

Workshop Report



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Unlocking Local Knowledge Production for Global Water Reanalysis

June 26, 2026

IWMI Ghana Office, Accra, Ghana | Hybrid

International Water Management Institute (IWMI)

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Unlocking Local Knowledge Production for Global Water Reanalysis

Co-creation workshop report for the case of Sherigu Catchment, Ghana

Mawufemor Afi Danyo, Moctar Dembélé, Mabel Kumah,
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Citation

Danyo, Mawufemor Afi, Moctar Dembélé, Mabel Kumah, Gerald Atampugre, and Seifu Tilahun. 2026. *Unlocking Local Knowledge Production for Global Water Reanalysis: Co-Creation Workshop Report for the Case of Sherigu Catchment, Ghana*. International Water Management Institute (IWMI).

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Cover photo: Participants' group photo taken during the workshop (*Photo: Klinsman Amissah*)

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Acknowledgments

This work was carried out under the project “Unlocking Local Knowledge Production for Global Water Reanalysis”. The authors gratefully acknowledge Schmidt Sciences for supporting this work through its Virtual Institute for Earth’s Water (VIEW) program. We also extend our sincere appreciation to the IWMI Accra office staff for their support in facilitating the event. Finally, we thank all participating institutions, community representatives, and individuals who generously contributed their knowledge, time, and data to this work.

Table of Contents

Acknowledgment	4
List of Figures	vi
List of Table	vi
Highlights	vii
1 Introduction	1
1.1. Project background	1
1.2. Workshop objectives.....	2
1.3. Participants	3
2 Workshop methodology	3
3 Workshop proceedings	4
3.1 Opening and welcome remarks	4
3.2 Introducing the UNLOCKiNG Project and Global Water Reanalysis	4
3.3 Plenary discussions.....	6
3.4 Identifying local knowledge, practices, and data sources	7
3.4.1 Key observations from the breakout discussions	9
3.4.2 Plenary Reflections on Local Knowledge and Non-Conventional Data	10
3.5 The Ghana pilot site and data characterization	16
3.5.1 The Sherigu Pilot Catchment	16
3.5.2 Discussion and methodological clarifications	17
3.6 Characterizing conventional and non-conventional data sources in the pilot sites	18
3.6.1 Group Report-Back and Plenary Reflections	19
3.7 Research design and planning for the Ghana pilot site.....	21
3.7.1 Participatory quantitative monitoring	21
3.7.2 Qualitative data collection	22
3.7.3 Discussion and feedback on the proposed research design	22
4 Conclusions and way forward	23
4.1 Closing discussion and remarks.....	23
4.2 Recommendations and action points.....	23
5 References.....	25
6 Annexes	26
6.1 Annex A: Workshop Overview	26
6.2 Annex B: Agenda	26

List of Figures

Figure 1: Overall project workflow and structure illustrating the various work-packages (Buytaert et al., 2026) 5

Figure 2: Groups 1 (left) and 2 (right) engaging in deeper peer-peer discussions during the breakout session 110

Figure 3: The location map of the pilot site; Sherigu catchment (Source: Authors construct)16

Figure 4: Introduction of breakout session 2 (left) and Group 3 reporting back to plenary (right)19

List of Table

Table 1: Categories of non-conventional data (Buytaert et al., 2026).....6

Table 2: Key discussion points and way forward from the opening plenary discussion6

Table 3: Synthesis of identified local practices/activities, their impact on water resources and potential data custodians11

Table 4: Participant-identified integration mechanisms, relevance to hydrological modelling, and barriers and enablers.....14

Table 5: Pilot Site (Sherigu Catchment) characteristics16

Table 6: Characteristics of non-conventional data identified for the Sherigu catchment and its environs19

Highlights

- **Identified a diverse but fragmented evidence base beyond statutory monitoring networks**, including community-based groundwater and rainfall monitoring, historical flow records, meteorological and streamflow observations, borehole records held by NGOs and private drillers, mining and sand-winning information, farmer observations, and satellite-derived land-use and reservoir datasets.
- **Clarified opportunities to strengthen data access while avoiding duplication**. Participants highlighted IWMI's small-reservoir dashboard covering more than 2,000 reservoirs across northern Ghana, additional White Volta reservoir information held by GIDA, and groundwater and water-use records held by WRC, WaterAid, World Vision, drilling companies, universities, and other organizations.
- **Identified local practices that have effect on hydrology**, including over 80 small reservoirs and dugouts within the pilot catchment, groundwater-dependent dry-season irrigation, indigenous rain-prediction and groundwater-divining practices, deforestation, bush burning, illegal small-scale mining ("galamsey"), sand winning, aquaculture, and dry-season river diversion. While no single practice was rated as having the highest impact by all four breakout groups, bush burning and irrigation activities have been assessed to have the highest direct impact on water resources. These were closely followed by improper disposal of agro-chemical waste and plastics, and seasonal hand-dug wells, dugouts and small-scale dams for multiple use. These demonstrate the importance of representing human–water interactions alongside conventional hydrological variables.
- **Corrected the pilot-site catchment boundary**, initially truncated at the Ghana–Burkina Faso border, to follow the natural watershed extending into Burkina Faso. This correction emerged directly from participant knowledge and demonstrated the practical value of co-creation in improving catchment characterization and ensuring that subsequent data collection and hydrological modelling follow hydrologically meaningful rather than administrative boundaries.
- **Identified critical gaps and tensions for follow-on work**: distinguishing conventional from non-conventional data, validating community-reported historical information, engaging recognized Indigenous knowledge custodians under appropriate ethical and benefit-sharing arrangements, improving event-based monitoring, strengthening institutional data access, and addressing the risk that undocumented oral knowledge may disappear through generational change and migration.

Introduction

1.1. Project background

Hydrological models play a critical role in water resources management (Buytaert et al. 2014) by enabling the assessment of catchment responses to changes in climate, land use, and water management practices. They also underpin global water reanalysis products, which combine process-based hydrological models with historical observations and satellite-derived data to generate consistent estimates of hydrological conditions across space and time. The accuracy and reliability of these products, however, depend substantially on the availability, quality, and spatial and temporal coverage of ground-based observations used to constrain and evaluate the models (Hannah et al. 2011). In many parts of the world, particularly in data-scarce environments, the limited availability of long-term, high-quality hydrological datasets therefore remains a major constraint on the performance and applicability of hydrological models and water reanalysis products.

This limitation has increasingly drawn attention to information that exists outside conventional or mandated hydrological data collection systems, including non-conventional data and local knowledge. Non-conventional data refers to qualitative and quantitative information collected by entities that do not have a statutory mandate to systematically collect and provide hydrological data. These may include non-governmental organizations, citizen science initiatives, community-based organizations, research projects, universities, and other institutions. Such information may also include local and community knowledge developed through long-term observation and experience and transmitted across generations (Harifidy et al. 2022) without being formally documented or incorporated into conventional databases. Although these sources cannot fully substitute for standard hydrological observations, their systematic identification, documentation, and integration into modelling frameworks can complement existing datasets and improve the representation of local hydrological processes and dynamics, particularly in data-scarce settings.

Despite their potential value, non-conventional data and local knowledge remain largely underutilized in hydrological modelling and global water reanalysis. Much of this information is undocumented, fragmented across institutions and communities, stored in inconsistent formats, or difficult to locate and access. In addition, there are limited established approaches for assessing its quality, structuring it for analysis, and integrating it into existing process-based modelling and reanalysis frameworks. Addressing these challenges requires not only improved approaches for identifying and documenting such information, but also meaningful engagement with the institutions, communities, and individuals (Haile et al., 2026) who generate, hold, and use it.

It is within this context that the International Water Management Institute (IWMI) and Imperial College London are implementing the project “Unlocking Local Knowledge Production for Global Water Reanalysis” (UNLOCKiNG), funded by Schmidt Sciences through its Virtual Institute for Earth’s Water (VIEW) programme. UNLOCKiNG contributes to the broader VIEW effort to develop a first-generation global water reanalysis product by identifying, characterizing, and developing practical approaches for integrating non-conventional data and local knowledge into hydrological modelling and reanalysis. IWMI co-leads this knowledge co-production work package across three pilot countries in Ghana, Ethiopia, and Laos.

In Ghana, the UNLOCKiNG project selected the Sherigu catchment as a pilot because it combines diverse hydrological conditions, strong dependence on local water resources, and dynamic human–water interactions. The approximately 1,295 km² catchment includes over 80 small/medium/large reservoirs, floodplains, perennial and ephemeral streams, and heavily used groundwater resources. It also represents varied land uses, including irrigation, mining, aquaculture, infrastructure development, dugouts, ponds, and savannah forest areas. These conditions create spatial and temporal variability that may not be adequately captured by conventional monitoring. Communities and local institutions also hold valuable observations, records, practices, and experiential knowledge of rainfall, groundwater, surface water, floods, agriculture, and environmental change. Sherigu therefore provides an ideal setting to assess how non-conventional data can complement conventional observations and strengthen water reanalysis.

1.2. Workshop objectives

The main aim of the workshop is to identify and prioritize existing local knowledge, practices, and non-conventional historical datasets related to hydrology, water resources management, and land–water interactions in the Sherigu catchment.

Specific objectives include;

- Develop an inventory of local knowledge, practices, and non-conventional datasets relevant to water
- Identify and characterize systems at each pilot site
- Identify and characterize the identified datasets
- General feedback on the data gaps and limitations

Identifying and prioritizing existing local knowledge, practices, and non-conventional datasets related to hydrology, water resources management, and land–water interactions.

1.3. Participants

The workshop brought together 31 participants from a diverse range of institutions, reflecting a broad mix of expertise and perspectives relevant to water resources, hydrology, climate, drainage, WASH, research, and community development. Participants represented academic and research institutions, government agencies, development organizations, civil society, and the private sector.

Academic and research institutions included the University of Ghana, University for Development Studies (UDS), Tamale Technical University, Kwame Nkrumah University of Science and Technology (KNUST), CSIR–Water Research Institute, and WASCAL. Government and public-sector institutions included the Ghana Meteorological Agency, Water Resources Commission, Ghana Hydrological Authority, and the Kassena West District Assembly. Development and civil society organizations included IWMI, WaterAid Ghana, and CIKOD, while ICOUR Ltd represented the private sector.

The participation also reflected a range of professional backgrounds and levels of expertise, including professors, researchers, lecturers, meteorologists, water resources specialists, engineers, programme managers, research officers, consultants, and interns. Importantly, the Sherigu catchment was represented by the Assembly Member of the area, providing a direct local perspective within the broader institutional dialogue.

The diversity of participants provided a strong foundation for the workshop's knowledge co-production objectives, bringing together knowledge holders, data producers, technical experts, and potential users of hydrological information. This multidisciplinary representation enabled participants to contribute different perspectives on existing data and knowledge sources, their accessibility and use, and opportunities for integrating non-conventional information into hydrological modelling and water reanalysis.

Workshop methodology

The workshop adopted a participatory knowledge co-production approach, combining presentations with facilitated small-group discussions to identify and characterize non-conventional hydrological data and local knowledge relevant to the Ghana pilot.

The programme was organized into four sessions. The first introduced the UNLOCKiNG project, its objectives, and the role of non-conventional data in improving hydrological modelling and global water

reanalysis. This was followed by small-group discussions to identify existing local knowledge, practices, and non-conventional data sources relevant to water resources management.

The third session presented the Ghana pilot site and was followed by a second round of group discussions to characterize the identified data and knowledge sources, including their custodians, accessibility, potential applications, and limitations. The final session outlined the proposed research design and planned activities for the Ghana case study, providing participants with an opportunity to offer feedback and identify areas for future collaboration.

A mid-morning coffee break, group photograph, and lunch break were incorporated into the programme, providing opportunities for informal networking among participants.

Workshop proceedings

The session opened with self-introductions from all participants, in person and online, followed by formal remarks from two speakers.

1.1 Opening and welcome remarks

The workshop was officially opened by IWMI's Country Representative for Ghana and West and Central Africa. In his welcome address, he acknowledged the diverse representation of participants from academia, government, research institutions, development organizations, and local leadership, emphasizing the importance of bringing together policymakers, practitioners, researchers, and community representatives to strengthen the link between science and policy.

Following the opening remarks, the workshop facilitator introduced the objectives and agenda for the day. The importance of incorporating local knowledge and non-conventional data into global hydrological datasets and models was highlighted, noting that many existing products have been developed primarily from data-rich regions. It was emphasized that improving the representation of local realities is a key objective of the UNLOCKiNG project before inviting the first technical presentation.

1.2 Introducing the UNLOCKiNG Project and Global Water Reanalysis

The first technical presentation was introducing the project's objectives, its role within the broader [Virtual Institute for Earth's Water \(VIEW\)](#) programme, and the rationale for integrating non-conventional data and local knowledge into hydrological modelling and global water reanalysis.

It was explained that the VIEW programme, funded by Schmidt Sciences, brings together several complementary research projects working towards the development of a first-generation global freshwater reanalysis product. Within this consortium, the UNLOCKiNG project is responsible for identifying, characterizing, and developing practical approaches for integrating non-conventional datasets and local knowledge into global water reanalysis. IWMI co-leads this effort alongside Imperial College London, with pilot activities implemented in Ghana, Ethiopia, and Laos.

It was noted that existing global hydrological products rely predominantly on conventional monitoring networks and remote sensing data, which often fail to capture local hydrological processes and the influence of human activities on water systems. The UNLOCKiNG project seeks to address this limitation by incorporating locally generated information, including institutional datasets, citizen science observations, and indigenous knowledge, into hydrological modelling frameworks to improve the representation of water systems, particularly in data-scarce regions.

The project's five interconnected work packages were also outlined (Figure 1)

. underscoring the workshop as part of the knowledge co-production activities under Work Package 1. This work package focuses on identifying, documenting, and characterizing non-conventional data and local knowledge, providing the foundation for subsequent data integration, hydrological modelling, and development of the global water reanalysis framework.

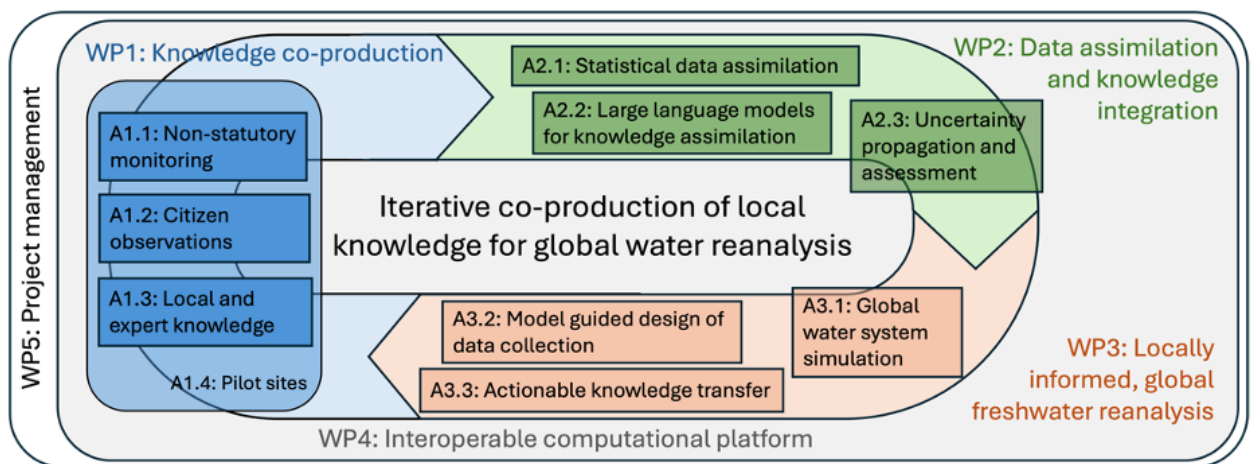


Figure 1: Overall project workflow and structure illustrating the various work-packages (Buytaert et al., 2026)

The presentation concluded with an overview of the concept of water reanalysis, explaining that reanalysis combines hydrological models with diverse observational datasets to generate increasingly accurate representations of the water cycle. Participants were introduced to three broad categories

of non-conventional information considered by the project: non-statutory monitoring data, citizen science observations, and local or indigenous knowledge. These categories (Table 1) provided the conceptual framework for discussions and participatory exercises that followed throughout the workshop.

Table 1: Categories of non-conventional data (Buytaert et al., 2026)

Category	Definition
Non-statutory monitoring	Data collected by an institution outside the formally mandated government monitoring system, even if collected by a professional (e.g., university) actor
Citizen science	Observations collected by non-professional, trained community volunteers, often in a participatory framework
Local / indigenous knowledge	Information about water systems derived from the lived experience, practices, observations, and expertise of local communities, often held informally and transmitted orally

1.3 Plenary discussions

The Q&A that followed ran long and substantively, surfacing several conceptual and ethical questions that would recur throughout the day. Asked why the project had selected its northern Ghana site, and it was explained that the area was chosen because of distinctive local practices of interest. These include heavy reliance on groundwater withdrawal for irrigation and domestic supply, and a large number of small reservoirs whose cumulative effect on the local hydrological cycle is not usually accounted for in conventional modelling - while being candid that this working hypothesis was itself provisional and exactly what the workshop was convened to test and expand.

Table 2 outlines participant's key reflections following the initial presentation and discussion.

Table 2: Key discussion points and way forward from the opening plenary discussion

Question	Response / Way Forward
Where is the line between conventional and non-conventional data?	This proved the single most contested definitional question of the day. A Ghana Hydrological Authority participant described discharge data formally collected by a mandated agency but, due to staffing limitations, gathered in practice by community members acting as citizen-science volunteers - complicating a strict statutory/non-statutory binary. Facilitators reaffirmed the underlying logic: the test is not the type of data, or even who formally holds it, but the practice by which it was generated.
How should the project handle communication, language, and the risk of lost knowledge?	One participant argued that engaging indigenous knowledge requires attention to both communication (will researchers understand what is being communicated, in the right language) and context (local knowledge is the product of specific circumstances that may not translate), invoking the film <i>Lost in Translation</i> . Oral-tradition knowledge is especially at risk of disappearing as it passes between generations under pressure from language shift and migration; attempting to access certain categories of indigenous knowledge without observing expected protocols of respect and reciprocity can fail to yield anything, or cause offense.

What are the ethics and institutions governing indigenous knowledge systems?	A Centre for Indigenous Knowledge and Organizational Development (CIKOD) representative argued that indigenous knowledge constitutes a complex knowledge system with its own internal ethics, institutions, and custodianship rules that are not simply a function of age. Before any attempt at integration, the project needs to map who the legitimate custodians of relevant knowledge systems are, what ethics and guidelines govern disclosure, and whether the goal is to integrate different knowledge systems outright or build an interface between them. He illustrated the stakes with an account of a community rainmaking ritual that, by his account, cannot be explained from outside that knowledge system, and offered CIKOD's support in engaging knowledge-holding institutions on their own terms.
How can community-reported historical data be validated?	One participant described weighting respondent credibility by length of residence and treating convergent independent accounts from multiple long-term residents as corroborating evidence. A Ghana Hydrological Authority representative described a related practice already in use: validating flood model outputs, in areas lacking sufficient gauge density, by asking community members after a flood event how high the water reached relative to their own body, non-conventional data already being used productively to support a conventional engineering model.
What is the risk of exaggeration, and how should the scope be bounded?	Participants cautioned that community members, aware that researchers may be “bringing something to them,” can be incentivized to amplify the scale of a problem, and warned against over-generalizing “northern Ghana” as a single context, since even neighboring communities can differ sharply (for example, in whether a given water body is considered sacred). The facilitators clarified the project is not interested in cataloguing every piece of locally relevant knowledge but specifically practices that plausibly affect water availability at a scale broader than a single household and that recur across multiple communities.
How urgent is the data-collection exercise given migration pressure?	A further intervention urged the team to treat the project through the lens of time-sensitivity: the pilot area is subject to substantial seasonal and permanent migration, meaning today's practices, especially labor-intensive traditional ones, are actively being abandoned as people relocate, what can be documented now may simply no longer exist in ten years.

Joining online, a participant (lecturer in Environmental Science) added that small-scale dry-season irrigation schemes drawing on subsurface water are a common and important practice worth including and raised the importance of a clear custodianship framework so that contributing community members are assured responsible use of, and can benefit from, the knowledge they share.

1.4 Identifying local knowledge, practices, and data sources

According to Lin et al (2009), different land uses in different sub-catchments invariably result in considerably different hydrologic outputs. This underscores the potential of integrated modeling approaches where local hydrologic knowledge and practices are systematically coupled with hydrologic models (Dwivedi et al., 2025; Legesse et al., 2003). Building on this rationale, the second technical session introduced the first participatory exercise, which focused on identifying local knowledge, water-related practices, and non-conventional data sources relevant to the Ghana pilot site (Sherigu catchment) and surrounding areas. Prior to the breakout discussions, facilitators outlined

the objectives of the exercise and emphasized the importance of locally generated information in strengthening hydrological modelling and global water reanalysis.

Participants were reminded that while conventional hydrological observations remain fundamental, they are often spatially sparse and temporally incomplete. Non-conventional data and local knowledge can complement these datasets by providing additional information on local water management practices, historical hydrological conditions, and human influences on the water cycle. However, facilitators also highlighted several challenges associated with their use, including limited accessibility, inconsistent data formats, fragmented ownership, and the absence of standardized mechanisms for integration into hydrological models.

To guide the discussions, participants were introduced to a range of potential non-conventional information sources, including citizen science initiatives, community-based monitoring programmes, project-generated datasets, construction and infrastructure records, household surveys, institutional datasets collected outside statutory mandates, and indigenous knowledge systems. These examples served as a common framework for identifying additional sources relevant to the Ghana pilot.

Participants were subsequently divided into four multidisciplinary breakout groups to complete three interrelated tasks:

1. **Identify and prioritize local water-related practices and activities** that significantly influence water resources management, accessibility, and use within the Sherigu catchment, particularly across seasons. Participants also assessed and ranked these practices based on their perceived impact.
2. **Identify and prioritize non-conventional data sources** that provide evidence of the identified practices. Participants evaluated each data source based on its relevance, accessibility, reliability, and potential application in hydrological modelling and global water reanalysis.
3. **Identify feasible mechanisms for integrating** the prioritized non-conventional data into hydrological models, while discussing the key opportunities, barriers, and enabling factors for successful integration.

The discussions from the breakout session revealed a wide diversity of locally relevant practices and information sources, reflecting both natural hydrological processes and human interactions with the landscape. Rather than representing the outputs of individual groups separately, the discussions were synthesized to identify themes

that occurred at least once, priority data sources and feasible integration mechanisms emerging from the breakout sessions.

1.4.1 Key observations from the breakout discussions

The breakout discussions highlighted groundwater-related practices, agricultural activities, land management, and indigenous knowledge as key influences on water resources within the Sherigu catchment. Participants identified groundwater abstraction and monitoring, seasonal hand-dug wells, dugouts, irrigation, soil moisture management, deforestation, bushfires, illegal mining, sand winning, construction activities and others presented in Table 3 as important processes affecting water availability, recharge, water quality, and other hydrological processes. Of these identified practices, no single practice was rated as having the highest impact by all four groups. However, on the basis of a practice identified and rated by at least two groups, bush burning and irrigation have been assessed to have the highest direct impact on water resources. These were closely followed by improper disposal of agro-chemical waste and plastics, and Seasonal hand-dug wells, dugouts and small-scale dams for multiple use.

Participants further emphasized the value of community observations, indigenous knowledge, and datasets generated by NGOs, research institutions, and community-based monitoring initiatives (

Table 4: as important complements to conventional monitoring, particularly in data-scarce settings. While barriers such as limited data accessibility, inconsistent formats, inadequate documentation, and institutional restrictions were identified, existing local knowledge systems, community monitoring programmes, and institutional partnerships were recognized as important enablers for integrating non-conventional data into hydrological modelling and global water reanalysis.



Figure 2: Groups 1 (left) and 2 (right) engaging in deeper peer-peer discussions during the breakout session 1

1.4.2 Plenary Reflections on Local Knowledge and Non-Conventional Data

Following the first breakout session, representatives of the four working groups presented their respective outputs (Table 3 & Table 4) to the plenary, highlighting the local water-related practices identified, their potential impacts on water resources, and associated sources of non-conventional data and knowledge. The group outputs, consolidated in the preceding tables, provided the basis for the plenary discussion that followed.

The discussion provided an opportunity to clarify and expand the group outputs. A notable reflection was the need to consider not only practices that adversely affect water resources, but also beneficial local practices that could contribute to water management. These included community groundwater monitoring and traditional soil- and water-conservation practices such as the Zai or half-moon approach and stone lines. Participants observed that some of these traditional practices are gradually disappearing, highlighting the importance of documenting and preserving relevant local knowledge.

The discussion also considered how information could be generated for activities for which formal records are limited or absent. For sand winning, possible approaches included reconstructing extraction volumes from the number and capacity of tipper-truck trips or, where feasible, estimating excavated volumes from physical measurements. Similarly, recall-based information on watering frequency and practices was suggested as a means of approximating water use by small-scale irrigators. These approaches were recognized as providing estimates rather than precise measurements but could help fill information gaps for otherwise poorly documented activities.

Another important reflection concerned how indigenous and experiential knowledge could eventually contribute to water modelling. Participants noted that qualitative observations and lived experience

would need to be systematically translated into appropriate metrics or categories to make them usable within a modelling framework. The discussion therefore underscored the need for an approach that can make local knowledge analytically useful while retaining its contextual meaning.

Table 3: Synthesis of identified local practices/activities, their impact on water resources and potential data custodians

S/ N	Local practice/activity	Potential impact on water resources	Examples of non-conventional data sources	Potential custodian of data	Breakout group(s)
1	Groundwater abstraction and monitoring (boreholes and wells)	Declining dry-season water table; well interference between users; provides water-level trends to support sustainable operation of water systems	Driller logs; borehole location, depth, yield and withdrawal records; groundwater-level trends; community monitoring records	Private/public borehole drillers; universities; NGOs; community-based water teams; WASCAL; WaterAid; ActionAid	2, 3
2	Seasonal hand-dug wells, dugouts and small-scale dams for multiple uses	Provides informal dry-season water access; may limit groundwater over-extraction; potential contamination from agricultural pesticides; location of dams may affect water movement to recharge zones; environmental degradation	Well/dugout coordinates and characteristics; seasonal water-availability information; NGO/WASH well registries; community well-mapping; household surveys	Community-based water teams; local NGOs; universities	2, 3
3	Irrigation, including farmer-led/seasonal irrigation	High-capacity pumping may exceed sustainable yield; dry-season abstraction	Farmer input-use surveys; agrochemical dealer sales records; satellite-derived irrigated area maps; surveys; project	GIDA; farmers; agrochemical dealers; project/research institutions	1, 2

		competition; reduced stream baseflow; inefficient irrigation may deplete water bodies	reports; water-use data		
4	Soil moisture management (e.g., ZAI approach)	Maintains soil moisture and reduces water loss through evaporation	Indigenous knowledge	Community-based water teams; JICA	3
5	Green infrastructure (trees and collective action)	Protects against water loss through evaporation; also reported as preventing physical access to water	—	Community-based water teams; WaterAid; ActionAid	3
6	Traditional practices and indigenous knowledge	Prevents water pollution	Indigenous knowledge	Community-based water teams	3
8	Deforestation/depleti on of forest cover and bush burning	Reduced infiltration; increased runoff and erosion; sedimentatio n; complicates recharge estimation	Qualitative information from local authorities/individual s; satellite data; land- use/land-cover information	Landowners; chiefs/traditional authorities; communities; local authorities	1, 2, 4
7	Animal watering	Localized depletion at dry-season water points; bank degradation at watering sites; competition with domestic water supply	Herder/community testimony; livestock census records; photographs of watering points	Herders/communities	2

9	Sand winning	Alters river morphology and bed levels; changes turbidity; pollution of water bodies; disrupts riparian habitat and complicates flow gauging	Volume of sand excavated; site photographs; testimony from fishermen/ferry operators and communities	District Assembly authorities; tipper-truck owners/association; fishermen/ferry operators; civil engineers/project managers; communities/traditional groups; NGOs	1, 2, 4
10	Illegal mining/mining activities	Pollution of water bodies, including heavy/toxic metals; turbidity; river-channel disturbance; increased water-treatment costs	Satellite mapping of mining sites; citizen/NGO water-quality monitoring; satellite/drone imagery; community health-post records	Minerals Commission; mining companies; NGOs/community monitoring networks	1, 2, 4
11	Excessive use/improper disposal of agrochemicals and plastics/waste	Pollution of water bodies	Water-quality data	—	1, 4
12	Dry-season river diversion	Changes turbidity and morphology of water bodies; pollution of water bodies	Satellite mapping of watercourses	—	1
13	Indigenous weather forecasting (traditional rainfall prediction)	Supports seasonal water management and agricultural decision-making through locally derived weather knowledge.	Indigenous weather indicators, local observations, oral knowledge	Traditional authorities; communities; Ghana Meteorological Agency (where documented)	3
14	Domestic water use	Increases demand on available	Household water-use surveys, water abstraction records	Ghana Water Company Limited (GWCL); communities;	2

		surface and groundwater resources, particularly during the dry season.		IWMI	
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Note: The table is synthesized such that only what the groups presented is captured as much as possible, limiting inferred interpretations

Table 4: Participant-identified integration mechanisms, relevance to hydrological modelling, and barriers and enablers

Water-related practice/activity	Reported integration mechanism	Participant prioritization of direct impact on water resources				Reported Barriers	Reported Enablers
		Group 1	Group 2	Group 3	Group 4		
Groundwater abstraction (boreholes and wells)	Input data; model validation	—	High	—	—	Not specified	Not specified
Seasonal hand-dug wells, dugouts and small-scale dams for multiple uses	Input as simple data via time-series	—	Moderate	Moderate	—	Language barriers; limited local knowledge; poor record keeping and documentation; different metrics for data collection	Ongoing activities around water resources management
Irrigation (including farmer-led irrigation)	Not specified	Moderate	High	—	—	Not specified	Not specified
Groundwater monitoring (deep drilled and shallow wells)	Input as simple data via time-series	—	—	High	—	Language barriers; limited local knowledge; poor record keeping and documentation; different metrics for data collection	Ongoing activities around water resources management
Soil moisture management (e.g. ZAI approach)	Input as simple data via time-series	—	—	High	—	Language barriers; limited local knowledge; poor record keeping and documentation; different metrics for data collection	Ongoing activities around water resources management

Green infrastructure (tree planting and collective action)	Not specified	—	—	High	—	Not specified	Not specified
Traditional practices and indigenous weather forecasting	Not specified	—	—	Moderate	—	Not specified	Not specified
Animal watering	Not specified	—	Moderate	—	—	Not specified	Not specified
Illegal mining activities	Input data	—	High	—	High	Data availability; institutional restrictions; accessibility; data gaps	Not specified
Sand winning	Not specified	Low	Moderate	—	—	Not specified	Not specified
Construction activities	Input data	—	—	—	High	Data availability; institutional restrictions; accessibility; data gaps	Not specified
Deforestation/depletion of forest cover	Input data	High	Moderate –High	—	High	Data availability; institutional restrictions; accessibility; data gaps	Not specified
Bush fires	Not specified	High	Moderate	—	—	Data availability; institutional restrictions; accessibility; data gaps	Not specified
Improper disposal of agrochemical waste and plastics	Input data	—	Moderate	—	Moderate	Data availability; institutional restrictions; accessibility; data gaps	Not specified

Note: Only custodians explicitly identified by participants have been included. A dash (—) indicates that no specific custodian was identified during the breakout discussions, and "Not specified" indicates the item has not been specified by the particular group.

The impact of the identified local practices has been ranked from low to high. The ranks of low, moderate, and high respectively represent relatively minimal, moderate, and markedly significant influences on water resources.

1.5 The Ghana pilot site and data characterization

Following the lunch break, facilitators presented the Ghana pilot site, responding to questions raised during the morning session about the location and selection of the study area. The Sherigu catchment, located within the White Volta Basin in Ghana's Upper East Region, was introduced and outlined its hydrological setting, water-use activities and relevance to the project's focus on local knowledge and non-conventional data. The presentation was followed by discussion and clarification of key methodological issues before participants reconvened in their four groups for the second breakout session on data characterization.

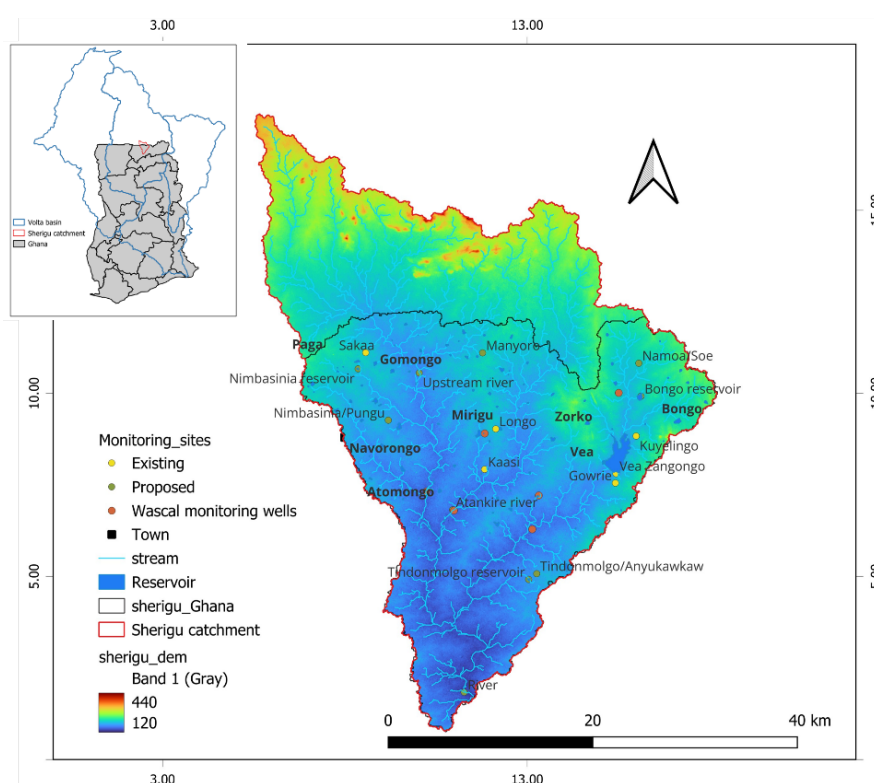


Figure 3: The location map of the pilot site; Sherigu catchment (Source: Authors construct)

1.5.1 The Sherigu Pilot Catchment

The Sherigu Catchment covers approximately 1295 km² and extends across Bolgatanga Municipal, Kassena-Nankana East, Kassena-Nankana West and Bongo District. Key characteristics of the pilot site presented during the session are summarized below in Table 5.

Table 5: Pilot Site (Sherigu Catchment) characteristics

Parameter	Detail
Pilot site name	Sherigu catchment (locally pronounced “Serego”)
River basin	White Volta basin

Region	Upper East Region, northern Ghana
Approximate catchment area	≈ 1295 km ²
Districts within the catchment	Bolgatanga Municipal; Kassena-Nankana East; Kassena-Nankana West; Bongo District
Main river systems	Three converging systems: the Veia River, the Atankwidi River, and a third tributary; the Tono river system lies just outside the delineated boundary
Reservoirs	The Veia Dam (managed by the Irrigation Company of Upper Region, ICOUR) plus over 80 small-scale reservoirs and dugout dams
Water use activities	Heavy dry-season reliance on groundwater; irrigation via the Veia Dam and other reservoirs; small-scale mining (notably Bongo District); aquaculture; a savanna forest reserve downstream
Rationale for selection	Pre-existing non-conventional, participatory data collection already under way, led by the Water Resources Commission's White Volta Basin Secretariat in collaboration with WaterAid

Beyond the physical characteristics of the site, it was highlighted the diversity of water sources, uses and pressures within the catchment. More than 80 small reservoirs and dugouts occur alongside the larger Veia Dam, while groundwater from boreholes and wells becomes particularly important during the dry season. Water supports irrigation and aquaculture, among other livelihood activities, while small-scale mining, particularly around Bongo District, represents an additional activity with implications for water resources. A savanna forest reserve is also located in the downstream area.

An important consideration in selecting Sherigu was its relevance to the project's interest in non-conventional data and local knowledge. Participatory data collection was already underway within the catchment through collaboration between the Water Resources Commission's White Volta Basin Secretariat and WaterAid. Other institutions such as West African Science Service Centre (WASCAL) also maintain hydrometeorological monitoring stations in the catchment and beyond. These existing engagements, combined with the diversity of water sources, uses and human activities within the catchment, provide a useful setting for exploring how conventional and non-conventional information can be brought together to strengthen water-resources assessment and modelling.

1.5.2 Discussion and methodological clarifications

The presentation generated substantive discussion on the delineation of the pilot catchment. A participant observed that the mapped boundary appeared to follow the Ghana–Burkina Faso national border unusually closely and questioned whether it represented the natural hydrological watershed or only the Ghanaian portion of the catchment. It was clarified that the natural catchment extends beyond the national boundary, while the area initially presented had been limited to Ghana. Participants stressed the importance of distinguishing clearly between the natural catchment and an administratively truncated study area.

The project team acknowledged the practical limitations imposed by available resources and the need to maintain a manageable area for data collection. At the same time, the discussion established that hydrological delineation should respect the natural watershed boundary rather than be artificially truncated at the national border. Historical and current data would therefore be assembled as comprehensively as possible to support subsequent modelling and validation.

A related clarification concerned the reported dependence on groundwater within the catchment. Participants noted that this should distinguish between shallow, unconfined groundwater sources and deeper aquifer systems, given their differing characteristics and management implications. This distinction was considered important for accurately characterizing groundwater use and conditions within the pilot area.

The discussion also highlighted opportunities to build existing participatory groundwater monitoring. A WaterAid Ghana representative described ongoing collaboration with the Water Resources Commission in which trained community volunteers monitor groundwater levels within the catchment. The project team welcomed this initiative as directly relevant to the project's participatory approach and emphasized the value of establishing monitoring arrangements that can be sustained beyond the project period. Experiences from longer-term participatory monitoring initiatives elsewhere were cited to illustrate the potential benefits of sustained collaboration among communities, research institutions, and water-management agencies.

With these clarifications, the workshop proceeded to the second breakout session, in which the four working groups reconvened to characterize the conventional and non-conventional data and knowledge sources identified during the morning session.

1.6 Characterizing conventional and non-conventional data sources in the pilot sites

Following the discussion of the Sherigu pilot catchment, participants reconvened in the same four working groups to examine more closely the data and knowledge sources identified during the morning session. The exercise focused on their type and format, spatial and temporal coverage, collection methods, accessibility and ownership, reliability and uncertainty, and challenges associated with accessing the data.

The groups considered a broad range of information relevant to water-resources assessment and modelling, including meteorological and hydrological time series, groundwater levels and abstraction, streamflow, land-use and land-cover information, irrigation and water-use data, reservoir information and demographic data. They also examined less conventional sources associated with activities such

as sand winning, mining and informal groundwater use, for which information may be held by communities, private actors or project-based initiatives rather than through established monitoring systems.

1.6.1 Group Report-Back and Plenary Reflections

Following the second breakout exercise, each group reported back on the characteristics of the non-conventional data sources identified for the Ghana pilot. The findings, consolidated in Table 6, revealed considerable diversity in the types, coverage, ownership, accessibility and reliability of the available data.

The groups identified information from community-based groundwater monitoring, historical hydrological records, private borehole drillers, mining and water-use records, small-reservoir inventories, meteorological and streamflow observations, groundwater abstraction records, and land-use datasets. These ranged from informal and recall-based information to project reports, spreadsheets, maps, digital time series and satellite-derived products.

A recurring concern was that potentially useful data are often fragmented across institutions and projects, held in inconsistent formats, or subject to access restrictions and variable quality assurance. Participants therefore emphasized the need to identify appropriate data custodians, document uncertainties and build existing datasets and monitoring initiatives rather than duplicate ongoing efforts.



Figure 4: Introduction of breakout session 2 (left) and Group 3 reporting back to plenary (right)

Table 6: Characteristics of non-conventional data identified for the Sherigu catchment and its environs

Data Source / Practice	Data Type & Format	Spatial & Temporal Coverage	Collection Method & Who Collects	Accessibility & Ownership	Reliability & Uncertainty	Challenges in Accessing Data
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Community-based groundwater monitoring	Groundwater levels	Community level; approximately 2 years	Dip-meter measurements by trained community members	Water Resources Commission (WRC), supported by WaterAid	Reliable; with occasional gaps noted	Delays in accessing data through formal request processes
Community-based climate observations	Surface temperature and rainfall	Community level; approximately 2 years	Measurements by trained community members	WRC, supported by WaterAid	Reliable	Delays in accessing data
Historical hydrological/flood data	Flow measurements	Historical measurements from the 1970s and 1980s	Measurements; specific method not reported	CSIR–Water Research Institute	Reliable	Delays in accessing data
Groundwater/borehole data held by private drillers	Groundwater levels; report-back also identified borehole location, yield and depth	Not specified	Recorded by borehole drillers; specific methods not reported	Private borehole drillers	Not specified	Specific contacts and access arrangements were not yet known
Underground water / borehole records	Yield, depth, coordinates and general well characteristics; Excel, reports and maps	World Vision and WaterAid project areas in the Upper West Region; drilling in dry season; pumping-test records, 2014–2017	Consultants through pumping tests	World Vision, WaterAid and consulting/drilling firms; not centrally archived	Quality varies by consultant/drilling firm; no centralized QA/QC across the 2014–2017 records	Data scattered across NGOs and consultants; inconsistent formats across years/projects
Sand-winning data	Volume of sand extracted from rivers; format not specified, largely informal/verbal records	Not specified	Interviews and focus group discussions with tipper-truck drivers, District Assembly, checkpoint owners and drivers' association	Held informally by tipper-truck operators, District Assembly, checkpoint owners and drivers' association; not centralized	Based on recall/testimony; accuracy depends on respondent memory and honesty	No formal records; difficult to independently verify extraction volumes
Mining water-use and abstraction data	Water-use/consumption rates; river abstraction volumes; coordinates of abstraction points; Excel, reports and maps	Mining concession areas in the Upper East Region; ongoing and linked to WRC permit-reporting cycles	Self-reported by mining companies as a condition of WRC abstraction permits	WRC; accessible through WRC as submission is a permit requirement	Depends on mining companies' compliance and accuracy of self-reporting	Possible delays or gaps where operators do not comply with reporting obligations

Water consumption (domestic supply and agricultural consumptive use)	Water consumption/use volumes (recall-based); reservoir location and surface area over time	Coverage varies by source; Ghana Water Company service areas and small-reservoir locations monitored over time	Surveys, recall and plot data; Ghana Water Company and MOFA/Department of Agriculture extension officers; remote monitoring through IWMI Small Reservoir Dashboard	Ghana Water Company, MOFA/Department of Agriculture and IWMI; IWMI dashboard more openly accessible	Recall-based consumption data subject to bias; reservoir dashboard considered more reliable but limited to small reservoirs	Multiple custodians with no shared format; harmonizing recall-survey and dashboard data requires additional processing
Small-reservoir inventory	Location, use, year of construction and seasonal water-availability status	More than 2,000 small reservoirs across northern Ghana; 2018–2024 and ongoing	IWMI monitoring/dashboard; specific collection method not reported	IWMI Ghana; GIDA also reported to hold detailed White Volta small-reservoir data	Not specified	Not specified
Meteorological data (rainfall and temperature)	Digital time series	Point data; hourly/daily	Automatic weather stations and rain gauges	Ghana Meteorological Agency; WASCAL	Group 4 reported as reliable	Institutional barriers; data access may not be free
Hydrological/streamflow data	Digital time series	Daily	Pressure sensors and staff gauges	WASCAL (tentative)	Reported as reliable	Data-format issues/inconsistencies identified
Groundwater level and abstraction data	Digital time series	Monthly	Manual measurements	World Vision; Group 4 output also referenced WASCAL	Reported as reliable	Not specifically reported for this data source
Land-use and land-cover data	Digital time series / land-use and cover data	Spatial and temporal coverage not specified	Satellite-derived	WaPOR; Dr Jacob Mensah/related university work	Reported as reliable	Not specifically reported

1.7 Research design and planning for the Ghana pilot site

The final technical session presented the proposed research design for the Ghana pilot, showing how the non-conventional data and local knowledge identified during the workshop would be complemented by targeted field data collection. The approach combines participatory quantitative monitoring with qualitative inquiry, while building on monitoring activities already underway within the catchment.

1.7.1 Participatory quantitative monitoring

The quantitative component builds on the existing citizen-science monitoring network established by the Water Resources Commission (WRC) and WaterAid, with plans to strengthen and expand

monitoring within the pilot area. Rainfall monitoring will involve nine rain gauges across nine communities. River discharge will be monitored using staff/stage gauges positioned upstream, midstream and downstream, while selected small reservoirs and dugouts will be monitored for water levels and outflows. Groundwater monitoring will similarly build on existing community-based monitoring wells using dip-meter measurements.

The presentation also incorporated practical recommendations emerging from the earlier breakout discussions. These included recording the timing and duration of spillway overflow at small reservoirs, aligning river-stage and groundwater measurements more closely with rainfall events, and strengthening staff-gauge installations to reduce the risk of damage or loss during flash floods.

1.7.2 Qualitative data collection

The qualitative component is intended to document local practices affecting water systems, examine the associated non-conventional and local knowledge, and identify gaps and opportunities for strengthening available information. Two principal methods were proposed: focus group discussions (FGDs) with community members and key informant interviews (KIIs) with relevant institutional actors.

The FGDs will be disaggregated by gender and age to allow differences in experiences, practices and knowledge to emerge without being obscured within a single group. In particular, separating older and younger participants was intended to capture traditional knowledge held by older residents alongside potentially different observations and experiences among younger community members. KIIs will use a semi-structured, open-ended approach and engage institutional actors at different levels.

The discussions will broadly explore water realities and seasonal change, local practices, non-conventional data and local knowledge systems, and issues of access, governance and accountability. The institutional interviews will examine similar issues while also considering institutional mandates and collaboration arrangements.

1.7.3 Discussion and feedback on the proposed research design

Participants provided several suggestions for refining the proposed approach. Concerns were raised that important dry-season irrigation activities around Tono and the Paga irrigation dam were either absent or insufficiently represented within the proposed monitoring scope, prompting a recommendation that major irrigation water users be more explicitly considered. The project team also confirmed that KIIs would use flexible, open-ended interview guides adapted to the Ghanaian context rather than rigid questionnaires.

The WASCAL representative shared experiences detailing their monitoring efforts within the catchment. He noted challenges such as equipment theft and flash floods washing same away. The WRC representative corroborated this experience. These accounts underscore the need to prepare for unforeseen occurrences and to put backup measures in place to ensure data monitoring continuity. The CIKOD representative reiterated that sensitive indigenous knowledge should be sought through recognized knowledge-holding institutions and appropriate local protocols rather than relying solely on general community focus groups. A further question concerned how the qualitative and quantitative information generated through the research would ultimately connect to hydrological modelling. The team confirmed that integration into the modelling framework is the longer-term intention, while the specific methodology for doing so is being developed through another work package within the UNLOCKiNG consortium.

Conclusions and way forward

1.8 Closing discussion and remarks

In closing the substantive discussions, facilitator reflected on the breadth of insights generated through the workshop, particularly the progression from identifying local practices, knowledge and non-conventional data sources to characterizing their potential value and limitations. Participants were acknowledged for their contributions and emphasized IWMI's intention to sustain engagement with the group as the project progresses.

It was also highlighted the workshop was a practical demonstration of co-design. Referring specifically, to the correction of the initially proposed catchment boundary by a participant familiar with the area, it was noted that such locally grounded insight illustrated why research design cannot rely solely on desk-based analysis.

Looking ahead, the immediate work would focus on determining where relevant data exist, who holds them and how they can be accessed. This will lead to the development of a data governance framework to guide the project in future works. The planned community-level qualitative fieldwork would build directly on the identification and characterization undertaken during the workshop. It also emphasized the importance of sustained institutional collaboration.

The workshop concluded with the collection of participant contacts and breakout-group materials for consolidation by the project team, acknowledgement of collaborating partners, and informal exchanges among participants on related research and opportunities for continued collaboration

1.9 Recommendations and action points

The discussion identified several priority actions to strengthen the Ghana pilot and ensure that data collection, local knowledge documentation, and subsequent modelling are scientifically robust and ethically grounded. First, the pilot-site map and description should be revised to distinguish the truncated Ghanaian study area from the natural cross-border catchment, with the natural catchment boundary guiding hydrological data collection and modelling.

Groundwater characterization should also clearly differentiate between shallow/unconfined and deeper/confined aquifer systems. Existing information should be mobilized before initiating additional data collection. This includes formally requesting community-collected groundwater and rainfall data from the Water Resources Commission (WRC) and WASCAL, building on IWMI's existing northern Ghana small-reservoir dashboard, accessing GIDA's White Volta small-reservoir dataset, and engaging private borehole-drilling companies and NGOs such as CIKOD, ActionAid, Plan International, and World Vision to identify additional groundwater and community water-use records. The monitoring scope should also capture important dry-season irrigation water users, particularly around Tono and the Paga irrigation dam.

Field monitoring protocols should be strengthened to better characterize hydrological responses. Small reservoirs and dugouts should include monitoring of spillway-overflow timing, duration, and dimensions to support runoff-volume estimation. River-gauge and groundwater dip-meter observations should move beyond fixed schedules toward event-based monitoring linked to rainfall events, while staff-gauge installation methods should be reviewed to reduce damage or loss during debris-laden flash floods. Community-reported historical observations should be supported by explicit and documented validation and triangulation procedures, particularly where independent historical records are unavailable.

For local and Indigenous knowledge, the project should establish a clear custodianship, ethical-use, and benefit-sharing framework so that communities understand how their knowledge will be used and can share in the value generated from it. Sensitive Indigenous knowledge should be approached through recognized knowledge-holding institutions and according to their own protocols, including drawing on CIKOD's offered methodological support. Separate gender- and age-disaggregated focus group discussions should be maintained to capture differences in knowledge and experience across social groups. Finally, IWMI should pursue longer-term data-sharing arrangements, including possible MOUs with WRC, GMet, WASCAL and other data-holding institutions, to facilitate sustainable, free or reduced-cost access to hydrological information. Collectively, these actions will strengthen the

evidence base for assessing how conventional observations, non-conventional data, and local knowledge can complement one another and contribute to hydrological modelling and water reanalysis under UNLOCKiNG.

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Annexes

1.10 Annex A: Workshop Overview

Item	Detail
Workshop title	Unlocking Local Knowledge Production for Global Water Reanalysis — Co-Design / Inception Workshop (Day 2 of 2)
Pilot site	Sherigu catchment (Atankwidi and Veia river systems), White Volta basin, Upper East Region, Ghana
Date	26 th June 2026
Venue/format	IWMI Ghana Office, Accra; hybrid (in-person plus one online participant)
Convening institutions	Imperial College London (overall project lead) and IWMI (Work Package 1 co-lead)
Funding/support	Schmidt Sciences (Virtual Institute for Earth's Water); five-year, performance-based award
Facilitators	Moctar Dembele and Mabel Kumah (IWMI) with Gerald Atampugre (IWMI) and Dr Seifu Tilahun (IWMI)

1.11 Annex B: Agenda

Time	Activity	Responsible
8:30 AM - 9:00 AM	Arrival and Registration	IWMI
9:00 AM - 9:15 AM	Section 0: Welcome - Welcome remarks; Introduction of participants	IWMI
9:15 AM - 9:30 AM	Section 1: Setting the Scene - Project Overview: Unlocking local knowledge production for global water reanalysis (UNLOCKiNG); Presentation on non-conventional data and local knowledge	Kehindi Ogunjobi, Moctar Dembele, Seifu Tilahun
9:30 AM - 10:30 AM	Section 2: Identification of Local Knowledge, Practices, and Non-Conventional Data Sources - Breakout group brainstorming (sources, stakeholder identification, typology, integration mechanisms, value assessment)	Moctar Dembele
10:30 AM - 11:00 AM	Health Break	
11:00 AM - 1:00 PM	Section 3: Characterization of Identified Knowledge and Datasets - Breakout discussion (data type/format, coverage, collection methods, accessibility, reliability, challenges, responsible actors)	Moctar Dembele
1:00 PM - 2:00 PM	Lunch Break	
2:00 PM - 3:45 PM	Session 4: Planning for Research Activities - Presentation on Ghana case study plan; Brainstorming	Mabel Kumah, Seifu Tilahun
3:45 PM - 4:00 PM	Closing Remarks	Seifu Tilahun



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