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Water insecurity in Johannesburg and beyond

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Water insecurity in Johannesburg (and beyond?)

Significance:

This Commentary draws upon news and other published information primarily from the last few years. The purpose of the article is to demonstrate that the water sector is complex, and that it sits at the interface of politics, science, engineering, social and behavioural science, economics, and public health. The lack of attention paid to maintenance and upgrades in the water sector, whilst demographic shifts occur, has resulted in water insecurity in South Africa's most populous province – Gauteng. The long-term prognosis for this situation is not good, unless we can mobilise society towards changing its understanding of how to fully reuse water and embrace the reuse of fully treated sewage. This represents a challenge that may take some time and will certainly require all the disciplines (and more) listed above.

Introduction

South Africans are familiar with load shedding. It has been a part of life since 2007 when we first experienced rolling blackouts as a result of insufficient capacity of the electricity supply grid. South Africans are also quite resilient; and over the last two decades, we have come up with many strategies to cope with an intermittent electric power supply. These strategies have included various battery backup systems, various solar installation systems, and a major switch from electric stoves to gas hobs and from electric geysers to gas or solar-thermal geysers.

This experience of load shedding has become the normal way of life for most of us. Unfortunately, 'shedding' has moved beyond electric power and firmly into the domain of water supply. Gauteng, and particularly the Johannesburg Metro, has started to be subjected to significant occurrences of 'water shedding'[1] or intermittent water supply (IWS).

South Africa has engineered effective systems to reduce and prevent water insecurity. Systems of dams and inter-basin transfer schemes have been built[2] across southern Africa to continue supplying water to primarily Johannesburg (and Gauteng), the industrial heartland of the country and the centre of South Africa's population mass[3]. This strategy was highly effective at ensuring water security, until very recently.

IWS is not only a South African phenomenon. Approximately one billion people globally have water connections which regularly undergo IWS.[4] The regular occurrence of IWS in Johannesburg is, however, a new phenomenon. IWS as a strategy for managing water supply has serious negative consequences, including increasing residential (i.e. household) capital outlay for water storage through the need for additional capacity, such as JoJo tanks and booster pumps[4], causing damage to the distribution network[5], and compromising the quality of the water, particularly with regard to its microbiological profile[6-8].

IWS in Gauteng – is this a scarcity or security issue?

Water scarcity is defined as an excess of water demand over available supply. This is generally signalled by an unsatisfied demand or tensions between users or competition for water or overextraction of groundwater and insufficient flows to the natural environment.[9] The definition of water security, according to United Nations Water, is[10]:

> *The capacity of a population to safeguard sustainable access to adequate quantities of acceptable quality water for sustaining livelihoods, human well-being and socioeconomic development, for ensuring protection against waterborne pollution and water related disasters and for preserving ecosystems in a climate of peace and political stability.*

In South Africa, water security is ensured by the Department of Water and Sanitation (DWS). They allocate water based on the population of a region and the availability of water in the storage systems (i.e. dams). This allocation is sold by the DWS to the bulk water utility (Rand Water for Gauteng, including Johannesburg) which treats it to obtain a potable quality. Rand Water sells this fresh potable water to a number of metropolitan municipalities (for Johannesburg the metro entity is Joburg Water), which then sells it onwards to consumers. There is currently, however, a mismatch between what the DWS sells and what is needed, as the DWS is responsible for supplying both current and future needs. South Africa, and particularly Johannesburg, is not currently water scarce (although this could change quite rapidly if we were to experience a day-zero type drought), but is currently very water insecure.

Johannesburg is located on the African continental divide at an altitude of approximately 1600 metres above mean sea level and has no large rivers or natural water sources. As a consequence of its geographical location, all its water is imported. To continue to maintain water security, additional dams are being built in Lesotho as part of the Lesotho Highlands Transfer Scheme. Unfortunately, the construction of these dams has been delayed by 8 years. This delay coincides exactly with a period in which Gauteng grew from 12 million to 15 million people. This means that in 2023, the province had the same water storage for a population which had grown by 25%.

Over the last 3–4 years, the City of Johannesburg has increasingly supplied water intermittently to its customers. In the summer of 2023/2024, water outages became a regular occurrence, especially for those living at higher elevations or in older suburbs in the city. These characteristics fit all the criteria for water insecurity, i.e. an excess of demand over supply.

In the older suburbs, the initial cause of these outages was primarily due to leaking water supply pipes which were patched (note – good engineering practice would define this as a *temporary* repair). During the patching process, water to the entire suburb would be shut off. This temporary nature of intermittent supply has now totally

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changed, and this is indicative of a larger system which is not being properly maintained. When some minimal maintenance is conducted, the job is not properly completed. As a result, the roads are left with large, open excavation works, sometimes for months on end following a water repair, and the water repair often still leaks.[11] This is happening across all suburbs now.

Whilst this was (and is) happening in Johannesburg, in Hammanskraal in Pretoria there was an outbreak of cholera in 2023 which claimed over 30 lives.[12] At the same time at which both of these events were occurring, the blue[13] and green[14] drop audits and reports were re-established and published. Both reports indicate that the freshwater treatment works supplying our drinking water, as well as the wastewater treatment works treating our sewage, are *increasingly dysfunctional*. This trend is seen across the entire country. In addition, a no-drop report[14] was released which shows the amount of water which is stolen or lost through leaking pipes. For Johannesburg, this amount is close to 50%. This means that the allocation of water for Gauteng which is distributed to Johannesburg, Pretoria and other cities, is reduced by 50% (in the case of Johannesburg), because of theft and/or leakages. The DWS will not increase the quota for this province because they are the stewards or the custodians of the resource at a national level. They are concerned with meeting both current and future needs for the entire country, not just the immediate needs of Gauteng, or Johannesburg.

These statistics indicate that we have 50% less water for 25% more people. This extra usage and loss overloads the system entirely. The rate of drawdown on our potable water reservoirs is greater than the maximum rate of recharge. This discrepancy has resulted in reservoirs running empty and the City of Joburg throttling back supply during periods of high demand in order for reservoirs to recover, leaving many residents without water, not just for nightly periods but in some instances for weeks.[15] For those in the highest-lying areas (i.e. those living higher up the hill) the impact is the greatest. In addition to this, the occurrence of load shedding and power supply challenges means that pumping stations are often also not working. This is the current state of water systems, especially in Johannesburg. The blame for this poor state must be firmly placed with the Johannesburg City Administration.

There is, however, one critical difference between water and electricity. It is possible to live for weeks without electricity, as many in South Africa do. It may not be a comfortable lifestyle; however, it is a possible lifestyle. Without water, the options rapidly diminish in terms of for how long people can be resilient. The cost of purchasing bottled/container water is prohibitive, and yet, under these circumstances, it becomes the only available option. For those who grow food in their gardens (as happens in many poorer settlements), the cost increases exponentially because the allotment-type gardens which contribute towards food security are dry and barren from lack of water. The poorest have to purchase not only water but additional food too.

The basic domestic usage of water is not for swimming pools or gardens, but rather for sanitation (flushing toilets, washing hands, bathing), cleaning vegetables, cooking food, and drinking. These activities require a steady supply of water, even if only a little, and for this reason, the state provides about 6 kL per household per month free of charge. Therefore, the ongoing water outages place an incredible strain on a society which, whilst incredibly resilient, is wasting that resilience on dealing with challenges which it should not actually be dealing with. That resilience could be better utilised by seeking meaningful employment or furthering education, rather than by thinking about ensuring a reliable source of water and the increased cost of food. Obviously, these consequences affect the poor far more than the rich.

Long-term prospects

What are the long-term prospects for a resolution to this problem? Unfortunately, there is very little space left in South Africa to construct new large dams. This means that water security will decline after 2028, especially if we proceed with current social, cultural, political and engineering practices. Additionally, there is the confounding impact of the climate crisis: this drives up water demand as temperatures are higher, it increases evaporative losses on the dams and there is an increased number of flood events from bigger storms which pose the very real risk of destroying infrastructure such as dams, water treatment plants and wastewater treatment plants (such as occurred in Durban in 2022[16]). Indeed, the UN Food and Agriculture Organization reported that South Africa's water stress increased from 61% in 2016 to 65% in 2020.[17] Johannesburg, in particular, notwithstanding the high rates of water lost from broken infrastructure, still uses too much water per capita – more than any other province.

Changes need to be made to ensure long-term sustainability and to improve water security. First, real shifts in the economics and pricing of water must occur. The value of water, especially potable water, is ZAR25 per 5 L of treated water purchased at a supermarket when there is no water available in a tap. At the higher tiers of municipal billing, the cost is only ZAR17/kL. Much steeper tariffs can be applied to users of water that exceed their fair share (although defining a fair share is somewhat contentious) and this will undoubtedly drive consumption downwards. The administrations of all cities in South Africa, particularly Johannesburg, need to urgently ring-fence funding for maintenance and infrastructural improvement.

As a global society, we need to reconsider how we value water. Our future requires some truly creative problem-solving. We might need to consider how to bring water from the African tropics (such as transfers from the Congo belt or the Zambezi). Once we have solved our energy crisis, the opportunity for desalination of sea or mine water for augmentation of potable supply might become a viable possibility. The future, however, must include direct reclamation (sewage to potable water) as the global population moves towards 10 billion people. In eThekwini (Durban), reclamation has been used to supplement industrial supply[18], and in Windhoek, Namibia, reclamation has been a way of life since 1968[19].

There is, however, still a critical need to conduct additional research to understand how pathogenic organisms (including emerging pathogens and viruses) and emerging contaminants (pharmaceuticals, per- and polyfluoroalkyl substances (PFAS), pesticides etc.) behave in wastewater treatment plants, such that when we return the treated sewage, especially to the potable water reticulation systems, we do not harm our societies with increased exposure to these compounds at potentially harmful levels (these will build up, possibly to toxic levels, if they are not removed at wastewater treatment plants). Significant civic education needs to take place to remove the 'yuck' factor of drinking treated sewage, despite the fact that we already drink water sourced from our rivers that are highly contaminated by sewage and wastewater treatment plant outfall, made all the worse by our failing wastewater treatment works. Society, including the water sector, needs to embrace true circular thinking: if we are good engineers, we can derive significant value from our wastewater, and, if we do this properly, our new waste stream will be clean potable water. The question we need to ask is: are we ready for this revolution?

Declarations

I have no competing interests to declare. AI was not used in the writing or editing of this manuscript.

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