Urban groundwater quality in Africa: benefits and challenges

Why is groundwater quality important?

Most urban centres in Africa rely on groundwater, in Southern Africa it is estimated that at least 36% of the population relies on groundwater, this number is much larger for many other settlements in Africa. Urban water supplies are reliant on local groundwater sources to supply 25% of water use, from both private and public/municipal sources. Groundwater is important even in areas where groundwater abstraction is limited by low productivity groundwater stores such as those found in hard-rock settings (e.g. granites). Urban centres are a focus for a wide range of human activities past and present that can alter groundwater quality with potential impacts on subsequent groundwater uses. Once contaminated, groundwater can be challenging to clean up. Despite these challenges, groundwater is often of better quality compared to surface water alternatives in urban settings.

Groundwater is generally well protected from surface contamination: as water percolates through the soil and deeper rock some contaminants (e.g. bacteria) may be removed. In contrast to surface water pollution, groundwater quality changes are often gradual, allowing scope for the problem to be assessed and interventions and adaptations to be planned and undertaken if recognised early. Even when groundwater is contaminated (e.g. by bacteria or organic contaminants) these are often detected at low concentrations. Compared to surface waters treatment, costs are often lower and simpler treatment solutions are possible due to the reduced pollution loads and fluctuations in groundwaters.

Access to groundwater is widely dispersed compared to alternative sources (lakes, rivers and piped supplies). This offers a clear potential to expand groundwater use in many towns and cities to enhance water security (e.g. via public water supply, piped systems with standpipes, self-supply such as private wells and in some cases tankered or sachet groundwater).

What affects urban groundwater quality?

Natural contaminants from sediments and rocks which store groundwater may be a source of groundwater contamination, including in urban settings, (e.g. arsenic, fluoride or manganese, see Figure 1). Both legacy and current contamination of groundwater due to ingress of materials from human activities can be a major issue in many urban centres: for example, from leaky petrol storage tanks, industry, agricultural activity and from liquid and solid waste, including poor sanitation practices. Surface water ingress to groundwater may also be a source of contamination in groundwaters.

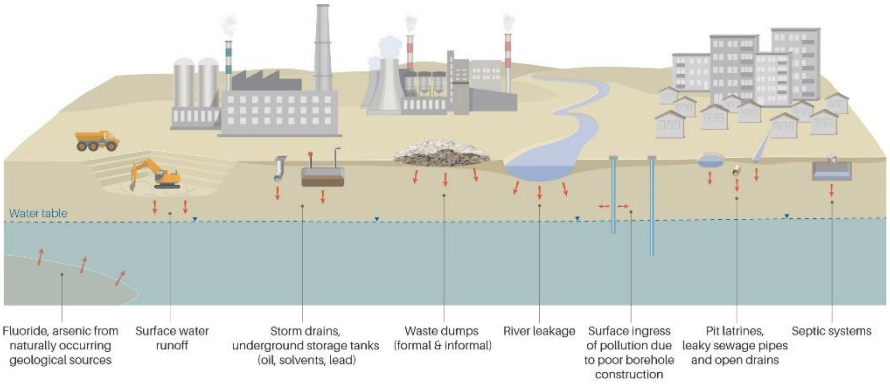

Figure 1. Urban groundwater quality challenges in Africa, BGS © UKRI 2022

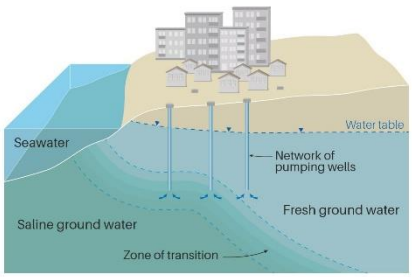

Figure 2. The challenge of seawater ingress in coastal settings due to over-pumping, BGS © UKRI 2022

Overall, this can lead to a complex mixture of contaminants in urban settings. In coastal urban centres groundwater quality is often also threatened by sea water ingress due to over-pumping which can draw in sea water (Figure 2).

What are the key urban water quality challenges?

Once degraded, groundwater can be time consuming and expensive to remediate, so preventing pollution is the best strategy. Where important drinking water sources are compromised it is essential to intervene quickly to undertake an assessment of options for treatment or use of alternative groundwater sources should these be required. However, the complexity of land use and ownership make the protection and management of urban groundwater challenging.

Groundwater quality monitoring is limited in many urban settings and as a result pollution may have already become widespread before the issue is identified, and measures taken to reverse the damage. A basic water quality assessment when a source is commissioned is often not undertaken, let alone monitoring to assess if there have been changes in water quality. There are many examples of saline intrusion along Africa's coastline which is where many large urban settlements in Africa are situated. Once contaminated by salinity, it is challenging to reverse saline intrusion and remediate groundwater.

Groundwater quality is intimately linked with urban liquid and solid waste management (including faecal waste) where poor management can lead to gross microbiological contamination of shallow groundwater supplies. This is of particular concern where groundwater levels are shallow and intersect pit latrines which store faecal waste. Similarly, waste dumps and cemeteries in urban centres may also be a risk for urban groundwater supplies (Figure 1). In many cases waste stores and dumps are not engineered in a way that minimises leakage into groundwater and contaminants can readily migrate from the waste dump to adjacent groundwater resources? accessed by wells.

Due to the long-time taken for water to reach groundwater, contaminant issues can persist for many decades undetected and spread if not remediated. This can lead to contamination of groundwater and dependent rivers and wetlands which takes time to appear, and which can last for decades depending on local conditions. This is a challenge for the use of urban green (areas of green space) and blue (surface water) infrastructure and can significantly impact on the quality of urban spaces for humans and other dependent ecosystems.

Groundwater has limited visibility which is a barrier to communicating groundwater quality issues. As well as this, there may be a mismatch between current land use and current groundwater quality, which is an additional obstacle for communication with stakeholders.

Recommendations and Policy context

Urban policy and planning can actively promote protection and monitoring of self-and public water supplies from a range of water quality challenges and promote the use of safe sources and appropriate treatment options. We recommend that good policy approaches should:

- Recognise the critical importance of groundwater quality constraints.
- Have a strategy for collecting and collating suitable groundwater quality monitoring data.
- Create a regulatory environment that maintains and protects the quality and quantity of groundwater available.
- Promote inclusive management of groundwater supplies by engaging with those operating wells and boreholes as well as waste management stakeholders.
- Promote the use of safe supplies and the use of appropriate well design and treatment solutions for drinking water supply.
- Deter deliberate actions that compromise groundwater quality.
- Reward positive actions that promote groundwater protection and improvement in urban areas.
- Include groundwater quality considerations in Urban planning projects and programs including in activities needing environmental impact assessments.

Safe, accessible, reliable and affordable water sources are essential for resilient urban communities to thrive. Groundwater has a unique role to play in this space, but it is important to consider groundwater quality as well as quantity and not assume that all groundwater is of good quality or even of the same quality.

Groundwater quality assessments need to be improved if urban groundwater resources are to be understood, managed and utilised safely.

Many of the contaminant challenges may not immediately be obvious to users – i.e. there may not be any discernible change to the taste, odour or appearance of the water. This necessitates a system of planned water quality monitoring assessment for sources used for human consumption. In some instances, it may be appropriate to recommend the use of deeper, better protected wells for drinking water use.

Groundwater quality monitoring of private sources and larger public abstractions in urban settings can be challenging. The regulatory drivers and motivation for monitoring water quality are often weak and poorly understood by responsible agencies. These aspects need to be strengthened, both with improved regulation and training. There can be capacity issues in local labs and the cost of analysis can be prohibitive. However, if groundwater is to continue to be an important source of secure water in urban settings, then the water quality dimension needs to be more adequately factored into the urban planning water management.

It is important to improve the communication of water quality challenges and solutions with all stakeholders and for all of these parties to take ownership of this aspect of water resources. Community-based monitoring can play a role in promoting water quality issues and bringing new evidence to bear as well as holding agencies to account for undertaking groundwater quality assessments.

Further reading

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Suggested citation: Lapworth D.J, Danert K, Eichholz M, Gicheruh C, Grönwall J, Healy A, Kebede S, Lalika M.C.S, Mwango F, Villholth K, Tijani M. (2023) Urban groundwater quality in Africa: benefits and challenges. Thematic Brief for AMCOW Pan-African Groundwater Programme (APAGroP).