COMMENT

RODGER BOSCH/AFP/GETTY

The narrow body of water that remained at South Africa's Theewaterskloof Dam in May 2017.

Lessons from Cape Town's drought

Don't blame climate change. People and poor planning are behind most urban water shortages, argues **Mike Muller**.

Since May, winter rains have brought a reprieve to the citizens of Cape Town, South Africa. The city had endured severe drought for three years. Concerns that its water supply might run out in the summer have been set aside, hopefully, for another year. But the city remains vulnerable.

The situation was very different in 2013. Then, Cape Town had one of its highest annual rainfalls in decades. Reservoirs brimmed, and officials declared there was no need to increase supplies before the 2020s. After another wet winter in 2014, the 6 main reservoirs that feed the city were 97% full.

Then the drought began. Reservoir levels fell to 71% in 2015 and to 60% in 2016 (see 'Cape Town drought'). When they reached 38% in 2017, at the beginning of what looked set to be a long, hot summer, people began to panic.

Municipal authorities told residents to slash their water consumption. For suburban households, that meant going from pre-drought usage of around 200 litres per person per day to 50 litres per person per day (picture a bathtub filled to less than 10 centimetres). Although many of their poorer compatriots regularly live with such a supply, suburbanites suddenly had to give up their gardens and collect shower water to flush their toilets. The city more than halved its overall use, to just over 500 million litres a day, and avoided 'day zero'.

Cape Town is one of several cities to see its water supply fail in the past decade. In 2014 and 2015, parts of São Paulo in Brazil received water for only two days a week. Once the city's reservoirs had been drained of clean water, the utility firm pumped and treated the polluted water that remained. In 2008, Barcelona in Spain had to ship water in from Marseille, France. During its decade-long 'millennium drought' in the 2000s, Australia spent billions of dollars on desalination plants, most of which have not been used since.

It is important to learn from the experiences of Cape Town and elsewhere. Urban growth means that many more places will face similar challenges as they compete with surrounding regions for water. Big cities need to begin informed long-range planning and to focus on minimizing risks from current climate variability. Climate change adds to the uncertainties. Shortages attributed to extreme weather or to global warming are still more often due to poor management. People's beliefs and behaviour are as much a part of the systems to be managed as are pipes, pumps and the environment.

SHORT-SIGHTED

Cape Town's problems are due in large part to a turn away from management based on science and risk assessment towards a more populist approach[1].

Since the 1980s, South Africa's major conurbations have used systems models to guide their water management[2]. These models, run by the national government, are considered world-class. They map links between river basins, reservoirs and transmission channels and use historical hydrological data to predict probable stream flows. Those are then matched to projections of demand to assess how much storage is needed. The models support real-time operations of the water network as well as planning for development. Crucially, they allow planners to assess risks of supply failures to different categories of users and evaluate the effectiveness of responses such as restrictions.

For two decades, policymakers heeded the models. They guided managers, for example, on when and where to tap sources and build reservoirs to enable the Western Cape Water Supply System (WCWSS) to meet rising demand from urban and industrial growth.

But dam building stalled in the 2000s, when local environmentalists campaigned to switch the focus to water conservation and management of demand. Such opposition delayed the completion of the Berg River Dam by six years. Eventually finished in 2009, the dam helped to keep the taps running in Cape Town this summer.

Back in 2009, the models had already flagged a need to boost Cape Town's water supplies after 2015, but officials dismissed the recommendations. They were happy to delay big capital investments and spend the money elsewhere. They missed that the Cape's wine and fruit farmers (who are entitled to one-third of the region's water) were not drawing their full allocation during the rainy years and, like the city's gardeners, were using more in drier years.

The response was short-sighted. The 6 Western Cape reservoirs that feed the city hold less than 2 years' supply: 890 million cubic metres, compared with a reliable annual yield of 570 million cubic metres. It took two successive dry winters, in 2015 and 2016, for the municipality to realize that it was in trouble. City leaders banned water use in gardens and car washing, and promoted conservation, water-efficient appliances and higher tariffs.

They defended their decisions. The councillor responsible for water services, Xanthea Limberg, wrote in April last year that they had not addressed the risk of such a severe dry spell because "it is not practical to ring-fence billions of rand for the possibility of a drought that might not come to pass".

Then the worst case happened — a very dry 2017. How dry is disputed. Rainfall and stream flows vary dramatically from place to place and year to year across the region's mountainous terrain. At the Jonkershoek weather station, which is close to the catchment of the two largest dams, rainfall varied: 1,250 millimetres in 2013; 900 millimetres in 2014; less than 500 millimetres in 2015; 750 millimetres in 2016; and 700 millimetres in 2017. In 2017, flows in a small, undeveloped stream in the same area were just 20% of what they were in 2013.

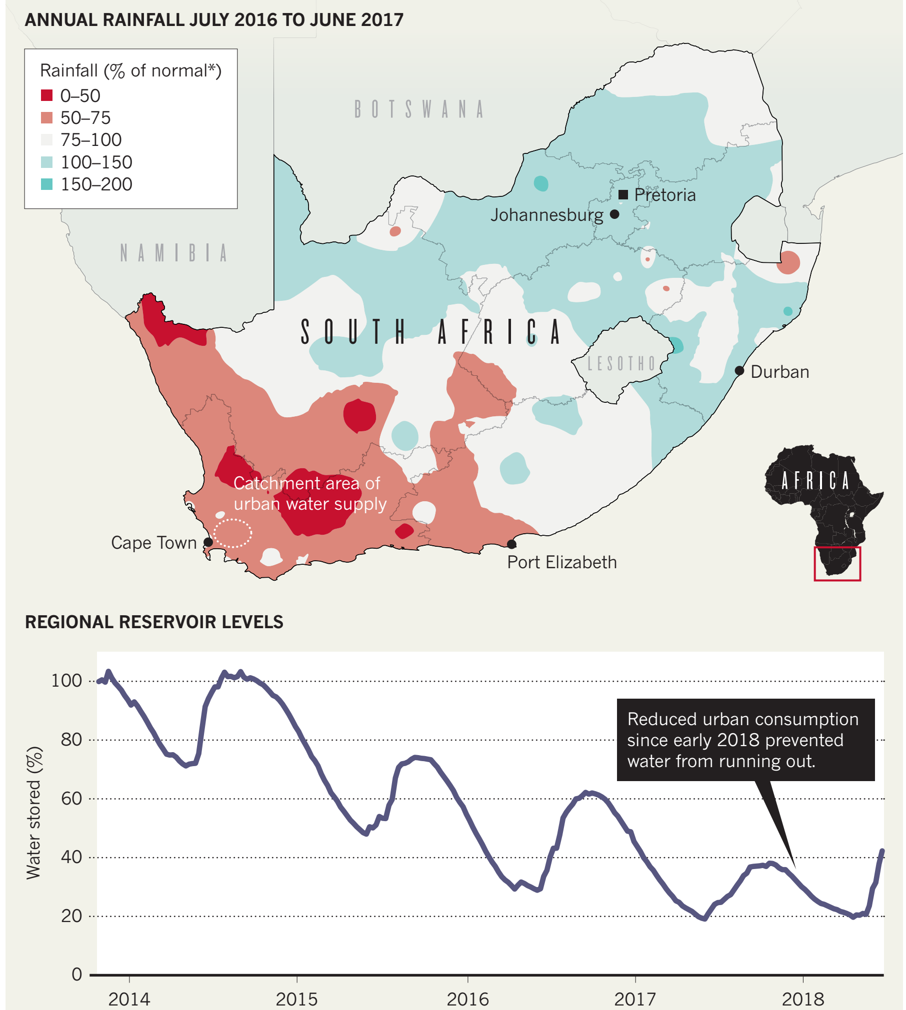
Three consecutive dry years have occurred before, in the late 1930s and from 1970. Three dry years in 2002, 2003 and 2005 were fortunately interrupted by a wet 2004. These risks were reflected in the hydrological models. But Cape Town's leaders did not comprehend the social and financial implications of their decisions.

They do now. So far, direct costs of the water crisis — reduced water revenue, losses in agricultural jobs and production and indirect costs such as a drop in tourism — have come to more than 2.5 billion South African rands (US$181 million). Water tariffs for consumers have been raised by 26% this year. Yet, investing 1 billion rands in infrastructure in 2013–14 would have cost just 75 million rands per year in interest charges — that would have been cheap insurance, even if it had proved unnecessary.

Cape Town's decision-makers have tried to shift the blame, with climate change an obvious target. Helen Zille, premier of the Western Cape, wrote last October that "the impact of climate change is probably the reason that climate cycles have become so unpredictable". Yet there is little evidence of a departure from normal variability in the catchments. Although data from outside sites are cited to support climate-change ▶

CAPE TOWN DROUGHT

Lower than average rainfall in South Africa's Western Cape exacerbated water shortages over the past 3 years. The total amount of water stored in the six largest reservoirs that supply Cape Town fell to new lows each year.



* Average for 1981 to 2010

SOURCE: CLIMATE SYSTEMS ANALYSIS GROUP


WALDO SWIEGERS/BLOOMBERG/GETTY

Residents fill water containers at the Newlands natural-water spring in Cape Town in November 2017.

theories, it was the three-year sequence of dry years that proved devastating.

Yes, meteorological changes are expected over coming decades. For Cape Town, most climate models predict a decrease in rainfall by 2050, although local impacts are uncertain[3]. Stream flows are even less predictable, because they will be reduced by heat and aridity but can be increased by more-frequent and intense rainfall. Such trends and uncertainties can be factored into models, although historical hydrology should still provide reliable perspectives for the next few decades.

A more-immediate challenge for Cape Town is that the area that supplies the Western Cape water system is very small — less than 800 square kilometres. Local variations in climate, by themselves, call for a conservative and risk-averse approach, and the need for a diverse range of water sources to fall back on.

Now, Cape Town's leaders are working feverishly to build the schemes that were recommended back in 2009 for managing groundwater, reuse and surface supply. The crisis has obliged them, and others elsewhere in the country, to look more carefully at future challenges. The premier of Gauteng province, the country's inland urban hub, has convened a high-level task force to tell officials how to avoid Cape Town's experience.

GLOBAL PROBLEM

São Paulo and Barcelona also had precedents for their dry spells. And political decisions exacerbated their water crises. São Paulo's drought risk was highlighted in hydrological models, but wrangling between city, state and national governments delayed action for a decade[4]. In Barcelona, a surprise 2004 election win saw the Spanish Socialist Workers' Party (PSOE) stop a long-planned programme of dam development and river transfers because of a manifesto commitment to regional allies[5]. In Australia, as in Cape Town, environmental opposition to dams and desalination increased cities' vulnerabilities to a multi-year drought.

China is a counter-example. It has managed to keep water flowing in some of the world's largest and fastest-growing cities through responsive government planning and major infrastructure projects. These include the Three Gorges Dam, which controls flooding on the Yangtze river, and the South–North transfer, which has channelled water from the Yangtze to Beijing since 2015. The nation has drawn some of those lessons from South Africa.

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In 2002, Wang Shucheng, the Chinese minister charged with resuscitating the transfer project, visited the Lesotho Highlands Water Project. This binational network of tunnels and dams diverts water from the mountains of Lesotho to South Africa's inland economic hub. Back in China, Wang got the sequence right. He completed the major engineering projects needed to underpin supply while, in parallel, starting longer-term programmes to reduce pollution, manage demand and promote efficient water use[6].

POLITICAL PROCESS

The greatest challenge for managers of urban water supplies is often getting political decisions made in a timely fashion, and with public support.

There is no universal best-practice approach to achieve this. Beyond implementing strong centralized systems such as China's, improving cooperation between the various organizations involved might help[7]. Because rivers generally cross political boundaries, water management is often organized in 'watersheds' that can be distant from politicians and their citizens. Cape Town draws water from two rivers beyond its boundaries, each of which is managed by a different agency. Managing water in 'problem-sheds' that encompass major water users and the geographical areas on which they depend would be a better approach[8].

As water needs grow and water systems evolve, more resources will need to be devoted to monitoring and modelling. Technical guidance must be integrated into political processes. As a minimum, politicians need to know who is doing the modelling and what the recommendations are.

They also need that information in a format and language that empowers them to act appropriately. So hydrologists must collaborate with experts from the social sciences and humanities, notably economics, policy and law, to develop water-management tools that decision-makers and the public can understand and use[9]. With greater involvement of other disciplines, it will be easier to ensure that appropriate social, economic and environmental criteria are used when selecting technical options — to store water in a dam or to use energy for desalination, for example.

Finally, practitioners also need to monitor and model peoples' behaviour. The long time scales over which decisions and interventions need to happen must also be better understood. And the easy resort to simplistic solutions to 'use less water' and 'rely on natural infrastructure' must be resisted.

Cities must move from crisis responses to effective management of the water that is essential to lives, livelihoods and environments. 'Day Zeros' are not inevitable. ■

Mike Muller *is an engineer and visiting adjunct professor at the Wits School of Governance at the University of the Witwatersrand in Johannesburg, South Africa.*
e-mail: mikemuller1949@gmail.com

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