Briefing

Water, urban

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Policy pointers

No single water source can meet Dar es Salaam's long-term needs. However, the city's shallow but polluted aquifer could increase water security if extraction declines to sustainable levels.

Meeting drinking water needs (SDG6) in Dar es Salaam requires stronger regulation, both of upstream water permits for farmers and of informal urban boreholes.

Meeting SDG6 will also require more and better data on rainfall, flows and groundwater throughout the basin, and strong, technically competent institutions able to manage potentially competing uses flexibly in the public interest.

DAWASA, WRWRB and municipal authorities should adopt a harmonised approach at the city and basin level to manage official and informal water sources, restoring the shallow aquifer to sustainable extraction levels, and recognising it as an essential source for informal settlements.

Dar es Salaam's water supplies need stronger, more flexible management to meet SDG6

Meeting the Sustainable Development Goal of access to drinking water (SDG6) is a significant challenge for growing cities like Dar es Salaam, where currently only half of the population of 5 million has secure and safe supplies. The city lies at the bottom of a small catchment. River flows are highly seasonal and upstream demands for dry season agriculture are increasing. Demand for drinking water, irrigation and environmental flows compete with one another, and operate at different institutional and spatial scales. Hydrological modelling suggests the city's plans for expanded supply will fall short unless supply and extraction regulators work jointly to use all the available water resources sustainably and flexibly.

Dar es Salaam faces significant challenges in meeting Sustainable Development Goal 6 (SDG6), which demands universal access to safe, affordable water by 2030. Informal settlements with no piped water have relied for years on the city's increasingly polluted and salinised shallow aquifer, and on water vendors for their water supply. Only 51 per cent of the city's population has access to clean drinking water.[1] Now, the Dar as Salaam water and sewerage board (DAWASA) is drawing up plans to expand the water supply network, supported by exploitation of deep boreholes and a new dam at Kidunda, which seeks to store and release water for downstream use.

The city has three potential sources of water supply (Table 1):[2] the Ruvu river (some 65km distant), the Kimbiji aquifer (a Neogene aquifer some 600m deep) and the shallow aquifer under the city. Recent plans[2] envisage an offtake of 366,000 m^3/day from the river, rising to 556,000 m^3/day by 2022, while the city also plans to take an additional 390,000 m^3/day from the deep Kimbiji aquifer. In addition to these formal sources of supply managed through the DAWASA network, community, NGO, municipality and private borehole owners extract 190,000 m^3/day from the shallow aquifer, which is theoretically managed by Wami-Ruvu Basin Water Board (WRBWB). IIED has worked with groundwater and surface water (catchment modelling) experts to assess the long-term sustainability of these plans and the water security risks to informal settlements.

Sustainability assessments

The hydrological model of the Ruvu catchment is housed at the Wami-Ruvu Basin Water Board (WRBWB) and was initially designed by JICA (The Japan International Cooperation Agency) in 2012. IIED worked with the University of Dar es Salaam and WRBWB to update the model to include environmental flow requirements as assessed by

The numbers on water supply in Dar es Salaam do not add up

USAID in 2014,[4] taking account of the proposed Kidunda dam (as outlined in a 2014 feasibility study).[5] Results[6] showed that during the dry season, water supplies at current demand levels will be only 95 per cent secure at the lower Ruvu offtake, and only 98 per cent secure at the upper Ruvu offtake. This implies that water demand will not be met for 18 and 7 days per year on average at the respective offtakes. The model suggests water security will decline further as DAWASA seeks to increase the Lower Ruvu offtake by a further 90,000 m^3/day towards 2022.

The WRBWB continues to allocate permits to farmers upstream in the catchment which authorise them to abstract water for irrigation. However, permits issued already exceed dry season minimum flows (Figure 1). It is not known for sure whether all this allocation is abstracted, since there is little practical restriction or monitoring in the field. But nor is it known how much illegal abstraction may also occur.

The potential resources available from the unexploited Kimbiji aquifer also change. Assessments of its sustainable yield have been revised downwards in recent years. Test boreholes have been dug and current proposals envisage abstractions of 135-150,000 m^3/day[3] to be sustainable in the long term, not the 390,000 m^3/day the city was initially looking for from this source by 2022.[7]

Yet the most controversial source of drinking water supply in Dar es Salaam is the shallow aquifer under the city.[8] Often close to the surface, it is polluted by industrial contaminants, saline intrusion and coliform bacteria,[9] but is the main source of water for many informal settlements. Up to 10,000 boreholes have been sunk into this aquifer, and these don't always have WRWRB authorisation under current regulations. Little data are available on where these boreholes are or how groundwater fluctuates, as there is no coherent city-wide monitoring programme.[10] This aquifer supplies an estimated 190,000m^3/day (around 20-25 per cent of total city consumption) through boreholes owned by private water vendors, NGOs, communities or municipalities.[11] Of this, only 36,000 m^3/day enters the official DAWASA supply system. This total offtake is unsustainable. Many existing wells are running dry, new wells are being drilled deeper than ever, and salt water intrusion is occurring near the coast. The sustainable yield of the aquifer is likely to be only 80,000 m^3/ day,[11] less than half the current abstraction. The city centre appears to be the worst affected area, where chloride concentrations are already over four times WHO's 250 mg/l drinking water standard in a number of boreholes.[11]

Table 1. Current and future water demand for Dar es Salaam (m^3/day)[2,3]

	2014	2016	2017
Piped network			
Upper Ruvu offtake	82,000	196,000	196,000
Lower Ruvu offtake	182,000	270,000	360,000
Local wells and Mtoni Treatment Plant	36,000	36,000*	36,000*
Kimbiji Aquifer		260,000**	390,000**
Informal boreholes			
Up to 10,000 boreholes	190,000	*	*

*Not included in official DAWASA plans. **Subsequently revised down to 135,000-150,000 by CDM Smith.[3]

Need for holistic water monitoring and management

While the basin board delivers irrigation abstraction permits, it has no track record in refusing applications to ensure existing needs can be met, and little capacity to enforce existing permits or sanction unauthorised abstractions. With the city lying at the bottom of the catchment, it is perfectly feasible that insufficient water will reach the Ruvu offtakes in dry years.

Meanwhile, there is no systematic monitoring of the vital shallow aquifer beneath Dar es Salaam, despite it supplying up to a quarter of the city's drinking water needs. The problems are compounded because DAWASA only has responsibility for the water that circulates within the piped network, and not that supplied by the up to 10,000 shallow informal boreholes, which are not systematically monitored by WRWRB.

Surprisingly, DAWASA's medium-term plans make no provision for using the shallow aquifer in future proposals to meet SDG6. In planning to expand supply from 51 per cent to 100 per cent coverage by 2022, DAWASA envisages surface water and deep groundwater as the future sources. Yet neither appears capable of entirely replacing the 190,000 m^3/day that currently comes from the shallow aquifer.

In addition, it will take years to build a piped network that delivers affordable drinking water to all in informal settlements. So the aquifer will continue to be used, especially if and when formal piped supplies sometimes fail, as seems likely given the flow models for the Ruvu River. It is perhaps understandable that DAWASA shies away from the complexities of managing a polluted and informally exploited aquifer, however, this is to ignore the daily reality of millions of people.

The question of who regulates that use, and helps ensure that supplies are as clean and as drinkable as possible, remains open. No institution under the current framework is clearly able to ensure quality water and protect health. Rather, a situation of 'institutional limbo' exists. If reinforced, the basin water board could authorise and monitor abstraction from the shallow aquifer, but it does not currently intervene on quality issues. Conversely, DAWASA takes no responsibility for water quality from supply infrastructure it doesn't formally own.

Urban resilience

The numbers on water supply in Dar es Salaam do not add up. Models using available data suggest that dry season flows in the Ruvu will not meet all future demands, even after the construction of Kidunda dam, partly because farmers upstream have been given significant water rights. The deep boreholes cannot sustainably provide the volumes required, and the shallow aquifer is already under unsustainable pressure.

The city will have to consider conjunctive use from all available sources, and also use restrictions on water consumption to reduce demand. However it seems inevitable that consumers, and particularly the poorest, will turn to the shallow aquifer, whatever its quality, when supplies fail. It is also possible that the poorest people in informal settlements may be unable to afford DAWASA connections (even if these exist in their community) and will continue to use groundwater sources up to, and beyond, 2030.

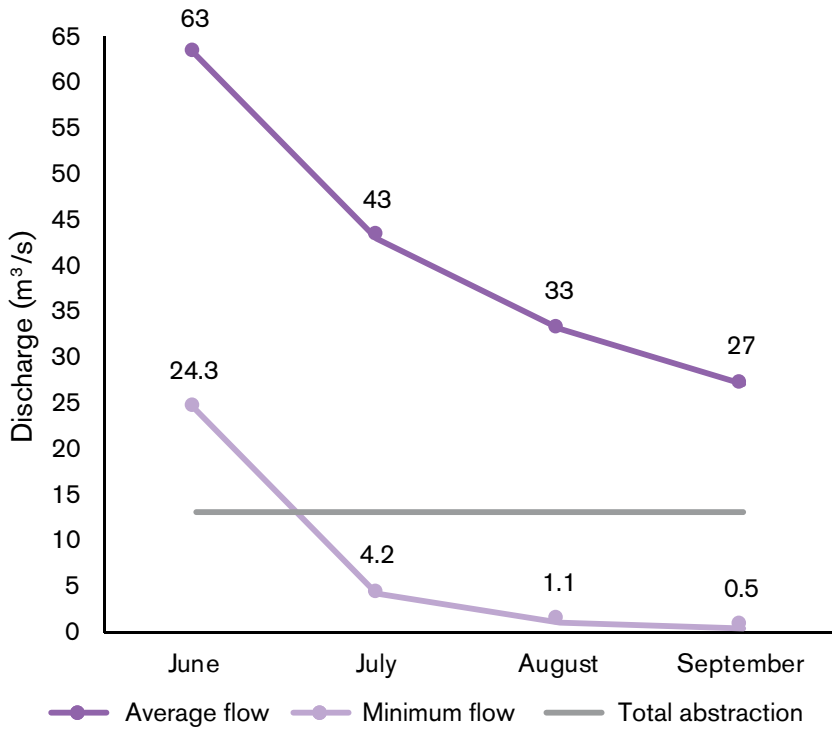
Perhaps the most optimistic scenario is to see extensions of the DAWASA network gradually supplying piped water, reducing the offtake required from boreholes, and returning abstraction from the shallow aquifer to more sustainable levels. During dry years, when the surface supply from the Ruvu River fails, temporary increases in pumping from the restored shallow aquifer, combined with water treatment, could then meet community needs for short periods. In other words, managing the shallow aquifer sustainably could play a key role in delivering urban resilience if climate change significantly affects surface flows.

Upstream-downstream interests — balancing demands

The greatest long-term threat to surface water supply for Dar es Salaam in the dry season is probably upstream authorisations for irrigation. Official allocations already exceed available minimum dry season flows, and while the law envisages priority being given to drinking water supply, the politics of rescinding existing upstream irrigation permits to meet future demands for the city downstream remains untested. The basin board's enforcement capacity would require significant bolstering before such approaches prove viable.

In reality, efficient, flexible and adaptive management of the different sources of drinking water supply requires that both formal piped and informal pumped supplies be managed under a single, coordinated institutional umbrella. While in principle this means the Ministry of Water and Irrigation, in practice it means organising more concerted action between the basin board (which should authorise all boreholes), DAWASA (which should be responsible for all water supply within the urban boundary), and municipalities (because these interact effectively with community needs).

Figure 1. Seasonal flow at 1H8 gauging station and volume of abstraction permits issued for upstream irrigation (lower Ruvu catchment)



Evidence-based decision making

The analysis of hydrological data undertaken during this study shows that water use within the Ruvu River catchment and within Dar es Salaam is reaching a critical juncture. More sophisticated, evidence-based decisions are needed, based on a good understanding of the state of the resource and the uses made of it. Currently, significant investment decisions are being made, based on

often shaky and inadequate hydrological data. The Ruvu basin has now gone beyond a phase of 'water mobilisation' and is clearly entering a phase of 'flexible, adaptive management' of increasingly scarce resources. Meeting the requirements of SDG6 effectively will demand more and better data on highly variable rainfall, flows and groundwater throughout the basin, and strong, technically competent, joined-up institutions able to manage potentially competing uses in the public interest.

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Connecting cities and basins project

This work was undertaken as part of a larger project assessing trajectories for meeting drinking water and sanitation targets in informal settlements in Dar es Salaam. The project worked with the Centre for Community Initiatives, the Tanzania Urban Poor Federation, Ardhi and Dar es Salaam universities, local municipalities, DAWASA, the Wami/Ruvu Basin Board and the Ministry of Water and Irrigation to assess water planning and delivery at three scales: the community level, the city level and the basin level. More information at **www.iied.org/connecting-cities-basins**.

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Notes

[1] Official data vary. The Ministry of Statistics estimated that the percentage served with clean water was 51.7 per cent in 2013 (United Republic of Tanzania (2014) *Dar es Salaam Region Socio-Economic Profile, 2014*. Page 157. National Bureau of Statistics, Dar es Salaam, Tanzania). See also: Kombe, W *et al.* (2015) Translocal learning for water justice: peri-urban pathways in India, Tanzania and Bolivia. Water Justice City Profile: Dar es Salaam, Tanzania. The Bartlett Development Planning Unit, UCL, London. www.researchgate.net/publication/280041313_Water_Justice_City_Profile_Dar_es_Salaam_Tanzania_Translocal_Learning_for_Water_Justice_Peri-Urban_Pathways_in_India_Tanzania_and_Bolivia; and McGranahan, G *et al.* (2016) Universalising water and sanitation coverage in urban areas: From global targets to local realities in Dar es Salaam, and back. IIED, London. http://pubs.iied.org/10812IIED / [2] DAWASA/Egis-Eau (2014) Groundwater drilling and construction of water supply system. Dar es Salaam Interim Water Supply Design Report rev. 3. Consultant Report. / [3] Interim feedback from CDM Smith at the Kimbiji Aquifer Assessment workshop, September 2016. / [4] GLOWS – FIU (2014) Environmental flow recommendations for the Ruvu River Basin. Florida International University, Miami. / [5] DAWASA (2013) Kidunda dam: feasibility study, detailed design and social and environmental impacts. Studio Pietrangeli. / [6] Nobert, J and Skinner, J (2016) Meeting future demand for drinking water supply in Dar es Salaam: Hydrological modelling of the Ruvu River and assessment of flows. IIED, London. http://pubs.iied.org/17599IIED; research undertaken as part of this project. / [7] Mwangingo, R (2013) Challenges for water supply and the growing demand in rapidly growing Dar es Salaam. Presentation at the Reality Check Workshop, Dar es Salaam. / [8] ESI (2016) Availability and sustainability of groundwater in Dar es Salaam and its potential role in meeting SDG 6. Research undertaken as part of this project (contact jamie.skinner@iied.org). / [9] Ministry of Water and Irrigation, Technical working group meeting, February 2016. / [10] But note that the World Bank is currently planning to finance a country wide ground water monitoring network. / [11] Mtoni, Y E (2013) Saltwater intrusion in the coastal strip of Dar es Salaam Quaternary aquifer, Tanzania. PhD thesis. Ghent University.