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Study aims to understand tap water sources in South Africa

In an effort to collect spatially representative water samples from across South Africa, researchers at the University of Cape Town (UCT) recently enlisted the help of the South African Post Office as project partner.

The purpose of the research, which was published in *Scientific Reports*, was to discover the likely sources of tap water across South Africa.

It formed part of an MSc dissertation by Ruan de Wet, the head of climate change mitigation at C4 EcoSolutions, under the supervision of Associate Professor Adam West, from UCT's Department of Biological Sciences, and Professor Chris Harris, the head of UCT's Department of Geological Sciences.

Being a water-stressed country with a growing population, together with uncertain supply due to climate change and catchment degradation, South Africa faces challenges with the delivery of municipal water.

"The more we understand about the sources of tap water, their potential variability and how or when they are recharged, the better," said West.

For De Wet, his particular interest in this study lay in gaining a better understanding of the stocks and flows of natural resources and ecosystem services in the face of numerous environmental and social challenges.

"Innovative solutions to monitoring and managing our water resources is a high priority in South Africa given the unequal distribution, access to and resilience of water supply across geographic and socio-economic lines," he said.

Conducting this study required spatially representative water samples from across the country to be delivered within a reasonably constrained time frame. Since it would be extremely expensive for the researchers to collect the samples themselves, West realised that this was the perfect opportunity to enlist the help of a citizen scientist network. "I wrote to the post office and they were happy to collaborate and supply the addresses of their branches," said West.

Armed with the necessary permission and information, West and De Wet sent out envelopes addressed to 340 post office branch managers across the country. One envelope was sent out at the end of the winter season and another at the end of the summer season. The researchers got 60–80% of their samples back within a two-week window.

Apart from the novelty of the approach, enlisting the help of the South African Post Office is seen as a major breakthrough for sampling water at high temporal and spatial frequency. Previously, the only national level groundwater map was done at great expense by directly sampling boreholes across the country over 18 months from 2006 to 2007.

By running the study in two different seasons and using the chemical signatures hidden in tap water, which are formed by the isotopic ratios of oxygen and hydrogen, De Wet and his supervisors were able to show that there are two different "tap-water worlds" in South Africa: a surface world and an underground world. The former is linked to resources like dams and reservoirs, while the latter is linked to deep, possibly ancient, groundwater resources.

"We can tell these apart because the isotopic composition of water changes when it evaporates (for example in surface water), but stays constant if it is groundwater," explained West.

The research aims to illuminate dependence on surface- versus deep-water resources in regions across South Africa. Both water sources have their pros and cons as far as sustainability is concerned. Therefore, it is crucial for municipalities not to be dependent on either, but rather to find a balance between the two.

Derived from rainfall and streamflow, the advantage of surface water is the fact that it is renewable. However, it is also particularly vulnerable to climate change. Groundwater, on the other hand, is largely decoupled from climate and, therefore, represents a more stable water source. The disadvantage is that it may not be renewable and sustainable if too much is extracted too fast. Furthermore, extraction of groundwater may cause ecological damage if not handled carefully.

One of the interesting findings from the study suggests a predominant use of groundwater sources in the Northern Cape and surface waters in the Eastern Cape. Other provinces proved to be more varied.

"Municipalities have to find a balance between renewable and reliable in the face of change," said West. "The exact solution will vary from place to place."

The researchers agree that the study holds major potential for expansion and development.

For De Wet, the focus is currently on finding ways to embed the rapidly developing isotopic tools and approaches from research labs across the world into national water-monitoring strategies, particularly in data-poor countries.

"Adapting our management practices or strategically intervening to build greater resilience is challenging without robust, quantitative monitoring of our water resources," he said. "I'm quite excited about what could be achieved through greater partnerships between academia, the public sector and the development community."

West added that part of his lab's plan is to increase the frequency of sampling to get a better handle on the temporal dynamics of tap water in South Africa. "This should help us to understand these sources much better," said West.

Furthermore, he hopes to launch a similar project with primary schools across the country, collecting and measuring rainfall. "I think it would be a wonderful scientific and educational project," West concluded.

Read the full paper.

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