Ghana: 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. Because men and women have differing livelihoods and gender roles and responsibilities, at times when water is scarce, tensions between men, women and families rise, and some livelihood activities are at more risk than others. This dynamic indicates that it is essential that these aspects are included in future water planning strategies.
- 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.
- Water abstracted from groundwater sources in peri-urban Dodowa needs to be **treated before consumption**. Efforts should be made to create protected areas around boreholes and wells to minimize contamination.
- Decision makers should focus on **diversifying and decentralising water supply solutions**. 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.

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**

Commented [SF1]: Target Audiences

Government
White Volta Basin Authority
-Aaron Aduna (Director)

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

iNGOs
Millennium Water Alliance

Private Sector

policy makers to reliable data and information to inform policy changes. **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 inequalities** and combining them with trust- and capacity-building based on local needs and priorities. CONIWAS (Coalition of NGOs in Water and Sanitation) plays a vital role in this space with over 100 members spread throughout the country supporting communities to have access to improved sustainable WASH service.

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

- As an umbrella CSO established to contribute to water resource management and sustainable provision of WASH services in Ghana, **CONIWAS** must continue to be supported in coordinating such collaborations and bringing community issues to the foreground of IWRM policymaking.
- Investment must be made in **long-term monitoring of groundwater** and the **decentralised collection of quantitative livelihoods data** (disaggregated to allow gender and other social categories to be identified).
- A **disaggregated livelihoods impact metric** should be included among other metrics used to identify winners and losers in evaluating the robustness of any theory of change. This would provide a crucial link between water security and issues driving conflict, migration, access to education and health services.
- 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**.**

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.

Further research needs identified by policy stakeholders at the BRAVE Ghana Scenario Planning workshop, held in January 2020, included building a better under understanding of groundwater availability and how rainfall changes may impact this over the coming years, research into drought resistant and contextually appropriate crops, and development of multiple advocacy strategies and plans to support policy development. Developing capacity and skill sets of multiple actors ranging from technicians to community members was identified as essential to support this work. Stakeholder synthesised the key actions to take forward as follows:

- Policy makers need to act on information that is provided to them, and there remains a need for policy to be translated into understandable, actionable implementation processes.
- However, linked to this, there is a need for research institutions to ensure that they are providing the information to policy making institutions and individuals in a way that is meaningful and relevant to them. This might be supported by encouraging locally funded research projects which are driven by national government priorities rather than international donor priorities.
- This being said, policies are designed not to be static, and for this to happen and for them to adapt in the way they need to over time, there is a critical need for accessible and reliable data to be made available to policy makers so that policies can be adjusted to reflect these changes.
- For this to happen, national and district institutions need to collaborate and communicate effectively and consistently. CONIWAS committed to supporting the establishment of such a connection platform.

In the urban water security context, testing in the Dodowa region of Ghana has shown significant faecal contamination of boreholes and hand dug wells. This points to a greater need for testing of water samples from groundwater supplies to ensure water is safe for consumption, particularly in informal settlements and peri-urban areas. Further research 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.

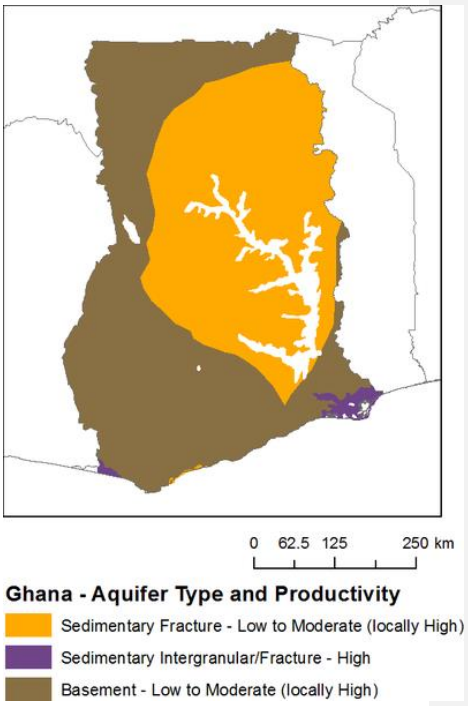
Commented [HP2]: T-GroUP inputs needed here

Context: highlights from the Africa Groundwater Atlas

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

Groundwater Quantity

- Few direct studies have been done on groundwater recharge in Ghana: those that have been done are largely for areas in the northern half of the country.
- Recharge to all the aquifer systems in Ghana is thought to be mainly by direct infiltration of precipitation.
- Some recharge also occurs indirectly as seepage from ephemeral stream channels and pools of accumulated runoff in the rainy seasons.
- Estimated recharge values are generally low, varying from 1.5% to 19% of annual rainfall, and there is high spatial and temporal variability.



Groundwater Quality

- Available data from past studies indicate that groundwater abstracted from boreholes in Ghana is generally of good chemical and microbiological quality and thus suitable for domestic (including drinking), agricultural and industrial uses. However, there are particular problems with the quality of groundwater in certain places. These problems include:
- Acidic: low pH (3.5-6.0) waters, found mostly in the forest zones of southern Ghana;
- high concentrations of iron in many places throughout the country;
- high natural concentrations of manganese and fluoride, mostly in the north, including the Upper East and Northern regions; and
- high levels of mineralisation, with total dissolved solids (TDS) in the range of 2000 up to more than 14,000 mg/l in some coastal aquifers, largely due to high salt (sodium chloride) from sea water intrusion.

Groundwater use

- Over 95% of groundwater use in Ghana is for domestic water supply, mostly in rural areas and small towns.
- Overall, around 41% of households in Ghana depend on groundwater for their water supply – this is generally much higher in rural areas (59%) than urban areas (16%). However, there are some urban areas, in the Upper East and Upper West regions, where 80% of the urban population depend on groundwater for their primary water supply.
- Less than 5% of groundwater in Ghana is used for irrigation and watering of livestock and poultry.
- Industrial use of groundwater in Ghana accounts for less than 1% of the total groundwater use. This includes large-scale commercial bottled water companies in the south of the country.

Transboundary aquifers

Ghana shares in two main transboundary aquifers, both of which are coastal:

- The Tano aquifer system, located in the extreme southwest of Ghana and shared between Ghana and Cote d'Ivoire. It covers an area of 806 square kilometres in Ghana and includes three aquifer units (Quaternary, continental terminal and Maastrichtian); and
- the Keta aquifer system, found in the extreme southeast of Ghana and shared among Ghana, Togo Benin, and Nigeria. It is a layered system covering an area of 2,721 square kilometres.

Each country currently manages its share of the aquifer systems independently. Ghana recognises the need for agreements and cooperation between countries that share in its transboundary aquifers (e.g. Togo and Cote d'Ivoire). However, such co-operations and the necessary frameworks have yet to be initiated.

Key activities and findings from UPGro research in Ghana

General UPGro findings with relevance to Ghana

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.

Ghana-specific activities and findings

Climate Resilience & Groundwater Resources

- In Ghana historical policies primarily focused on surface water usage, with groundwater use promoted solely as a domestic water source. These investments mean that communities in Ghana make less use of groundwater than neighbouring communities in Burkina Faso where groundwater use has been encouraged, and are therefore at higher risk of increased water scarcity. Policy choices and investments into groundwater infrastructure have a significant effect on changing groundwater usage at the ground level.
- 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.

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.
- Vulnerabilities and gender directly affect groundwater access, use and management. Social and economic arrangements directly impact the use and access to water points, including groundwater access. Women were particularly vulnerable to water insecurity because their activities were dependent on agriculture inputs and water, whether this was Shea Butter processing, food processing, or small livestock rearing.
- Because men and women have differing livelihoods and gender roles and responsibilities, at times when water is

scarce, tensions between men, women and families rise, and some livelihood activities are at more risk than others. This dynamic indicates that it is essential that these aspects are included in future water planning strategies.

Urban Water Security in Dodowa, Ghana

- Transition Management, a participatory governance approach, has played a crucial role in empowering and mobilizing communities in Dodowa, Ghana, 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.
- Transition Management experiments have proven successful in empowering citizens in Dodowa to organise activities to improve water, sanitation and solid waste management situations in their neighbourhood.
- Analysis of water samples from borehole and hand-dug wells in peri-urban Dodowa showed systemic microbial and fecal contamination of groundwater in the area. On-site sanitation facilities are likely the most common sources of contamination. Water abstracted from groundwater sources needs to be treated before consumption. Efforts should be made to create protected areas around boreholes and wells to minimize contamination.
- Poor households ensure resilience of water supply by accessing multiple sources for different purposes. 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.

Agriculture and livelihoods

- 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. 83% of callers changed farming practice based on radio programme information.
- 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.

- Funding has been secured for two follow-on projects in northern Ghana that will deliver two new series of radio programmes targeted at shea nut gatherers and shea butter producers. This focus was determined by the radio listeners themselves, in particular women, for whom shea harvesting and processing as an important source of supplementary income.

Case Studies

Community members in Dodowa contributing to sustainability transitions

http://t-group.science/2019/04/community-members-in-dodowa-contributing-to-sustainability-transitions-of-their-communities/

The Transition Management approach has been inspiring community members in Dodowa (Ghana) to actively organise in different groups to solve problems related to water, sanitation and waste management in their communities. Since September 2017 the T-GroUP project has been working with communities to support them to set up Transition Experiments, including multiple activities and pilot projects.

Two community members presenting the results of their mapping activities

Community members participating in clean-up activities

Activities have included mapping the quantity and quality of water and sanitation services in their communities, with support from the grassroots network Slum Dwellers International and People's Dialogue NGO. The mapping activity build community understanding of which families do not have access to safe water and sanitation services and how many areas are polluted by solid waste. This lead to the recognition of the need for improving sanitation facilities at the household level and the need to learn how to build sustainable sanitation facilities themselves. With the support of the T-GroUP transition team, a design for biogas sustainable toilets was developed and an artisan training for biogas toilet installation was organized in April 2019.

Furthermore, the participants of the Transition Management process realised the importance of supporting systemic changes in practices and behaviours of community members in sustainable management of their communities. For this reason, they created active groups in their communities and developed creative ways of engaging other community members.

Theatre, music and sport were thought to be very powerful to raise awareness about the importance of properly recycling solid waste, building toilets and stopping open defecation. Since August 2018, three active groups of community members from Wedokum, Zongo and Obom have developed their own jingles (short songs, usually transmitted via radio). These jingles have been transmitted daily since December 15th, 2017. In addition, three groups of residents from three different communities performed dramas narrating inspiring stories of change in their communities. Joint clean up-activities were also organised through the collaboration between active groups of community members and local government.

The active engagement of community members is making them motivated to address other challenges in their localities with critical thinking and a more collaborative attitude. This new mindset, collaborative spirit and willingness to act is spreading to neighbouring communities where residents are starting to meet to deal with the challenges they face.

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/

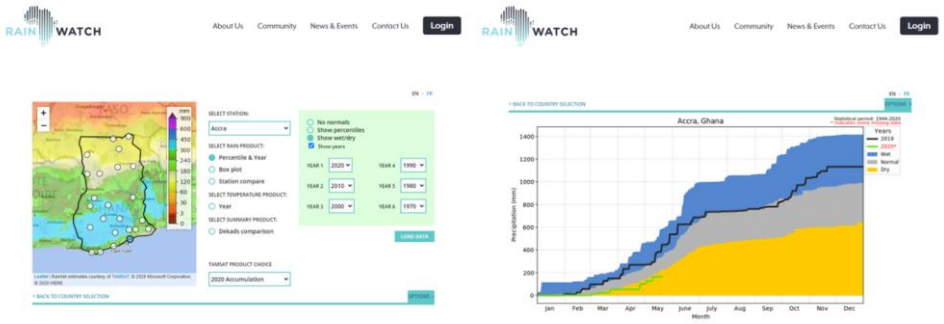
Farmer Voice Radio in action.

Since 2018, the BRAVE project has adopted the Lorna Young Foundation's Farmers' Voice Radio in northern Ghana in collaboration with CARE International and the radio station GBC URA Radio. Farmers' Voice Radio is bringing together scientific climate data and local agricultural expertise to ensure farmers have the information they need to make wise farming decisions. The Farmers' Voice Radio programme content comes from regular Listener Group meetings in two different communities made up of farmers, agricultural extension officers, radio presenters and the project team. The programmes are broadcast on community radio stations, in two local languages, to an estimated listenership of 146,600. Interviews with farmers in Listener Groups have highlighted that Farmers' Voice Radio training has influenced land management and farming practices, including introduction of measures which improve soil fertility and water retention, and changing planting times, to increase yields. In addition, discussion of rainfall data from Rainwatch (http://www.rainwatch-africa.org/) on the radio programmes has provided farmers with the knowledge they need to make informed planning decisions, such as when to adapt livestock shelters for wet conditions.

As a result the reach and impact of the BRAVE Farmers' Voice Radio programmes, funding has been secured from UK Aid and The Body Shop for two follow-on projects in northern Ghana that will deliver two new series of programmes targeted at shea nut gatherers and shea butter producers. This focus was determined by the radio listeners themselves, in particular women, who see shea harvesting and processing as an important source of supplementary income during the lean season and would like to maximise the value derived from it.

Rainwatch increases access to rainfall information across Africa

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

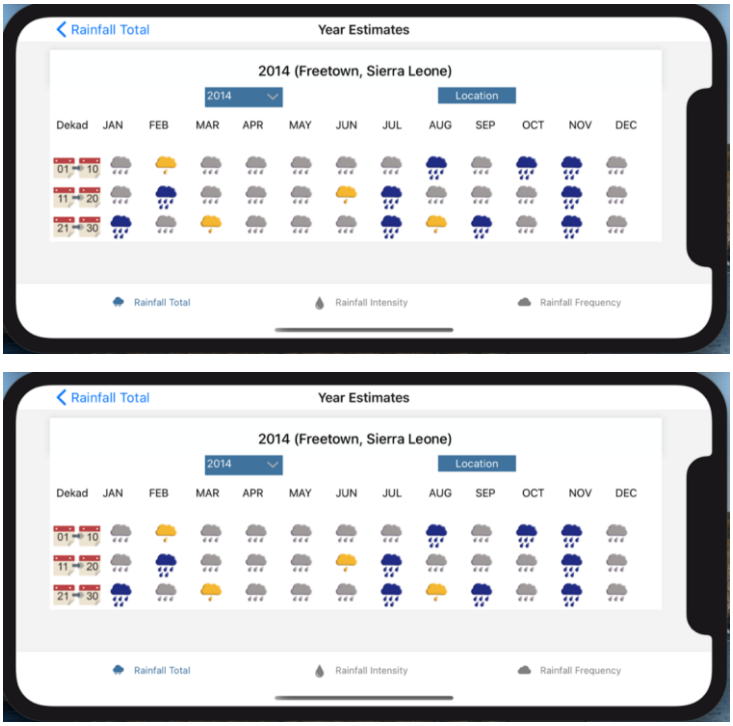


The Rainwatch website interface, showing weather stations in Ghana (left) and cumulative rainfall for Accra for 2019 and 2020 compared to wet, normal and dry years (right).

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.

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.

Scenario-based planning for groundwater management and resilient livelihoods

Participants of BRAVE Scenario Planning Workshop, Accra, Ghana.

Unlocking the Potential of **Ghana's** Groundwater for the Poor

The BRAVE project ran a policy level Scenario Planning Workshop in Ghana in January 2020, attended by government departments, NGOs and academic representatives from the Ghanaian Water Sector. This high-level workshop was built around three alternative, plausible scenarios of future water resources under climate change [INSERT LINK ONCE NARRATIVES ONLINE], 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, stakeholder pathways identified included establishing a platform for collaboration among multiple sectors at national and district levels on water resource policy, supported by CONIWAS, and further investment in groundwater monitoring and data collection and sharing at multiple policy levels. Alternative water management strategies discussed included researching alternative crop varieties able to sustain yields under varying water availability, improving water harvesting and supporting groundwater management strategies. Full report available here: [INSERT LINK ONCE WORKSHOP REPORT UPLOADED].

More information

Type	Organisation	Contacts
Ministries and authorities	Water Directorate of the Ministry of Water Resources Works and Housing: Hydrological Services Department (HSD), Ministry of Water Resources Works and Housing:	
	Water Resources Commission (WRC)	Dr Lumor Mawuli (BRAVE)
	Community Water and Sanitation Agency (CWSA): Ghana Water Company Limited (GWCL):	
	Ghana Space Science Technology Institute	Kofi Asare (BRAVE)
	Ghana Meteorological Agency (GMet)	Patrick Lamptey (BRAVE)
	National Disaster Management Organisation, Ghana	Charlotte Norman (BRAVE)
	WASCAL (Regional, based in Ghana)	Sammy Guug (BRAVE)
	CSIR Water Research Institute (WRI):	Dr William Agyekum (BRAVE)
UPGro projects in Ghana	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/
	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	Institute for Environment and Sanitation studies, University of Ghana	Shani Haruna (BRAVE)
	CARE International (Ghana)	Agnes Loriba (BRAVE)
	Central University College (CUC; Ghana)	Dr George Lutterodt (T-GroUP)
	Kwame Nkruma University of Science and Technology (KNUST; Ghana)	Dr Sampson Oduro-Kwarteng(T-GroUP)
	Africa Groundwater Atlas	earthwise.bgs.ac.uk/index.php/Hydrogeology_of_Ethiopia

Online tools and databases	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

UPGro published work relating to Ghana

https://upgro.org/publications-papers

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(6) Adjei, Seth (2016) Household access to groundwater and its implication in an urban poor community, Ghana, 39th WEDC Conference, Ghana (11-15 July 2016)

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Credits

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