Uganda: Groundwater Dossier

Key recommendations

Government: National and Local

- Actively engage with the **AMCOW Pan-African Groundwater Program**
- Decision makers should focus on **diversifying and decentralising water supply solutions**. Conjunctive use, managed aquifer recharge, and suitable treatment measures are vital to make groundwater a strategic resource on the urban agenda.
- The main physical factors affecting handpump functionality in Uganda are the poor condition of handpump components, and the complex aquifer resource. The impact of these factors can be mitigated through **appropriate material choice for handpump components (not galvanised iron), increased investment in borehole siting and testing, and adequate accessibility to repairs and maintenance capacity** with breakdowns.
- Accept that **handpump services will breakdown and design robust systems** that reduce the number of breakdowns per year and minimise the time it takes to repair a pump (downtime).
- Set **realistic targets for handpump functionality using metrics that provide information on long-term sustainability of the facility**, rather than simple functionality, and collect data accordingly.
- Require all agencies providing drinking water through handpumps to use **standard definitions and methods to measure functionality**. This will enable national measurement of progress towards the **SDG goal of ensuring that everyone has access to drinking water** by 2030.
- Analyse **handpump functionality data** to determine whether irreversible breakdown and abandonment is occurring early in handpump lifecycles, as this indicates problems in site selection, installation, and commissioning. These problems can be rectified through **better planning, improved contracting, and building of capacity of well-drillers.**
- Policy focusing on extending water supply coverage, at the expense of sustainable service provision, must be revisited.
- **Overlapping roles and responsibilities** for the management and delivery of water supplies need to be clarified.
- Decentralised delivery of water supply services must be matched with **adequate fiscal decentralisation** to ensure that districts have the financial resources needed to perform their role.
- **Districts need structured capacity support** to enable them to adequately support communities in managing and maintaining their water supply.
- Efforts to **calculate the full costs of reaching and sustaining universal water supply access** (using various service options) in the district must be undertaken and integrated into district plans. These must be complemented by efforts to identify and leverage additional funding sources to implement costed plans.

Civil society, national NGOs and private sector

- **Participatory governance** approaches, such as Transition Management, have multiple benefits for management of WASH services in Sub-Saharan Africa. Successful engagement relies on critical **assessment of structural and cultural**

Commented [SF1]: Target Audiences

Government

Donor/Development Partners
DFID Country Office
UNICEF WASH team (country/regional)
World Bank
African Development Bank

iNGOs
Millennium Water Alliance

Private Sector

Commented [HP2]: Combined these two categories as recommendations overlapped

inequalities and combining them with trust- and capacity-building based on local needs and priorities.

- Developing community initiatives for Transition Management **requires careful actor analysis and selection**. Consideration of power dynamics, identification of frontrunners, engagement of most vulnerable community members, and selection of actors from institutions are all key factors.
- **Behavioural and cultural change** related to water, sanitation and waste management need time, resources and capacity building activities at multiple levels (local team, communities, authorities, NGOs). Behaviour change needs to be constantly supported by organizing awareness raising and education activities, by mobilizing and empowering community members, and by ensuring the reinforcement of laws. The collaboration and dialogue between local community members, institutional organisations, NGOs and private companies play a key role in the implementation of these actions.
- All agencies providing drinking water through handpumps should use **standard definitions and methods to measure functionality**.

International Development Cooperation and Aid agencies (iNGOs, UN organisations)

- Recommendation !

Commented [HP3]: Inputs welcome

Further research

In the urban water security context, further research is needed into the potential for participatory governance approaches, such as Transition Management, to be successfully applied in the cultural and political context of sub-Saharan Africa to support changes away from non-existent or unsustainable practices towards sustainable urban groundwater management which takes the interests of slum dwellers into consideration.

Commented [HP4]: T-GroUP inputs welcome here

For sustainable rural water services, further research needs include…

Commented [HP5]: Hidden Crisis inputs welcome here

Context: highlights from the Africa Groundwater Atlas

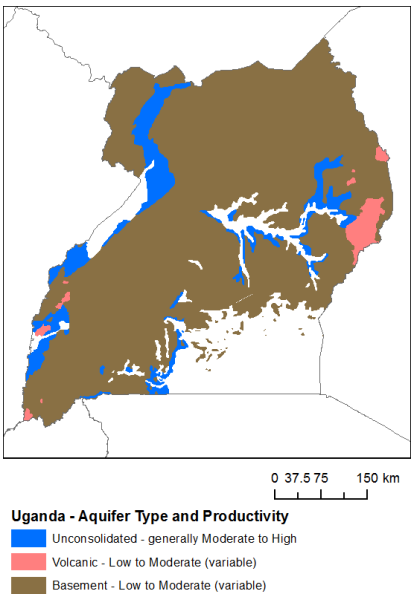
http://earthwise.bgs.ac.uk/index.php/Hydrogeology_of_Uganda

Groundwater quantity

- There are currently no widespread issues with groundwater quantity, although localised groundwater depletion may be an issue where the low permeability basement aquifers are exploited by high yielding electric pumps.
- Estimates of recharge are highly variable.

Groundwater quality

- Groundwater quality is generally good, although high concentrations of iron and manganese are common in the crystalline basement aquifers, and microbial contamination related to faecal waste has been observed in shallow urban aquifers.
- High fluoride concentrations are often observed in igneous groundwaters, for example at Kisoro and Mbale.



Groundwater use

- A total of 73 of the 98 operational water supply systems in Uganda are dependent on groundwater. This accounts for around 75% of all towns and cities. In Kampala City several industries are also reliant on groundwater, including mineral water and chemical industries.
- Groundwater abstraction permits are provided to users of motorised pumps by the Directorate of Water Resources Management.
- Most of the rural population relies on groundwater, dominantly from shared boreholes equipped with handpumps. Most boreholes in Uganda tap groundwater from the weathered and/or fractured basement aquifer. The depth and yield of these boreholes varies, for example depending on the local rock lithology and the degree of weathering and fracturing: most boreholes are less than 80 m deep but they can be as deep as 200 m. Borehole yields can vary from 0.5 up to 50-80 m3/hour.

Transboundary Aquifers

- Uganda shares two transboundary aquifers: the Nile and Lake Victoria Basins. The Transboundary Water Resources Management Division promotes regional transboundary cooperation for the equitable and reasonable utilisation of the shared water resources of the Nile and Lake Victoria Basins.

Groundwater monitoring

- The national groundwater monitoring network was started in 1998. Daily observations are available for 30 stations across a range of hydrogeological environments.
- The National Groundwater Database (NGWDB) contains information on all boreholes drilled to a depth of 30m or greater.

Key activities and findings from UPGro research in Uganda

General UPGro findings with relevance to Uganda

Climate Resilience & Groundwater Resources

- Climate change may enhance groundwater recharge in arid and semi-arid areas, presenting opportunities for long-term management as part of national climate adaptation strategies.
- Across the West African Sahel, rainy seasons are projected to be later than historically, with fewer but more intense rainfall events.
- This may favour more focused groundwater recharge along watercourses.
- Observed groundwater levels have generally risen across the Sahel, despite declining rainfall, this "Sahelian Paradox" is thought to be due to changes in the land use and vegetation cover. UPGro research aligns with this view.
- Local hydrogeological understanding is required to define the sustainable yield of water points, particularly in weathered basement aquifers.
- Numerical groundwater models can be used to assess the sustainability of different groundwater scenarios to inform groundwater management and planning.
- Bacteriological contamination of groundwater is likely to be a significant barrier to achieving safely managed water services under SDG6, but this can be tackled by improved construction practices.

Groundwater and Poverty

- Communities are routinely under high water stress due to social pressures (e.g. funerals, cultural events) and environmental pressures (e.g. dry periods). These pressures cascade with routine sharing of water points.
- Women are more at risk of water scarcity due to gender roles and gender task allocation.

Sustainable Rural Water Services

- New methods for defining and measuring water point functionality are required to adequately monitor progress towards SDG6 for safely managed water services.
- Affordable maintenance and repair are one of the main predictors of borehole functionality. This highlights the need for effective management models to address poor functionality.

Urban Water Security

- In urban areas experiencing rapid population growth, increased demand for water is likely to have a much more significant impact on groundwater than climate change.
- Groundwater can only gain a role as a strategic urban resource where an integrated approach to urban water management and governance acknowledges the importance of all available resources. Conjunctive use, managed aquifer recharge, and suitable treatment measures are vital to make groundwater a strategic resource on the urban agenda.

	▶ Participatory, community-led approaches, such as Transition Management, can provide new and collaborative ways of using and managing urban groundwater.
Agriculture and livelihoods	▶ Access to groundwater is associated with improved agricultural production, reduced agricultural risk, and improved livelihoods. ▶ Knowledge sharing approaches, such as Rainwatch and Farmer Radio, can be used to increase resilience by communicating farming practices that align with sustainable intensification, climate and groundwater forecasts with farmers.

Uganda-specific activities and findings

Climate Resilience & Groundwater Resources	▶ Groundwater is generally available through the dry season. Access to functional water services is the key constraint to water availability for communities.
Sustainable Rural Water Services	▶ Communities are routinely under high water stress with diaries showing both regular pressures from funerals, cultural events and dry periods. ▶ Pressures on water points often cascade with routine sharing of water points with neighbouring communities due to poor functionality. ▶ A 2016 survey of boreholes with handpumps across 112 districts of Uganda showed that only 55% were working on the day of the survey. Only 18% of handpumps surveyed passed the design yield, reliability and water quality criteria. ▶ Reducing the number of handpump breakdowns and minimising the time it takes to repair them are vital to improve access to water services. ▶ Data collection and analysis on handpump functionality is essential for rapid repair. Metrics should focus on long-term sustainability of the facility, rather than simple functionality at the time of measurement. ▶ Handpump functionality datasets should include information on water point age, frequency of breakdown, and length of downtimes, as well as differentiating 1) water yield and quality limitations, including seasonality constraints 2) limitations in well siting, design, and installation, and 3) limitations of handpump maintenance and financing arrangements. ▶ At the District level, a Water Supply Sustainability analysis for Uganda identified three main threats to functionality of rural groundwater supply: poor construction practices, weak management models, and lack of ownership. ▶ Handpump corrosion is continuing to lead to premature failure of pump components and poor water quality in rural Uganda. Increased use of corrosion-resistant

	pump components is needed, as well as improvements to project planning and implementation, pump rehabilitation, and water quality testing.
Urban Water Security	▶ Quantitative approaches to ranking and improving urban liveability miss the complex governance and contested political space in which water services are delivered. ▶ A study in Kampala showed that increasing the number of water connections does not guarantee improved access to water and sanitation in the long run due to land-rights issues and political game-playing between central government, the opposition, the traditional leadership, and slum dwellers in governance processes of service delivery. ▶ Urban liveability can be enhanced by broadening political participation in city development planning. ▶ Communities can make collective claims towards improving their quality of life and the environment, through acquiring community ownership of lands prior to installation of water and sanitation facilities. ▶ This acquisition can be supported by constructing a vision that links livelihood struggles with broader sustainability issues as well as building ties among communities, intermediary organisations (i.e. NGOs, universities, social movements, etc.) and some groups within the governmental agencies. ▶ Transition Management, a participatory governance approach, has played a crucial role in empowering and mobilizing communities, creating a sense of responsibility for local problems and ownership of the actions and solutions developed, and building trust between communities and institutions to sustain actions and solutions over time.

Case Studies

Multiple actions have been developed by community members in Kampala to address their sustainability problems

http://t-group.science/2019/01/multiple-actions-have-been-developed-by-community-members-in-kampala-to-address-their-sustainability-problems/

Figure 1. A group of participants Kawaala community during the back-casting exercise

Figure 2. A group of participants from Makerere and Mukubira zones are brainstorming about the actions to be developed in their communities.

At the end of October 2018 the local transition team in Kampala organized three 'agenda setting' transition arena meetings with participants from multiple communities (Makerere, Mukubira, Bwaise and Kawaala) in informal settlements in Kampala. The meetings started by sharing some of the most important insights from previous meetings such as the vision narratives previously developed by the participants, helping them to identify short-, medium- and long-term actions to address local problems.

Short-term actions focused on educational and awareness raising activities related to water, sanitation and waste management. For example, teaching community members correct hygiene practices, proper construction of toilet facilities and practices of maintenance and protection of water sources. Long-term actions included ensuring the enforcement of laws related to water, waste and sanitation management. In Bwaise, for example, the implementation of fines related to poor toilet usage and construction were discussed. Additionally, participants in all areas spoke about the importance of mobilizing community members and setting up active groups aiming to carry on sensitization activities and to ensure the maintenance of services over time. Other important actions included the creation of Savings and Credit Cooperatives (SACCOs) for supporting the local circular economy by producing products from waste materials.

The results of the 'agenda setting' arena meetings show that the implementation of facilities and services alone do not contribute to solve local water, sanitation and waste management problems. Rather, a combination of actions is needed for addressing the rooted and interlinked problems. New organizational and governance capacities at both community and institutional level need to be developed in order to ensure the maintenance of facilities over time. The change of practices and behaviours related to water, sanitation and waste management need to be constantly supported by organizing awareness raising and education activities, by mobilizing and empowering community members, such as through

active groups as well as by ensuring the reinforcement of laws. The collaboration and dialogue between local community members, institutional organisations, NGOs and private companies play a key role in the implementation of these actions.

Measuring progress on water point functionality requires standards definitions and assessments

http://nora.nerc.ac.uk/id/eprint/523090/

Currently, there is no universally adopted definition of water point functionality, or what constitutes a functioning water point. Assessing progress towards the SDGs requires agreed definitions and standard assessment approaches.

The Hidden Crisis project developed a set of common definitions and methods for assessing water point functionality and performance. A tiered approach to defining and measuring functionality was found to be useful to examine functionality for different scales and purposes. This approach has been applied in functionality surveys across Ethiopia, Uganda and Malawi, as part of Hidden Crisis research.

The guidelines for assessing water point functionality are summarised as:

1. Functionality should be measured against explicitly stated standards of the performance of the water point, so that functionality data from different regions and surveys can be compared.
2. It should be measured separately from the users' experience of the service provided.
3. Functionality assessments should be tiered, to ensure a minimum top-tier assessment can be completed by all surveys, but allowing for further, more detailed, tiers of assessments to be conducted at local levels.
4. A distinction should be made between surveying functionality as a snapshot (e.g. for national metrics) and surveying individual water point performance (where a temporal aspect of the water point performance is included in a rapid assessment).

The tiered approach to defining water point functionality involves 4 levels:

1. Binary Functionality – is the water point working and delivering some water (yes/no)
2. Functionality: yield snapshot – does the water point work and provide sufficient yield (10 L/min) on the day of the survey
3. Functionality: reliable yield – does the water point provide sufficient yield (10 L/min) on the day of survey, is it reliable (<30 days downtime in last year) or abandoned (not worked in past year)?
4. Reliable yield and water quality - as 3 above, and also passes WHO guidelines for water quality.

Application of these definitions of functionality in the field have shown that the measure of *reliable yield* gives much more useful information about the service level of the water point than a binary assessment, and generally reduces functionality rates by 50%.

For full details of the definitions and methods developed, please see the technical briefing which has been published here: http://nora.nerc.ac.uk/id/eprint/523090/.

Corrosion of handpump facilities leads to poor water quality in Amuria and Katakwi districts of Uganda

https://www.developmentbookshelf.com/doi/full/10.3362/1756-3488.2016.006

WaterAid Uganda (WAU) currently operates in a number of districts in north-east Uganda working closely with District Local Governments and through two local implementing partners: Church of Uganda-Teso Diocese Planning and Development Office (CoU-TEDDO) and Wera Development Agency (WEDA). In two of these districts, Amuria and Katakwi, there had been increasing concerns over problems with poor water quality in groundwater sources due to high iron concentrations.

Revision of WAU's water quality testing protocol raised concerns about the way water quality was being tested during borehole construction. In Uganda, responsibility for sampling and testing is usually given to the drilling contractor and the authors' experience suggests that, for a number of reasons, this procedure may lead to unreliable results being reported.

In 2012, WAU began using staff from the government laboratory in Mbale to carry out on-site pH measurements at boreholes before handpump installation rather than including water quality testing in the drilling contract. An analysis of the pH measurements in Amuria and Katakwi districts from these recent tests indicated that the pH of the groundwater was much lower than was expected. Of 34 samples, 91% were below pH 6.5 and 38% below pH 6. This reinforced the suspicion that corrosion was likely to be contributing to the high iron concentrations reported in groundwater sources.

In August 2014, WAU undertook a field testing programme on a number of recently installed boreholes where high iron concentrations had been reported by communities to clarify the origin of high iron concentrations. All the samples from boreholes with galvanised iron (GI) components showed a sharp decline in iron concentration when pumped continuously for two hours, demonstrating that high iron concentration is not naturally occurring in the water supply. In the final samples, iron concentrations in filtered samples were between 0.17 and 0.86 mg/l. The unfiltered samples often showed very high iron concentrations, 144 mg/l in one case, indicating that solid corrosion particles are likely to be present and incorporated in the analysis result. PVC riser pipes appear to be working effectively on one installation where the pH of the groundwater suggests that corrosion and poor water quality would be a risk if GI pipes were fitted. These findings contributed to the recommendation to install non-GI pump components in areas with aggressive groundwater.

More information

Type	Organisation	Contacts
Ministries and authorities		
UPGro projects in Uganda	Hidden Crisis: Unravelling past failures for future success in Rural Water Supply	Prof. Alan MacDonald (BGS) https://upgro-hidden-crisis.org/
	Experimenting with practical transition groundwater management strategies for the urban poor in Sub-Saharan Africa (T-GroUP)	Dr Jan Willem Foppen (UNESCO-IHE) http://t-group.science/
UPGro researchers in-country	Makerere University	Prof Dr Frank Kansiime, Dr Robinah Kulabako, Dr Philip Nyenje (T-GroUP) Dr. Michael Owor (Hidden Crisis)
	Uganda Christian University (UCU)	Jennifer Isoke (T-GroUP)
	WaterAid Uganda	(Hidden Crisis)
Online tools and databases	Africa Groundwater Atlas	earthwise.bgs.ac.uk/index.php/Hydrogeology_of_Ethiopia
	Groundwater Assessment Platform	www.gapmaps.org/gap.protected/
	Water Point Data Exchange	www.waterpointdata.org/
	IGRAC Global Groundwater Information Systems	www.un-igrac.org/global-groundwater-information-system-ggis
	UNHCR WASH Data Portal	wash.unhcr.org/wash-gis-portal/
	Uganda National Groundwater Database (NGWDB)	https://www.mwe.go.ug/sites/default/files/library/Consolidated%20Hydrological%20YearBook%201978-2014%20for%20Uganda.pdf

Commented [HP6]: Inputs welcome here

UPGro published work relating to Uganda

https://upgro.org/publications-papers

1. Giorgia Silvestri & Julia M. Wittmayer & Karlijn Schipper & Robinah Kulabako & Sampson Oduro-Kwarteng & Philip Nyenje & Hans Komakech & Roel Van Raak, 2018. "Transition Management for Improving the Sustainability of WASH Services in Informal Settlements in Sub-Saharan Africa—An Exploration," Sustainability, MDPI, Open Access Journal, vol. 10(11), pages 1-19, November.
2. Maryam Nastar, Jennifer Isoke, Robinah Kulabako & Giorgia Silvestri (2019) A case for urban liveability from below: exploring the politics of water and land access for greater liveability in Kampala, Uganda, Local Environment, 24:4, 358-373, DOI:10.1080/13549839.2019.1572728
3. Vincent Casey, Lawrence Brown, Jacob D. Carpenter, Jacinta Nekesa & Bonny Etti (2016). The role of handpump corrosion in the contamination and failure of rural water supplies. Waterlines, 35(1), DOI: 10.3362/1756-3488.2016.006
4. Owor M, MacDonald AM, Bonsor HC, Okullo J, Katusiime F, Alupo G, Berochan G, Tumusiime C, Lapworth D, Whaley L, Lark RM. (2017). UPGro Hidden Crisis Research Consortium – Survey 1 Country Report – Uganda. British Geological Survey (BGS) Open Report, OR/17/029, pp 18.
5. Owor, M.; Fallas, H.C.; MacAllister, D.J.; Okullo, J.; Katusiime, F.; Berochan, G.; Whaley, L.; Banks, E.; Casey, V.; MacDonald, A.M.. 2019 Physical factors contributing to rural water supply functionality performance in Uganda. Nottingham, UK, British Geological Survey, 24pp. (OR/19/056) (Unpublished)
6. Bonsor H C, Oates N, Chilton P J, Carter R C, Casey V, MacDonald A M, Calow R, Alowo R, Wilson P, Tumutungire M, Bennie M (2015). A Hidden Crisis: strengthening the evidence base on the sustainability of rural groundwater supplies – results from a pilot study in Uganda. UPGro Catalyst Grant Report (NE/L001969/1).
7. Miriam Denis Le Sève (2018). A political economy analysis of Uganda's rural water supply sector. Overseas Development Institute 2018, pp29.
8. Fredrick Tumusiime (2018). District Water Supply Sustainability Assessment, Final Country Report Uganda. UPGro Hidden Crisis.
9. Richard C. Carter & Ian Ross (2016). Beyond 'functionality' of handpump-supplied rural water services in developing countries. Waterlines, 35(1), DOI: 10.3362/1756-3488.2016.008
10. UNC Water Institute WaSH Policy Research Digest Issue #3, March 2016. Detailed Review of a Recent Publication: Getting handpump functionality monitoring right can help ensure rural water supply sustainability.
11. Bonsor, H., MacDonald, AM., Casey, V., Carter, R., Wilson, P. 2018. The need for a standard approach to assessing the functionality of rural community water supplies. Hydrogeology Journal, 26; 2, 367-370. https://doi.org/10.1007/s10040-017-1711-0
12. Whaley, L., Cleaver., F. 2017. Can 'functionality' save the community management model of rural water supply? Water Resources and rural development; 9: 56-66. http://dx.doi.org/10.1016/j.wrr.2017.04.001
13. Liddle, ES., Fenner, R. 2017. Water point failure in sub-Saharan Africa: the value of a systems thinking approach Waterlines; 36: 2: 27pp. http://www.developmentbookshelf.com/doi/10.3362/1756-3488.16-00022
14. Howard, G., Calow, R., MacDonald, A., Bartram, J. 2016. Climate change and water and sanitation: likely impacts and emerging trends for action, Annual Review of Environmental Resources, 41: 253-276. https://doi.org/10.1146/annurev-environ-110615-085856
15. Cleaver., F, Whaley, L. 2018. Understanding process, power, and meaning in adaptive governance: a critical institutional reading. Ecology and Society; 23 (2): 49. https://doi.org/10.5751/ES-10212-230249.
16. Whaley, L. 2018. The Critical Institutional Analysis and Development (CIAD) Framework. International Journal of the Commons; 12 (2): 137-161. http://doi.org/10.18352/ijc.848
17. Whaley, L., MacAllister, D.J., Bonsor, H.C., Mwathunga, E., Banda, S., Katusiime, F., Tadesse, Y., Cleaver, F., MacDonald, A.M. 2019. Evidence, ideology and the policy of community management in Africa. Environmental Research Letters. https://iopscience.iop.org/article/10.1088/1748-9326/ab35be
18. Liddle, E.S., Fenner, R. A. 2018. The impact of procurement and siting procedures on handpump functionality in Uganda. WEDC Paper, 41st WEDC International Conference, Nakuru, Kenya. Pp 6. https://dspace.lboro.ac.uk/dspace-jspui/bitstream/2134/35834/1/Liddle-2886.pdf
19. Fallas, H. C., MacDonald, A.M., Casey, V., Kebede, S.,Owor, M., Mwathunga, E., Calow, R., Cleaver, F., Cook, P., Fenner, R.A., Dessie, N., Yehualaeshet, T., Wolde, G., Okullo, J., Katusiime, F., Alupo, G., Berochan, G., Chavula, G., Banda, S., Mleta, P., Jumbo, S., Gwengweya, G., Okot, P., Abraham, T., Kefale, Z., Ward, J., Lapworth, D., Wilson, P., Whaley, L. Ludi, E. 2018. UPGRO Hidden Crisis Research consortium: Project approach for defining and assessing rural water supply functionality and levels of performance. British Geological Survey (BGS) Open Report, OR/18/060, pp 25. http://nora.nerc.ac.uk/id/eprint/523090/
20.

Credits

This briefing note was prepared for the UPGro (Unlocking the Potential of Groundwater for the Poor) programme (2013-2020) funded by DFID, NERC and ESRC. Edited by Sean Furey (Skat Foundation) with contributions from Heather Plumpton (Walker Institute) [… add your name here if you edit this document]