IWMI
International Water Management Institute

CGIAR RESEARCH CENTER

Digital Solutions for Africa's Water Management

THE LEONA M. AND HARRY B. HELMSLEY CHARITABLE TRUST

Acknowledgements

This work was supported by a grant from The Leona M. and Harry B. Helmsley Charitable Trust to IWMI.

We acknowledge Ethiopia's Ministry of Irrigation and Lowlands (MILLs) and the Ministry of Water and Energy (MoWE), the Ghana Irrigation Development Authority (GIDA), Burkina Faso's General Directorate of Water Resources (DGRE) of the Ministry of Water and Sanitation (MEEA), and Zambia's Water Resources Management Authority (WARMA) for their vital support to the DIWASA use cases. These key stakeholders initiated the use-case ideas and actively supported their implementation. Their active involvement throughout the co-design, co-development and co-delivery phases, in addition to the provision of input data for the use cases, were instrumental to success.

We also extend our sincere appreciation to the Limpopo Watercourse Commission (LIMCOM) for their strong partnership in the co-design and implementation of the Digital Twin for the Limpopo River Basin.

Finally, we gratefully acknowledge Digital Earth Africa (DE Africa) for their capacity-building support, which facilitated the seamless integration of DIWASA water products into their platform.

Authors

Naga Manohar Velpuri[1], Abdulkarim H. Seid[2], Mansoor Leh[1], Kirubel Mekonnen[2], Alemseged T. Haile[2], Mariangel Garcia Andarcia[1], Afua Owusu[3], Komlavi Akpoti[3], Samuel Storr[1], Emma Greatrix[2], Elizabeth Wamba[2]

[1]IWMI, Colombo, Sri Lanka; [2]IWMI, Addis Ababa, Ethiopia; [3]IWMI, Accra, Ghana

Cover photo: Distribution of annual discharge across Africa and outflow to various oceans. *Source:* Akpoti et al. 2024
Back cover photo: Blue Nile Waterfall in Ethiopia. *Source:* Framalicious/Shutterstock

Disclaimer

This publication has not been independently peer-reviewed. Responsibility for opinions expressed and any possible errors lies with the authors and not the institutions involved.

For further information or inquiries, contact Abdulkarim H. Seid (A.Seid@cgiar.org)

Data and technology: Transforming water management in Africa

Africa faces increasing pressure on its water resources due to growing demands on water resources, climate variability, and deteriorating water quality. The lack of data on water availability and scarcity hinders effective planning and decision-making to address these challenges. However, advances in digital innovation technologies provide unprecedented opportunities for transforming water management across the continent.

Developed by the International Water Management Institute (IWMI) with support from The Leona M. and Harry B. Helmsley Charitable Trust, and in collaboration with Digital Earth Africa (DE Africa), the Digital Innovations for Water Secure Africa (DIWASA) initiative is reshaping how data, technology, and partnerships intersect to improve water management. By providing access to decision-support tools, remote sensing data, tailored capacity development, and inclusive stakeholder engagement, DIWASA enables African institutions to plan, monitor, and manage water more effectively and sustainably.

At DIWASA's core lies a data-driven approach that aims to build the capacity of African institutions to collect, analyze, and apply data—moving from reactive responses to proactive planning. Through integrated digital tools and open data systems, DIWASA is empowering government agencies, basin authorities, and local communities to address critical water challenges with greater efficiency, transparency, and evidence-based decision-making (Figure 1).

This document highlights the key data, tools, and products developed by DIWASA, and their applications through use cases in Africa.

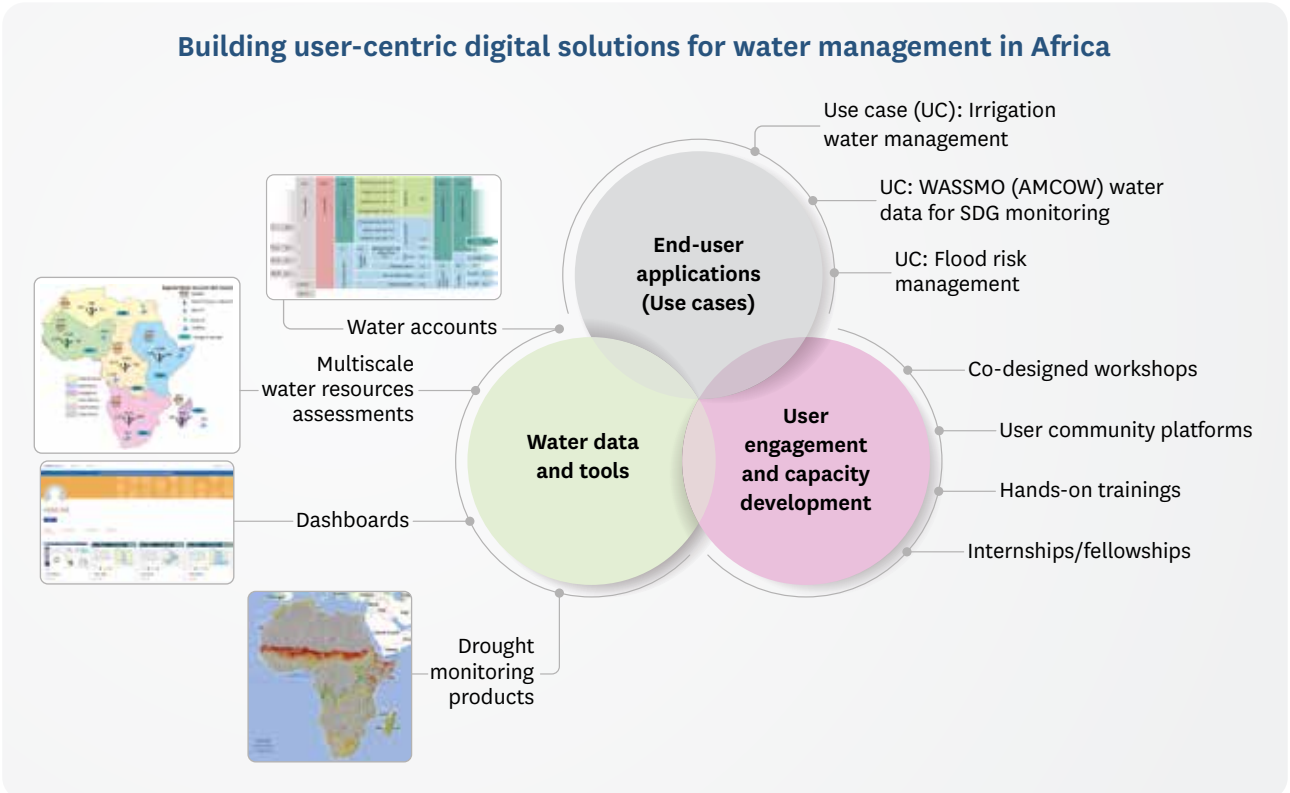

Figure 1. DIWASA's three-pronged approach to deliver water data products and capacity.
Source: Abdulkarim H. Seid, IWMI.
Notes: WASSMO - Water and Sanitation Sector Monitoring and Reporting System; AMCOW - African Ministers' Council on Water; SDG - Sustainable Development Goal.

DIWASA water data and products

DIWASA develops key water data products for Africa by integrating digital innovations such as Earth Observation, hydrologic modeling frameworks, Artificial Intelligence (AI), and advanced data analytics tools (Figure 2). These products address data fragmentation and tackle food and water security challenges across the continent.

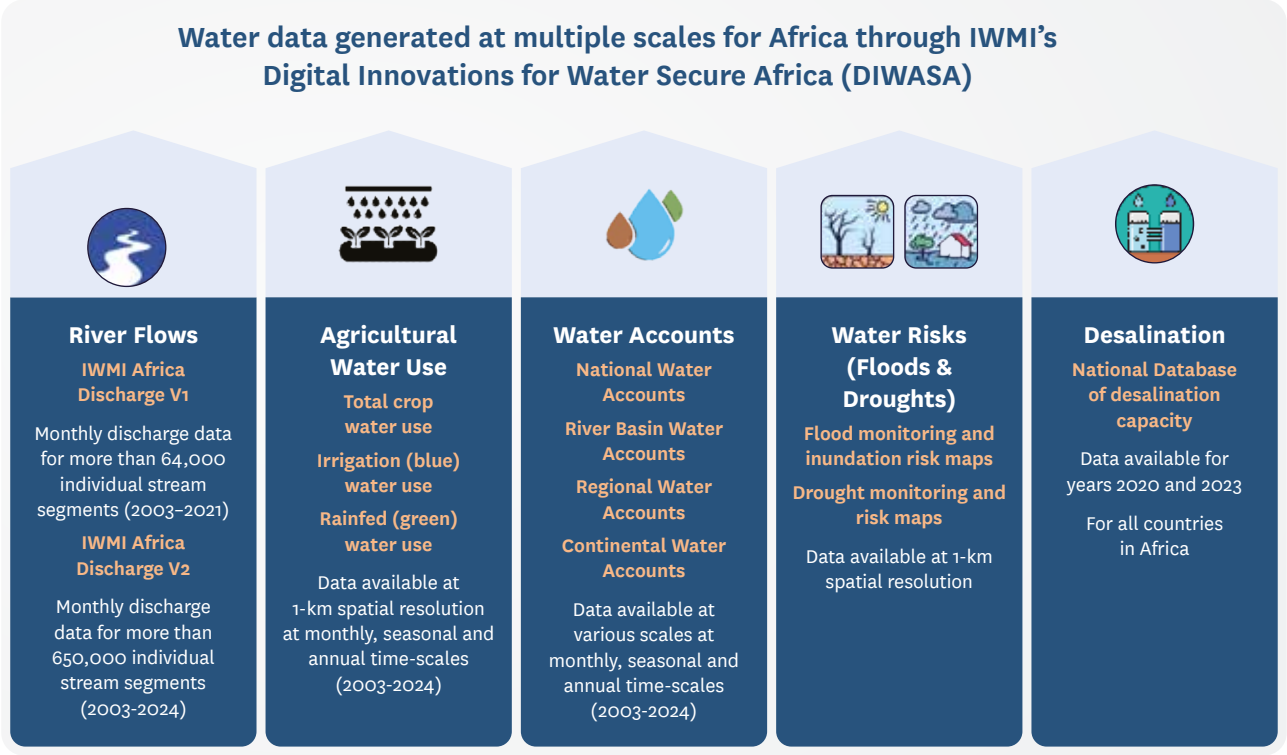

Figure 2. Key water data products and tools generated under DIWASA.
Source: Naga Velpuri, IWMI.

Agricultural water use data

Most large-scale agricultural water use data in Africa are available at coarse resolution, which restricts the monitoring of water use in agriculture. DIWASA provides data on crop water use estimates for both irrigated and rainfed crops across Africa. These data are available at one-kilometer spatial resolution spanning different time scales, from 2001 to 2021, at continental level, and at 30-meter spatial resolution for large areas across Burkina Faso, Ethiopia, Ghana, Kenya, and Zambia.

Continent-wide streamflow data

Long-term discharge data are critical to understand hydrological patterns, manage transboundary water resources, and support informed planning across sectors such as agriculture, water resources, energy, and environmental conservation. Therefore, DIWASA has developed monthly streamflow data across Africa, covering over 650,000 stream segments from 2001 to 2021. The data are available via AfriDischarge: http://afridischarge.iwmi.org/app/.

Water accounts

Water accounts provide information on supply, demand, use, and accessibility at various spatial scales (Owusu et al. 2025). They enable a comprehensive understanding of water balance and allocation, helping countries and regions make evidence-based decisions for sustainable water management and policy development.

DIWASA has generated water accounts at multiple spatial and temporal scales. At one-kilometer spatial resolution, water accounts have been generated for all of sub-Saharan Africa from 2001 - 2021. High spatial resolution (30–500 meters) water accounts have been generated for specific locations in response to end-user demand. These water data products have been used in Burkina Faso, Ethiopia, Ghana, Kenya, and Zambia to support specific irrigation water management decisions.

Multi-scale water availability and irrigation performance indicators

Using water data products derived from the Water Accounting Plus (WA+) framework, DIWASA generates water availability and irrigation performance indicators at multiple scales including national, basin, catchment, and irrigation scheme levels. These indicators are key for decision-making in agricultural water management.

Crop partitioning framework

Accurate mapping of cropland and irrigation types is crucial for understanding agricultural water use in Africa. Using a high-confidence cropland map, DIWASA's crop partitioning framework distinguishes between rainfed, irrigated, and supplementary irrigated areas (Owusu et al. 2024). With 73% accuracy against field data, the framework identifies nearly three times more irrigated areas than currently reported statistics by the Food and Agriculture Organization, significantly enhancing knowledge of agricultural water use across the region.

Water data tools for improving water management

To address needs for field-scale water monitoring and management, DIWASA has developed a portfolio of tools tailored to local realities (Figure 3). These tools deliver spatially detailed and analytically robust insights that support data-driven planning and improve operational efficiency in water management. Most products and tools are co-developed in collaboration with national authorities and tailored to address country-specific water management challenges. For sustainability, these tools are then transferred to national partners through targeted capacity building and training programs.

Figure 3. DIWASA's water data tools to improve water management.
Source: Naga Velpuri, IWMI.

a) Vegetable Irrigation for Climate Resilience Toolkit (VICR) https://vict.itechmission.org/toolkit/

Information on land suitability for vegetable production and appropriate irrigation technologies in Africa is often lacking or only accessible at coarse resolutions. To address these critical gaps that hamper the design of targeted interventions and to support smallholder farmers with effective planning, DIWASA has developed this geospatial framework to map suitable areas for vegetable production. The toolkit has been applied in Mali, Ethiopia, Ghana, and Burkina Faso, and is being scaled to other countries.

b) Securing Water in Agriculture (SWAG) and storage mapping tools

The SWAG tool identifies croplands facing water deficits or surpluses by integrating data on the amount of water that plants and soils lose to the air, land use, and climate. Linked to a storage suitability tool, it assesses the feasibility of small-scale water storage such as ponds, and quantifies runoff, overflow, seasonal water balance, and groundwater availability. Together, these tools can be used in planning irrigation investments, water conservation, and storage development.

c) Sustainable Water Resources Development (SWaRD) tool

The SWaRD tool assesses the potential and adequacy of water availability for irrigation by analyzing both surface water and groundwater availability and their sustainable limits. This tool integrates surface water estimates with global maps of groundwater recharge. SWaRD has been applied in Ghana and is scalable across Africa.

d) Access to Water (ACWA) tool

ACWA is a high-resolution geospatial platform that maps water access across Africa to support strategic planning, humanitarian response, and equitable water service delivery. It combines travel time to water sources with reliability, seasonal variability, and population demand. Using the World Health Organization/UNICEF Joint Monitoring Programme framework, it categorizes access levels and incorporates climate-driven water risks such as drought. ACWA is built on DIWASA discharge data for Africa (Akpoti et al. 2024a).

e) Climate Data Engine for Agricultural Resilience (CDEAR) tool

The CDEAR tool offers valuable insights for developing climate-resilient strategies in agriculture and water resource management. It allows users to select and analyze climate projection data under different scenarios and visualize the impacts of climate change on water availability for agriculture.

Digital Twin of the Limpopo Basin

Developed by IWMI and partners in collaboration with the Limpopo Watercourse Commission (LIMCOM), representing Botswana, Mozambique, South Africa, Tanzania, and Zimbabwe, the Digital Twin of the Limpopo River Basin sets a precedent for how African river basins can harness digital tools to strengthen cooperation, resilience, and sustainability in shared water governance.

As a virtual platform, it provides a comprehensive, real-time view of the basin and integrates national datasets, satellite imagery, remote sensing, citizen science data, and modeling. Through an online portal, decision-makers can visualize flows, reservoir levels, water quality, and irrigation use, enabling proactive responses to droughts, floods, and water allocation pressures.

The Digital Twin includes an AI assistant that delivers rapid, science-based insights, maps, and scenario analyses to support timely and informed action. Adopted by LIMCOM as part of its data strategy, it is continuously evolving to reflect institutional needs and regional priorities.

Further, the Digital Twin promotes inclusive governance through a growing transboundary citizen science network. In partnership with UNICEF's Yoma platform, local communities, especially youth and marginalized groups, can contribute AI-verified data and gain incentives, voice, and visibility in water management.

Earth observation data in action: Water use cases

In collaboration with government institutions, DIWASA's digital tools, remote sensing platforms, and participatory approaches have been customized and applied in Burkina Faso, Ethiopia, Ghana, and Zambia to address specific demand-based water management challenges.

Burkina Faso

Nakanbé Moyen Sub-Basin

In partnership with the General Directorate of Water Resources (DGRE) of the Ministry of Environment, Water and Sanitation (MEEA), DIWASA is co-developing a dashboard to support multi-scale water resource monitoring. Integrating satellite and in-situ data, the dashboard provides information on water availability and use by different sectors. It will support the DGRE in implementing equitable allocation measures to address water-use conflicts arising from competing demands and declining river water due to climate change impacts. It enables filling water data gaps and informs sustainable water allocation in the Nakanbé Moyen Sub-Basin.

Primary beneficiaries: MEEA, DGRE, Nakanbé Water Agency, women-led farmer cooperatives, academic institutions

Ethiopia

Amibara Irrigation Scheme

Through the Ministry of Irrigation and Lowlands (MILLs), DIWASA is supporting the revitalization and modernization of the underperforming Amibara Irrigation Scheme. Using high-resolution water accounting, digital mapping, and irrigation performance analysis, the initiative has identified inefficiencies and gaps in water allocation.

Scenario modeling and a monitoring dashboard now guide strategic decision-making–supporting MILLs prioritize interventions and select appropriate technologies within budget constraints. This integrated, data-driven approach offers a scalable model for modernizing large-scale irrigation in water-stressed regions.

Primary beneficiaries: MILLs, Ministry of Water and Energy, Ministry of Agriculture, Agricultural development enterprises, local communities

Lake Tana Sub-Basin

In collaboration with the Ministry of Water and Energy (MoWE), DIWASA is addressing gaps in river discharge data for Lake Tana by applying two different models–one for vegetation drought tracking and another for river flow routing (Akpoti et al. 2024a; Akpoti et al. 2024b).This approach blends satellite and observed rainfall data, corrects data inconsistencies (Mekonnen et al. 2023), and generates two decades of discharge records including key water-availability indicators.

A dashboard is being developed to support informed decision-making, enhance resilience to water-related risks, and promote sustainable water resource management in the (sub-)basin.

Primary beneficiaries: MoWE, basin administration offices, reservoir operators, Ethiopian Meteorological Institute, Environmental Protection Authority, the Ethiopian Disaster Risk Management Commission

Ghana

Bontanga Irrigation Scheme

Faced with data scarcity that hinders informed decision-making, the Ghana Irrigation Development Authority (GIDA) and DIWASA are co-developing a high-resolution water accounting assessment for the Bontanga Irrigation Scheme. The tool will quantify irrigation needs, water loss, and adequacy across the scheme, guide improvements in efficiency and equity, and support potential expansion from 500–800 hectares.

A dashboard will also be developed to interactively visualize the use case outputs, including implications of selected water management scenarios. The data-driven planning aims to reduce user conflicts, enhance productivity, and enable conflict-sensitive management practices (Figure 4).

Primary beneficiaries: GIDA

Figure 4. Capacity building and training of government officials from West Africa on tools and products.
Source: Klinsman Amissah, IWMI.

Zambia

Lunsemfwa Basin

In partnership with the Water Resources Management Authority (WARMA), DIWASA aims to strengthen WARMA's capacity to monitor the implementation of a permit system, thereby providing an evidence-based workflow to address issues around water use for irrigation. It applies water accounting to monitor annual use, quantify over-abstraction by irrigation users, and support decisions on permits (Figure 5).

This case will measure water use and availability across the basin at moderate resolution, alongside a high-resolution assessment in a site with critical gaps between water demand, actual use, and permitted volumes. This will support balancing demand and availability across a growing agricultural basin.

Primary beneficiaries: WARMA, Ministry of Agriculture, Ministry of Green Economy and Environment, private sector stakeholders

Figure 5. Zambia Government officials discuss use case at a DIWASA training workshop.
Source: Agricomms Media and Communications, IWMI.

Data dissemination platforms: Powering access, insight, and action

Effective water management depends on timely, accessible, and context-relevant data. Through a strategic partnership with DE Africa, DIWASA enhances the availability of satellite-derived, analysis-ready Earth observation (EO) data across the continent. Some of the continental water accounting datasets are now available through the DE Africa platform. These can be integrated with other EO datasets on DE Africa to support data-driven decision-making. This collaboration supports African institutions to leverage regionally calibrated datasets for water monitoring and planning, and to advance the broader goals of data sovereignty and innovation.

The IWMI Geoportal serves as the primary access point for DIWASA's water data products. With an intuitive interface, the portal allows users to explore water accounts through web apps, interactive maps and story maps, and other visualization tools. Further, it provides access to technical insights on water availability and scarcity. Designed for both experts and practitioners, it transforms complex geospatial data into easy-to-grasp information and formats that support evidence-based decision-making across sectors.

Complementing this are ten dashboards: eight focused on water accounting for the continent, the Limpopo, Zambezi, Incomati, Maputo, Volta and Souss-Massa river basins, and the Lake Tana Sub-Basin; one on irrigation monitoring for the Amibara Scheme (Figure 6); and one on regional water discharge. These dashboards depict hydrological balance, revealing stress points and efficiency gaps. For basin authorities, planners, and development partners, they deliver reliable, up-to-date information to guide strategic decision-making and interventions.

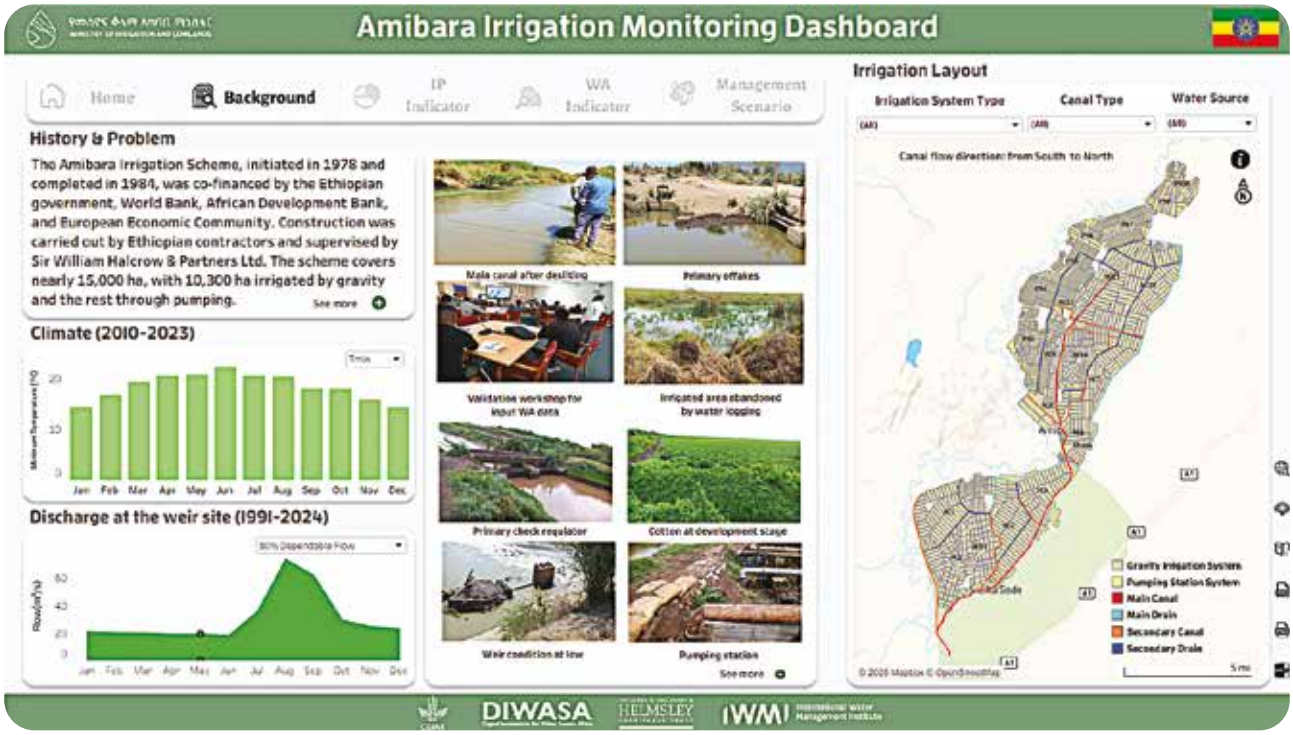

Figure 6. Amibara Irrigation Monitoring Dashboard.
Source: Kirubel Gebreyeus, IWMI.

Together, these platforms embody DIWASA's commitment to open data, institutional empowerment, and transformative water management across Africa.

References

Akpoti, K.; Velpuri, N.M.; Mizukami, N.; Kagone, S.; Leh, M.; Mekonnen, K.;...Seid, A. 2024a. Advancing water security in Africa with new high-resolution discharge data. *Scientific Data* 11: 1195. https://doi.org/10.1038/s41597-024-04034-0

Akpoti, K.; Mekonnen, K.; Leh, M.; Owusu, A.; Dembélé, M.; Tinonetsana, P.;...Velpuri, N.M. 2024b. State of continental discharge estimation and modelling: Challenges and opportunities for Africa. *Hydrological Sciences Journal* 69(15): 2124–2152. https://doi.org/10.1080/02626667.2024.2402938

Mekonnen, K.; Velpuri, N.M.; Leh, M.; Akpoti, K.; Owusu, A.; Tinonetsana, P.;...Munzimi, Y. 2023. Accuracy of satellite and reanalysis rainfall estimates over Africa: A multi-scale assessment of eight products for continental applications. *Journal of Hydrology: Regional Studies* 49: 101514. https://doi.org/10.1016/j.ejrh.2023.101514

Owusu, A.; Kagone, S.; Leh, M.; Velpuri, N.M.; Gumma, M.K.; Ghansah, B.;...Mohammed, I. 2024. A framework for disaggregating remote-sensing cropland into rainfed and irrigated classes at continental scale. *International Journal of Applied Earth Observation and Geoinformation* 126: 103607. https://doi.org/10.1016/j.jag.2023.103607

Owusu, A.; Akpoti, K.; Leh, M.; Perera, T.; Madushanka, L.; Mekonnen, K.;...Velpuri, N.M. 2025. Bridging scales and borders on water availability and use in the transboundary Volta River Basin: A water accounting approach. *Journal of Hydrology: Regional Studies* 59: 102377. https://doi.org/10.1016/j.ejrh.2025.102377

IWMI
International Water Management Institute

CGIAR RESEARCH CENTER

The International Water Management Institute (IWMI) is an international, research-for-development organization that works with governments, civil society and the private sector to solve water problems in developing countries and scale up solutions. Through partnership, IWMI combines research on the sustainable use of water and land resources, knowledge services and products with capacity strengthening, dialogue and policy analysis to support implementation of water management solutions for agriculture, ecosystems, climate change and inclusive economic growth. Headquartered in Colombo, Sri Lanka, IWMI is a CGIAR Research Center with offices in 16 countries and a global network of scientists operating in more than 55 countries.

International Water Management Institute (IWMI)

Headquarters
127 Sunil Mawatha, Pelawatte,
Battaramulla, Sri Lanka

Mailing address:
P. O. Box 2075, Colombo, Sri Lanka
Tel: +94 11 2880000
Fax: +94 11 2786854
Email: iwmi@cgiar.org
www.iwmi.org