Burkina Faso: Groundwater Dossier

Key recommendations

Government: National and Local

- Actively engage with the **AMCOW Pan-African Groundwater Program**
- There is potential for increased groundwater use in the Volta Basin to support resilience of smallholder farmers, but this varies by location due to the localised nature of the groundwater aquifer and local land use. To ensure that policies are effective, a **detailed understanding of local livelihood activities and site-specific groundwater modelling** are essential.
- Ensuring that this water resource is **managed equitably and sustainably** there is need for policies to engage with and encourage local governance mechanisms and support training so that groundwater monitoring can play a central role in extraction processes.
- Given the localized nature of groundwater resources, **local, community-based management** of resources may be more appropriate than top-down approaches.
- Any increases in groundwater use needs to be supported by **investments in groundwater infrastructure**, such as additional wells.
- **Local governance structures** will be key to ensuring access to groundwater infrastructure for the most vulnerable in the community. Such structures should consider **gender** role allocation, as this is a key determinant of water usage on the ground. Greater engagement with SP/CONASUR may be helpful as it is a public organization with a humanitarian vocation. With a mandate for prevention and reduction of natural disasters in Burkina Faso, CONASUR is essentially in charge of the implementation of DRR programmes.
- There is a need to **strengthen local understanding** of groundwater recharge to ensure that communities can make informed decisions on how they use groundwater. This can be achieved through a combination of **capacity building** in groundwater monitoring and analysis, and **information sharing** on sustainable use of water resources in agriculture.
- Information sharing should include information on groundwater use and management, rainfall, agriculture and markets to support stable food security and poverty reduction.
- **Credit facilities** would allow communities the opportunities to invest in initial infrastructure needed to make use of groundwater resources.

Civil society and NGOs

- Support effective and consistent collaboration and communication between national and district institutions, researchers and policy makers. This will enable **access for policy makers to reliable data and information** to inform policy changes. **Participatory governance** approaches have multiple benefits for management of WASH services in Sub-Saharan Africa. Successful engagement relies on critical **assessment of structural and cultural inequalities** and combining them with trust- and capacity-building based on local needs and priorities.

Commented [SF1]: Target Audiences

Government
MEE / ONEA: Senior Technical Advisors

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

iNGOs
Millennium Water Alliance

Private Sector
Uduma / Odial Solutions (France)

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

- Investment must be made in supporting **DGRE's long-term monitoring of groundwater**, analysis and access to this data.
- Investment in the **decentralised collection of quantitative livelihoods data** (disaggregated to allow gender and other social categories to be identified) is vital to provide a crucial link between water security and issues driving conflict, migration, access to education and health services. The **disaggregated livelihoods impact metric** could then be included among other metrics in order to identify winners and losers in evaluating the robustness of any theory of change.
- It is essential to **widen access to the latest data and local knowledge**, while providing training in the skills required to interpret that data and knowledge, to support informed debate and build a consensus for timely actions based on this evidence. Equally, if decision making is to be effectively devolved, rural people may need training in the skills necessary to interpret and apply this information.
- To widen access, capacity must be built in local institutions and partner universities in data collection (groundwater and livelihoods) and analysis, adopting a **'Training of Trainers' approach.** This will accelerate, grow and sustain uptake and monitoring activities and ensure local institutions can continue to deliver both groundwater and livelihoods training as 'trainer of trainers'). This will provide a sustainable, ongoing basis for climate resilience research**.**
- Efforts to **re-engage with the National Met Services (DMN Burkina) is vital** for climate resilience research in Burkina Faso going forwards. UK ODA projects (e.g. within BRACED, UPGro, FCFA) that have included working in partnership with DMN Burkina have experienced multiple challenges due to its internal structures.

Further research

The Upgro/BRAVE (https://braveupgro.org) project has improved understanding of how water moves through catchments representative of the Volta River Basin, and with output from land surface and groundwater models, new scientific knowledge is supporting planning from basin-scale, to seasonal community management of groundwater supplies and emergency planning. However, we currently have only qualitative information on the actual impact this is having on the livelihood security of different groups across the population.

Therefore, in future research, rigorous analysis of the livelihood impact of changes in access to or availability of water should be included as an integral part of water security research. This will provide quantitative information on the social and economic impacts of infrastructure investments, governance changes, and local financing arrangements. Quantitative livelihoods data (disaggregated to allow gender and other social categories to be identified) should be included among other metrics used to identify winners and losers in evaluating the robustness of any theory of change. The disaggregated livelihoods impact metric would provide a crucial link between water security and issues driving conflict, migration, access to education and health services. This would also provide additional insight to qualitative work on issues of gender inequality and other forms of discrimination and exclusion.

Modelling of the impacts of climate change on groundwater resources has demonstrated the important of long-term groundwater monitoring records for model validation. Greatly increasing the spatial coverage of long-term groundwater monitoring across Africa is needed to support model validation and improve projections of climate impacts on water security. Investment in observation-driven research into ground and surface water resources is therefore needed, to support modelling and development of scenarios for future water resource, to inform national adaptation planning for the Water Sector.

Research gaps identified by policy stakeholders at the BRAVE Burkina Faso Scenario Planning workshop, held in November 2019, included:

- Identify how best to mobilize and exploit groundwater resources for agriculture
- Instigate new in-depth interdisciplinary research on groundwater that integrates physical and social sciences
- Establish a central hub of data, research and knowledge available in Burkina Faso on water resource management, including datasets on groundwater, surface water, hydrology, and livelihoods.

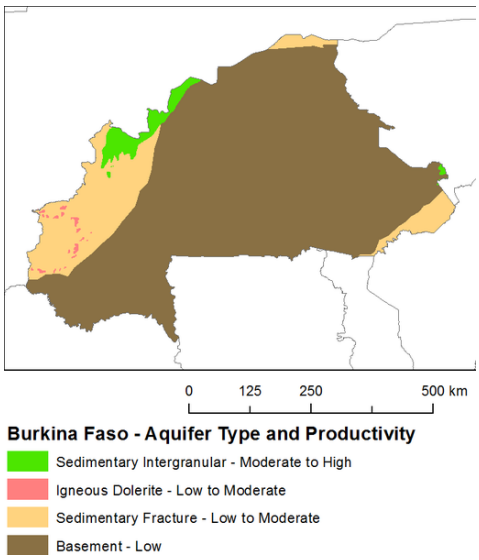
Furthermore, on capacity building they identified a need to build the capacity of technicians and communities for the collection of data on groundwater, to enable the scaling-up of local community groundwater management. On governance, they highlighted the need to better manage and govern existing water resources and ensure equitable access to both ground and surface water. They also recognised the need to advocate for and create opportunities to foster cross-sectoral collaboration across government departments, research institutes and NGOs, with sharing of data and information, to enable all sectors to unite and better exploit water resources to boost development. It was suggested that this could be best achieved by identifying the champions within government, NGOs, and academia that have the necessary influence and energy to facilitate real change.

Context: highlights from the Africa Groundwater Atlas

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

Groundwater quantity

- Average recharge rates are estimated at 5 mm/year in the drier north and 50 mm/year in the south, but locally, recharge can be much higher, with estimates ranging up to 250 mm/year.
- Estimates indicate that over the whole countries, groundwater abstraction is only a small proportion of recharge - less than 1% in the Volta basin, and more than 5% in the far north. However, locally, groundwater abstraction may exceed recharge.



Groundwater quality

- Generally, groundwater in Burkina Faso is of suitable quality for drinking water supplies, although there are local problems.
- Naturally occurring arsenic has been identified as a problem in some areas.
- Pollution from nitrate is thought to be common in shallow groundwater sources, derived from domestic waste as well as agricultural sources, often highest in areas of high housing density.
- Groundwater in some areas of north-west Burkina Faso has high salinity.

Groundwater use

- Groundwater in Burkina Faso is primarily accessed by unprotected dug wells and used mainly for drinking water supply, particularly for small supplies in rural areas and smaller towns.
- The second city of Bobo Diolasso, which lies on a moderately productive aquifer, relies relatively heavily on groundwater.
- The capital Ouagadougou, lying on the relatively low productivity basement aquifer, is largely dependent on surface water, but some 15% of its water supply comes from groundwater, which is particularly important in the dry season.
- Some groundwater is used for small-scale market garden irrigation which is largely accessed through shallow wells, for example supporting dry season cultivation in the south. It is also used for livestock watering. Industry is the smallest user of groundwater in the country.
- Groundwater abstraction is mainly from drilled boreholes and hand-dug wells. The total estimated number of boreholes in Burkina Faso was 24,350 in 2005. Most boreholes are fitted with pumps: these are typically mechanised in urban areas, and hand pumps in rural areas.
- There are no major transboundary aquifers in Burkina Faso.

Key activities and findings from UPGro research in Burkina Faso

General UPGro findings with relevance to Burkina Faso

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.

Burkina Faso-specific activities and findings

Climate Resilience & Groundwater Resources	▶ The localised nature of groundwater resources in areas underlain by weathered and fractured hard rock is a key factor in management. The need for site-specific groundwater modelling means local, community-based management is more appropriate than a top down approach in these environments. ▶ Monitoring is needed to understand the response of individual wells to pumping and groundwater level decline. This can be achieved using low-cost rainfall and groundwater monitoring equipment, installed into communities. At the local scale, this enables communities to make decisions on water use during the dry season, based on levels at the end of the wet season. ▶ At the national scale in Burkina Faso, long term groundwater level monitoring data is being collected from a network of >50 sites, with time series of ~30 year at >10 sites. This dataset has allowed site-specific models to be developed and used to reconstruct past groundwater levels to inform water resource management. ▶ The groundwater and climate models have informed development of three alternative, plausible future scenarios for water resources under climate change in Burkina Faso. These scenarios can be used to support policy makers to make national-scale planning and adaptation decisions for the Water Sector.
Groundwater and Poverty	▶ Local capacity and complex user perception of vulnerability are often overlooked when planning development of groundwater supplies. This is important as it determines if and how communities can uptake, access and govern new opportunities and benefits.
Agriculture and livelihoods	▶ There is potential for increased groundwater use in the Volta Basin to support resilience of smallholder farmers, if investments are made into infrastructure, governance,

capacity building and information sharing on sustainable use.

- Some people will be better able to manage their resources and participate in the strategy to use groundwater effectively for cropping and livestock, and some people will not.
- It is important to understand people's livelihoods locally and what characterizes their vulnerability to water scarcity. Gender and location are key factors in vulnerability.
- Sharing information with farmers on weather, climate and groundwater conditions as well as agricultural techniques for managing water resources is crucial to enable them to build sustainable livelihoods.
- The BRAVE project built successful communication using local weekly radio programmes with Farmer Listening Groups who helped shape the programme content. Information was communicated in relation to their farming calendar.
- Radio programmes included seasonal rainfall information from Rainwatch (www.rainwatch-africa.org). Rainwatch information has been important in supporting farmers to make decisions about seasonal risk of drought conditions or opportunities from higher rainfall.

Case Studies

Groundwater Monitoring supports Modelling Future Scenarios

http://www.walker.ac.uk/about-walker/news-events/brave-training-the-trainers-on-groundwater-modelling/

Burkina Faso has a groundwater level monitoring network that currently includes 52 piezometer sites across the country, operated by the Government's Direction Générale des Ressources en Eau (DGRE). Twelve of these sites have been running since the late 1970s/early 1980s with limited data gaps. These long groundwater level time series are rare in Africa. The data have provided the opportunity for the BRAVE project team to develop groundwater models for each of the sites in collaboration with DGRE, following training of their officers in the use of the model code. The models developed have been used to reconstruct groundwater levels at the long-term sites back as far as 1902. The understanding of the multi-decadal fluctuations of groundwater level are providing Government with insights that will help with future planning in relation to resilience of groundwater supplies for agriculture and other livelihoods. The models have also been used to project future groundwater levels, based on a large number of climate models. The wide range of changes in level, both increasing and decreasing, help to illustrate the challenge in water resource planning given the significant uncertainty.

Scenario-based Planning for Groundwater Management and Resilient Livelihoods

Participants of BRAVE Scenario Planning Workshop, Burkina Faso.

The BRAVE project ran a policy level Scenario Planning Workshop in Burkina Faso in November 2019, attended by government departments, NGOs and academic representatives from the Burkina Faso Water Sector. This high-level workshop was built around three alternative, plausible scenarios of future water resources under climate change, based on modelling conducted for the BRAVE project. For each scenario, storylines of human and socio-economic impacts for rural communities were presented. These narratives provided a springboard to guide the workshop discussion and outcomes. This scenario-planning workshop approach offered a space for participants to identify realistic actions and designate responsibility in their own departments for planning of vital water resources for sustainable and resilient livelihoods under future climate change. During the workshop, stakeholders identified key measures to include in the National Adaptation Plan for the Water Sector, which is under review in 2020. These actions included improving the groundwater monitoring network, encouraging uptake of sustainable land management techniques, increasing the availability of qualitative and quantitative data on groundwater and surface water resources, and providing training on the ability of groundwater to support more resilient livelihoods. Full report available at http://doi.org/10.5281/zenodo.3746621.

Volta Basin Integrated Water Resource Management Planning

http://www.walker.ac.uk/about-walker/news-events/brave-a-2-day-training-lab-on-adaptive-social-protection/

BRAVE participation in the Volta Basin Authority 5 year Planning Meeting in 2017 ensured that the sustainable use of groundwater, which has previously been overlooked with the focus remaining on surface water, was incorporated into the Integrated Water Resources Management (IWRM) plan and introduced the concept of knowledge exchange, establishing a two-way dialogue between the water supply sector and community users of water. Following on from this engagement, the Volta Basin Authority specifically requested support from BRAVE to incorporate consideration of gender issues and to review and expand sections of the IWRM plan relating to groundwater resources and sustainable use. BRAVE

engagement raised awareness of groundwater significantly amongst policy makers at the Volta Basin Authority and successfully integrated this with issues of poverty and water resource access. The integration of groundwater and poverty has been supported by attendance of key policy makers from the Volta Basin Authority and CONIWAS at the Adaptive Social Protection training held in early 2020 in Accra, Ghana. This training highlighted the important linkages between poverty and social protection planning, and water resource availability, demonstrating how groundwater can unlock poverty in practice. This Adaptive Social Protection approach is now informing the development of the IWRM plan as well as being integrated into the CONIWAS Strategic Plan for policy engagement, ensuring that a more integrated approach to poverty and groundwater will continue to be advocated for at a high policy level across the Volta Basin.

Farmers' Voice Radio and Listening Groups help farmers to adapt and improve practice

https://www.lyf.org.uk/2017/05/community-groundwater-resources-in-ghana-and-burkina-faso/

First radio listening programme meetings in Poa and Tomo, April 2018.

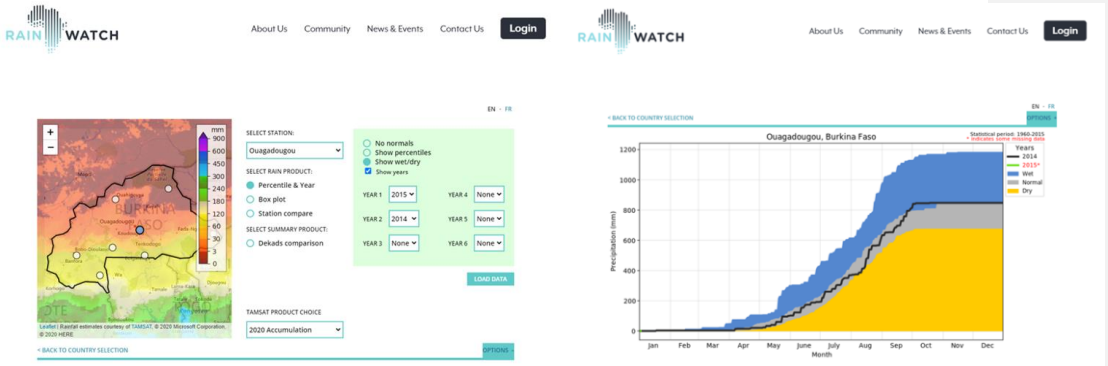
The BRAVE project has adopted the Lorna Young Foundation's Farmers' Voice Radio in northern Ghana and Burkina Faso. The Farmers' Voice Radio methodology centres around the formation of community-based Listener Groups made up of farmers, agricultural extension officers, radio presenters and the project team. The Listener Groups meet every 6 weeks in two communities and discuss the Rainwatch rainfall data (http://www.rainwatch-africa.org/), alongside the key agricultural issues they are facing at that time. The discussions are recorded and are broadcast on a local community radio station, twice a week, in two local languages. Farmers' Voice Radio brings together scientific climate data and local agricultural expertise to ensure farmers have the information they need to make wise farming decisions and build resilient livelihoods.

Unlocking the Potential of **Burkina Faso's** Groundwater for the Poor

In Burkina Faso, two farmer listening groups were established in Tomo (4 men, 11 women) and Poa (5 men, 12 women) communities. 48 episodes of the programme were recorded and broadcast weekly by La Voix du Sanguié, a local radio, covering an area with a population of 20,390 (9,616 males, 10,774 females). To support farmer participation at no additional cost, listening group members were provided with a radio equipped with solar panels. The programme topics were defined by each community group and covered water harvesting and conservation of resources, sustainable land management, health and nutrition and crop yield improvement. Impact assessment surveys show that participation in listening groups and hearing the weekly radio programmes improved farmer's technical capacity to manage their land and water resources, access to water sources, crop and livestock production, and empowerment of women.

Rainwatch increases access to rainfall information across Africa

http://www.rainwatch-africa.org/

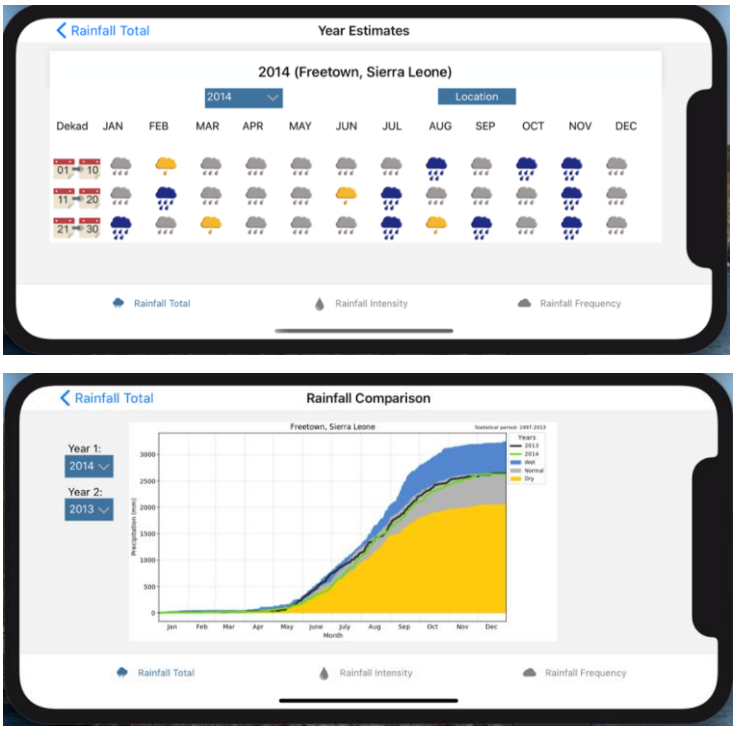


The Rainwatch website interface, showing weather stations in Burkina Faso (left) and cumulative rainfall for Ouagadougou for 2014 compared to wet, normal and dry years (right).

Rainwatch is an open-source, web-based GIS platform that provides rainfall data in near-real time from national weather stations and tracks key seasonal characteristics important for food production, health service response and social protection systems. It has been operating since 2009 in West Africa but is now developed and sustained through a continent-wide Rainwatch Alliance - a partnership of more than 15 African National Hydro Meteorological Services (NHMS). These NHMS are working together to build an effective, African climate service partnership working with Government Agencies, NGOs and Research Institutions across Sub-Saharan Africa (SSA), supporting a climate resilient future for all. The overarching goal of the Rainwatch Alliance is to encourage collaboration to increase access to and use of climate information services. This will enable better targeted decision-making processes across a wide range of sectors, including Agriculture, Disaster Risk Reduction (DRR), Integrated Water Resource Management, Energy and Health. Through long-term trust and partnership building across African NHMS, Rainwatch has become an Africa-owned and locally trusted source of information for national meteorological agencies, governments and NGOs. Now through the integration of Rainwatch into the BRAVE project radio programmes, Rainwatch information has become accessible for local

communities without internet access and is informing farmers' seasonal decision making and agricultural planning whilst helping to build their adaptive capacity and resilience.

Furthermore, a Rainwatch phone application is in development, following requests from members of the Rainwatch alliance and attendees of multiple Rainwatch training sessions targeting national and district extension services run throughout Northern Ghana as part of the BRAVE project. The ongoing development of this application is being co-produced with multiple users such as National Met Services from West Africa, agricultural extension officers and water resource advisors and will be trialled and adapted with users in due course to ensure its usefulness.



Screenshots of the Rainwatch App interface (development ongoing).

The first round of app development was based around the 'use-case' of agricultural extension workers to ensure they can easily access real-time, straightforward informatics about cumulative rainfall and establish how the current season is either classed as normal, wet or dry in comparison to the previous thirty years. This information will enable them to tailor contextually accurate advisories for communities.

The second co-designed 'use case', intended for meteorologists in NHMS, introduces further functionality such as rainfall intensity and frequency, year to date rainfall total comparison and a resource bank of identified information that will support and expand on current functionality. The final 'use case' will focus on water resource advisors and managers, establishing functionality that will provide users with information on groundwater.

Building on the third and final 'use case', research is currently ongoing, together with British Geological Survey, into the possibility of relating rainfall data from the Rainwatch platform to groundwater recharge. If successful, this will be the first of its kind and provide water resource advisors with a simple and easy to use application to better understand groundwater and recharge in relation to rainfall events.

The Rainwatch app will be a legacy item of the BRAVE project, with an initial trial launch in Ghana, the Rainwatch Alliance hopes to quickly expand this across its 15 countries. With further funding, and scoping sessions with key users Rainwatch could benefit, the Rainwatch Application will continue to develop and expand its functionality.

More information

Type	Organisation	Contacts
Ministries and authorities	Office National de l'Eau et de l'Assainissement (ONEA).	
	Bureau des Mines et de la Geologie du Burkina	www.bumigeb.bf/index.htm
	Ministere de l'Environment et de L'Eau (MEE)	
	Direction Generale des Ressources en Eau / Direction des Etudes et de L'information sur L'eau (DGRE/DEIE)	
	Autorite du Basin de la Volta (ABV)	
UPGro projects in Burkina Faso	Building understanding of climate variability into planning of groundwater supplies from low storage aquifers in Africa (BRAVE)	Professor Rosalind Cornforth (Walker Institute), Dr David MacDonald (British Geological Survey) http://www.walker.ac.uk/research/projects/building-understanding-of-climate-variability-into-planning-of-groundwater-supplies-from-low-storage-aquifers-in-africa-brave/
UPGro researchers in-country	International Water and Sanitation Centre (Burkina Faso)	Narcisee Gahi (BRAVE)
	Rainwatch Alliance	Kofi Asare (BRAVE)
	Ouagadougou University	Dr Jean Pierre Sandwidi (BRAVE)
	Christian Aid Sahel	Assieta Kabre (BRAVE)
	2iE	Dr David MacDonald (BRAVE)
	Reseau Marp	Julien Nimbrata Ouedraogo (BRAVE)
	Practical Action	Mary Allen (BRAVE)
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/
	Rainwatch platform	www.rainwatch-africa.org

There is a national borehole database which currently stores information about more than 15,000 boreholes. The database includes detailed information about borehole location (coordinates and village/region); depth; whether the borehole was successful; the geology; and the borehole yield.

UPGro published work relating to Burkina Faso

https://upgro.org/publications-papers

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(4) Cuthbert, M.O.; Taylor, R.G.; Favreau, G. et al. Observed controls on resilience of groundwater to climate variability in sub-Saharan Africa. Nature 572, 230–234 (2019). https://doi.org/10.1038/s41586-019-1441-7

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Credits

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