty-one river basins that cross international political borders, fifteen of which are considered to be the most important in terms of socio-economic development. The SADC region is characterized by a specific hydrological regime, made more complex by the fact that the majority of the area lies between the Inter-Tropical Convergence Zone and the Southern Ocean, both of which drive different patterns of weather and precipitation. The precipitation patterns are characterized by steep gradients from north to south and from east to west, with the most currently economically diverse countries being on the "wrong side" of the global average of 860 mm/yr^{-1}.



The conversion ratios of mean annual precipitation (MAP) to mean annual runoff (MAR) in the SADC region are shown in this graphic. The small dots represent specific river basins in the SADC region, with the large dots representing non-African reference countries by way of comparison. South Africa, for example, receives the same MAP as Canada does, but the latter has a far greater MAR by virtue of prevailing environmental factors. The key difference is the loss of water to evaporation after falling as precipitation. Canada retains what falls, whereas South Africa loses most of what falls to the thirsty atmosphere. In SADC rivers are clustered around the 10th Percentile (redrawn from O'Keeffe *et al.,* 1992) which is among the lowest in the world.

It becomes more nuanced when one looks at specific river basins. Using South Africa as an illustrative example, of 100 units of rain falling over the geographic extent of the entire country, only 8.6 units ends up in the average river. However, if we repeat the same exercise for the Limpopo and Orange River basins – both critically important for the regional economies of South Africa, Lesotho, Namibia, Botswana, Zimbabwe and Mozambique – of 100 units of rainfall over the geographic extent of these basins, only 5 units ends up in the river. If one calls the 5 units of rain that become 100% of the streamflow in the Orange River basin, then we are surprised to note that we have built dams capable of capturing 270% of that. In short we have almost three times as much storage capacity in the Orange River than we have in an annual average natural flow, and more dams will merely increase the evaporative loss as global warming changes the already delicate balance between rainfall and runoff.

This set of nuances opens a specific dimension to the investment case, because the traditional infrastructure model based on dams is not entirely appropriate to all parts of Africa. If our hydrologically-defined development constraint is our poor conversion of rainfall to runoff, then the future investment will increasingly be focussed on two different models.

The first area of future investment is the creation of basic infrastructure where none exists. Dams, pumps, pipelines and water treatment plant are the very foundation of any economy. Their core function is to decouple the economy from the vagaries of nature. Major investment opportunities exist in almost all countries other than South Africa and Zimbabwe, with both being listed among the top twenty countries globally in terms of the number of large dams they already have. This investment model will be the traditional one involving large sums of money loaned to sovereign states for the development of specific projects.

The second area of future investment is the next generation of bulk water recovery and storage, which is likely to become the cutting edge of smart investment. Next generation sewage treatment plants are coming online and their performance is truly phenomenal. Capable of recovering potable quality water from sewage, this unlocks a market with vast potential. In South Africa alone, that market is conservatively calculated at around 24 billion cubic metres (BCM) of water per annum. This is massive when compared to the current national strategic storage capacity of 38 BCM, assuming that all dams are performing as designed and have not silted up. A sub-set of this new trend is the emergence of the need for uninterrupted water supply systems (UWSS), driven by the breakdown of service provision exacerbated by extreme drought. These UWSS systems are being developed for private sector clients, for which water disruption will increasingly be seen as a financial and operational risk to be managed like any other. This unlocks a different investment model that is as yet poorly defined but starting to precipitate out as various actors converge in this space. Given that both package sewage recovery plant and UWSS systems have defined economic values, are movable but underpinned by a known life cycle and are produced by reputable companies, they can be rented or leased like any other movable asset. More importantly, the growing scarcity of water will drive the cost up, making it increasingly necessary to optimize the management of both water and waste from a financial perspective alone. This is a game changer in the investment environment that will increasingly be refined as new players enter the market. More exciting than this, is the emergence of next generation technology that will see water being stored in underground aquifers, safe from the ravages of a thirsty atmosphere, where it can be banked for decades. Current experimental work in Perth will soon recover 120 million litres a day from the sewage stream at Beenyup Waste Water Works and bank it in the Leederville Aquifer for future use. This is truly trail-blazing and deserves to be monitored by savvy investors.

The convergence of drivers like global warming, population growth and changing levels of food security, will increasingly mean that water is more contaminated and scarcer than before. Actual water scarcity will be defined in terms of quantity while induced water scarcity will be driven by deteriorating quality, both of which will drive the cost up. This is already unlocking technology, underpinned by business models that differ fundamentally from those seen in the past. Emerging rapidly from this is a new investment landscape into the water sector of Africa that any savvy investor needs to be aware of. These drivers are so strong, that increasingly states will be unable to cope on their own, giving rise to various permutations of a public-private investment scenario. The private sector case is already emerging in South Africa, where rental and lease options are being rolled out for the first time in both UWSS and sewage management. The real challenge is to generate plus-sum solutions in which the political sensitivities triggered by the intrusion of the private sector, into what has traditionally been the sole domain of the public sector, is managed in a way that does not trigger trade union or civil society protest of a ferocity that can derail investment.

The African water sector is a truly exciting place for savvy investors with a healthy appetite for risk.