

WaterNet Sessions Feedback Report

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Manare Prisca Moloto, Zolo Kiala, Surajit Ghosh, Nicholas Pattinson, and Jai Clifford-Holmes

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Authors

Manare Prisca Moloto, Intern - Water Futures Data & Analytics (WFDA), International Water Management Institute (IWMI), Pretoria, South Africa

Zolo Kiala, Post Doctoral Fellow - Water Futures Data & Analytics (WFDA), IWMI, Pretoria, South Africa

Surajit Ghosh, Regional Researcher - Water Futures Data and Analytics (WFDA), IWMI, Colombo, Sri Lanka

Nicholas Pattinson, Research Scientist, GroundTruth, Kwa-Zulu-Natal, South Africa

Jai Clifford-Holmes, Executive Director, Association for Water and Rural Development (AWARD), Hoedspruit, South Africa

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Front cover photo: Representatives from IWMI, LIMCOM, AWARD and GroundTruth at the WaterNet 26 Symposium (*photo*: IWMI)

Back cover photo: The Ministry of Water Development and Sanitation of Zambia, along other symposium participants at the IWMI's exhibition stand (*photo*: IWMI)

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Acronyms and Abbreviations

IWMI	International Water Management Institute
YOMA	Youth Agency Marketplace
LIMCOM	Limpopo Watercourse Commission
DT	Digital Twin
LIMIS	Limpopo Management Information System
CS	Citizen science
LRB	Limpopo River Basin
RBO	River Basin Organizations

WaterNet Sessions Feedback Report

IWMI sessions at the 26th WaterNet/WARFSA/GWP-SA Symposium

Executive Summary

At the 26th WaterNet/WARFSA/GWP-SA Symposium (28–31 October 2025, Lusaka, Zambia), IWMI, in partnership with YOMA, GWP, Enable, The Leona M. and Harry B. Helmsley Trust and LIMCOM, convened two interactive sessions and a field excursion focused on citizen science and a Digital Twin (DT) for the Limpopo River Basin (LRB). With participation from LRB Member States (Mozambique, Zimbabwe, Botswana, South Africa), the events showcased how low-cost field tools, youth-led data collection, and advanced digital platforms can jointly strengthen evidence-based, transboundary water governance in a basin facing climate variability, ageing infrastructure, and fragmented monitoring systems.

Session 1 highlighted a hybrid citizen science model that combines affordable tools (e.g., miniSASS, clarity tubes, velocity planks) with platforms such as the miniSASS App, YOMA, Water Copilot, and the LRB DT. Early results show strong usability and engagement, particularly among youth, while underscoring the need for better offline functionality, multilingual access, ethical integration of Indigenous knowledge, and stronger incentives for community participation. Session 2 focused on the DT and Water Copilot as integrative platforms that bring together satellite, sensor, citizen science, and administrative data to support near real-time monitoring, forecasting, and scenario planning for droughts, floods, and reservoir operations.

Across both sessions and the hands-on field excursion, participants identified common strategic priorities: establishing clear policy frameworks for data sharing and transparency; standardizing reservoir operation protocols; expanding capacity-building and digital literacy; improving platform usability and accessibility; and more systematically integrating citizen science data into formal decision-support systems. Together, citizen science approaches and DT technologies offer a complementary and scalable pathway to more transparent, inclusive, and adaptive water management in the LRB and beyond.

1. Introduction

The International Water Management Institute (IWMI) participated in the 26th WaterNet/WARFSA/GWP-SA Symposium, hosting two interactive sessions in partnership with the United Nations Children’s Fund (UNICEF) Youth Agency Marketplace (YOMA), GWP, Enabel, The Leona M. and Harry B. Helmsley Trust and Limpopo Watercourse Commission (LIMCOM), with LRB Member States representatives from Mozambique, Zimbabwe, Botswana, and South Africa. This symposium took place from 28 to 31 October 2025, in Lusaka, Zambia (Global Water Partnership, 2025). Across these engagements, IWMI showcased a portfolio of practical, field-ready approaches that pair citizen science methods with a Digital Twin (DT) ecosystem for the Limpopo River Basin (LRB). Together, these approaches aim to strengthen evidence-based, transboundary decision-making by improving how data are collected, verified, integrated, and communicated.

The drive behind this work is clear: the LRB continues to experience climate variability, infrastructure constraints, and fragmented data systems that limit timely risk assessment and adaptive operations (e.g., early flood warning, drought preparedness, reservoir releases, and water quality safeguarding)¹. At the same time, rapid urban growth, rising pollution, and patchy monitoring continue to leave critical data gaps across the basin (FAO.org, 2025). The sessions focused on two key pathways: (i) empowering communities and youth to collect near-real-time, verifiable data using simple tools and mobile platforms; and (ii) integrating satellite, sensor, citizen science, and administrative data into a modular DT that enables analytics, forecasting, and scenario planning.

Anchored in WaterNet’s regional mandate, the sessions also advanced broader policy objectives aligned with the Southern African Development Communities (SADC) Protocol on Shared Watercourses, open and interoperable data principles, and inclusive participation. Figure 1 shows IWMI’s interaction with the Zambian Minister of Water Development and Sanitation at the exhibition booth. Deliberations highlighted ethical integration of indigenous and local ecological knowledge, multilingual accessibility, and the need for clear governance around data ownership, quality assurance, and institutional mandates for risk communication.



Figure 1. IWMI representatives are engaging with the Zambian Ministry of Water Development and Sanitation on the work IWMI is actively involved in, around citizen science in the LRB (photo: IWMI).

¹ wlearn.org (last accessed November 6, 2025)

1.1. Session Purposes

The purposes of the session were:

- Demonstrate pragmatic workflows that couple low-cost field tools with digital platforms (the mini stream assessment scoring system (miniSASS), YOMA, Water Copilot, and the LRB DT) for end-to-end data capture, validation, and use.
- Share lessons from LRB Member States on operational realities, trust-building, youth engagement, and private sector participation.
- Identify actionable steps to standardize operating procedures (e.g., reservoir operations), strengthen early warning chains, and mainstream data sharing across agencies.

1.2. Expected Outcomes

The expected outcomes of the session are as follows:

- A common understanding of priority data gaps and validation needs, with candidate solutions (e.g., AI-assisted photo checks, offline data capture, and standardized protocols).
- Clear next actions to enhance platform usability (e.g., navigation and multilingual options), expand capacity-building, and scale citizen-science pilots to new sub-basins.
- A set of strategic priorities for LIMCOM and partners on policy frameworks for data transparency, sustainable operations, and cross-border coordination.

1.3. Structure of this Report

This document is written as a concise narrative. It begins with an expanded introduction that frames the basin's challenges and the objectives of the two IWMI-led sessions at the 26th WaterNet/WARFSA/GWP-SA Symposium. The story then moves into Session Summaries. First, Session 1, titled "Citizen Science and Digital Twins for near-real-time water quality monitoring", recounts the presentations, distills the key strengths, and weaves in LRB Member State perspectives from the panel discussion and questions and answers (Q&A) session, before noting practical areas for improvement and acknowledging the conveners. The narrative then shifts to Session 2, titled "Toward a Transboundary Data-Driven Digital Ecosystem for the Limpopo River Basin", which explores the emerging transboundary, data-driven digital ecosystem for the LRB. Here, we summarize the presentations, cross-cutting insights from the panel and Q&A, identify strategic priorities from participants, and conclude by summarizing key messages and outlining immediate actions for LIMCOM and its partners. Finally, insights into the field excursion that IWMI and GroundTruth organized are provided.

2. Session Summaries

2.1. Session 1: Citizen Science and Digital Twins for Near Real-Time Water Quality Monitoring in the Limpopo River Basin

IWMI, YOMA, and LRB Member States joined in a presentation and panel discussion to explore the integration of citizen science into water management within the LRB. These presentations and discussions highlighted citizen science as an effective approach for data collection, community engagement, and supporting early warning systems. In Figure 2, a representative from IWMI's delivers an introductory talk for the session, setting the stage for the conversations that were had and facilitating the conversations.



Figure 2. IWMI representative introducing the session on transboundary citizen science digital ecosystems for the LRB (photo: IWMI).

2.1.1. Presentations

IWMI's citizen science project review (see Figure 3): The LRB faces significant climate variability and water stress, impacting over 18 million people (IWMI, 2025). IWMI presented a three-phase approach, which combines:

- Physical citizen science tools: miniSASS, velocity planks, and clarity tubes (affordable, low-tech solutions).
- Digital platforms: miniSASS App, YOMA, Water Copilot, DT.
- Focus: Near real-time data collection and community participation.

Initial results for inclusivity, as assessed using the Multi-Dimensional Digital Inclusivity Index (MDII), indicate strong usability and navigation performance. However, improvements are needed in offline functionality and platform navigation.



Figure 3. IWMI’s representative presenting on the citizen science project across the LRB (photo: IWMI).

YOMA platform: YOMA enables youth engagement in the citizen science program through learning-to-earning pathways (Storr, 2025). The platform supports:

- **Verified skills accumulation** through task completion and micro-learning.
- **Employment opportunities** linked to demonstrated competencies.
- **Incentives** such as equipment, transport, and mobile data access for active participants.
- **Multilingual, mobile-friendly interface** that is designed to be accessible to youth across the region.

2.1.2. Strengths

The key strengths identified during the session were:

- Effective hybrid approach (physical and digital tools).
- Strong multi-stakeholder engagement.
- Positive user experience feedback.
- Youth empowerment through YOMA.
- Trust-building via direct communication channels.
- Community ownership of data collection processes reduces vandalism.
- Data gap reduction in under-monitored areas.

2.1.3. Insights from LRB Member States

Figure 4 shows panelists sharing insights from across the LRB. From this panel discussion, Mozambique highlighted its reliance on community monitors and citizen scientists to strengthen and support early flood warning systems. Zimbabwe emphasized the importance of trust, underscoring that communities must see that the data they provide leads to tangible action. Botswana focused on data quality, including the use of photo verification and promoting community ownership of information. Finally, South Africa reported on the use of WhatsApp for rapid communication with communities and the active engagement of private stakeholders in these communication channels.



Figure 4. a) Panelists for the transboundary citizen science efforts within the LRB were Member States representatives from Botswana, Mozambique, South Africa, and Zimbabwe (left to right), b) IWMI representative (far left) engaging with the panelists (photo: IWMI).

2.1.4. Insights from the Q&A

Figure 5 shows audience members actively engaging in a Q&A session with the presenters, panelists, and the broader project team. The discussion highlighted several cross-cutting themes. First, **the effectiveness of citizen science tools** was noted to depend not only on the availability of appropriate tools but also on sufficient training and the broader maturity of regional systems. Participants emphasized the importance of integrating indigenous knowledge, calling for research-informed approaches and clear ethical guidelines to ensure respectful and meaningful inclusion.

On **scalability**, ongoing assessments are exploring opportunities to expand the model beyond LIMCOM to other river basins, supported by improved **data integration** that enables seamless interoperability between platforms while preserving their specialized capabilities. The conversation also underscored the importance of **incentives for participating community members**, particularly through YOMA, where a multi-faceted model combines education, access to tools, and tangible community benefits.

Participants further stressed the need for **urban investment** to address pollution and infrastructure challenges, including theft, vandalism, and limited operational capacity of tools in rapidly growing urban areas. To improve data quality, work is underway to develop AI-driven photo interpretation to enhance accuracy and reliability. Finally, a recurring theme was trust and action: Communities must see visible, tangible outcomes from their contributions to sustain engagement and confidence in the process.



Figure 5. Audience members engaging in a Q&A session, for Session 1 (photo: IWMI).

2.1.5. Suggestions for Areas of Improvement

The following areas for improvement were identified:

- **Ethical integration of indigenous and local ecological knowledge**, supported by further research and clear guidelines, alongside the development of **multilingual interfaces** to improve accessibility.
- **Offline functionality for YOMA**, particularly to support participation in remote or low-connectivity areas.
- **Enhanced platform navigation and user journeys**, recognizing that improving digital literacy and connectivity is essential for scaling citizen science efforts and ensuring broader impact across and beyond the LRB.
- **Stronger data integration across tools and platforms** to enable seamless sharing, analysis, and reuse of citizen science data.
- **Standardised data validation protocols** to improve consistency, reliability, and comparability of data collected across countries and initiatives.

2.1.6. Session Engagements

Approximately 39 participants joined the session, with 38 attending in-person and 1 connecting online. This strong turnout highlighted the relevance of the discussion and the commitment of stakeholders across the region. The session brought together a diverse group of contributors, guided by a moderator who linked citizen science efforts to broader basin management priorities. Country representatives enriched the dialogue by sharing perspectives from their national contexts, allowing participants to compare experiences and identify common challenges and opportunities across borders. Together, participants engaged in lead presentations and panel discussions that

reflected contributions from basin institutions and regional partners. The session concluded with key discussion points and strategic messages carefully captured by the rapporteur.

Figure 6 shows attendees participating in Session 1, reflecting strong engagement from across the basin. Figure 7 illustrates the collaborative nature of the initiative, depicting LIMCOM Member State representatives together with the IWMI citizen science and DT team, as well as partners from GroundTruth and Global Water Partnership Southern Africa (GWP-SA), working jointly on the project.



Figure 6. Attendees in IWMI's citizen science Session 1 (photo: IWMI).



Figure 7. LIMCOM Member State representatives, IWMI citizen science and DT team, GroundTruth, AWARD, and GWP-SA representatives working together on the project (photo: IWMI).

2.2. Session 2: Toward a Transboundary Data-Driven Digital Ecosystem for the Limpopo River Basin

Day 2 focused exclusively on the DT and its role in transforming water resource management in the LRB. The session explored how DT addresses fragmented data systems, improves transparency, and enables proactive decision-making through advanced modelling and integration of diverse datasets (Storr, 2025). In Figure 8, IWMI-Consultant, from the Association for Water and Rural Development (AWARD), is presenting on the development and implementation of the DT and Water Copilot for water resources monitoring in the LRB.



Figure 8. IWMI-Consultant presenting on the DT and Water Copilot technologies in Session 2 (photo: IWMI).

2.2.1. Presentations

A) Summary of the DT presentation

The LRB continues to face significant data gaps and monitoring challenges, with fragmented and inconsistent data collection systems and many gauging stations outdated or non-functional. This has increased reliance on remote sensing.

In this context, the **LRB DT** was presented as a unifying platform that integrates multiple datasets to enable near real-time monitoring and advanced scenario modelling (IWMI, 2025). **Water Copilot** complements the DT by drawing on verified information from LIMCOM documents and related sources, thereby enhancing trust and accessibility for researchers, planners, and policymakers across the basin.

B) LRB Member State insights for the DT and Water Copilot (see Figure 9):

LRB Member State inputs highlighted how the DT and Water Copilot are already supporting operational and strategic decision-making. In terms of **water and risk management**, the integration of real-time and forecasted data was noted as critical for drought preparedness, flood risk mitigation, and more adaptive reservoir operations.

For **decision-making and planning**, the tools enable scenario simulations, crop planning, and resource allocation by combining diverse datasets in user-friendly visualizations. On **data integration and ecosystem health**, the centralized platforms help bridge gaps between satellite observations, in-situ sensors, and citizen science, while tracking key variables such as river discharge and water quality to maintain ecological integrity.

From a **community engagement and governance** perspective, the DT and Water Copilot were seen as important enablers of strengthened transboundary coordination, improved stakeholder engagement, and bridging the gap between scientific information and community realities, supporting more sustainable basin development.



Figure 9. The Zimbabwe Member State representative, presenting in Session 2 on the application of the DT and Water Copilot for water monitoring in the LRB, from Zimbabwe's point of view (photo: IWMI)

2.2.2. Key Insights (Panel Discussion and Q&A)

The discussion highlighted several strategic themes for strengthening basin-wide water management using the DT and Water Copilot. **Reservoir operations and drought monitoring** emerged as a key concern: Reservoir operations, particularly in South Africa, remain largely unstandardized, with some dams lacking formal operating rules. This situation increases vulnerability to both floods and droughts. The DT's AI-driven forecasting and modelling capabilities were identified as an opportunity to support standardized operating procedures and more proactive water management.

On **data ownership and democratization**, participants noted that unclear institutional mandates and power dynamics can hinder effective communication, especially regarding flood warnings and water level alerts. The DT aims to promote greater transparency through shared access and interoperable systems, while Water Copilot provides structured, verified data access for decision-makers. **Sustainability and scalability** were also discussed: High operational costs and reliance on external funding pose challenges, yet the DT's modular architecture and API-based integration were seen as strengths that enable cost-effective scaling across river basins, with operational costs expected to decrease over time.

In terms of **stakeholder engagement and citizen science**, limited integration of field scientists and community-based monitoring was recognised as a barrier to improving data accuracy and responsiveness. Participants underscored the need to prioritise plans for incorporating citizen science and automated data collection, such as automated gauge readings, to enhance inclusivity, timeliness, and trust in basin data.

Figures 10–12 illustrate these dynamics in practice: Figure 10 shows panellists and LRB Member State representatives and LIMCOM/GWP-SA representatives, reflecting the strong multi-stakeholder engagement in the session. Figure 11 captures audience members engaging in an active Q&A with the panel, while Figure 12 depicts attendees of the session, underscoring the broad interest in the DT and Water Copilot as tools for transboundary water governance.



Figure 10. Session 2 panellists, including LRB Member State representatives, a LIMCOM/GWP-SA representative and IWMI representatives (*photo: IWMI*).



Figure 11. Audience members engaging in the Q&A session (photos: IWMI).



Figure 12. Attendees at Session 2 on the DT and Water Copilot (photo: IWMI).

2.2.3. Strategic Priorities

The discussion converged around several strategic priorities for LIMCOM and its partners:

- **Establish clear policy frameworks for data sharing and transparency** among LRB Member States, to enable timely access to reliable information for decision-making.
- **Expand capacity-building and digital literacy programmes**, ensuring that technical staff, youth, and community members can effectively use the available tools and platforms.
- **Develop and implement standardized reservoir operation protocols across the basin**, reducing vulnerability to floods and droughts and supporting more coordinated transboundary water management.
- **Improve platform usability and multilingual accessibility**, so that the DT, Water Copilot, YOMA, and related tools can be used effectively by diverse users across the LRB.

2.2.4. Session Engagements

Session 2 brought together 19 participants, underscoring strong regional interest in advancing digital innovation for water management. Discussions centered on the role of DTs in supporting basin planning and decision-making, with participants exploring how these tools can enhance transparency and collaboration. Data governance emerged as a critical theme, highlighting the need for clear frameworks to ensure accountability and trust in shared information systems. Equally important was the emphasis on data democratization.

2.3. Field Excursion

As part of the WaterNet Symposium's final day programme, IWMI and GroundTruth successfully co-organized a hands-on excursion showcasing innovative, low-cost water monitoring techniques through citizen science approaches (see Figure 13). The excursion took place on 31 October 2025 at Kalimba Reptile Park, Zambia, and attracted participants from academia, the public sector (including the Ministry of Water Development and Sanitation of Zambia), and research institutions. The purpose was to demonstrate and develop practical skills for simple, cost-effective water monitoring approaches applicable to local and transboundary river basins, such as the LRB (GroundTruth, 2024). By combining ground-level data collection with digital tools like the LRB DT, the excursion illustrated how citizen science can strengthen water management strategies and support inclusive, data-driven decision-making.

The techniques are used in the field for data collection by citizen scientists, as part of IWMI and GroundTruth's collaborations in research for effective tools for water management (GroundTruth, 2024). This practical session was built on the platform founded during the IWMI-GroundTruth-LIMCOM Special Sessions 1 and 2. The excursion aimed at providing participants with real-world experience in applying simple, cost-effective methods that complement advanced digital tools like the LRB DT.



Figure 13. Members of the Zambian Ministry of Water Development and Sanitation, GroundTruth, IWMI, and GWP-SA at the excursion, at Kalimba Reptile Park, Lusaka, Zambia (photo: IWMI).

2.3.1. Activities Conducted

Participants worked in small groups under expert guidance to learn and apply practical techniques for assessing surface water quality and quantity. Activities included **streamflow velocity measurements**, where participants collected streamflow data using both a flow meter and low-cost tracer methods (see Figures 14–16).



Figure 14. Demonstration by GroundTruth, using table salt in citizen science hydrological data collection, collecting streamflow velocity data using a flow meter (photos: IWMI).



Figure 15. Participants taking salinity readings in the stream, to determine channel velocity and discharge (*photo: IWMI*).

They also carried out a **stream health assessment using miniSASS**, scoring river health based on observed macroinvertebrates (Figure 16).



Figure 16. GroundTruth leading a demonstration on the use of a miniSASS scoresheet to score river/water body health based on the organisms observed (*photos: IWMI*).

Further exercises covered water clarity measurement with a clarity tube to assess suspended solids (Figure 17), streamflow velocity measurement using a velocity plank (Figure 18), and river cross-section and discharge estimation using transparent velocity head rods and off-the-shelf SoNAR devices (Figure 19).



Figure 17. Demonstration of the use of the clarity tube for observing suspended solids in river water, a core parameter of river water quality (photo: IWMI).



Figure 18. Demonstration on taking velocity and discharge measurements using the velocity plank (transparent velocity head rod) (photo: IWMI).

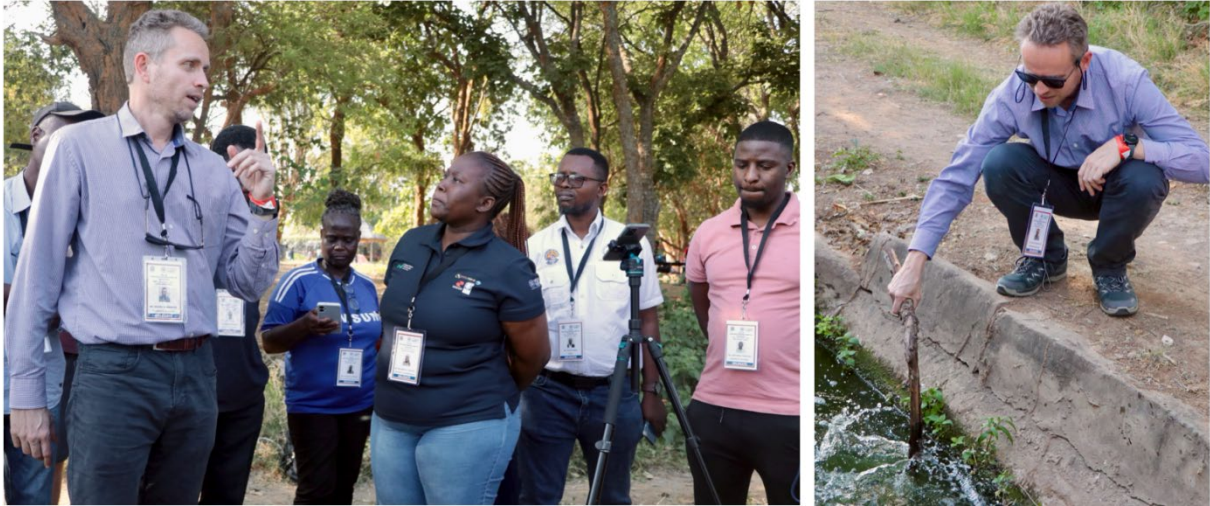


Figure 19. GroundTruth demonstrating the use of off-the-shelf, high-quality Sound Navigation and Ranging (SoNAR) devices (*photo: IWMI*).

Finally, participants explored **smartphone-based discharge estimation**, using videos captured on mobile phones to derive flow estimates (Figure 21).



Figure 20. Example of smartphone use in data collection (measuring streamflow and estimating discharge with videos from a smartphone) (*photo: IWMI*)

2.3.2. Outcomes

The session resulted in several key outcomes, with over 50 participants. Participants gained **practical skills in citizen science water monitoring**, building confidence in applying simple, field-based techniques. They developed an **understanding of low-cost, scalable methods for streamflow and water quality assessment**, including tools such as miniSASS, clarity tubes, velocity planks, and smartphone-based approaches. In addition, the exercises provided **insights into how field data can be integrated with digital modelling tools**, such as the DT and Water Copilot, to support **transboundary water management** across the LRB.

3. Conclusion

The 26th WaterNet/WARFSA/GWP-SA Symposium highlighted that citizen science and DT technologies are complementary strategies for strengthening water governance in the LRB. Citizen science provides grassroots-level data collection and community participation, while the DT offers advanced modelling, real-time monitoring, and interoperability for informed decision-making. There is a strong interest in the citizen science tools (and approaches), the DT, and Water Copilot technologies to be implemented in other river basins.

Key priorities going forward include standardizing reservoir operations, improving platform usability, improving integration of citizen science data into digital systems, and establishing policy frameworks for data sharing and transparency. Sustained success will depend on addressing technical and financial sustainability, fostering inclusive stakeholder engagement, and scaling interoperable solutions across transboundary contexts. Together, these approaches present a transformative opportunity to build a resilient, data-driven ecosystem that supports equitable and sustainable water resource management in the LRB and beyond.

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Contact

Surajit Ghosh, Regional Researcher - Water Futures Data and Analytics (WFDA), IWM, Colombo, Sri Lanka
(S.Ghosh@cgiar.org)



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