Household Water Demand in Urban Africa: understanding the potential of Groundwater for a sustainable urban future

Summary

The rapid growth of urban areas across Africa is creating immense pressure on the provision of sufficient quantities of safe and affordable water. Many urban communities are now exploiting groundwater reserves to meet these needs. In many cases, the rate of urban growth has outpaced the ability of public authorities to deliver required infrastructure, leading to a proliferation of households relying on hand-dug wells in peri-urban and urban areas, and increasing numbers of boreholes within areas of greater wealth.

Groundwater has significant potential in helping enable sustainable and safe, integrated water management approaches in urban areas, as well as promoting the resilience of households and places. However, realising these approaches, and harnessing the potential of groundwater requires us to have significantly greater understanding of urban areas and resources. At present there are key knowledge gaps within many urban environments and context, as to: the current magnitude (and anticipated trends) in the level of urban self-supply; the contextualised condition (and resilience) of the groundwater resource in key urban centres; the substantial economic and equity implications of the revealed trends, and how collective perceptions and values are driving the observed transition to privatised and individual water supplies.

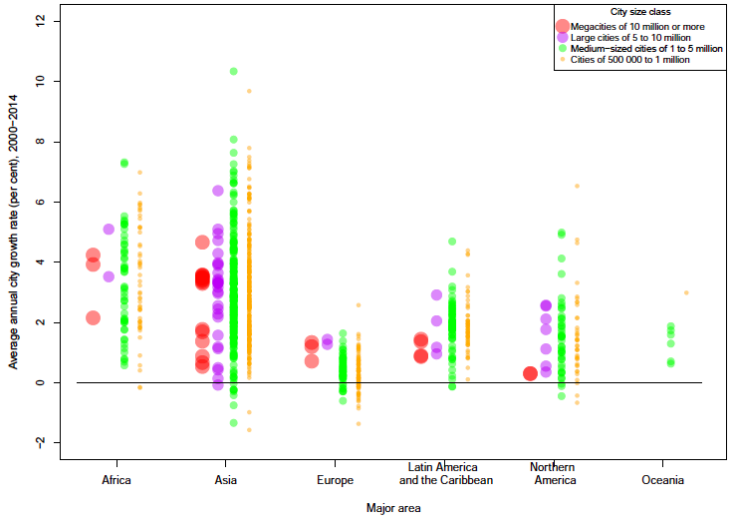
This note presents a summary of the findings of a workshop undertaken at Cardiff University in March 2018, in association with the GW4 Water Security Alliance, to discuss the challenges emerging in the burgeoning development of groundwater resources in urban Africa. Speakers included:

Helen Bonsor	British Geological Survey
Stephen Foster	IAH past president
Jenny Grönwall	Stockholm International Water Institute
Adrian Healy	Cardiff University

1. Introduction

We live in an increasingly urbanised world. Cities now house 54% of the world's population and account for more than 80% of economic activity (World Bank 2013). In Africa, the urban population is expected to double to almost 1 billion people in the next 25 years (Lall et al, 2017) with some of the fastest growth rates in the world (Figure 1). Yet, as cities expand, at rates of up to 8% per annum, utility companies struggle to meet the expanding demand for basic services, such as access to water supplies, or even to maintain a reliable provision to those that are served by the existing infrastructure. The recent water crisis in Cape Town, South Africa, highlights the fragility of urban water supplies in the face of environmental shocks, yet in cities such as Lagos, Nigeria, water crisis is, for many households, pervasive and unremitting.

Figure 1 Urban growth rates (population)



Source: United Nations (2014)

Water security is a feature of accessibility and affordability of water supplies, as well as the acceptability of sources and their sustainability over time (Foster and MacDonald, 2014). Groundwater is increasingly recognised as a potentially significant source of municipal water supplies. However, in many areas municipal water supplies struggle to meet demand. In the absence of accessible (or affordable) public water supplies, households look to alternative sources of water to fill the gap and so ensure their own water security.

Whilst in the past this has often been met through the actions of water vendors or the work of charitable and donor bodies, households are now increasingly taking matters into their own hands and investing in their own domestic water provision. One consequence of this is a steadily falling proportion of the urban population supplied from public reticulated systems, as well as a rapid

proliferation of privately-commissioned domestic boreholes and shallow hand-dug wells. However, whilst the trend is now widely recognised its extent is poorly understood, with a paucity of reliable data a critical limiting factor.

The potential for groundwater reserves to meet urban water needs is increasingly being recognised by governments, charities and donor bodies. Not only can it provide a sustainable store of water in arid and semi-arid climates but, for many cities, it is also readily accessible and relatively cheap to exploit. Yet, for such an important resource, our understanding of urban sub-surface hydrogeologies at the level of particular cities is under-developed and often unrecognised.

The exploitation of groundwater reserves to meet domestic water needs is proving critical to maintain the expansion of towns and cities across Africa. Yet, it also raises new and crucial questions about the long-term sustainability of the resource and the resilience of the communities that rely upon it. Not least it begs the question as to potential spillover effects of unfettered development, the distributional consequences of the trends that we currently witness and the extent to which the pattern of development might prove resilient to future environmental shocks.

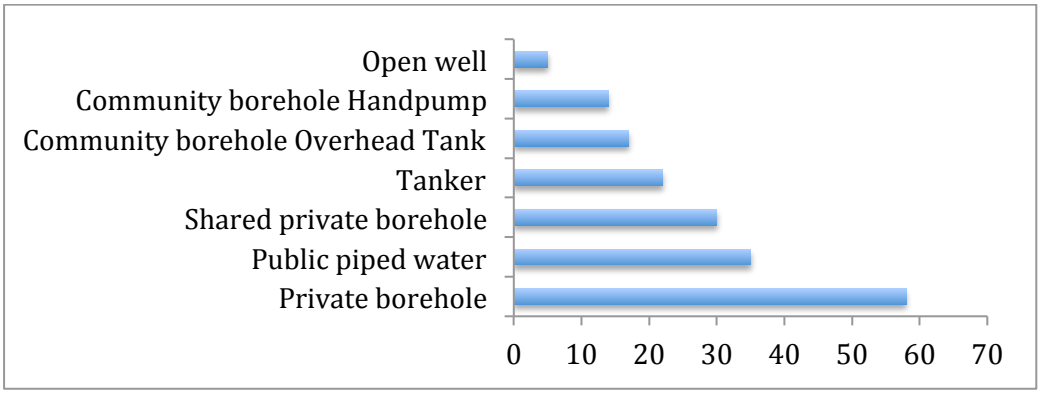
2. Patterns of activity

Groundwater is increasingly important in domestic water supply, either as a source of supply by a water utility, through individual action by households themselves, or through some mix of the two. Typically, individual households directly access groundwater reserves either through shallow wells or through the commissioning of deeper boreholes. To date, our understanding of the significance of these domestic provisions has been limited by a paucity of data. In 2010, the IIED estimated that some 269m urban dwellers globally rely on wells and boreholes as their principal source of drinking water. However, the extent to which urban populations are dependent on accessing groundwater individually varies by significantly by location, in particular in SSA. In some cities (such as Abidjan, Dakar and Arusha), municipal utilities provide a good service with a high reliance on groundwater abstraction. In others (such as Nairobi, Lusaka and Mombassa) water utilities struggle to provide an adequate level of service and substantial proportions of households develop the groundwater resource independently to ensure their water supply. Conjunctive use has also been reported in cities such as Benin and Dar-es-Salaam.

In Lagos, Nigeria it is estimated that less than 20% of the population have access to public piped water supplies. In consequence, households are increasingly investing in their own borehole to secure a reliable water supply. Even where

households do have access to public piped water supplies they will invest in their own borehole owing to the regularity with which public supplies are not available. In a survey of some 500 households across Lagos (Capstick et al, 2018) 51% of households owned their own borehole and a further 36% of households shared a borehole with other families. Households with their own boreholes are most likely to drink this water (Figure 2). Households which use other, more communal sources, tended not to drink this demonstrating issues of trust, the availability of affordable alternatives and, potentially, convenience.

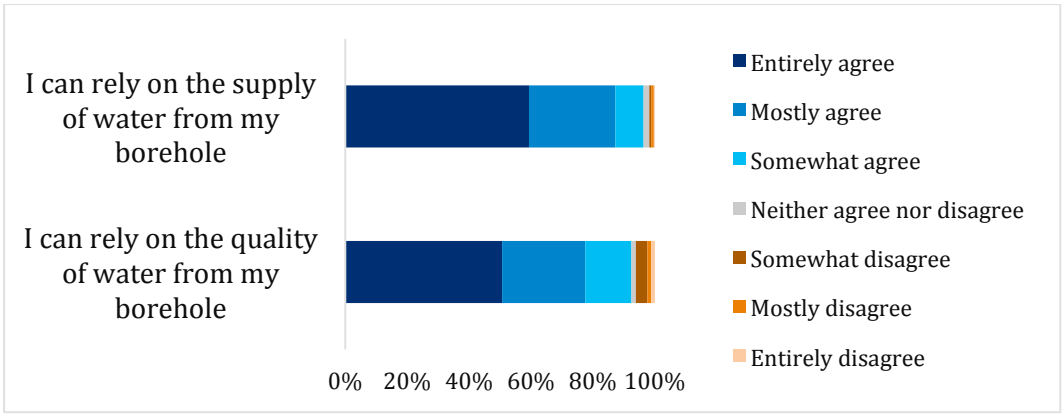
Figure 2 Propensity to drink by source (Lagos).



Source: Capstick et al (2018)

Respondents to the survey illustrated the confidence that households tend to have towards groundwater supplies. Confidence in the quality of the water available, and the reliability of the water was almost universal (Figure 3). Such underlying assurance underpins the decision of many households to invest in their own borehole.

Figure 3 Perceptions of reliability of supply and quality of private borehole water



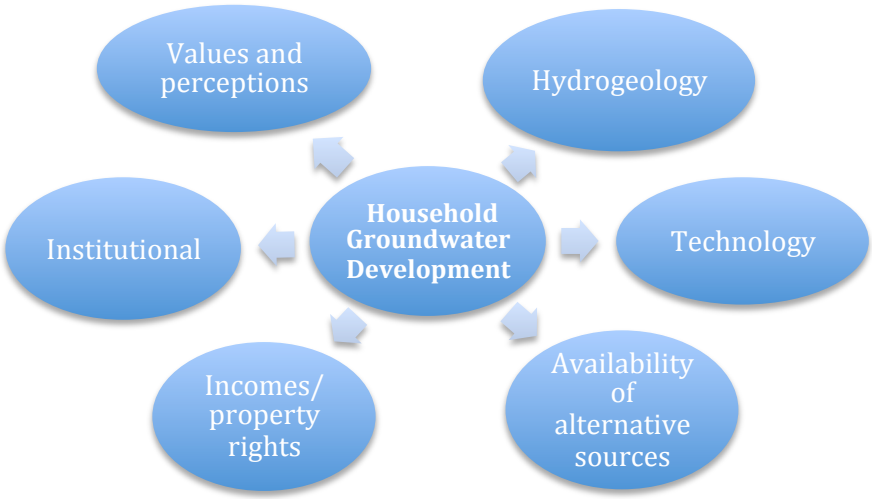
Source: Capstick et al (2018)

Evidence from Dodowa, a peri-urban suburb of Accra, Ghana, further illustrates the broader point of how groundwater reserves are often used to augment public

water supplies. In Dodowa, less than 20% of the population has direct access to water supplies provided by the public utility. Some 56% of households indirectly access water provided by the utility, through public standpipes or, more commonly, intermediate resellers. As public water supplies are unreliable and can be expensive (especially when purchased from resellers), many households in Dodowa dig a well or drill a borehole where this is possible. In other parts of Accra this option is not available to households as saline intrusion affects the quality of groundwater supplies. This access to groundwater means that many households in Dodowa feel that they are 'better off' than their counterparts in Accra, who have no access to potable groundwater.

There are, as yet, too few studies exploring the factors that influence domestic groundwater development in urban areas to provide a clear picture of the key drivers. Early signs from initial work suggest that the tendency to blame this on government failure (or failures of utility companies) is too simplistic. In their work on Lagos, Healy et al (2018a) suggest that whilst the failure to connect households to water supplies is undoubtedly a factor (alongside a failure to provide reliable water supplies, or to enforce existing legislation) equally important is the prevailing hydrogeology, technological developments and the availability of acceptable alternatives as well as income levels and property rights. They also find that the prevailing values and cultural norms towards different forms of water supply within an urban area impact on the propensity for households to develop their own boreholes. Figure 4 illustrates the influence of these key variables. More work is required however if we are to develop a stronger appreciation of these drivers and their complex interaction.

Figure 4 Drivers of groundwater development by households

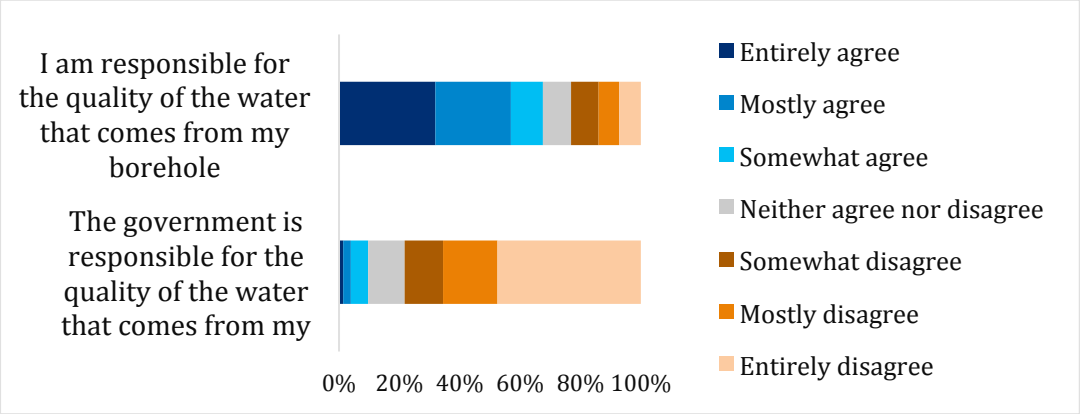


Source: Healy et al (2018a)

3. Governance of groundwater supplies

The governance of groundwater supplies emerges as an area where there is little collective responsibility. In survey work in Nigeria, Capstick et al (2018) find that most borehole owners regard themselves to be responsible for assuring the quality of water emanating from their borehole. In contrast, remarkably few regard this to be the responsibility of a government (Figure 5). In practice, this means that there is little or no effective oversight of the primary means of water supply in one of the world's largest mega-cities.

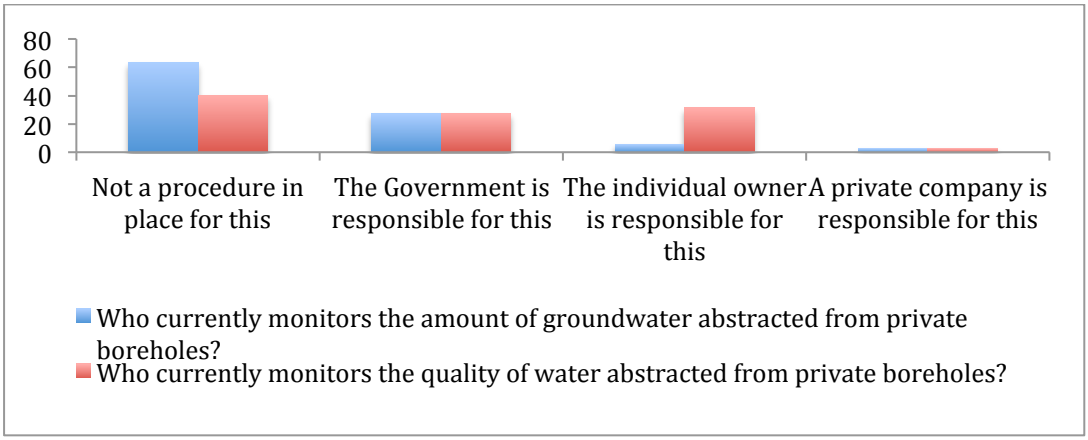
Figure 5 Perceived responsibility for water quality (Lagos)



Source: Capstick et al (2018)

This situation appears to be replicated across much of Africa. In a survey of water professionals across the continent, almost two-thirds claimed that there was no procedure in place for monitoring the amount of groundwater abstracted from privately owned boreholes (Figure 6). Similarly, 40% stated that there was no procedure for monitoring the quality of the water being abstracted. Where a procedure was reported, this was seen by many (31%) to be the responsibility of the individual borehole owner rather than government (27%).

Figure 6 Reported monitoring responsibilities (Africa)



Source: Healy et al (2018b)

4. Spillovers

Whilst there is little doubt that, in the short-term, the development of domestic boreholes is beneficial to individual households, there is less certainty over the collective longer-term effects of unfettered development. The risk is that over-exploitation may lead to over-abstraction, certainly in some climatic and hydrogeological contexts, or that contamination of the groundwater may imperil the groundwater resource, with corresponding implications for health and economic well-being. A better understanding of the vulnerability of groundwater resources in major urban areas, and in many smaller towns and cities, is urgently required if we are to avoid major shocks in the future. Coupled with this is an urgent need to revisit the planning of groundwater exploitation for urban development.

A second concern is the distributional consequences of the proliferation of household boreholes. Evidence from South America (Foster et al, 2010), as well as anecdotal evidence from African cities, demonstrates how the presence of private domestic boreholes can reduce the incomes of water utilities to the extent that they struggle to provide infrastructures and supplies to resident populations. This tends to adversely impact on the urban poor most significantly, as they are forced to rely on sources of poor water quality or source clean water at significantly higher cost. In Dodowa for example, the cost per m^3 of water from the public utility ranges from 0.67 US dollars to 1.14 US dollars, yet for those who have to purchase water from a private reseller the cost is around 25 US dollars per m^3 (Grönwall & Oduro-Kwarteng, 2018).

A secondary implication of access to groundwater in Dodowa is that there are indications that it is beginning to drive development processes. In this case middle-income households are purchasing housing plots in the area owing to the access to potable groundwater, which may, in the long run, drive poorer households from the area. Such development processes are visible in other African cities and merit deeper exploration.

5. Conclusions

Groundwater is increasingly accepted as a major source of water supply in urban Africa. One component of this is household self-supply and the rapid proliferation of privately commissioned domestic boreholes alongside shallow hand dug wells in many urban areas of Africa is increasingly recognised. Amongst the many factors driving this, the inability of public water utilities to adequately supply urban populations with water is a decisive aspect. Yet our

understanding of the scale of urban self-supply and its implications remain woefully inadequate, undermined by a lack of data and research in this field.

On first sight it appears that urban self-supply may be positive for those households that have access to this option. Yet incipient spillover risks of unfettered development may confer a collective vulnerability in the longer-term. There are also questions as to the distributional consequences of the trends being observed. To begin to tackle the challenges being identified requires a holistic and systems-based perspective on contemporary urban development patterns which addresses four main themes: the current magnitude (and anticipated trends) in the level of urban self-supply; the condition (and resilience) of the groundwater resource in key urban centres; the substantial economic implications of the revealed trends, and how collective perceptions and values are driving the observed transition to privatised and individual water supplies.

If we are to meet the Sustainable Development Goals of ensuring universal access to safe and affordable drinking water for all by 2030 and ensure sustainable communities and cities, then action is urgently needed to begin to address these fundamental questions.

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Dr. Adrian Healy

Healya2@cardiff.ac.uk

Full details of the workshop are available at:

Cardiff University Water Research Institute