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Developing Water Resources Decision Support System to Strengthen Landscape Resilience Planning and Investment in West and Central Africa

A Scoping and Needs Assessment Report

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Summary

The International Water Management Institute (IWMI) conducted a virtual scoping and need assessment workshop to develop a water resources decision support system (DSS) to strengthen landscape resilience planning and investment in West and Central Africa. The workshop, which took place on May 8, 2023, involved 51 participants from the public sector, private companies, research, and civil society organizations, as well as academia of six countries: Ghana, Nigeria, Cote d'Ivoire, Burundi, DRC, and Rwanda. The objective was to explore the current data gaps, information, and knowledge products in water DSS, where IWMI could provide support on appropriate science-based decision-support systems for water resources management, with a particular emphasis on strengthening landscape resilience planning and investment in the respective countries within the TAFS-WCA initiative. Most participants from six countries expressed interest in AWARE, a flood forecasting tool of IWMI, which facilitates coordination across sectors to trigger actions ahead of extreme climate events. Stakeholder mapping, end-user participation, comprehensive needs assessments, expert maintenance, and knowledge-sharing forums were identified as crucial for successful DSS implementation as part of reflection in the meeting.

Introduction

Decision Support Systems for water management (Water DSS) are essential for resource managers and scientists in making near real-time diagnoses and informed decisions to the complex and dynamic climate variabilities and interdependencies over the years. Within West and Central Africa, Water DSS presents a cogent approach to addressing water stressors, availability, and management, to aid in transforming agri-food systems, strengthening resilience, and reducing risks, particularly among smallholder farmers in the region.

As a result, through the CGIAR-funded initiative on Transforming Agri-food Systems in West and Central Africa (TAFS-WCA) work package 3, the International Water Management Institute (IWMI) convened a one-day virtual scoping and need assessment workshop among stakeholders within the region. The workshop brought together participants from the public sector, private companies, research and Civil Society Organizations (CSOs), as well as academia, to explore the development of water resources decision support systems to help strengthen landscape planning and investment in West and Central Africa.

The specific objective of the workshop was to work with stakeholders to explore the current data gaps, information and knowledge products, where IWMI could provide support on appropriate science-based decision-support systems for water resources management, with particular emphasis on strengthening landscape resilience planning and investment in the respective countries of the region within the TAFS-WCA initiative.

The virtual meeting held on the 8th of May 2023, was attended by fifty-one (51) participants from five countries, namely, Ghana, Nigeria, Cote d'Ivoire, Burundi, and Rwanda (see annex for the organizations).

Dr. Olufunke Cofie, the Regional Representative for IWMI West Africa, facilitated the event giving a brief overview of the purpose of the meeting, IWMI's architecture, and TAFS-WCA. Dr. Cofie highlighted IWMI's core mandate in TAFS-WCA to promote robust innovations and approaches that engender access to and proper use of resources, particularly water resources, in building a healthy, productive environment for resilient agri-food systems and livelihoods in the region. The project focuses on six countries: Ghana, Nigeria, Cote d'Ivoire, Burundi, DRC, and Rwanda.

IWMI has initiated some feasibility studies and situational analysis within selected landscapes in the focal countries such as at the Offin sub-basin in Ahafo Ano South, Ghana; Doma Rutu in Nassarawa State, Nigeria; Imbo Plain of the Ruzizi River, Burundi; and Akagera Lower Catchment in the Kayonza District, Rwanda. The studies aim to understand ground level reality and need for inclusive landscape management to be implemented in TAFS-

WCA. Other Experts from the International Water Management Institute delivered additional presentations.

What is a Decision Support System?

Dr. Seifu Tilahun, a hydrologist from the IWMI West Africa office, presented an introduction to water DSS. He defined DSS as computational tools or systems that integrate data and models on water and relevant drivers of change (e.g., climate, landscape, or development) to aid in water resources management decisions. DSS allows resource managers to evaluate potential outcomes or forecasts from near real-time or stimulated scenarios on complex challenges (e.g., flood, drought, nutrient stress, and pollution) within selected sub-national, sub-basin, or transboundary basin water resource management. The system runs either based on hydrological and hydraulic models from physical processes or based on data-driven algorithms through artificial intelligence and machine learning platforms.

Through the Mentimeter platform, participants indicated the existing Water DSS in their countries. Existing DSS include: Water Evaluation and Planning Model (WEAP), using machine learning through Random Forest, AquaCrop Model, Soil and Water Assessment Tool (SWAT), GMet-WIDS, General Algebraic Modelling System (GAMS), Nimet report, Nile Basin DSS and Catchment-based landscape Restoration Opportunity mapping Decision Support System (CROM DSS) as outlined in Table 1.

Table 1: Table of existing Water DSS in selected countries

Ghana	Nigeria	Rwanda	Cote d'Ivoire
<ul style="list-style-type: none"> • Ghana MET Weather Information Dissemination system • SWAT • WEAP • AquaCrop model 	<ul style="list-style-type: none"> • The Annual Flood Outlook (AFO) by Nigeria Hydrological Services Agency • NiMET heat advisory 	<ul style="list-style-type: none"> • Nile Basin DSS • CROM DSS: DSS on catchment restoration • SWAT • WEAP 	<ul style="list-style-type: none"> • WEAP • Random Forest

Current Water DSS needs and gaps within the Region

Water DSS are essential tools for addressing complex global and sub-national challenges, with their intricate purpose and application with a subjected spectrum influencing this wide variability. Thus, to prevent a one-size-fits-all intervention with DSS in the region, participants were asked to assess the current situation in their respective countries to provide specific Water DSS needs or gaps.

In Nigeria, for example, downscaling Water DSS applications for adoption by the farmers at the grassroots level was a major challenge. In Ghana, there were challenges with the coordination and utilization of several developed Water DSS, limiting their usage to the academic domain. This is probably due to lack of knowledge of the market demand for the products, lack of funds for validation of model outputs, scarcity in baseline data and barriers in continuity in monitoring in-situ equipment over long temporal scales (Figure 1). Further, Water DSS was identified to be highly needed for sustainable flood and landslide management in Rwanda.

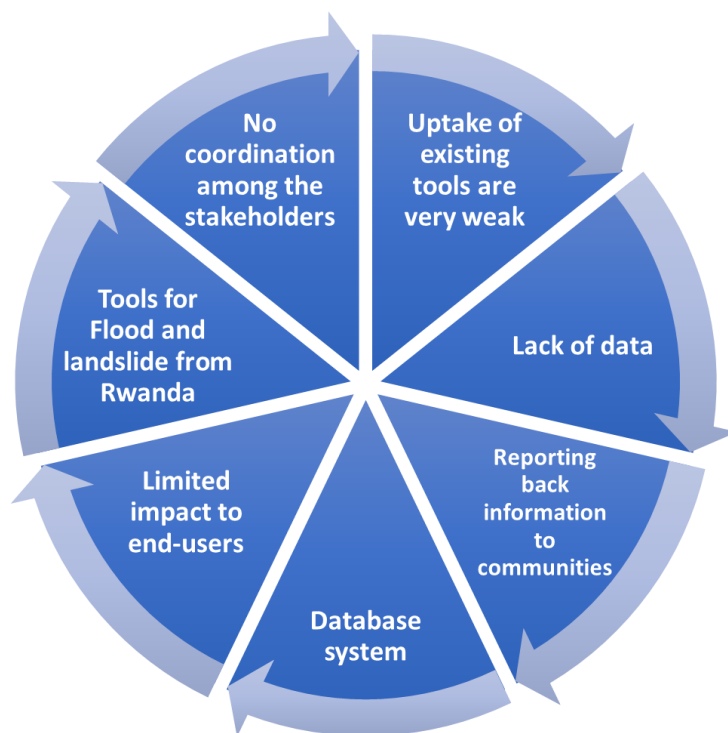


Figure 1; Illustration of the outlined problems associated with current Water DSS in the target countries. (Source: Authors construct)

Water DSS catalog by IWMI

The International Water Management Institute in a bid to ensure substantial impact in research for development has developed several DSS products for addressing various challenges from flood to erosion management which are

open source and available to the general public through this [link](#) as shown in Figure 2.

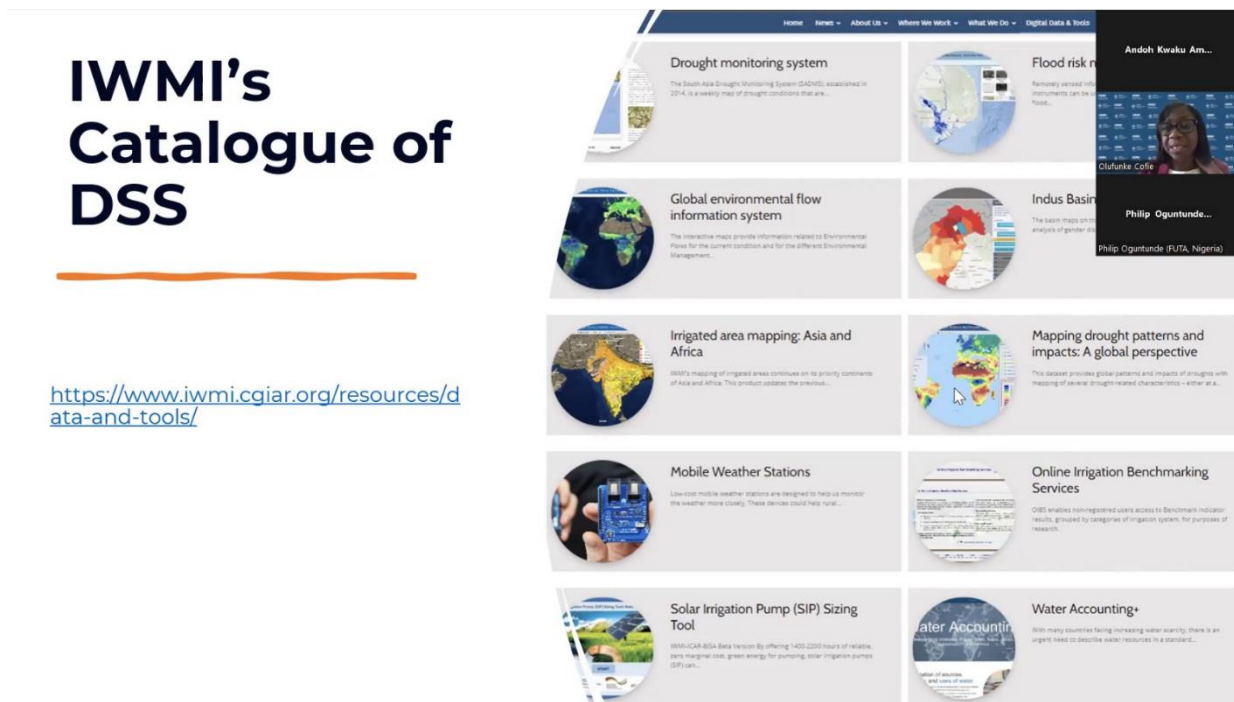


Figure 2. Image of some DSS platforms developed by IWMI. (Source: <https://www.iwmi.cgiar.org/resources/data-and-tools/>)

However, among the several platforms in the context of Water DSS discussed during the session were Water Accounting+, Flood forecasting tools, Drought management tools, AWARE platform and the Earth Observation for Agriculture Risk Management Decision Support Platform (EO4ARM).

Presenting on the Water Accounting Plus (WA+), Dr. Moctar Dembele a Spatial Hydrologist from IWMI reiterated the structure and framework of the Water Accounting+ platform, functional capacity in providing a basic understanding of a basin's water account and use over time. Water Accounting+ source data from remote sensing and computational robustness to generate accurate and reliable information for end users of different categories. The product capability of Water Accounting+ was identified to span agricultural services, utilized flows, surface water, groundwater, ecosystem services, and sustainability as shown in Figure 3.

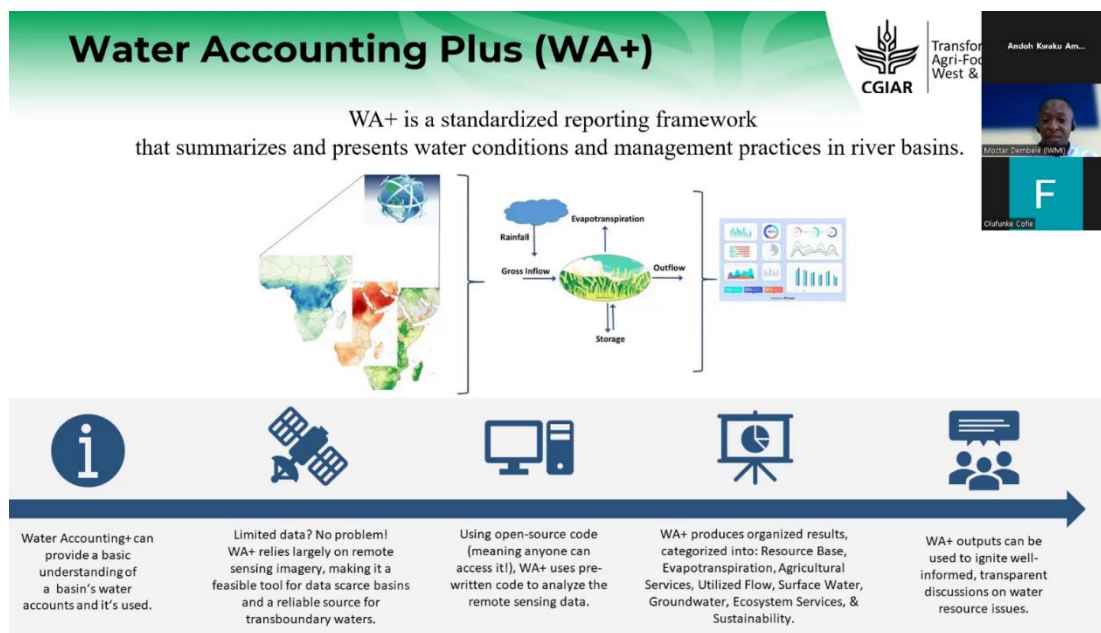


Figure 3. Image from the presentation on Water Accounting Plus. (Source: Authors construct)

On early warning tools for floods and drought, Dr. Giriraj Amarnath from IWMI presented the platform used within the entire African continent, integrating several open-sourced algorithms with remote sensing to enable users to forecast floods and drought over a long temporal scale (Figure 4). Factoring elements on available precipitation, soil moisture, current vegetation condition, and overall growth of the crop systems to assess the severity of drought or flood. This system also produces contingency plans for resource managers and it is integrated into national management platforms such as ZADMS, Black Volta and Ethiopian basin platforms. The platforms also integrate models such as WFlow to forecast floods.

Monitoring and early warning of drought

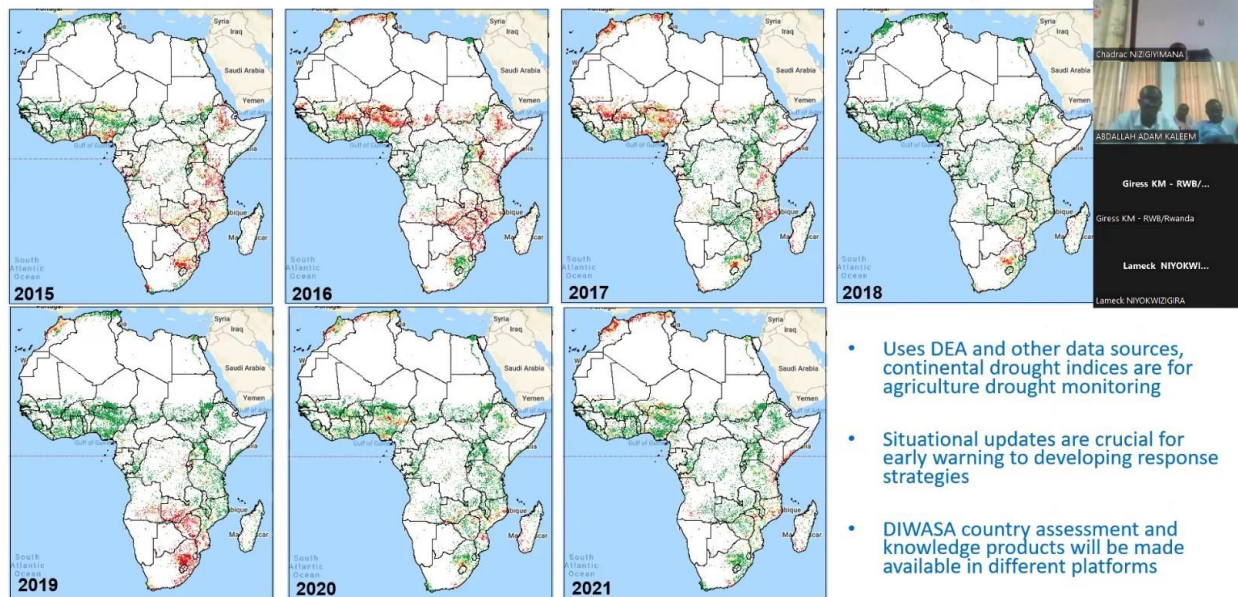
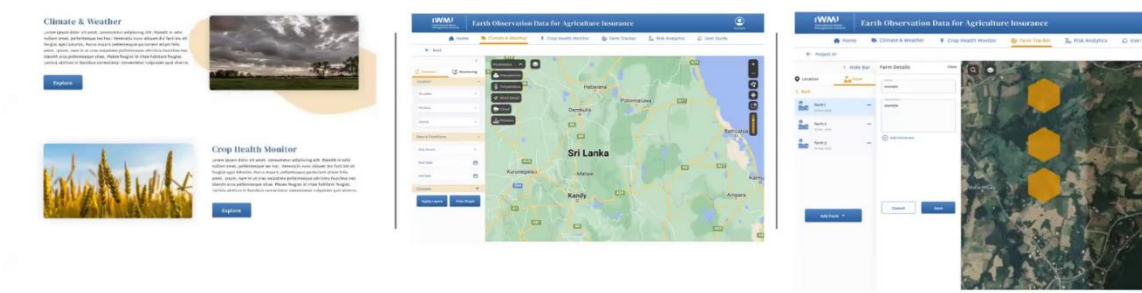


Figure 4. Image of time-series projection for monitoring drought across the continent. (Source: Authors construct)

The [AWARE Platform](#) was established in partnership with 6 countries over multiple sectors to provide near real-time data for climate risk preparedness in investment and sector action over different areas of interest in a more easily accessible interface for ensuring inclusive governance.

Further, Dr. Giriraj Amarnath touched on the Earth observation for Agriculture Risk Management Decision Support Platform (EO4ARM), which generates information tailored for decisions at the farm level. The platform is structured to provide climate and weather monitoring, crop health monitoring and risk analytics for farmers at the grassroots level (Figure 5).

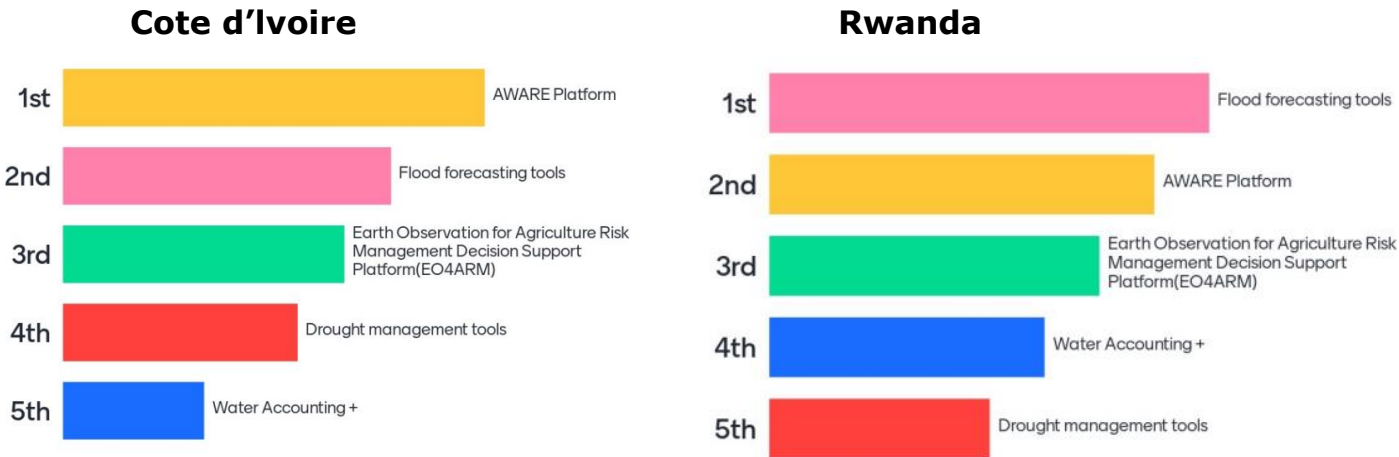


Earth Observation for Agriculture Risk Management (EO4ARM) Decision Support Platform

Figure 5. Image of the EO4ARM platform interface. (Source: Authors construct)

Assessing the priority need of Water DSS in the Region

Following the brief introduction of the Water DSS platforms, participants were requested to prioritize the Water DSS based on their country-specific needs through the Menti platform. Based on the responses, an overview of the results is presented below (Figure 6).



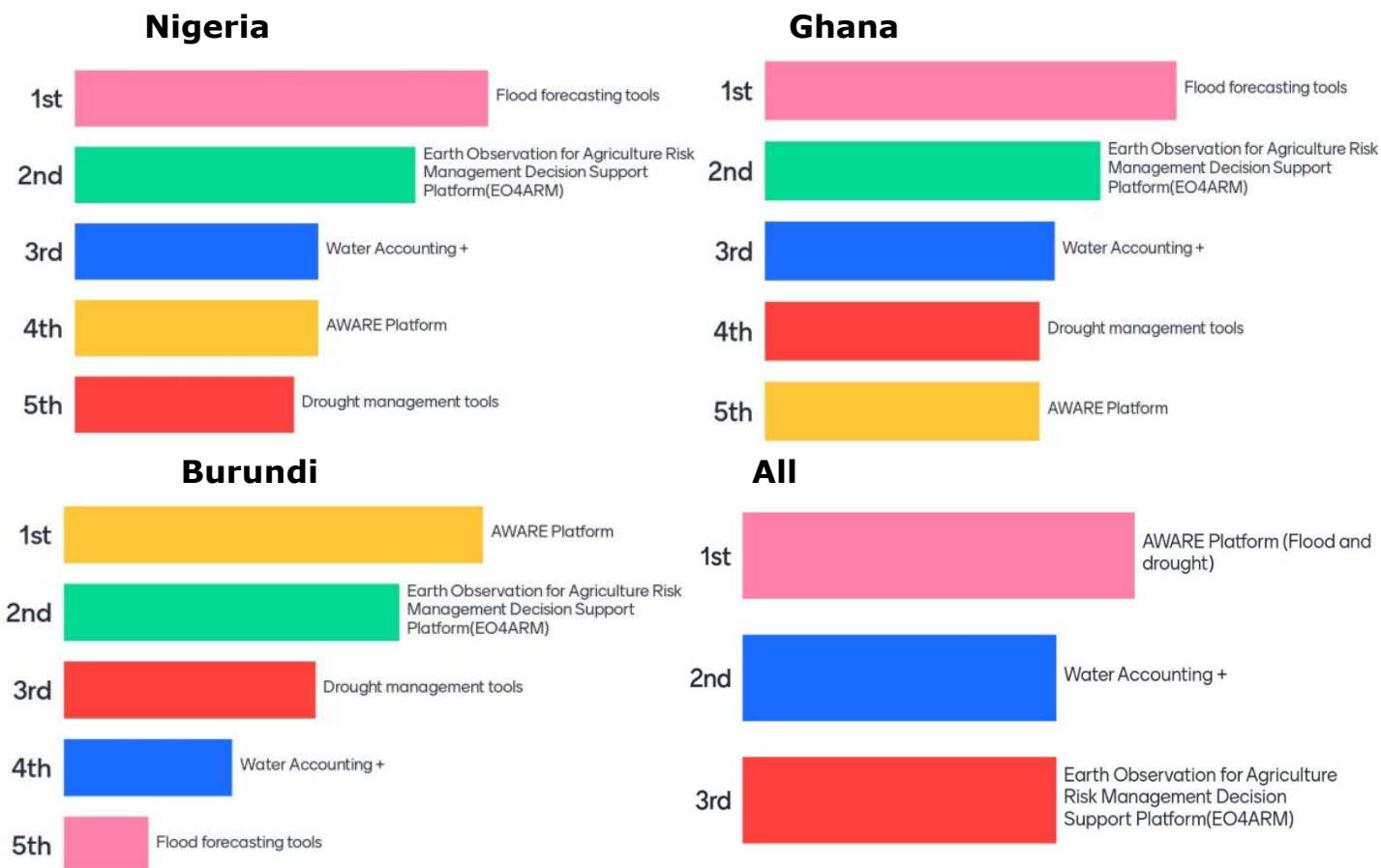


Figure 6: Rank of Water DSS based on prioritization of participants from each country (Source: Authors construct)

Most of the participants from the 6 countries indicated an interest in having the AWARE which facilitates coordination across different sectors to trigger actions ahead of extreme climate events, integrating the flood forecasting tool.

Identified organizations and potential partners to support IWMI Water DSS development, uptake and sustainability

To ensure effective roll-out and uptake of Water DSS within the region it is prudent to include organizations in the co-design and co-development of the platforms. Thus, participants were requested to provide the names of potential organizations and partners to be engaged in the process. The suggested Institutions are listed below for each of the countries (Table ???).

Ghana

- Ghana Meteorological Agencies
- Country disaster management units/departments
- Academics
- Researchers
- Spatial planning department of the District Assemblies
- Water Research Institutes
- Water Resource Commission
- Hydrological Services
- CSIR
- Water User Associations
- Water Resource Managers
- Ministry of Food and Agriculture
- Traditional Authorities
- NGOs

Nigeria

- Hydrological Agency
- Academia
- Meteorological Agency
- Ministry of Water Resources
- Agricultural Ministry

Rwanda

- Rwanda Water Resources Board
- Ministry of Environment
- Rwanda Agriculture Board
- University of Rwanda
- MINEMA
- Rwanda Meteorological Agency

Cote d'Ivoire

- SODEXAM (Meteorological Agency)
- Community in Basin level
- Hydropower dam Agency
- SODECI (Water and Sanitation Supplier)
- CIE (Electricity Company)

Final Reflection

Reflecting on different DSS, participants considered key factors to support the development of DSS in the context of TAFS-WCA, using the case of Zambia drought management system as case study. To ensure success, interventions included coordinating of the data providers across sectors and ensuring the utilization of DSS output by the highest government authorities in developing policy structures. Products were tailored to offer affordable solutions, and the entire process was automated to minimize lapses and delays in processing and operationalization. In the case of Nigeria, NiMet has developed a Memorandum of Understanding with the Federal Ministry of Agriculture and Rural Development on the uptake of all DSS platforms generated for dissemination to all farmers through the extension officers. The main challenge in Nigeria was funding. For the successful uptake of Water DSS, it was identified that stakeholder mapping and participation of end-users was crucial in the development of the tools and feedback mechanism for the better enhancement of the system. There was also the need to initiate a comprehensive needs assessment before the development of the systems. The tools also need to be constantly maintained by highly trained experts and involved in the co-development. There is also the need to establish a forum for knowledge sharing in the development of Water DSS with the region.

Annex

List of organizations who participated in the meeting.

- International Water Management Institute (IWMI), Ghana
- Rwanda Water Board, Rwanda
- Ahafo Ano South West District Assembly, Ghana
- Federal Ministry of Humanitarian Affairs, Disaster Management and Social Development, Nigeria
- Directorate-General of Water (DGEau)
- Association of Small-Scale Agro-Producers in Nigeria (ASSAPIN)
- Crop2Cash, Nigeria
- Nigeria Meteorology, Nigeria
- WASCAL
- Water Resource Commission, Ghana
- Institut des Sciences Agronomiques du Burundi
- University of Cape Coast, Ghana
- Ghana Hydrological Authority, Ghana
- AfricaRice, CGIAR
- Community Water and Sanitation Agency, Ghana
- Kwame Nkrumah University of Science and Technology, Ghana
- Institute for Agricultural Research, Nigeria