Water supply

Where will our future water-supply come from? The challenge with non-conventional options

South Africa's National Water Week theme, 'Water and sanitation are human rights', evoked deep thinking about how the country can sustainably provide water to its citizenry amid growing demand. Article by Jeremiah Mutamba of Trans-Caledon Tunnel Authority.

South Africa's conventional (mostly surface) water sources have been unable to cope with growing demand. Most of the economically viable dam sites having been fully developed.

This challenge is further exacerbated by a number of poignant factors, namely, growth in population which concomitantly drives demand, economic growth, the need to improve livelihoods, continued pollution of freshwater sources and the potential scourge of climate change. Drought conditions, such as those recently experienced in many parts of the country, combined with high system losses, further worsen the situation.

Average non-revenue water is estimated to be 37%, while current demand levels are estimated to be in the region of 15 x 10^3 Mm^3 per annum and projected to increase to 17.7 x 10^3 Mm^3 per annum by 2030 (WRG, 2009), at which point demand outstrips economically usable freshwater supply. Total local yield, including further developments, is estimated to be 15 x 10^3 Mm^3 (Adewumi ***et al.***, 2010; WRG, 2009). With limited and already stretched water resources barely meeting ever-growing demand, South Africa is challenged to improve its water use efficiency as well as proactively explore alternative water sources, including non-conventional options. These options include: wastewater reuse, greywater use and seawater desalination.

This article briefly discusses the challenges facing South Africa in promoting proactive use of non-conventional water sources.

Non-conventional water sources

The three non-conventional water sources mentioned above hold a lot of potential in South Africa. With more than 2 500 km of coastline, seawater desalination has significant potential for the coastal cities. In this vein, a number of coastal cities, for example Cape Town, Durban and Nelson Mandela Bay, have progressed in investigating seawater desalination. However, few have progressed beyond investigative work, with the few implemented projects being small desalination plants.

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Similarly, South Africa has significant potential for greywater and wastewater reuse. Adewumi ***et al.*** (2010) estimate the total usable return flows as 1.2 x 10^3 Mm^3 per annum. Turton (2015), however, estimates South Africa's daily wastewater volume as 4.9 million m^3 per day, which is equivalent to 1.8 x 10^3 Mm^3 per annum of wastewater. Apart from indirect reuse through return flows to receiving rivers and, while there are known pockets of reuse in the country, the proportion of planned water reuse in South Africa is very small compared to the national potential.

Over time, there has been significant research and technological developments to support seawater desalination and water reuse. The country's water legislation supports both water reuse and desalination. Further, South Africa, as part of its National Water Resources Strategy 2013 Edition, developed and published sound strategies to guide both desalination and reuse.

Notwithstanding legislative provisions, concrete strategies, known potential, technological advancements and research, seawater desalination and water reuse still encounter considerable challenges to effectively contribute to South Africa's water-supply basket. While there are other bottlenecks, a few set of factors critically influence the slow uptake for water reuse and seawater desalination. The instrumental factors holding back large-scale reuse and desalination include: perceived high unit cost of desalination projects, lack of localised best practice, poor public perception for reuse, and the need to learn from international approaches to drive reuse and desalination. These four factors are briefly discussed in the next few sections.

Challenges affecting non-conventional water sources

Traditionally, desalination water is considered much more expensive compared to conventional water sources. Tariffs for conventional water in South Africa's coastal metros ranges from R11.63/kℓ to R16.54/kℓ. The cost varies from location to location depending on associated infrastructure for water abstraction, conveyance, treatment and distribution.

In comparison, benchmark production cost for desalinated water range from R8.10/kℓ and R16.20/kℓ also influenced by capital and operational cost outlay for each project. Notably, the quoted desalination cost estimates exclude distribution and other related costs which will push up the unit cost at the tap. Agreeably, the desalination costs are on the higher end of conventional water supply costs. However, these costs, with improvements in technology over time have been slowly approaching affordable levels.

It is important to also consider that most, if not all, economical conventional water supply sources have been fully developed, leaving more expensive options. As such, desalination costs should be compared with the next complex and likely more costly conventional options as these are the ones remaining following development of most economical options.

While South Africa has a few cases of both wastewater reuse and small-scale desalination projects, it is acknowledged that the country lacks substantial experience and expertise in large-scale projects in both domains. In addition, the knowledge levels of wastewater reuse among potential users is low – an additional factor which fuels pessimism and anxiety among would be users. These factors result in subdued public trust in our utilities' ability to safely deliver such complex projects. Po ***et a***l. (2004) posits that public's trust in a utility's ability to provide safe and reliable treated wastewater is a critical factor to why residents are willing to reuse wastewater.

By its nature and value-chain history, reclaimed wastewater attracts a lot of resistance from society – a challenge relating to the perception the public has on the water source. This perception negatively influence the public's willingness to use reclaimed water. This challenge is, however, not unique to South Africa as many countries that have attempted reuse programmes have battled to secure public buy-in. A number of authors (Adewumi ***et al.***, 2010; Bhungu, 2014; Robinson ***et al***., 2005; Vedachalam & Mancl, 2010) have identified public perception as a major obstacle to wastewater reuse.

As such, it is important to underscore public perception challenges can ruin a reuse project irrespective of scientific and engineering-based considerations (Vedachalam & Mancl, 2010). Locally, while a diverse number of successful reclamation projects have been implemented, some projects have been victim to the public perception and acceptance dilemma. One of such examples is the eThekwini Wastewater Reuse project which has been shelved mainly from public perception challenges.

To circumvent this, it is imperative that extensive public engagement and awareness programs are instituted, including involving the key stakeholders and would be users in strategic decision making. End-users need not only be consulted, but should to be part of the solution formulation and decision-making right from the early stages of the project conception. In addition, transparency is pivotal for the process to gain the trust of the people and have legitimacy. In Australia, for example, a perception survey conducted by Po ***et al***. (2004) revealed that public trust was instrumental in the success wastewater reuse projects. It is important to highlight that this approach tends to increase the project cycle. However, given the high risk for the project to fail due to lack of public buy-in, the prolonged project cycle is necessary to ensure successful project delivery.

Complex projects and programmes like seawater desalination and wastewater reuse tend to invoke anxiety and, perhaps, some phobia – mainly because of the associated high risks and attendant implications in the event of failure. This is particularly so where a country is breaking new ground – which is the case for both programmes in terms of large-scale projects.

For example, a failed direct reuse project can pause unthinkable health hazards with concomitant large public outcry. Similarly, large-scale desalination projects, if developed as drought mitigation interventions, have the risk of, as the case of many of Australia's projects, white elephants should the drought be broken. Such outcomes unfortunately can be seen as suicidal and professional liabilities to sector players. As such, due care and meticulous planning are required when considering such projects. South Africa can draw credible lessons and the lead of other nations that have successfully introduced these two water resource options into their water mix.

Credible lessons on desalination and water reuse can be sourced from the many countries including Australia, Israel, Singapore and USA. A number of Middle East countries, such as Saudi Arabia, also offer powerful lessons on desalination projects.

Critical lessons South Africa can adapt from international experiences include establishing a steering node to guide selection of appropriate technologies, criteria and administrative changes that will guide safe wastewater reuse as did the team that led reuse in Arizona in the US (Fulton, 2014); and having a high profile champion to lead an advocacy programme for the initiative as did Singapore in its water reuse programme. Importantly, these approaches will need to be supported by an extensive and transparent stakeholder engagement programme to take the people along as seen in some Australian and US projects (Biggs, 2017; Bloxom, 2017).

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