

Working Paper

A Framework for an African Water Quality Program (AWaQ)

Patience Mukuyu, Chris Dickens, Nilanthi Jayathilake, Moshood Tijani,
Deborah V. Chapman and Stuart Warner



Working Papers

The publications in this series record the work and thinking of IWMI researchers, and knowledge that the Institute's scientific management feels is worthy of documenting. This series will ensure that scientific data and other information gathered or prepared as a part of the research work of the Institute are recorded and referenced. Working Papers could include project reports, case studies, conference or workshop proceedings, discussion papers or reports on progress of research, country-specific research reports, monographs, etc. Working Papers may be copublished, by IWMI and partner organizations. Although most of the reports are published by IWMI staff and their collaborators, we welcome contributions from others. Each report is reviewed internally by IWMI staff. The reports are published and distributed both in hard copy and electronically (www.iwmi.org) and where possible all data and analyses will be available as separate downloadable files. Reports may be copied freely and cited with due acknowledgment.

About IWMI

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 15 countries and a global network of scientists operating in more than 55 countries.

IWMI Working Paper 209

A Framework for an African Water Quality Program (AWaQ)

Patience Mukuyu, Chris Dickens, Nilanthi Jayathilake, Moshood Tijani,
Deborah V. Chapman and Stuart Warner

The authors:

Patience Mukuyu was a Researcher – Transboundary Water Management at the International Water Management Institute (IWMI), Pretoria, South Africa, at the time this study was conducted

Chris Dickens is Principal Researcher - Ecosystems at IWMI, Colombo, Sri Lanka

Nilanthi Jayathilake is Researcher – Septage Management and Reuse at IWMI, Colombo, Sri Lanka

Moshood Tijani is Senior Policy Officer – Water Resources Management at African Ministers’ Council on Water (AMCOW), Abuja, Nigeria

Deborah V. Chapman and Stuart Warner are independent consultants based in Ireland

Mukuyu, P.; Dickens, C.; Jayathilake, N.; Tijani, M.; Chapman, D. V.; Warner, S. 2024. *A framework for an African Water Quality Program (AWaQ)*. Colombo, Sri Lanka: International Water Management Institute (IWMI). 22p. (IWMI Working Paper 209). doi: <https://doi.org/10.5337/2024.202>

/ water quality / monitoring / frameworks / coordination / collaboration / governance / data management / capacity development / assessment / policies / implementation / strategies / integrated water resources management / innovations / indicators / Sustainable Development Goals / Goal 6 Clean water and sanitation / water pollution / financing / stakeholders / organizations / training / transboundary waters / ecosystems / earth observation satellites / citizen science / Africa /

ISSN 2012-5763

e-ISSN 2478-1134

ISBN 978-92-9090-964-4

Copyright © 2024, by IWMI. All rights reserved. IWMI encourages the use of its material provided that the organization is acknowledged and kept informed in all such instances. The boundaries and names shown and the designations used on maps do not imply official endorsement or acceptance by IWMI.

Please send inquiries and comments to IWMI-Publications@cgjar.org

A free copy of this publication can be downloaded at:
<https://www.iwmi.org/publications/iwmi-working-papers/>

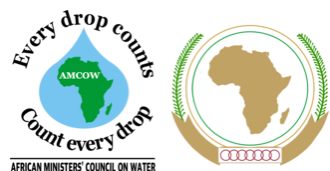
Acknowledgments

The authors acknowledge funding from the CGIAR Initiative on NEXUS Gains for conducting this research study. Additional funding came from the World Water Quality Alliance (WWQA) of the United Nations Environment Programme (UNEP), which oversees the periodic World Water Quality Assessment and contributes to an understanding of emerging water quality issues around the world. The respondents to the water quality questionnaires – country representatives working on water quality issues – are thanked for the time taken to submit a detailed response that informed the project about country capacity for monitoring water quality and managing water quality issues in their countries. Furthermore, the authors would like to thank the African Ministers' Council on Water (AMCOW) for their collaboration and guidance in the design of the framework for an African Water Quality Program (AWaQ).

Collaborators



International Water Management Institute (IWM)



African Ministers' Council on Water (AMCOW), Abuja, Nigeria

Donors



This work was carried out under the CGIAR Research Program on Water, Land and Ecosystems (WLE) and finalized under the CGIAR Initiative on NEXUS Gains, which is grateful for the support of CGIAR Trust Fund contributors (www.cgiar.org/funders).



World Water Quality Alliance (WWQA) of the United Nations Environment Programme (UNEP)

Contents

Acronyms and Abbreviations	vi
Summary	vii
Introduction	1
Project Background	1
Contextual Background: Water Quality Monitoring in Africa	1
Situation Assessment: The Need for Improved Water Quality Monitoring in Africa	2
Innovations in Water Quality Monitoring and Management: Potential for Africa	2
A Framework for an African Water Quality Program (AWAQ)	3
Scope	3
Primary Stakeholders	3
Objective	3
Key Outcomes	3
Scale of Implementation	3
Approach to Developing the Framework	4
Policy Frameworks	4
Guiding Principles	4
State Custodianship	4
Co-development	4
Coordination and Collaboration	4
Core Components of the Framework	6
Component 1: Governance	6
Governance in AWaQ	6
Component 2: Water Quality Monitoring	6
Water Quality Monitoring in AWaQ	7
Component 3: Data Management	7
Data Management in AWaQ	10
Component 4: Capacity Development	10
Priority Areas for Capacity Development	10
Capacity Development in AWaQ	11
Operationalizing the Framework	11
Strategic Implementation Plan	11
Role of AMCOW, Member States, RBOs and Supporting Organizations	12
Activities in Preparation for Program Implementation	12
Financing for AWaQ	12
Conclusion	13
References	14

Acronyms and Abbreviations

AMCOW	African Ministers' Council on Water
APAGroP	AMCOW Pan-African Groundwater Program
AU	African Union
AWaQ	African Water Quality Program
GEMS/Water	Global Environment Monitoring System for Freshwater
IWMI	International Water Management Institute
IWRM	Integrated Water Resources Management
RBO	River Basin Organization
REC	Regional Economic Commission
SDG	Sustainable Development Goal
UNEP	United Nations Environment Programme
WASSMO	Water and Sanitation Sector Monitoring and Reporting System
WQ	Water quality
WWQA	World Water Quality Alliance

Summary

As water quality challenges continue to escalate in Africa, a collective response is needed to stem the tide and improve the quality of water for millions of people and the environment that depend on it. Rampant population growth in Africa together with progressive industrialization, and agricultural expansion and intensification are driving the increasing loads of pollutants into waters. Anthropogenic water pollution can be exacerbated by climate change impacts such as changes in hydrological regimes and increased temperatures. Climate change worsens water quality degradation through higher pollutant concentrations from decreased flows during periods of drought and acceleration of chemical reactions in warmer waters, among others.

To respond to these surface water and groundwater quality challenges, the African Ministers' Council on Water (AMCOW) envisages an African Water Quality Program (AWaQ) with the aim of informing a continent-wide response. Water quality directly impacts human and ecosystem health and ultimately socioeconomic development. An Africa-wide program will rally countries in the continent to highlight the importance of good ambient water quality and the direct benefits to be derived from monitoring and managing water quality. Further, enhancing the availability and application of water quality data will strengthen management strategies and ultimately improve water quality.

This paper provides a foundational structure for developing a framework for AWaQ and is guided by the three principles of state custodianship, co-development, and coordination and collaboration. It has been proposed that AMCOW Member States will retain their sovereignty and become custodians of the data and information generated as part of AWaQ, and will be closely involved in the development of program activities. Further, AWaQ entails coordination and collaboration between regional, global and transboundary institutions and initiatives involved in water quality monitoring, assessment and management.

The framework for AWaQ rests on four core components which were developed based on stakeholder consultations and literature studies:

- Governance
- Water quality monitoring
- Data management
- Capacity building

AWaQ will aim to deliver within each of these core components. The governance component of AWaQ will build on already existing country governance structures and regulatory provisions through management approaches such as Integrated Water Resources Management and Catchment-based Water Management, with the aim of achieving the goal of improved water quality. The water quality monitoring component will aim to encourage countries to collect basic water quality data to support regional and global indicators. The data management component will make use of decentralized national platforms, where countries submit only final national assessments to AMCOW for reporting and planning while retaining the raw data on their own databases. Lastly, the capacity building component would be coordinated through AMCOW to deliver standardized and tailor-made training to Member States with support from global donors.

Development of this framework needs to be followed by a strategic implementation plan that would provide a road map for implementing AWaQ. The strategic implementation plan would involve a series of steps, including stakeholder mapping, clarified roles and responsibilities, budgets, key indicators and associated monitoring programs, and overall coordination and reporting mechanisms. Specific activities under each core component of the framework need to be designed to meet the objectives of AWaQ. This paper only goes as far as providing the overall framework for AWaQ.

A Framework for an African Water Quality Program (AWaQ)

Patience Mukuyu, Chris Dickens, Nilanthi Jayathilake, Moshood Tijani, Deborah V. Chapman and Stuart Warner

Introduction

Project Background

This paper set out to prepare the foundation for developing a framework for a new African Water Quality Program (AWaQ). At the invitation of the African Ministers' Council on Water (AMCOW), the International Water Management Institute (IWMI) implemented a study which was conducted over five phases (Figure 1), culminating in the development of a framework for the envisaged AWaQ. In phases 1 and 2 (Mukuyu et al. 2024a), a situation analysis of water quality monitoring and assessment capacity across Africa highlighted efforts currently undertaken to manage continued deterioration of water quality. Phases 3 and 4 (Mukuyu et al. 2024b) presented potential innovations that can be considered to advance water quality monitoring and management in Africa. The information collected in phases 1-4 was used to design a framework for monitoring and assessing water quality (this paper), i.e., a framework for developing an AWaQ. This framework serves to guide AMCOW in the implementation of a water quality monitoring program across the continent.

AWaQ will also be used as an African contribution to the monitoring and assessment of water quality at a global level. In this regard, this work is supported by the World Water Quality Alliance (WWQA)¹ convened by the United Nations Environment Programme (UNEP), which oversees the periodic World Water Quality Assessment and contributes to understanding emerging water quality issues. Further, AWaQ will assist in supporting African and global water quality data repositories such as the AMCOW-based Water and Sanitation Sector Monitoring and Reporting System (WASSMO) and the UNEP Global Environment Monitoring System for Freshwater (GEMS/Water), thereby leading to a better understanding and management of water quality across the continent.

Contextual Background: Water Quality Monitoring in Africa

Throughout the implementation of this project, the main aim was to determine the key challenges facing African countries in relation to water quality monitoring and

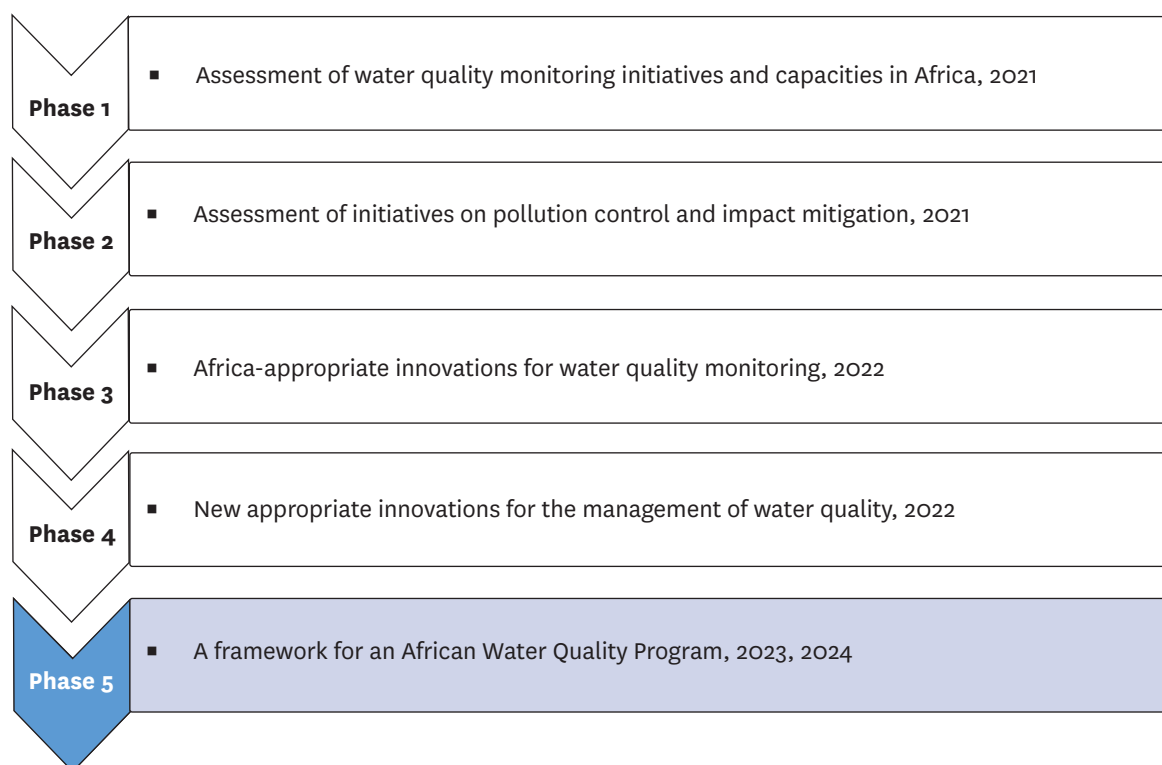


Figure 1. Five phases in the development of a framework for the African Water Quality Program.

¹ <https://www.unep.org/explore-topics/water/what-we-do/world-water-quality-alliance-wwqa-partnership-effort/towards-pan>

management, and to propose a suitable design framework for AWaQ. These efforts were guided by policy frameworks at the African Union (AU) and AMCOW levels (see Box 1), and supporting studies conducted during the project's implementation. Central to this study was the need to emphasize the importance of the effective use and application of water quality monitoring data to underpin management decisions.

Situation Assessment: The Need for Improved Water Quality Monitoring in Africa

In phases 1-2 of this study (Mukuyu et al. 2024a), an assessment was carried out on the state of water quality monitoring and pollution control in Africa. This was done through (i) a review of the status of water quality monitoring and analytical capacities across African countries based on a continent-wide survey (AMCOW-IWMI Africa-wide survey); (ii) a desktop review of available literature at global, regional, transboundary and national scales with a specific focus on water quality monitoring, pollution control and mitigation in Africa; (iii) an analysis of survey data to identify priority pollutants; and (iv) a synthesis of country water quality profiles based on the data gathered and the literature reviewed. The study emphasized the need for AWaQ to advance water quality monitoring objectives, including responding to requests to report on United Nations Sustainable Development Goal (SDG) Indicator 6.3.2 (proportion of bodies of water with good ambient water quality) and the synonymous AMCOW WASSMO Indicator I-4.3 (a-d). These two phases of the study (Mukuyu et al. 2024a) provided a background on the status of water quality across African countries with respect to monitoring and management, building a basis for a continent-wide water quality program.

The AMCOW-IWMI Africa-wide survey probed laboratory testing capacity, human technical capacity, and effectiveness of water quality management efforts. The survey revealed the following:

- There is an encouraging availability of national water testing laboratory facilities across African countries. Nonetheless, some weaknesses such as limited laboratory equipment require attention to ensure effectiveness and sustainability.
- Regular and ongoing training is needed to keep up with laboratory testing methodologies. However, a low trend was observed in routine training, which does not augur well for keeping abreast of the best practices in water quality monitoring, including quality assurance in the monitoring process. While there are varying degrees of training requirements across the continent, training should be conducted more regularly than at present.

- Water quality monitoring and assessment capacities are inconsistent, and capacities related to staff training, laboratory infrastructure and monitoring program activities need strengthening.
- Pollution control mechanisms are facing challenges, and regulatory mechanisms and wastewater treatment technologies—the most widely deployed pollution control solutions—may benefit from more concerted investment and the political will and financing to boost their effectiveness.

The survey showed that countries are at different levels of implementing water quality monitoring and management programs, and that there are extensive financial and technical capacity challenges. Nonetheless, there is scope to develop strong synergies and collaboration across regional initiatives within the proposed AWaQ.

Individual country profiles were developed to show the nuanced water quality challenges in different countries (Mukuyu et al. 2024c). Water quality profiles were prepared for the countries that responded to the AMCOW-IWMI Africa-wide Survey. A common observation is that water quality challenges are real, and require immediate and coordinated efforts at the continental, transboundary and national scales to avert a continued deterioration in the water quality situation. Further consultation through a session at the Africa Water Week 2021 showed the importance of transboundary water management and the need to establish robust monitoring and data management systems.

Innovations in Water Quality Monitoring and Management: Potential for Africa

In phases 3-4 of this study (Mukuyu et al. 2024b), a review was carried out of leading, globally tried and tested innovations in water quality monitoring and management. This led to the identification of potential innovations that can be applied within the African context. Not all innovations are suitable for implementation in resource-constrained environments characteristic of many parts of Africa. For example, statistical analysis and modelling may require large amounts of existing monitoring data which are currently unavailable in most African countries. Nonetheless, other interventions, such as the priority monitoring approach, can be beneficial in optimizing resource utilization. Similarly, technological interventions such as multi-parameter sensors for assessing basic water quality variables are now widely available and affordable and can provide in situ results, lessening the need for laboratory analysis.

Available and existing traditional methods for water quality monitoring and management offer a good starting

point to strengthen and streamline efforts for increasing efficiency and effectiveness. Available laboratory facilities may benefit from instrumentation upgrades and continuous staff training. Additionally, there is scope for community and citizen engagement in the various water resources monitoring and management processes. There is evidence that this enables success where governments do not have the monitoring capacity or adequate resources.

Effectively managing water quality is still a challenge in most African countries, and even more so at the national and transboundary scales. By undertaking suitable investment

and targeted capacity development, existing monitoring programs could be expanded to increase the monitoring station density and improve subsequent data flows. However, a substantial data gap already exists in that there is little historical water quality data to indicate the reference or baseline conditions (before industrialization and major development) that would define the natural state of African water bodies. Such data are useful to allow interpretation of present-day water quality by showing the deviation from the baseline that has already taken place. In the absence of such data, it is possible to use general water quality data as a standard, ideally from a nearby region with similar landscape characteristics.

A Framework for an African Water Quality Program (AWaQ)

The proposed framework is a foundational structure of ideas and/or concepts, which will guide the formation of an African Water Quality Program (AWaQ). In the context of this paper, the framework presents only the conceptual structure and does not provide the protocols and detailed plans that would be required for the implementation of AWaQ. It does, however, present the building blocks for developing AWaQ, based on previous studies, and consultations with AMCOW and African water quality experts. As such, the framework can be defined as the foundational basis for developing AWaQ. The framework consists of four components: (i) governance, (ii) water quality monitoring, (iii) data management, and (iv) capacity development.

Scope

AWaQ will ideally be a platform where AMCOW can work with Member States to develop the narrative around water quality. This would require some level of oversight regarding standard monitoring programs across countries, assessment capacities and laboratory performance, among others. AWaQ is more about interpreting water quality data, helping to inform society about water quality at all levels, including policy development, and thus bettering the lives of all African people and the environment.

Primary Stakeholders

AU Member States will be custodians and implementers of this framework. They will retain ownership of outputs, including the data generated, but in a coordinated way across Africa so that the entire continent can benefit. As such, Member States were consulted to further develop the proposed framework at the Stakeholders' Engagement on AMCOW Strategic Groundwater Program and African Water Quality Program (AWaQ) on November 10, 2022,

in Dar Es Salaam, Tanzania. During this consultation, a draft of the framework was shared with representatives of AMCOW Member States and some provided feedback.

Objective

The main aim of this framework is to guide the development of AWaQ towards strengthening water quality monitoring and assessment while creating an understanding of water quality data and information and helping to mitigate water pollution across African countries.

Key Outcomes

Through implementation of the framework and rollout of AWaQ, AMCOW will be able to facilitate the coordinated reporting of water quality data to various repositories and formulate continental overviews of water quality. AMCOW can then more assertively communicate the important role of good ambient water quality in relation to human and ecosystem health, by forming important connections between water quality and observed impacts such as disease outbreaks and loss of biodiversity.

Scale of Implementation

The success of AWaQ is supported by national water quality monitoring efforts. While there are initiatives at the transboundary levels, water quality monitoring largely occurs within national boundaries and data are then shared at the river basin level. The transboundary and national scales are essential units of analysis and for implementation of AWaQ. Attention should be paid to strengthening the capacity of national water quality monitoring programs, which, in turn, feed into the basin structures. River basin organizations should play an important role in the strategic direction of water quality monitoring, data management and capacity building.

Approach to Developing the Framework

A series of steps formed the foundations for developing the framework:

- A situation analysis was carried out on the state of Africa's water quality monitoring and management, and assessment capacity, and a forward-looking overview of innovations suitable for Africa was presented (see Mukuyu et al. 2024a, 2024b).
- A review of existing water quality frameworks across different implementation scales – global and regional, transboundary and national – was carried out to gain a better understanding of key water quality monitoring and management needs.
- An AMCOW-IWMI Africa-wide Survey was conducted to solicit input from government representatives of African countries as well as water quality experts across the continent (see Mukuyu et al. 2024a).
- Individual water quality profiles were developed for those countries participating in the AMCOW-IWMI Africa-wide Survey to highlight in-country water quality challenges (Mukuyu et al. 2024c).
- A session was held at Africa Water Week 2021 to gain more insights into the challenges encountered in implementing water quality monitoring and management programs at the transboundary level.
- To ensure that this framework aligned with the needs of Member States, draft copies of the framework were circulated to these states for feedback and input. Those present at the Stakeholders' Engagement on AMCOW Strategic Groundwater Program and African Water Quality Program on November 10, 2022, in Dar Es Salaam, Tanzania, were given the opportunity to provide feedback on the framework, which has duly been incorporated.

At each stage in the process of developing the framework, there was ongoing consultation with AMCOW to ensure alignment with the organization's strategic plans and objectives.

Policy Frameworks

- The vision and policy objectives for the African continent, as presented through AU and AMCOW, provided a basis for developing the framework. Continental aspirations articulated in the African Union Agenda 2063: The Africa We Want (AU n.d.) and the Africa Water Vision 2025 (UNECA, AUC and AfDB 2003) are further supported by AMCOW's mission to "*provide political*

leadership, policy direction and advocacy in the provision, use and management of water resources for sustainable social and economic development and maintenance of African ecosystems."

Further, AMCOW's strategic objectives in the African Water Resources Management Priority Action Programme 2016-2025 (AUC and AMCOW 2016) informed the framework and proposed design of AWaQ (Box 1).

Guiding Principles

Three guiding principles – state custodianship, co-development, and coordination and collaboration – were applied in developing a framework for AWaQ based on who holds the overall responsibility for the program and who benefits from its success.

State Custodianship

AMCOW Member States remain custodians of water quality data generated during the implementation of AWaQ, while at the same time agreeing to share these data and information to develop a trans-African understanding of water quality issues. Member States would need to establish or review national water quality programs based on allocated budget and annual work plan to support the implementation of AWaQ.

Co-development

AWaQ should be the result of co-development efforts between AMCOW and its Member States to ensure maximum uptake of the program and common goals. Aligning country water quality visions with the vision of AWaQ is an important first step towards ensuring success of the program. A clear articulation of the importance of a continent-wide initiative on water quality can drive investment in water quality monitoring and management.

Coordination and Collaboration

Strategic coordination will be essential to ensure AWaQ builds on and expands already existing mechanisms, such as the reporting requirements of WASSMO Indicator I-4.3 (a-d), SDG Indicator 6.3.2 and UNEP's Global Environment Monitoring System for Freshwater (GEMS/Water), as well as form linkages with programs such as the AMCOW Pan-African Groundwater Program (APAGroP). Challenges identified with current efforts to meet the minimum reporting requirements of existing initiatives can form the basis of AWaQ and potentially bridge the gap. Enhancing the role of partnerships such as Regional Economic Commissions (RECS) and transboundary river basins organizations will further strengthen the impact of AWaQ.

Box 1. Guiding Policy Frameworks in Africa.	
African Union Agenda 2063: The Africa We Want (AU n.d.)	The First Ten Year Implementation Plan (FTYIP) of Agenda 2063 (2013–2023) highlights priority areas, including the Science Technology Innovation Strategy for Africa (STISA). Under STISA, priority areas for research or innovation include ‘protection of our space” through knowledge of the water cycle and river systems as well as river basin management, and ‘wealth creation’ through management of water resources.
Africa Water Vision 2025 (UNECA, AUC and AfDB 2003)	<p>The vision: <i>"An Africa where there is an equitable and sustainable use and management of water resources for poverty alleviation, socio-economic development, regional cooperation, and the environment"</i></p> <p>It is a vision of an Africa where:</p> <ol style="list-style-type: none"> 1. There is sustainable access to safe and adequate water supply and sanitation to meet the basic needs of all; 2. There is sufficient water for food and energy security; 3. Water for sustaining ecosystems and biodiversity is adequate in quantity and quality; 4. Institutions that deal with water resources have been reformed to create an enabling environment for effective and integrated management of water in national and transboundary water basins, including management at the lowest appropriate level; 5. Water basins serve as a basis for regional cooperation and development, and are treated as natural assets for all within such basins; 6. There is an adequate number of motivated and highly skilled water professionals; 7. There is an effective and financially sustainable system for data collection, assessment and dissemination for national and trans-boundary water basins; 8. There are effective and sustainable strategies for addressing natural and man-made water-resources problems, including climate variability and change; 9. Water is financed and priced to promote equity, efficiency, and sustainability; 10. There is political will, public awareness and commitment among all for sustainable water resources management, including the mainstreaming of gender issues and youth concerns and the use of participatory approaches.
African Water Resources Management Priority Action Programme 2016-2025 (AUC and AMCOW 2016)	<p>The four priority action areas under this program are as follows:</p> <ul style="list-style-type: none"> • Improving environmental integrity through wastewater and water quality management. • Ensuring water security by managing water pollution. • Ensure readiness of AU Member States to achieve Goal 6 (ensure availability and sustainable management of water and sanitation for all) of the SDGs and monitor progress towards achieving its targets. • Enhance information and knowledge management systems. <p>Implementation of these actions is guided by principles such as best practices and the river basin approach.</p>

Core Components of the Framework

When addressing Africa's multifaceted ambient water quality challenges, there are critical aspects to consider. Based on the findings of phases 1-2 of this study (Mukuyu et al. 2024a), four key components were selected to form the overarching design of AWaQ: (i) governance, (ii) water quality monitoring, (iii) data management, and (iv) capacity development. Implementation options for each of the core components were presented to the Member States during a consultative workshop held in Tanzania on November 10, 2022. The final recommended modalities for developing AWaQ are highlighted here.

Component 1: Governance

In most countries of Africa, the principles of Integrated Water Resources Management (IWRM) have been adopted so that institutional structures for catchment-based water management are in place, albeit operating with varying degrees of success. It is important to note that while IWRM is a widely accepted paradigm, it is not without its shortcomings. Still, it provides a common denominator for managing water resources, including water quality. Based on the general acceptance of IWRM, the governance component of AWaQ will build on already existing institutional structures and regulatory provisions, with the aim of achieving the goal of improved water quality.

Water quality governance entails giving special attention to mitigating water pollution and protecting water resources from continued pollution. This framework focuses on water quality monitoring as the first step towards understanding water quality, which then informs the management of water pollution. Ensuring a standardized approach is followed in water quality monitoring (i.e., for reporting, sampling and analysis, and setting water quality standards) enables a common interpretation of water quality across Africa at country level. Water quality governance requires enforcing pollution control regulations through the issuing of licenses and permits. It is important to ensure that such provisions and directives are enforced to have the desired impact. Resource-constrained environments such as those witnessed in Africa generally suffer in this regard.

Also crucial in water quality governance is consideration of the knowledge and values of water quality to society, the natural human processes, institutions and systems, and how these interact with water quality. Diverse actors need to be considered in AWaQ to ensure active participation across all spheres of society such as the private sector and civil society.

Governance in AWaQ

AMCOW promotes AWaQ as a platform for coordinating water quality monitoring in Africa and will continue to oversee its implementation. AMCOW will provide

direction for implementing AWaQ at country level (while coordinating with regional and transboundary institutions), and coordinate the Africa-wide development of knowledge and collation of reports. Member States will contribute to AWaQ through established AMCOW structures, including WASSMO and APAGroP. Further, Member States may also engage with communities to collect certain types of data most relevant at a community scale. Nonetheless, such procedures will likely differ in each country. The AWaQ governance structure adopted places the Member States at the center, while AMCOW provides the framework for participation and overall coordination and management of program outputs.

Component 2: Water Quality Monitoring

The basis for improving water quality lies in the strength of the monitoring program. The water quality monitoring component of this framework harmonizes operational guidelines for water quality monitoring (i.e., testing and monitoring methods) to ensure there is a standardized approach. Further stipulating water quality standards and the minimum testing requirements in line with other existing water-related programs (e.g., SDG Indicator 6.3.2, WASSMO Indicator I-4.3 (a-d), UNEP GEMS/Water, etc.) will consolidate and strengthen synergies across continental initiatives. Innovations in water quality monitoring (Box 2) can guide Member States in selecting the options that will work best in their context.

Figure 2 and the text below outline monitoring activities that should form part of AWaQ, the interconnected nature of these actions and the scale of the intervention.

1. **Water quality context in African countries.** Given the many water quality challenges, African countries should develop water quality objectives to preserve ambient water quality for the benefit of people and the environment.
 - a. **Water quality objectives** can be defined for specific and strategic river systems to guide policies that address the delicate balance between water use and managing pollution for humans and natural ecosystems.
2. **Water quality monitoring plans** include establishing water quality monitoring guidelines, standards, and laboratory testing and certification. Such plans should also address staff capacity to conduct water quality monitoring including laboratory testing.
3. **Implement water quality monitoring** considering the available innovations in monitoring technologies, including the development of capacity in laboratory assessment. Various innovations applicable in Africa are presented in Mukuyu et al. (2024b).

4. **Data management systems** need to manage and coordinate data generated through monitoring efforts so that they are applied and interpreted meaningfully. Developing in-country data management systems and capacity for interpreting data is a critical step to ensure that data are not lost in 'data graveyards' but are used to inform decision-making and ultimately improve water quality.
5. **Reporting data** from in-country data repositories should be linked to existing data monitoring systems including WASSMO and UNEP GEMS/Water. AWAQ should also facilitate the development of useful knowledge emanating from the data that could be used to improve the water quality situation for the environment and society.

Feedback from water quality monitoring efforts informs capacity-building initiatives and governance structures. Building the capacity of technical staff to interpret data so that it can be used in management actions is critical to deriving benefits from the data generated for in-country policy and operational decisions, and regional responses. Processing ambient water quality data further facilitates identifying and tracking polluted water bodies and provides a feedback loop for response mechanisms.

Water Quality Monitoring in AWAQ

Options for enhancing water quality monitoring activities were presented to AMCOW and Member States present at the Stakeholders' Engagement on AMCOW Strategic Groundwater Program and African Water Quality Program (AWAQ) on November 10, 2022, in Dar Es Salaam, Tanzania.

Collection of basic water quality data to support regional and global indicators, thus ensuring Member States follow a basic minimum standard.

The option to only collect basic water quality data was selected as most appropriate for rollout within AWAQ. Under this proposed option, a monitoring program that provides basic data in support of regional and global indicators, such as WASSMO Indicator I-4.3 (a-d) and SDG Indicator 6.3.2, would be advanced, covering the main impacts on water quality such as excess nutrients, oxygen depletion and salinization. A key objective should be the collection of reliable and standardized water quality data at the national or river basin level, which help to improve the water quality situation in countries and can feed into larger data repositories.

Innovations in water quality monitoring are encouraged for application across the African region. Innovations such

as citizen science and the use of biological indices are potentially affordable in most countries and could be built into existing national water quality monitoring programs to enhance regional assessment of water quality.

Component 3: Data Management

Generating appropriate water quality data to enable decision-making is a critical focus dependent on well-designed monitoring programs and data management systems. Adequate data generated from strategic water bodies and channelled through robust information systems that highlight the water quality situation in Africa can enable better-integrated decision-making and feed into overall regional and global reporting programs such as WASSMO Indicator I-4.3 (a-d) and SDG Indicator 6.3.2. Weaknesses in the design of water quality monitoring programs and data management systems as well as the lack of capacity to conduct monitoring activities and interpret the data were identified by most African countries as key areas that need to be addressed.

Applying standard data management practices throughout all stages of the data management cycle will be central to the success of AWAQ. This includes defining protocols around data recording, inputting, retrieval and archiving, and applying common data standards to management. This will allow carrying out assessments at multiple scales, ensuring the maximum amount of information is extracted from the valuable data collected. Emphasis should be placed on processing and converting data into actionable information for effective decision-making.

There are some essential aspects to be considered in a data management strategy:

- Application of common data management standards (e.g., data types, code lists, file formats, dictionaries).²
- Development of common data management practices (e.g., approaches used for quality assurance and quality control, data sharing), e.g., through national data management policies.
- Delineation of Africa-wide river basin water management units (and possibly smaller water body units).
- Addressing capacity requirements in data management.
- Establishing principles of intranational and international data sharing.

² <https://www.ogc.org/standards/waterml> (accessed on November 12, 2023).

Box 2. Examples of water quality monitoring innovations with high potential for uptake in Africa.

Monitoring program network design

- Satellite imagery can be used to identify monitoring locations, thus reducing the time required to visit and select locations. High-resolution imagery is freely available from Google Earth.
- The HydroBASINS network contains information about river basins of the world and is useful for mapping the initial selection of monitoring locations.
- Co-location of hydrometric and water quality monitoring locations facilitates the calculation of loads/fluxes. This may require cooperation and data sharing between two different government agencies.

Sample collection and field analyses

- Multi-parameter sensors for basic water quality variables provide in situ data with no requirement for laboratory analysis. These are widely available and affordable albeit with a limited range of parameters.
- Kits and portable instruments are available for measuring water quality parameters in the field, e.g., nitrogen (N), phosphorus (P), turbidity and fecal coliforms. These are useful for remote locations and generate results on site. There are a limited range of parameters that can be tested, while accuracy and precision are often not as good as equivalent laboratory analyses, although there is rapid improvement in the technology taking place.

Laboratory analysis

- Standardized methods enable comparability of data between monitoring locations and laboratories performing analyses. Standard methods are readily available for different levels of analytical complexity.
- Multiple parameter analytical instruments allow for the reduction in sampling and sample processing, thus increasing laboratory throughput. Such instruments may, however, be costly, so suitable training and maintenance contracts are essential to ensure the impact of high-end equipment is maximized.

Biological monitoring

- Biotic indices based primarily on benthic macroinvertebrates and diatoms can be used to indicate the general health of freshwater ecosystems. Existing biotic indices can be refined for national use.
- Bioaccumulation of toxins in fish and crustaceans, especially human food species, provides a useful confirmation of the presence of contaminants when concentrations in the water are below analytical detection limits. This is particularly useful for monitoring heavy metals in mining areas and also for persistent organic compounds.
- Microbiological monitoring of water identifies risks to human health during recreation or when used for drinking. Field kits are available for use in remote locations, but are less sensitive than laboratory methods.

Citizen/community monitoring

- Physical and chemical monitoring by communities using simple kits, with data uploaded by mobile phone, offers the potential for greater spatial and temporal monitoring coverage than can be achieved by national agencies. These kits also provide supplemental data for national and international monitoring. Training is, however, important for local communities to ensure reliable data collection, while regular engagement and feedback are necessary to maintain involvement.
- Optical measurements of water bodies collected by citizens using smartphones can be useful to validate satellite data.
- Fish kills and algal blooms can be reported by citizens using smartphone apps. These data can assist in identifying localized pollution incidents and can protect public health.
- River health and water quality monitoring using invertebrate species with smartphone identification and recording helps to determine ecosystem health and the presence of pollution. A system to do this can be found at <https://minisass.org>

Earth observation

- Use of satellite data for monitoring suspended solids, turbidity, chlorophyll and algal blooms in large lakes facilitates monitoring at high spatial and temporal resolution in near real-time and are freely available. This, however, requires trained personnel and dedicated *in situ* validation monitoring.

Source: Adapted from Mukuyu et al. 2024b.

The African Water Quality Monitoring Framework (AWaQ)

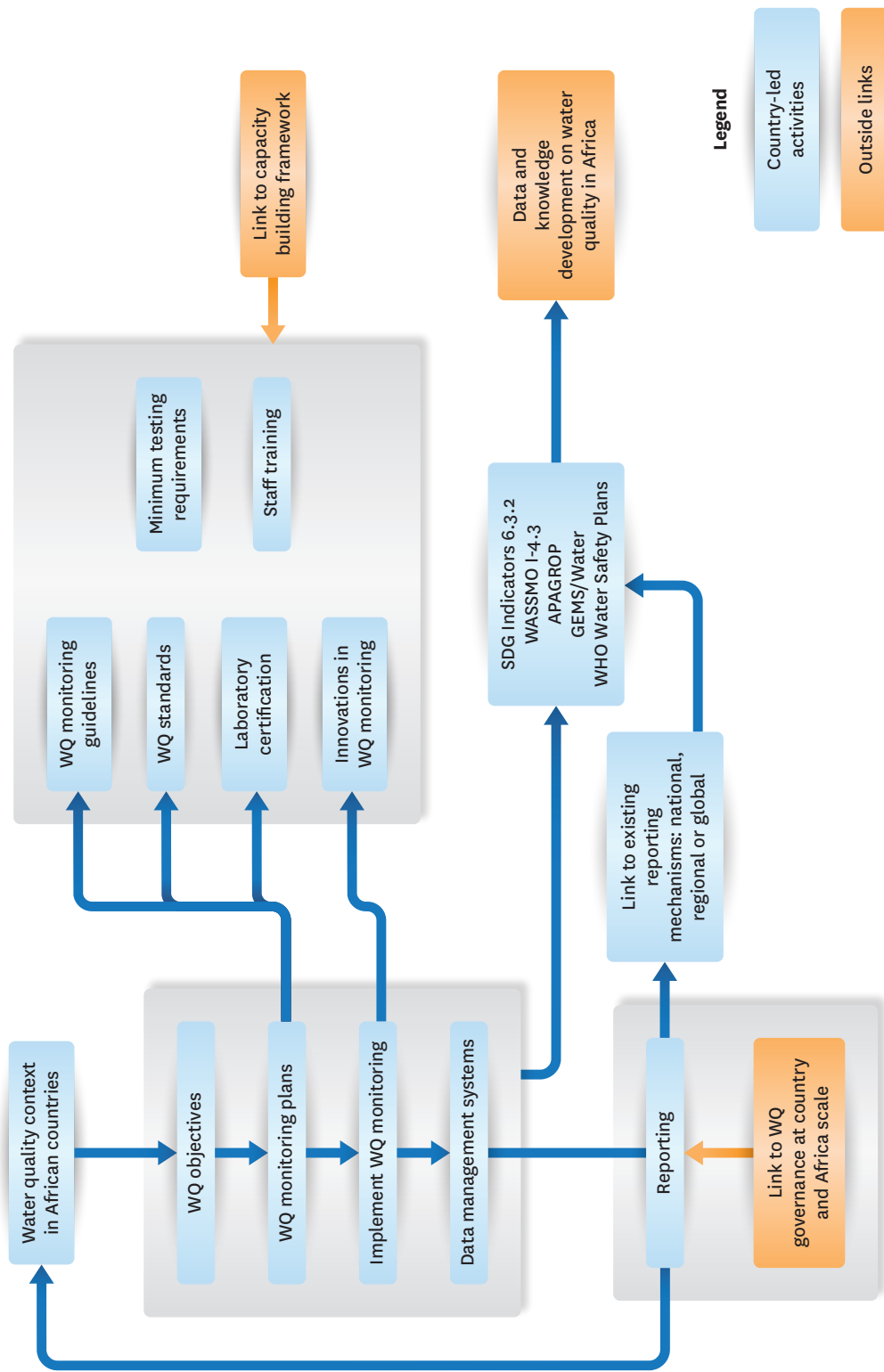


Figure 2. Framework for AWaQ showing the country involvement in African water quality monitoring with links to capacity building and data management.

Note: WQ – water quality, WASSMO – Water and Sanitation Sector Monitoring and Reporting System, SDG – Sustainable Development Goal, GEMS/Water – Global Environment Monitoring System for Freshwater, APAGROP – Pan-African Groundwater Program, WHO – World Health Organization

Data Management in AWaQ

Of the proposed data management strategies, the selected³ option does not require a central water quality portal, but countries only need to submit final national assessments or interpretations to AMCOW for reporting purposes. Established national data platforms

will thus form the basis of the strategy. Given that the aim is for AMCOW to have a complete regional

Decentralized national platforms with no central water quality portal for Africa. Countries only submit final national assessments to AMCOW for reporting and planning purposes.

estimation of water quality trends, this approach was deemed by Member States as most suitable. While this strategy would be straightforward to implement across African countries and requires minimum data storage at the centralized scale, there is a risk of limited participation, as is observed in the current WASSMO I-4.3 (a-d) and SDG Indicator 6.3.2 reporting. This reporting lethargy will detract from developing the full picture of the continent's water quality and how human and ecosystem health is impacted across the region.

Success stories developed from the water quality assessment information submitted by Member States can lead to unlocking funding that can be channelled towards strengthening water quality monitoring programs, potentially leading to greater participation in AWaQ by Member States.

Managing water quality data in a manner that supports decision-making and triggers the appropriate response is an adaptive process. While there is a general appreciation of the importance of water quality monitoring, African countries are at different levels of implementation and data management systems differ in operational design and function. Given the current complexities and contextual challenges around data management, the following may need to be considered when implementing a continent-wide initiative such as AWaQ.

- A phased approach is essential for reaching optimal standards and bringing countries up to a minimum operational level.
- Harmonizing existing data management systems in the Member States will ensure better reporting.
- Information sharing among Member States will help in identifying gaps and emerging water quality issues. This will provide guidance for future and targeted capacity development activities.

Component 4: Capacity Development

AMCOW identified capacity development⁴ as a critical feature within AWaQ with the following two important aspects to consider:

- Translating data into knowledge and information is important if there is to be a change in attitude to water quality issues across Africa. One recommended approach is to elevate the data into the public sphere by building local stories around water quality issues that convey the meaning beyond the data. For example, stories about polluted water can focus on the risk and impacts and not on the data itself.
- Capacity building is key. Country capacities should be enhanced in terms of monitoring, laboratory testing and interpretation of data, among others.

AWaQ will establish ongoing and effective capacity development programs at all levels (national, local, river basin, civil society, etc.). The AMCOW-IWMI Africa-wide Survey carried out in 2020 to gather information to develop the framework for AWaQ revealed a substantial need for capacity development. Capacity development programs can cover a wide range of activities including the following:

- Training and education in water quality monitoring, including fieldwork, water sampling and on-site testing.
- Developing the capacity of water utilities and private laboratories, including handling and maintenance of laboratory equipment, data management and reporting, leading to laboratory accreditation and certification.
- Establishing citizen science monitoring in local communities.
- Integrating water quality monitoring elements into education systems as appropriate (primary, secondary, university education).
- Interpretation of water quality data and how these data highlight the water quality situation, its impact on the environment and society, and most importantly, exactly what this means for the people of Africa. Such capacity development is key, not only for citizens but also for policymakers who need to appreciate the evidence when drafting policy and management plans.

Priority Areas for Capacity Development

During the discussions at the stakeholder engagement meeting held in November 2022, Member States

³ Selected after consultation with representatives from Member States at the Stakeholders' Engagement Meeting in Dar es Salaam, Tanzania, on November 10, 2022.

⁴ During a meeting with the authors of this report (May 24, 2022).

identified areas for immediate capacity development as follows:

- Sophisticated and modern laboratory equipment and trained experts
- Training of water quality experts
- Real-time water quality data equipment
- Funding the design/redesign of water quality monitoring programs
- Support the use of water quality models and other water quality data management systems
- Support the sustainability of laboratory equipment, including operation and maintenance

Additional areas for training include the following:

- Monitoring network design and network evaluation
- Incorporating biological indices into ambient water quality assessment
- Incorporating citizen science into ambient water quality assessment
- Using remote sensing data for water quality monitoring – current and future potential
- Quality assurance in water quality monitoring activities in the field and laboratory

It is important to create linkages to the existing capacity building and data collection platforms such as SDG Indicator 6.3.2, WASSMO Indicator I-4.3 (a-d), APAGroP, GEMS/Water, etc. Another important aspect is to identify existing steering committees associated with water quality, water resources, river basin management, IWRM and water safety plans, especially in facilitating the capacity development programs. Individual countries should essentially conduct capacity needs

assessments to identify the real need before designing their capacity development program to best suit a country's context.

Capacity Development in AWaQ

Within the various activities involved in water quality monitoring and assessment, there is a need to strengthen and develop human and technical capacities. For AWaQ, Member States supported capacity development coordinated through AMCOW, which means that AMCOW would select training

courses tailored to suit the agreed final monitoring and management strategy, thereby providing a standardized Africa-

AMCOW selects and coordinates training, providing a standardized Africa-wide approach.

wide approach. Further, multiple repeats of the same training courses can be cost-efficient, and AMCOW can potentially engage large donors to fund these activities. While this approach is desirable, AMCOW would be responsible for coordinating the training programs. The alternative option for countries to source training courses independently would lessen this responsibility on AMCOW. However, the quality and level of training would depend on the country's ability to fund it. The lack of a standardized approach could lead to variations in knowledge and practices.

AMCOW's role in coordinating this capacity building component of AWaQ may be vital for knowledge sharing across water quality professionals, further enabling the development of young professionals in the field.

Operationalizing the Framework

Translating the framework into a functional Africa-wide water quality program with associated protocols would require coordination at multiple levels, including the regional (through AMCOW), transboundary and national governments (see Figure 3). Structured coordination channels and mechanisms are critical for success of the program, highlighting synergies across various initiatives implemented on the continent, and harnessing solutions and data generated through these efforts. There is scope for the involvement of specialists to develop guidelines and protocols that address identified areas of the framework and these can be shared between Member States. This section proposes the immediate next step in operationalization of this framework and rollout of AWaQ.

Strategic Implementation Plan

Developing an implementation plan provides a time-bound road map for operationalizing this framework and implementing AWaQ. The plan should clearly set out the role of various institutions (e.g., river basin organizations [RBOs] and regional economic commissions [RECs]) and how they feed into AWaQ. Further, the plan can define specific activities under the core components presented in this framework (i.e., governance, water quality monitoring, data management and capacity development), possible financing mechanisms and indicators for measuring success.

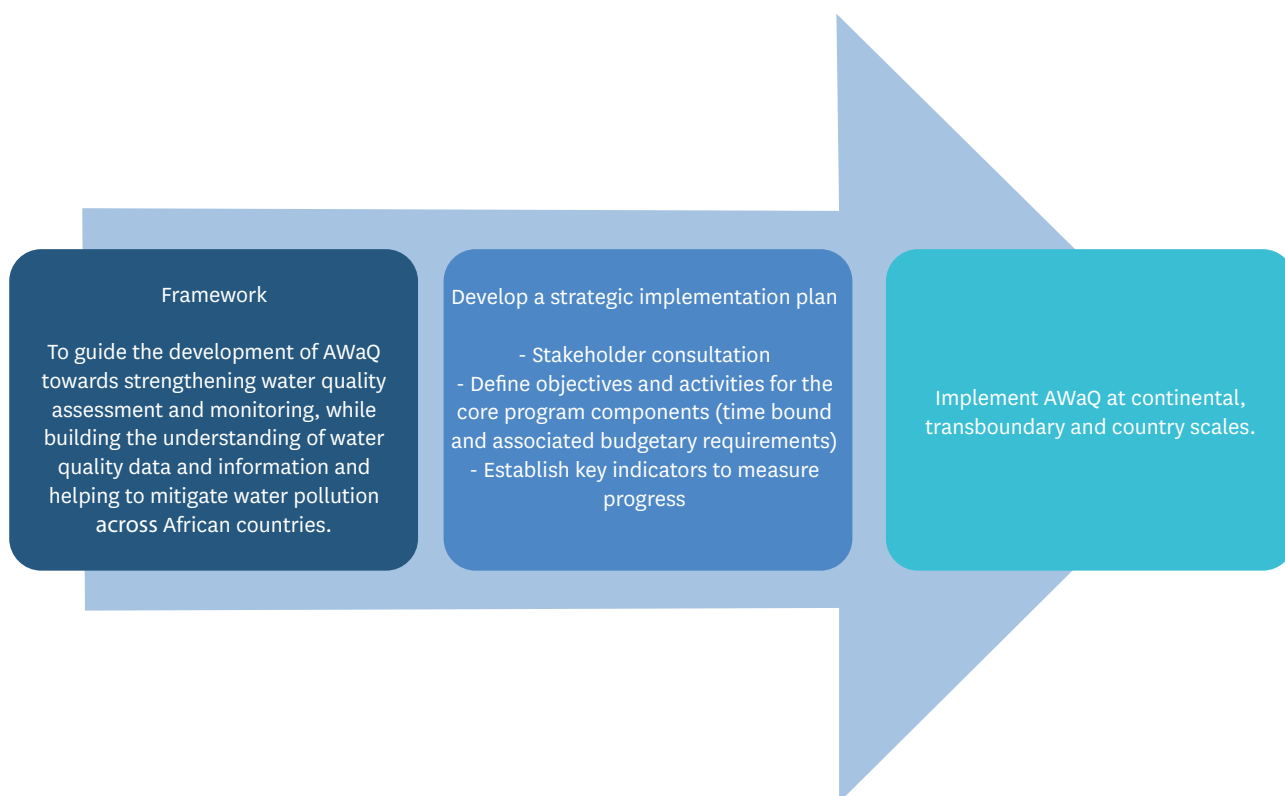


Figure 3. Progress towards implementing AWaQ (i) developing the framework, (ii) developing the strategic implementation plan, and (iii) implementing the program at continental, transboundary and country scales.

Role of AMCOW, Member States, RBOs and Supporting Organizations

As highlighted in preceding sections, AMCOW will play a facilitating and coordinating role across the four components of the framework (Figure 4). Through this oversight, AMCOW will develop and implement suitable coordination mechanisms in the governance of AWaQ among the various initiatives, stakeholders and regional institutions, facilitating the flow of water quality information from Member States through available platforms such as WASSMO. This information will form the basis for countries to develop water quality stories that give meaning to the data and highlight water quality issues and the impacts that they are having. Further, AMCOW will coordinate capacity building activities to deliver harmonized training programs tailored to different country needs. As the main beneficiaries of this program, Member States will, through their formal association with AMCOW, implement proposed activities and interventions, both at the river basin and country levels.

Activities in Preparation for Program Implementation

During consultation with representatives from AMCOW Member States, it was noted that specific activities must be undertaken to prepare the program for successful implementation. These include (i) stakeholder mapping and establishing coordinating mechanisms; (ii) consensus on priority data and/or information that should form part of AWaQ; (iii) performance evaluation of the WASSMO platform on how it can best support the demands of AWaQ. This evaluation would address the bottlenecks Member States currently encounter in using this platform; and (iv) building country capacity needs assessments that will inform the design and creation of training programs by grouping countries with similar needs for targeted training.

Financing for AWaQ

Implementing AWaQ at a country level requires financing, and AMCOW can play a central role in attracting funding for program activities. Given the current climate crisis and its impact on water quality, unlocking the potential for leveraging climate finance would be an essential avenue to explore.

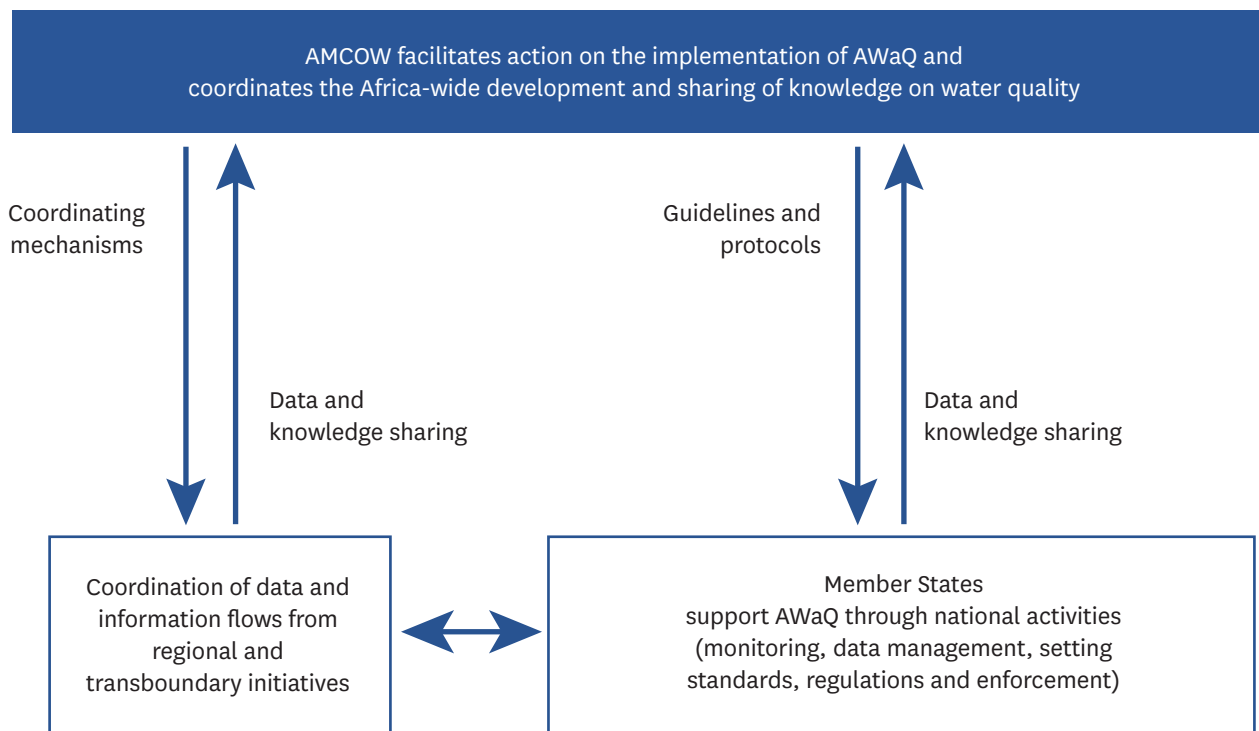


Figure 4. The involvement of AMCOW, Member States and regional organizations in AWAQ.

Conclusion

This paper details the final phase of a five-phase study. Phases 1-2 (Mukuyu et al. 2024a) documented the capacity for water quality monitoring in Africa. Phases 3-4 (Mukuyu et al. 2024b) proposed innovative ways of monitoring pollution and for the management of water quality issues. Phase 5 (this paper) presents the skeleton framework for AWAQ that is intended to guide AMCOW and Member States in the development of a full water quality monitoring program. To become fully implemented, this will require that AMCOW and Member States take the framework forward by producing a detailed strategy with

a Standard Operating Procedure that provides details of program implementation, responsibilities, action plans, schedules, budgets, etc.

Protection and management of water quality in Africa is a key aspect of the continent's future development. Without a conscious effort to engage in water quality monitoring, the prospects for Africa are bleak. AMCOW has expressed its commitment to engaging in water quality monitoring and promoting the development of AWAQ.

References

AU (African Union). n.d. Agenda 2063: The Africa We Want. Web page. Available at <https://au.int/en/agenda2063/overview> (accessed on November 12, 2023).

AUC (African Union Commission); AMCOW (African Ministers' Council on Water). 2016. *African water resources management priority action programme 2016-2025*. Addis Ababa, Ethiopia: African Union Commission (AUC); Abuja, Nigeria: African Ministers' Council on Water (AMCOW). Available at <https://bit.ly/3nbwFUq> (accessed on November 2, 2023).

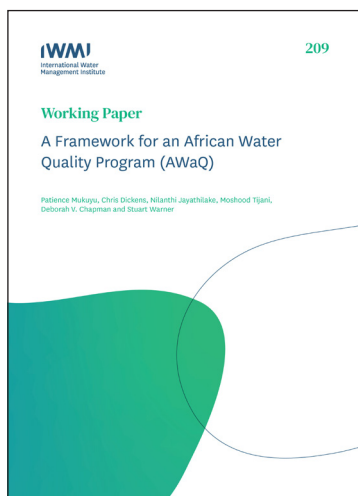
Mukuyu, P.; Jayathilake, N.; Tijani, M.; Nikiema, J.; Dickens, C.; Mateo-Sagasta, J.; Chapman, D. V.; Warner, S. 2024a. *State of water quality monitoring and pollution control in Africa: towards developing an African Water Quality Program (AWaQ)*. Colombo, Sri Lanka: International Water Management Institute (IWMI). 44p. (IWMI Working Paper 207). <https://doi.org/10.5337/2023.216>

Mukuyu, P.; Warner, S.; Chapman, D. V.; Jayathilake, N.; Dickens, C.; Mateo-Sagasta, J. 2024b. *Innovations in water quality monitoring and management in Africa: towards developing an African Water Quality Program (AWaQ)*. Colombo, Sri Lanka: International Water Management Institute (IWMI). 52p. (IWMI Working Paper 208). <https://doi.org/10.5337/2023.217>

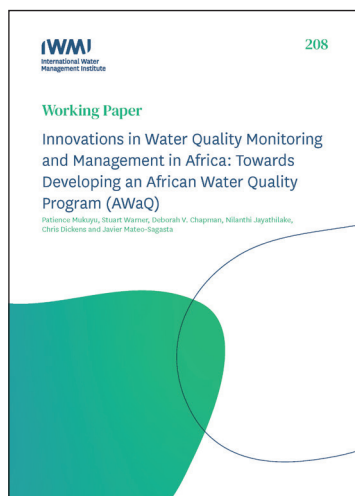
Mukuyu, P.; Jayathilake, N.; Tijani, M.; Nikiema, J.; Dickens, C.; Mateo-Sagasta, J.; Chapman, D. V.; Warner, S. 2024c. *Country water quality profiles: towards developing an African Water Quality Program (AWaQ)*. Colombo, Sri Lanka: International Water Management Institute (IWMI). 86p. doi: <https://doi.org/10.5337/2024.215>

UNECA (United Nations Economic Commission for Africa); AUC (African Union Commission); AfDB (African Development Bank). 2003. *Africa water vision for 2025: Equitable and sustainable use of water for socioeconomic development*. Addis Ababa, Ethiopia: United Nations Economic Commission for Africa. 71p. <https://hdl.handle.net/10855/5488>

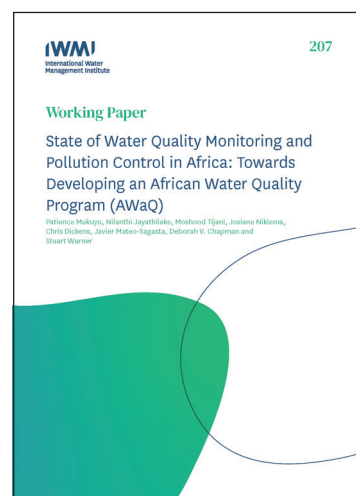
IWMI Working Paper Series



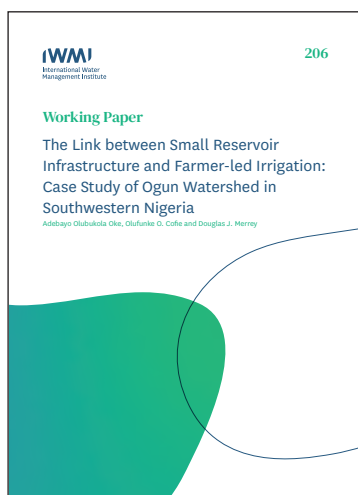
209 A Framework for an African Water Quality Program (AWaQ)
<https://doi.org/10.5337/2024.202>



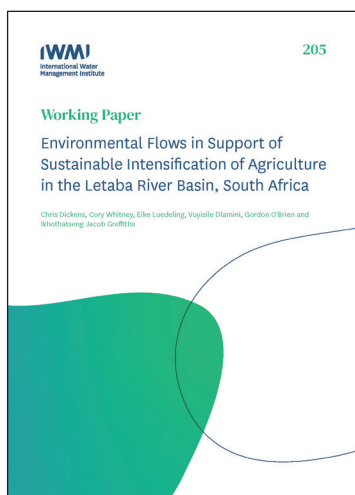
208 Innovations in Water Quality Monitoring and Management in Africa: Towards Developing an African Water Quality Program (AWaQ)
<https://doi.org/10.5337/2023.217>



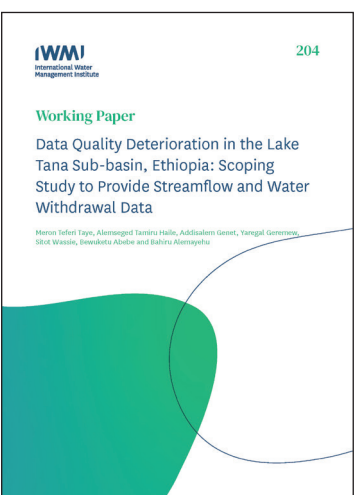
207 State of Water Quality Monitoring and Pollution Control in Africa: Towards Developing an African Water Quality Program (AWaQ)
<https://doi.org/10.5337/2023.216>



206 The Link between Small Reservoir Infrastructure and Farmer-led Irrigation: Case Study of Ogun Watershed in Southwestern Nigeria
<https://doi.org/10.5337/2022.229>



205 Environmental Flows in Support of Sustainable Intensification of Agriculture in the Letaba River Basin, South Africa
<https://doi.org/10.5337/2022.226>



204 Data Quality Deterioration in the Lake Tana Sub-basin, Ethiopia: Scoping Study to Provide Streamflow and Water Withdrawal Data
<https://doi.org/10.5337/2022.208>

Headquarters

127 Sunil Mawatha
Pelawatta
Battaramulla
Sri Lanka

Mailing address

P. O. Box 2075
Colombo
Sri Lanka

Telephone

+94 11 2880000

Fax

+94 11 2786854

Email

iwmi@cgiar.org

Website

www.iwmi.org