AfWA /AAE

FINANCED BY Federal Ministry for Economic Cooperation and Development

SUPPORTED BY sequa

THE WHITE PAPER ON WATER QUALITY IN AFRICA

AfWA FOSTERING PEER-TO-PEER LEARNING PARTNERSHIPS AMONG WATER UTILITY LABORATORIES FOR EFFICIENT WATER QUALITY SERVICE DELIVERY: THE STATUS OF WATER QUALITY LABORATORIES IN AFRICA

Disclaimer:

This publication is made possible by the generous support of
the German Federal Ministry for Economic Cooperation and Development (BMZ) via sequa gGmbH.
The contents do not necessarily reflect the views of BMZ or sequa gGmbH.

Table of content

List of tables

List of photos

List of figures

Abbreviations and acronyms

AfWA	African Water Association
CAMWATER	Cameroon Water Utilities Corporation
DWL/CB	Drinking Water Laboratory Capacity Building program
FCTWB	Federal Capital Territory Water Board
FIU	Florida International University
GEMStat	Global Freshwater Quality Database
GWCL	Ghana Water Company Limited
JMP	Joint Monitoring Program
MDG	Millenium Development Goals
ONEP	Office National de l'Eau Potable (National Office for Drinking Water)
OSWC	Ogun State Water Corporation
PIPs	Performance Improvement Plans
SDG	Sustainable Development Goals
SEG	Société des Eaux de Guinée (Water utility of Guinea)
SEEN	Société d'Exploitation des Eaux du Niger (Water utility of Niger)
SODECI	Société de distribution d'eau de la Côte d'Ivoire (Water utility of Cote d'Ivoire)
SOP	Standard Operating Procedures
SWOT	Strength, Weakness, Opportunity, Threat
UN	United Nations
UNICEF	United Nations Children's Fund
UNEP	United Nations Environment Programme
UNESCO	United Nations Educational, Scientific, and Cultural Organization
USAID	United States Agency for International Development
USEPA	United States Environmental Protection Agency
AfriCap	African Water Association Capacity building program
WASH	Water Sanitation and Hygiene
WHO	World Health Organization
WMO	Meteorological Organization

FOREWORD

It has been a decade since the United Nations (UN) General Assembly adopted a resolution recognizing "the right to safe and clean drinking water and sanitation" as a human right, and five years race towards the UN Sustainable Development Goal 6 pertaining to water and sanitation for all by 2030. Despite that, accurate data from various reports show that the world is still far from achieving this important goal (UNICEF, 2021). Although the final millennium development goals (MDG) evaluation report has globally shown progress in drinking water access, the UN millennium water group however pointed out that the current pace of progress is still too slow to reach the goals in developing countries especially Africa, where half of the people who drink water from unsafe sources live. Indeed, the (UNICEF, 2021) report shows that, in 2015, Africa accounted for 435 million people who lacked a basic drinking water service, while among those that obtained safely managed water supplies, there is only 36% of coverage for quality drinking water in Sub-Saharan Africa.

In addition, Africa is the continent where water quality impairment is getting worse. It remains the part of the world with a weak coverage when it comes to water quality data collection. This poor performance is due to the fact that water quality laboratories in African countries lack equipment, well-trained human resources, and funding to efficiently assess water quality in their respective fields. With the international community preparing to engage the race toward achieving the sustainable development goals (SDG), there is increasing agreement that, solving WASH–related challenges in Africa require reaching a wider audience with the lessons learned from best practices. Such approach will hopefully effectively contribute towards addressing systemic issues with sustainability and indiscriminate approaches that plague the WASH sector in Africa.
This report seeks to:

- Characterize the state of drinking water quality, particularly focusing on the opportunities and challenges in the sector;
- Build on baseline information of good performing water utilities' laboratories to identify best practices for potential replication;
- Assess the outcome of the 10 laboratory audits conducted through peer-to-peer learning partnership between mentors and mentees from municipalities, utilities and operators in the sub-region.

The white paper is written in a provocative style, allowing the figures and numbers to speak for themselves and to call for action towards a holistic approach to improving water quality in Africa. If we are to achieve the Sustainable Development Goal 6, everyone must play a role in tackling the inequality faced in the water sector, more specifically on the quality of water that people use in their daily life.

1

EXECUTIVE SUMMARY

The African Water Association (AfWA) is a continental knowledge management platform of the water and sanitation sector that brings together corporates of drinking water production and distribution, corporates managing sanitation services, as well as the regulators of water and sanitation sectorial policies in African countries in view of sharing knowledge and best practices. Following a successful peer-to-peer learning partnership's approach with water operators that was initiated by the Advisory Board of the United Nations Secretary in 2006, AfWA developed a five-year business plan for its programs with focus on addressing the water supply challenge in Africa through the peer-to peer learning partnership approach. With financial support from the United States Agency for International Development (USAID) from 2016 to 2019, AfWA has been implementing the African Water Association Capacity building program (AfriCap).

This white paper is a combination of results from case study audits on the status of water quality laboratories conducted through the third component of AfriCap which aims at developing the capacity of drinking water quality laboratories in West Africa with the support of US EPA. To achieve this, a total of ten (10) laboratories namely, the Laboratories of CAMWATER (Cameroon), LACQUE (ONEP Cote d'Ivoire), SEEN (Niger), SEG (Conakry, Guinea), SODECI (Cote d'Ivoire), the two laboratories of the Federal Capital Territory Water Board (FCTWB, Abuja, Nigeria) and finally the two laboratories of Ogun State Water Corporation (OSWC, Ogun, Nigeria), were selected to go through the ten (10) phases of a Peer-to-Peer partnership program. A SWOT analysis was then conducted to analyze their Strengths, Weaknesses, Opportunities and Threats with regard to human resources development, external services offered by the central laboratory, maintenance and laboratory equipment as well as water quality management.

Results from the audits showed that none of the laboratories is accredited and most of them do not have laboratory manuals for procedures. This could explain the low capacity of these laboratories which implies low quality of results, and great expenses due to poor management of equipment. Results also highlighted the weakness in managing human resources.
It was concluded that to achieve the Sustainable Development Goals, there is need to prioritize the management of water quality, both at utility and government level, by training human resources and managing the infrastructure. In addition, actors in WASH sector were urged to pay more attention to regulatory, technical and financial aspects related to water quality for a better consideration of water quality as part of the implementation of the Sustainable Development Goals (SDGs). Furthermore, benchmarking visits and knowledge sharing could be sustainable solutions to water quality management challenges in Africa. It is only at this price that the health of populations will be guaranteed.

2

BACKGROUND

Africa is the continent where water quality impairment is getting worse. It remains the part of the world with a weak coverage when it comes to water quality data collection. This poor performance is due to the fact that water quality laboratories in African countries lack equipment, well-trained human resources, and funding to efficiently assess water quality in their respective fields. Water quality monitoring is a fundamental tool for water resources management in Africa. Its implementation requires high technical and organizational capacities of water quality laboratories. Unfortunately, Africa in general and West African countries in particular fail to provide good water quality data because of the poor performance of their laboratories.

This highlights the significance of the Drinking Water Laboratory Capacity Building Program under which the organization of validation workshop for stakeholders as well as training of auditors were held.

this Paper seeks to

1

Characterize the state of drinking water quality, particularly focusing on the opportunities and challenges in the sector;

2

Build on baseline information of good performing water utilities' laboratories to identify best practices for potential replication;

3

Assess the outcome of the ten (10) laboratory audits conducted through peer-to-peer learning partnership between mentors and mentees from municipalities, utilities and operators in the sub-region.

4

Raise awareness on the water quality challenges and advocate for its consideration in the implementation of SDG6.

3

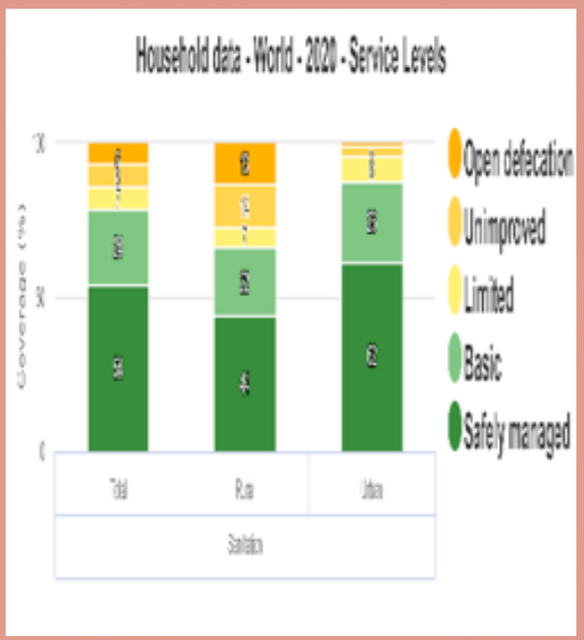
OVERVIEW OF DRINKING WATER QUALITY IN AFRICA

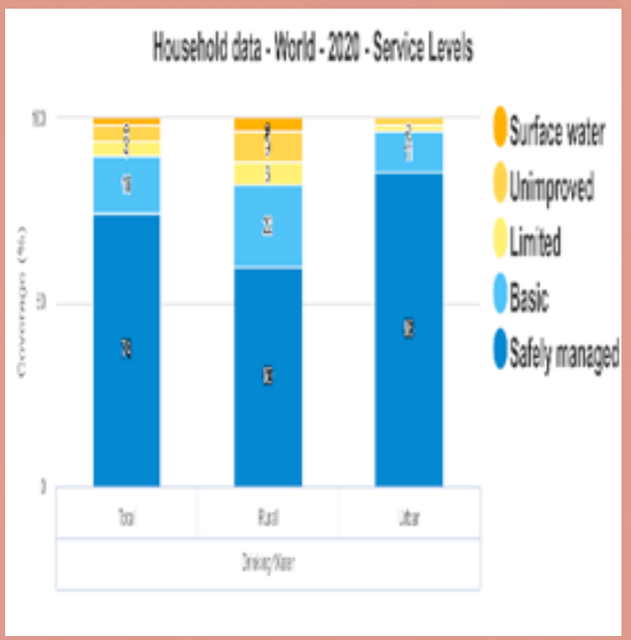
This section lays a foundation for this study by briefly reviewing the status of the water and sanitation sector in Africa. It summarizes the WASH status from the latest reports while focusing on the opportunities and challenges in the drinking water quality sector in Africa. Water quality, by definition, describes the chemical, physical, and biological characteristics of water, usually with respect to its suitability for a particular purpose such as drinking or irrigating. Water scarcity and lack of sanitation threaten public health. Poor sanitation and limited water lead to outbreaks of cholera, typhoid fever and dysentery, which can contaminate the limited stores of fresh water. When people store water in their homes, this creates a breeding ground for mosquitos, which leads to an increase in malaria and dengue fever. Other diseases connected to water scarcity include trachoma, plague and typhus. Prioritizing water quantity over quality can lead to bacterial diseases causing diarrhea, dehydration and death, especially in children (Niz, 2020). The section discusses in details the drinking water quality status in Africa, water quality laboratory analysis, major challenges with water quality laboratories in the region.

3.1 Overall Drinking Water Quality Status in Africa (WASH DATA)

3.1.1 General Overview and Statistics

The WHO & UNICEF JMP report released in 2021 (UNICEF, 2021), shows the global progress on WASH from 2000-2020 and highlights the five (5) years journey into the SDG. According to the report, a staggering 785 million people live without basic access to clean water. That's roughly 1 in 9 people on earth. While a tremendous progress has been seen, some countries still could not submit data which hinders the report coverage for all the countries. However, the following is the global update of household data for drinking water, sanitation and hygiene. The other part illustrates the quality of drinking water, sanitation and hygiene in Sub-Saharan Africa as our main target.





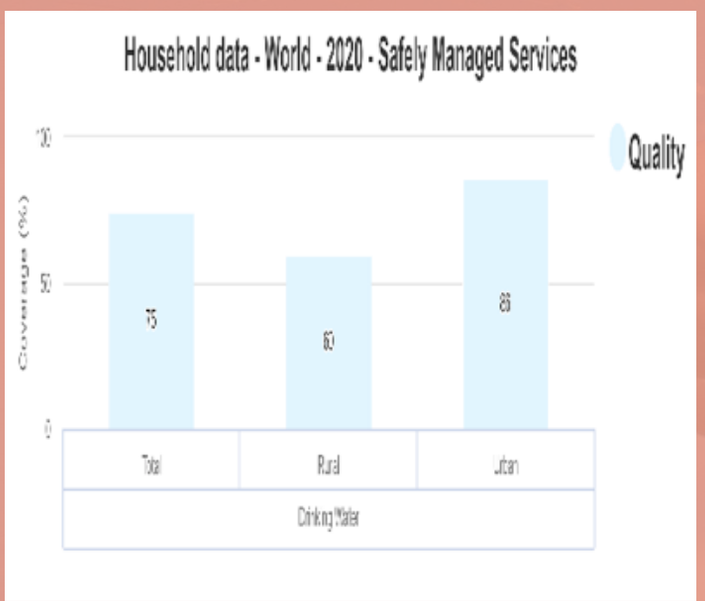
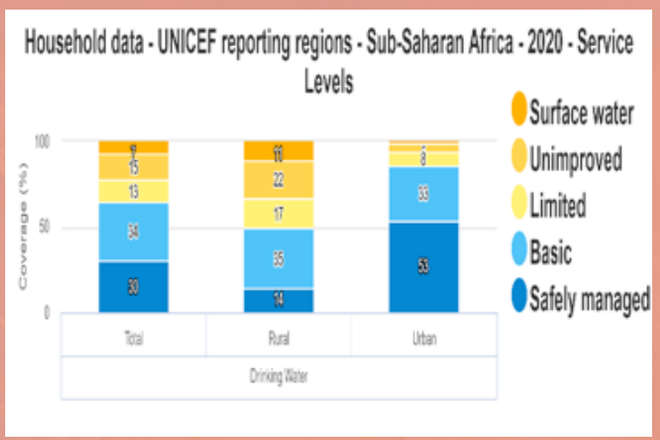


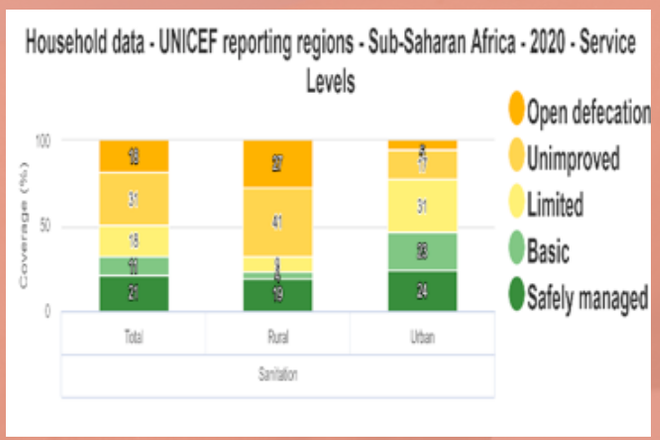
Fig. 2: WASH status in Sub- Saharan Africa

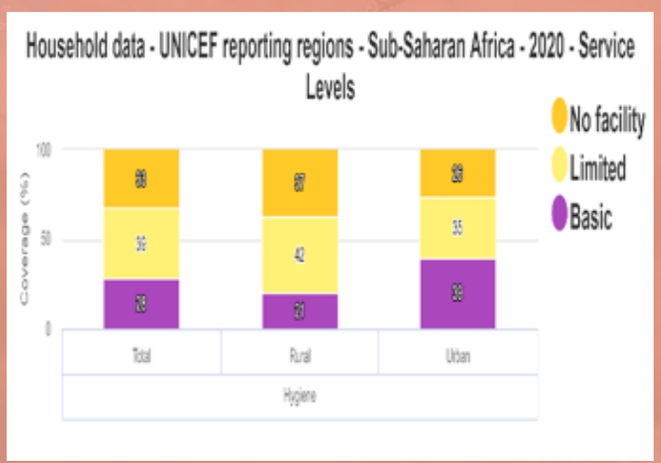
The figure clearly shows that there is only 36% coverage of quality drinking water in Sub- Saharan Africa.

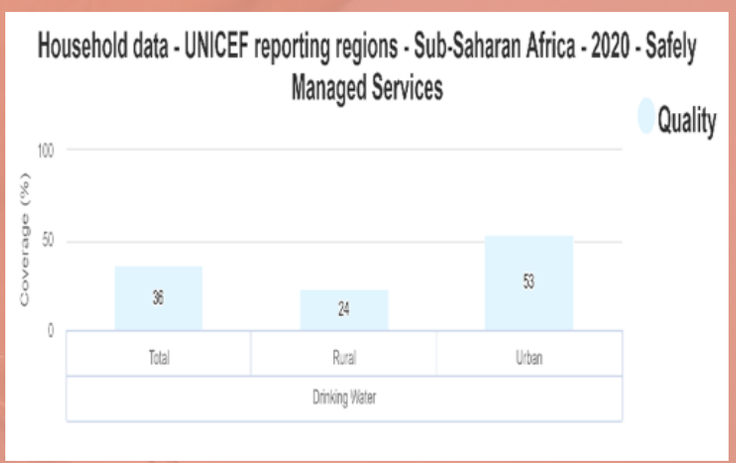
Fig. 1: Global Household WASH Data

The following is the status of WASH and Drinking Water Quality in Sub-Saharan Africa:









3.2 Water Quality Laboratory Analysis

3.2.1 Water Treatment

Water treatment refers to any process of improving water quality for the safety of the end-user. Water comes from different sources, and with different kind of contaminations, the treatment process may differ. To every treatment process, there is need to conduct a laboratory analysis to know the quality of water from the raw to the treated and distributed one.

Below is the general treatment illustration (for the main surface water treatment).

Photo 1: Water treatment plant.

Coagulation and Flocculation

Coagulation and flocculation are often the first steps in water treatment. Chemicals with a positive charge are added to the water. The positive charge of these chemicals neutralizes the negative charge of dirt and other dissolved particles in the water. When this occurs, the particles bind with the chemicals and form larger particles, called floc.

Sedimentation

During sedimentation, floc settles to the bottom of the water supply, due to its weight. This setting process is called sedimentation.

Filtration

Once the floc has settled to the bottom of the water supply, the clear water on top will pass through filters of varying compositions (sand, gravel, and charcoal) and pore sizes, in order to remove dissolved particles, such as dust, parasites, bacteria, viruses, and chemicals.

Disinfection

After the water has been filtered, a disinfectant (for example, chlorine, and chloramine) may be added in order to kill any remaining parasites, bacteria, and viruses, and to protect the water from germs when it is piped to homes and businesses.

3.2.2 Water Storage, Supply and Distribution

The distribution system includes all parts of the water system past treatment. Typical components of the distribution system are storage tanks, pipes, valves, and hydrants. Their quality must be approved for potable water use.

3.2.3 State of Water Utility Laboratories

As stated by the (US EPA, 2017), water sector, mainly drinking water and wastewater utilities should comprise of water laboratories in order to respond to natural, intentional or unintentional water contamination incidents. These laboratories should be capable to analyze water samples involving chemical, biological or radiochemical contaminants.

3.2.4 Enabling Environment

Currently, interventions for improving water quality monitoring performance among water suppliers and surveillance agencies are more focused on hardware and knowledge inputs, including upgrading laboratories, supplying equipment, digitization of the sector through introduction of mobile phone applications for data acquisition and management, and capacity building of the staff personnel (Peletza, 2018) (African Water Association, 2017) (US EPA, 2017). In addition, appropriate testing methods that are affordable to any water supplier have been developed (Peletza, 2018).

3.3 Major Challenges with Water Quality Laboratories in the Region

According to (Niz, 2020) study, the major challenges facing water quality laboratories in African countries are lack of equipment, insufficient well-trained human resources, as well as the lack of funding to efficiently assess water quality in their respective fields.

4

APPROACH FOR SOLVING THE WATER QUALITY CHALLENGES

4.1 Peer-to-Peer Learning Partnership for Water Quality

4.1.1 Drinking Water Laboratory Capacity Building program (DWL/CB)

Africa Water Vision 2025 has emphasized the vital role of water quality and sufficient quantity for Africa's sustainable development. Water quality laboratories play a key role in water quality monitoring and it is essential to build their capacity in order to allow them to serve people with safe water efficiently and effectively. To accomplish this aim, the United States Agency for International Development (USAID) is funding a Drinking Water Laboratory Capacity Building Program (DWL/CB) to be implemented by the United States Environmental Protection Agency (US EPA) in collaboration with Florida International University (FIU) and the African Water Association (AfWA). US EPA is an agency of the U.S. federal government that was created for the purpose of protecting human health and the environment. It is the largest US institution dedicated to environmental preservation.

Florida International University (FIU) is an American metropolitan public research university located in Miami, Florida. FIU is classified as a "tier-one" research university with a high research activity by the Carnegie Foundation and a first-tier research university by the Florida Legislature. FIU has a presence in Ouagadougou, Burkina Faso as the implementer of the West Africa Water Supply, Sanitation, and Hygiene Program funded by USAID. These two organizations have common concerns pertaining to the preservation of the environment and research within the fields of water and health. It is in this context that USAID/West Africa is funding a program entitled Drinking Water Laboratory Capacity Building (DWL/CB). US EPA is collaborating with FIU, which has a presence in West Africa to help with the logistical aspects of the Program.

4.1.2 Program Justification

Water quality monitoring is vital for water resources management. Well aware of the importance of water quality, the United Nations Environmental Program (UNEP) has set up GEMStat database, dedicated to water quality data in the world including Africa (Pan African Chemistry Network, 2010). Furthermore, to underpin its importance, the World Health Organization (WHO), the UNEP, the United Nations Educational, Scientific, and Cultural Organization (UNESCO), and the World Meteorological Organization (WMO) launched a monitoring program in 1977 in order to collect detailed data on the quality of global groundwater and surface water. WHO and UNICEF through the Join Monitoring Program (JMP) have also been collecting water quality data throughout the world. Consequently, all of these global organizations show the great importance of water quality data collection.

Water quality monitoring is necessary for water

quality protection and the implementation of preventive policies and practices. Water quality assessment plays a key role in drinking water purification, since the information helps to warn about the types of water contamination and select the best purification method. The success of this important process is closely related to the capacity of water quality laboratories to yield accurate and reliable data. The application of analytical quality assurance by laboratories demonstrates that they are capable of producing accurate and dependable data (Berwouts, 2010), (Pan African Chemistry Network, 2010).

Africa is the continent where water quality impairment is getting worse. It remains the part of the world with a weak coverage when it comes to water quality data collection. This poor performance is due to the fact that water quality laboratories in African countries lack equipment, well-trained human resources, and funding to efficiently assess water quality in their respective fields. Water quality monitoring is a fundamental tool for water resources management in Africa. Its implementation requires high technical and organizational capacities of water quality laboratories. Unfortunately, Africa in general and West African countries in particular fail to provide good water quality data because of the poor performance of their laboratories. This highlights the significance of this Drinking Water Laboratory Capacity Building Program (DWL).
AfriCap is a program whose mission is to build the capacity of the African Water Association (AfWA) financed by USAID. It promotes partnership in the drinking water sector. The general objective of the program is to strengthen AfWA towards improved regional coordination and collaboration for water, sanitation and hygiene (WASH) initiatives, the harmonization of WASH policies, capacity building of WASH stakeholders, and the diffusion of best practices and innovative knowledge products in order to enhance WASH services in West Africa.

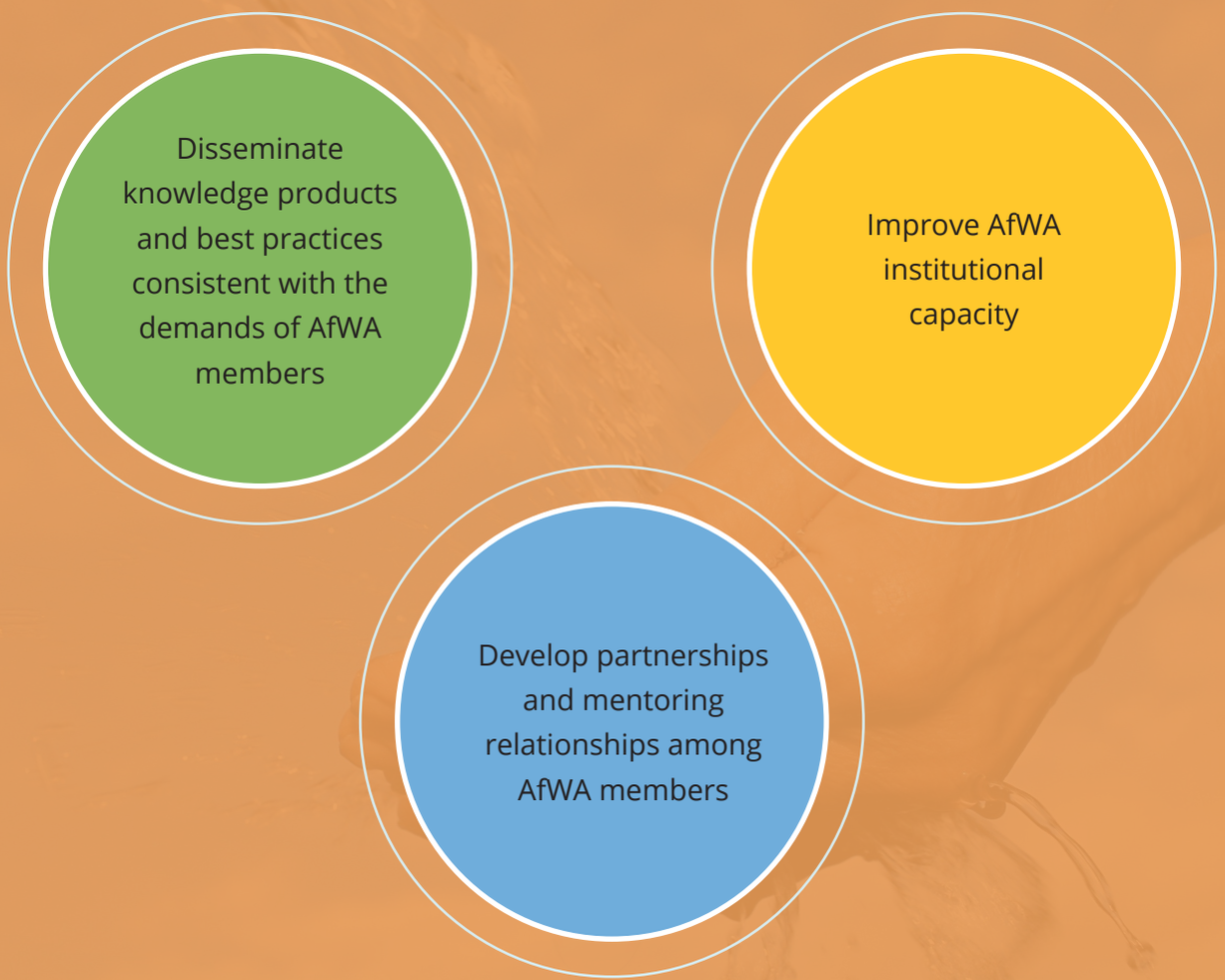


Fig. 3: Three Components of AfriCap

4.1.3 Program Implementation

Fig. 4: 10 Steps for the implementation of water quality management (AfriCap)

The next section presents a summary table of the Strengths, Weaknesses, Opportunities and Threats (SWOT) analysis of ten laboratories, namely the Laboratories of CAMWATER (Cameroon), LACQUE (ONEP Cote d'Ivoire), SEEN (Niger), SEG (Conakry, Guinea), SODECI (Cote d'Ivoire), the two laboratories of the Federal Capital Territory Water Board (FCTWB, Abuja, Nigeria) and finally the two laboratories of Ogun State Water Corporation (OSWC, Ogun, Nigeria).

Table 1: Summary table of the Strengths, Weaknesses, Opportunities and Threats (SWOT) analysis of 10 laboratories

SWOT ANALYSIS								
Laboratories/ Countries	**Strength**	**Weakness**	**Opportunity**	**Threat**	**Strength**	**Weakness**	**Opportunity**	**Threat**
	Human Resources Development				**External services offered by the Central Laboratory**			
CAMWATER/ Cameroon	-Gender balance (50% of the workforce) -Young, motivated and qualified staff -Training offered by the staff	-Weak management of the team and the Laboratory -Training-Work mismatch -Lack of training plan for the laboratory	--Ongoing reforms (CDE and CAMWATER merger) -Technological innovations -Partnerships for training	Job insecurities Reforms in progress (End of the affermage (lease) which could lead to the skills drain)	NONE			
LACQUE/ ONEP/ Cote d'Ivoire	-Competent and efficient staff (Enough Technical assistance and a metrologist) -Sharing of expertise and good practices with partners -Adoption and implementation of a training plan	-Under-staffed -Weak staff management - Poor execution of the training program -Poor Knowledge sharing -Lack of career orientation	-Dynamism of the drinking water sector -Synergy between LACQUE and other laboratories -New technologies -Decentralization of ONEP	-Insufficient financing for ONEP to fully implement the training plan -Budget restriction -Insufficient offers for specific training -Competitive environment -Partial consideration of the LACQUE organizational chart at the General Directorate level	-LACQUE's commitment to a quality approach -New generation equipment, - Premises and facilities in accordance with international standards with the possibility of extension -Institutional anchoring of LACQUE in the drinking water supply sector -Good reputation with industry stakeholders	-Insufficient human resources -Lack of equipment for micropollutants analysis -Non-accredited Laboratory -Delay in sending test reports -Lack of operational communication procedures between the Departments of ONEP, SODECI and LACQUE	-Increasing public / political interest in water quality issues -Processing of the New national regulations on drinking water standards -Development of new DWS projects in rural and urban areas -Extension of the laboratory's operational and analytical capacity: heavy metals, emerging pollutants.	-Competition -Accreditation requirement in calls for tenders -Insufficient legal and operational framework to strengthen the intervention and role of LACQUE in the drinking water supply sector -Lack of performance-based contract between ONEP and LACQUE Directorates and between DG and LACQUE

SWOT ANALYSIS								
Laboratories/ Countries	**Strength**	**Weakness**	**Opportunity**	**Threat**	**Strength**	**Weakness**	**Opportunity**	**Threat**
	Human Resources Development				**External services offered by the Central Laboratory**			
SEEN / Niger	-Efficient and Competent staff -Renovation of the Central Laboratory	-Insufficient human resources. -Lack of a replacement plan -Lack of formal satisfaction survey -Lack of authorization of laboratory staff	-Development of the SEEN -Existence of a training plan for Laboratory staff	Movement and shifting of staff from the Central Laboratory -Financial health	-Supervision of students; -Existence of computer security	-Insufficient technical platform	-Sufficient demand for laboratory analyzes -Technical assistance	-Non-payment of third- party analysis invoices
SEG / Guinea	-Young, competent and dynamic staff	-Lack of training plan -Lack of a succession plan -Insufficient human resources Lack of satisfaction survey Lack of replacement plan	A project to build a new Laboratory SEG-CTB training project (Wallone des Eaux)	-Movement and shifting of staff from the Central Laboratory -Financial health of SEG	-Supervision of students; -Compliance with commitments -Formalization of analysis rates	-Insufficient technical platform -Lack of IT security -Lack of equipment -Lack of a pricing study	-Sufficient demand for laboratory analyzes -Existence of new payment methods	-Non-payment of third- party analysis invoices
Central Laboratory (CL) of SODECI	-Competent and dynamic staff -Training plan -Existence of a satisfaction survey, Plan-Employment-Resources, -Job description sheet, objectives and a Substitution plan	Insufficient staff	-Continuous capacity building -Rehabilitation project for the CL	Movement and shift of staff of CL	-Existence of analysis tariffs -Respect of service commitments -Computerization of the database	-Insufficient technical platform	Ongoing and upcoming projects	Competitive environment

SWOT ANALYSIS								
Laboratories/ Countries	**Strength**	**Weakness**	**Opportunity**	**Threat**	**Strength**	**Weakness**	**Opportunity**	**Threat**
	Human Resources Development				**External services offered by the Central Laboratory**			
Central Laboratory of Federal Capital Territory Water Board (FCTWB), Abuja, Nigeria	-Well educated and qualified staff -Adequate staff strength Commitment from top management	-Inadequate continuous staff development (specific training) and management Low ICT application in laboratories for reporting and data management and lack of internet services	-Readiness of staff to rise up to challenges -Commitment support from Top Management and other departments	-May lead to frequent staff exit (leaving the organization or crossing to other departments) -May lead to low morale amongst staff in the department -May lead to low productivity and inefficiencies -Threat to public health protection	-Render services to external clients (Lab. Analysis of client water samples) Generation of extra revenues for the Water Board -External clients have confidence in lab. capability	-Inadequate budgetary allocation for Water Quality operations -Lack of adequate SOPs and chain of Custody procedures in place -Inadequate documentation for all processes -Inability for the laboratory carry some specialized analysis due to lack of adequate equipment and reagents	-Generation of extra revenue for the Water -Contribute to Public health protection -Public confidence in the operation of FCTWB/OSWC as a result of quality services rendered -Customer confidence in the water supply to the consumers -Integrity in data generated by the laboratory -Commitment and support from top management	-Poses threat to public health protection -Compromise quality of data generated from the Laboratory -Loss of revenues to the Water Board and state -Loss of customers to other competitors

SWOT ANALYSIS								
Laboratories/ Countries	**Strength**	**Weakness**	**Opportunity**	**Threat**	**Strength**	**Weakness**	**Opportunity**	**Threat**
	Maintenance and laboratory equipment				**Water Quality Management**			
CAMWATER/ Cameroon	Existence of a good technical platform	-Non-existence of an ECME management plan (Test measurement control equipment) -Lack of specific equipment to perform certain analyzes (Pesticides, TOC, etc.) -Metrology not mastered -Lack of compliance with safety standards	-Existence of private companies for the maintenance of laboratory equipment -New premises for the laboratory	-Unavailability of consumables and some laboratory spare parts on the local market -Lack of alternative energy sources	-Compliance with the pre-established monthly control program -Mastery of analytical water activities -Financial availability	-Low reliability of results -Non-certified laboratory -Insufficient rolling logistics	-Inter laboratory activities -Support from ONEE and AfWA -Laboratory accreditation and Low competition -Integration of liquid sanitation in the field of competence of Camwater	Centralized control of activity -Positioning of the Water Quality Department with respect to the general organization chart -Safety at work
LACQUE/ ONEP/ Cote d'Ivoire	Existence and implementation of a maintenance plan for key equipment	-Insufficient funding to meet equipment maintenance needs -Lack of maintenance contract for certain equipment -Lack of monitoring and technological watch	Collaboration with funders	-Unavailability of some spare parts on the local market -Lack of local skills for the maintenance of certain equipment -The challenge of updating analytical capacities and skills	-Existence of a planning procedure for water quality control -Existence of a non-interference agreement from the CEO in the impartiality of LACQUE -Use of standardized methods -Management's commitment to achieving performance -Mastery of analytical water activities -The existence of an integrated IT strategy: LIMS software	-Non-compliance with the pre-established annual control program -Insufficient human resources and means of mobility	-Growing demand for analyzes -LACQUE accreditation	-The almost total dependence of the ONEP funding laboratory for its operation and extension -Existence of risk of conflict of interest with certain ONEP departments -Perception of a lack of impartiality of the laboratory in the test reports where ONEP can be accused

SWOT ANALYSIS								
Laboratories/ Countries	**Strength**	**Weakness**	**Opportunity**	**Threat**	**Strength**	**Weakness**	**Opportunity**	**Threat**
	Maintenance and laboratory equipment				**Water Quality Management**			
SEEN / Niger	-Existence of certified standards -Existence of a mapping of the hydraulic zones of the Niamey distribution network -An agent recruited to monitor online measuring devices	-Lack of a preventive maintenance plan for equipment -Lack of life sheets and equipment codification -Lack of plans / procedures for renewal, maintenance and disposal of equipment	The existence of the CMMS	Equipment obsolescence	-laboratories in the regions -Existence of a sampling program and a schedule for visiting the indoor centers -Existence of a record of customer complaints on water quality -Existence of a procedure for managing non-conformities on water quality	-Lack of a Water Quality Control plan -Insufficient metrological monitoring of laboratory equipment	-Current and future AEP projects (Opening of new centers)	-Public health problem, natural disasters -Unreliable results -Financial health
SEG / Guinea	-Existence of equipment renewal request sheets -Existence of a mapping of the hydraulic zones of the Conakry distribution network	-Lack of a preventive maintenance plan for equipment -Chronic lack of standards and reference solutions -Lack of the list of equipment heritage -Lack of renewal plan / procedures, and disposal of equipment	-Current and future projects for the acquisition of equipment -Non-renewal of equipment in time for service continuity		-Existence of qualified personnel -Daily analysis -Existence of an analysis program -Existence of a program for analysis, sampling and visit of the inland centers -Customer complaint	-Lack of a non-conformance management procedure -Lack of water quality targets -Lack of a measurement management system -Lack of a risk management plan	Support from technical and financial partners	-Unreliable results -Public health problem -Financial health of SEG

SWOT ANALYSIS								
Laboratories/ Countries	**Strength**	**Weakness**	**Opportunity**	**Threat**	**Strength**	**Weakness**	**Opportunity**	**Threat**
	Maintenance and laboratory equipment				**Water Quality Management**			
Central Laboratory of SODECI	-Existence of a preventive maintenance plan for equipment, disposal procedures. -Creation and furnishing of a metrology station at the DQE	Non-existence of a device maintenance contract	-Construction of the new CL -Support for capacity building	SODECI's financial health	-Existence of a control laboratory -Existence of a DR visit, sampling and analysis program -Daily analysis Existence of a measurement management system, a non-conformance management procedure and a risk management plan	-Confined workspace -Lack of a codification and sample management procedure	-Construction of the new LC -Donor support for capacity building -Remote monitoring of the quality of the water distributed in Abidjan -Development of a cartography of treated water through the CMMS -Installation of mobile disinfection kits -Improvement of water production units	-SODECI's financial health -Public health problem

SWOT ANALYSIS								
Laboratories/ Countries	**Strength**	**Weakness**	**Opportunity**	**Threat**	**Strength**	**Weakness**	**Opportunity**	**Threat**
	Maintenance and laboratory equipment				**Water Quality Management**			
Laboratories of Federal Capital Territory Water Board (FCTWB), Abuja, Nigeria	-Minimal day-to- day maintenance in place for laboratory equipment	-Absence of laboratory equipment maintenance program/plan -Inadequate budgetary allocation for equipment maintenance -Inadequate released of funds for equipment maintenance -Lack of personnel competence in equipment maintenance and repairs -Inadequate performance checks on laboratory equipment -Inadequate calibration of laboratory and equipment	-Enhanced equipment reliability and reproducibility -Prolonged life span of laboratory equipment -Promote integrity of data generated from the Lab -Reduced cost of laboratory operations and maintenance -Commitment and support from top management	-Frequent breakdown of equipment -Reduced life span of Laboratory equipment -Low integrity of data generated from the Laboratory -Increased cost of operations -Loss of clients to other competitors -General integrity of laboratory affected	-Adequately educated and qualified staff for water quality management -Adequate staff strength -Good institutional structure to support water quality management at all levels -Capability to carry out basic plant control, distribution and Catchment water quality assessment -Availability of basic laboratory equipment to assess and manage water quality -Well defined separation of laboratory for microbiology and chemistry for Uuman Dam WTP Labs 1 and 2. -Performance of sterility test on microbial media in the city lab -Meeting expectations of consumers for regular supply and quality of service	-Absence of Laboratory Quality Assurance Manual For Water for laboratory operations and management -Inadequate Standard Operating procedures (SOPs) for equipment, test methods and sampling plan -Inadequate Quality control and Quality assurance in laboratory operations -Inadequate documentation for all Laboratory Operations (Log books, bench sheets, Chain of custody forms} -Inadequate continuous staff development (External and internal training Opportunities) for water quality management -Microbiology and chemistry labs not seperated for all laboratories (both in same room) -Inadequate budgetary allocation and release of funds for water quality monitoring and management	-for important decision- making -Improved consumer, regulatory and investor confidence in quality of service delivery -Increased motivation and morale of staff -Minimize wastage of resources and cost for water quality management and operations -Compliance to quality and regulatory targets -Good record keeping and management -Improved health and safety -Good Water quality is key to the attainment of all the SDGs, agenda 2030 (especially SDG 6) -Water quality is receiving attention nationally and internationally	-Quality of water supplied may be compromised -Threat to public health protection that increase the national disease burden -Loss of very important data for planning and decision-making -Loss of consumer, regulatory and investor confidence in quality of service delivery -Low commitment of staff leading to low productivity -Wastage of resources and high cost for water quality management and operations -Non-compliance to quality and regulatory targets Low productivity from staff leading to poor performance of the corporation -Feeling of lack of recognition from staff

SWOT ANALYSIS								
Laboratories/ Countries	**Strength**	**Weakness**	**Opportunity**	**Threat**	**Strength**	**Weakness**	**Opportunity**	**Threat**
	Maintenance and laboratory equipment				**Water Quality Management**			
Laboratories of Federal Capital Territory Water Board (FCTWB), Abuja, Nigeria						-Power supply to laboratory very erratic affecting equipment stability, sample storage, continuity of work etc -Unsatisfactory housekeeping, health and safety in all the laboratories and the water treatment plants -Inadequate reference standards for calibration and standardization of laboratory equipment and reagents -Lack of reliable means of transport for water quality management and operations -Absence of internal auditing and inter laboratory proficiency testing exercices -Inadequate distribution of water sampling	-Commitment and support from top management -Support national development agenda (sustainable development)	-Low morale of some staff in department May miss the opportunity to the attainment of all the SDGs goal 6 (Ageda 2030)

4.1.4 Challenges of the Peer-to Peer Learning Partnership for Water Quality Laboratories

The following major challenges were addressed:

Table 2: Major challenges of the Peer-to Peer learning Partnership for water quality laboratories

CATEGORIES	MAJOR CHALLENGES FACING THE LABORATORIES
Human Resources	• Insufficient staff • Lack of work profile • Weak managerial and technical capacity of staff
Technical Aspect	• Non-standard workspace • Weak laboratory equipment • Poor management of assets (stocks, monitoring, etc.) • Lack of lab manuals • Lack of safety and waste management plans

4.1.5 Lessons learned

Following the assessments, the operators of the laboratories visited were able to draw the following lessons:

- The development of laboratory assessment tools and the training of auditors provide a" pool" of experts and other tools to implement the performance improvement plan.
- The involvement of the General Managers of the water companies visited, is proof of the desire to improve the performance of laboratories in the control and monitoring of water quality.

5

CONCLUSION AND RECOMMENDATIONS

None of the audited laboratories is accredited, which indicates the low capacity of these laboratories. Most of these laboratories also do not have a manual of procedures, and this has a bad impact on the quality of the results and the management of the equipment often acquired at great expense. Finally, there is a weakness in the management of human resources, the quality of which is to be deplored in most cases. On this race toward the Sustainable Development Goals (SDGs), we must no longer provide water in quantity only, but also in line with quality standards. Therefore, the management of water quality becomes one of the priorities of governments, it being understood that the public authorities must address this aspect in terms of training human resources and adequate management of infrastructure. It is therefore imperative for our governments and other actors in the WASH sector to pay more attention to regulatory, technical and financial aspects related to water quality for a better consideration of water quality as part of the implementation of the Sustainable Development Goals (SDGs). Benchmarking visits and knowledge sharing could be serious solutions to explore for reversing the current trend. It is only at this price that the health of populations will be guaranteed.

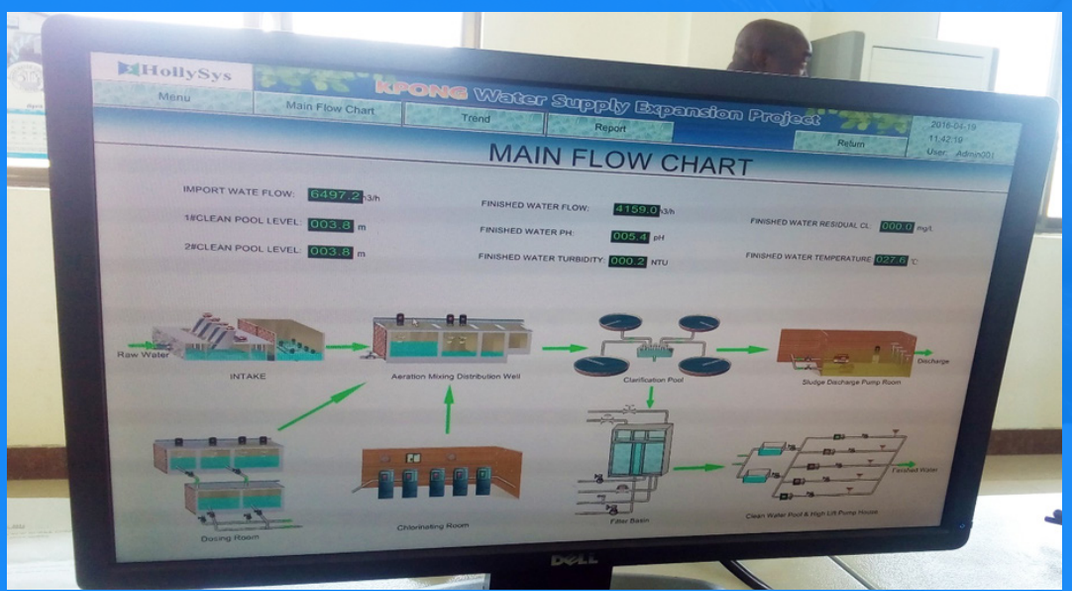
REFERENCES

- African Water Association. (2017). *Water Quality: The ONEP Gets Equipped With a 1.7 Billion Fcfa Value Laboratory.* Retrieved 10, 24, 2021
- Berwouts, S. M. (2010). Approaches to quality management and accreditation in a genetic testing laboratory. *Eur J Hum Genet* .
- *Niz, S. (2020). 6 FACTS ABOUT WATER QUALITY IN SUB-SAHARAN AFRICA.*
- Pan African Chemistry Network. (2010). *Africa's Water Quality: A Chemical Science Perspective.* Pan African Chemistry Network.
- Peletza, R. (2018). Why do water quality monitoring programs succeed or fail? A qualitative comparative analysis of regulated testing systems in sub-Saharan Africa. I*nternational Journal of Hygiene and Environmental Health, 2-3.*
- UNICEF, J. (2021). *PROGRESS ON HOUSEHOLD DRINKING WATER, SANITATION AND HYGIENE 2000-2020 FIVE YEARS INTO SDGs.*
- US EPA. (2017). *Urban drinking Water quality laboratory capacity building in West Africa. EPA Collaboration With Sub-Saharan Africa.*

APPENDICES

Appendix 1:

Benchmarking Visits to Mentor-Mentee Laboratories



Benchmarking Visits to Mentor-Mentee Laboratories

Appendix 2:
Laboratory Auditing Material Tools

MICRO CHECKLISTS

Element	Number	Yes	No	NA	Comments
Are presterilized plastic or sterilizable glass culture dishes used?	**3.12.1**	.	.	.	.
Is the sterility of the glass culture dishes maintained by placement in stainless steel or aluminum canisters or a wrap of heavy aluminum foil or char-resistant paper?		.	.	.	.
Are loose-lid petri dishes incubated in a tight-fitting container with a moistened paper towel?	**3.12.2**	.	.	.	.
Are opened packs of disposable culture dishes resealed between use periods?	**3.12.3**	.	.	.	.
For membrane filter methods, are culture dishes of an appropriate size to allow the transfer of a single membrane per plate?	**3.12.4**	.	.	.	.
Pipets	**3.13**	.	.	.	.
Are glass pipets sterilized and maintained in stainless steel or aluminum canisters or wrapped individually in char-resistant paper or aluminum foil?	**3.13.1**	.	.	.	.
Do pipets have legible markings and are they not chipped or etched?	**3.13.2**	.	.	.	.
Are opened packs of disposable sterile pipets resealed between use periods?	**3.13.3**	.	.	.	.
Are pipets delivering volumes of 10 mL or less accurate to within a 2.5% tolerance?	**3.13.4**	.	.	.	.
Are calibrated micropipetters used with sterile tips?	**3.13.5**	.	.	.	.
Are micropipetters calibrated annually and adjusted or replaced if the precision or accuracy is greater than 2.5%?	.	.	.	.	.
Glassware and Plasticware	**3.14**	.	.	.	.
Is the glassware made of borosilicate glass, or other corrosion resistant glass, and free of chips and cracks?	**3.14.1**	.	.	.	.
Are markings on graduated cylinders and pipets legible?	.	.	.	.	.
Are plastic items clear and nontoxic to microorganisms?	.	.			
QC Are the graduated cylinders used for measurement of sample volumes, or other precalibrated containers that have clearly marked volumes used in lieu of graduated cylinders, accurate to within a 2.5% tolerance?	**3.14.2**	.	.	.	.
Are culture tubes and containers containing fermentation medium of sufficient size to contain medium plus sample without being more than three quarters full?	**3.14.3**	.	.	.	.
Are tube closures made of stainless steel, plastic, aluminum, or screw caps with nontoxic liners?	**3.14.4**	.	.	.	.

MICRO CHECKLISTS

Element	Number	Yes	No	NA	Comments
QC On days the refrigerator is in use, and the laboratory is staffed, is the calibrated-corrected temperature recorded at least once per day?	**3.9.2**	.	.	.	.
Inoculating Equipment	**3.10**	.	.	.	.
Are sterile metal or disposable plastic loops, wood applicator sticks, sterile swabs, or sterile plastic disposable pipet tips used?	.	.	.	.	.
Are wood applicator sticks, if used, sterilized by dry hear?	.	.	.	.	.
Are metal inoculating loops and/or needles made of nickel alloy or platinum?	.	.	.	.	.
Membrane Filtration (MF) Equipment	**3.11**	.	.	.	.
Are MF units made of stainless steel, glass, porcelain, or autoclavable plastic?	**3.11.1**	.	.	.	.
Are they scratched, corroded, or leaking?					
QC If graduations on clear or plastic funnels are used to measure sample volume, is their accuracy checked with a Class B graduated cylinder or better (or other Class B glassware) and a record of this calibration check retained?	**3.11.1**	.	.	.	.
Is a 10 to 15x stereo microscope with a fluorescent light source used to count sheen colonies?	.	.	.	.	.
Are the membrane filters approved by the manufacturer for total coliform water analysis?	**3.11.2**	.	.	.	.
Are membrane filters to be used cellulose ester, white, gridmarked, 47 mm diameter, and 0.45 µm pore size?	**3.11.3**	.	.	.	.
If alternate pore sizes are used, does the manufacturer provide performance data equal to or better than the 0.45 µm pore size?	**3.11.4**	.	.	.	.
Are membrane filters and pads purchased presterilized or autoclaved for 10 minutes at 121°C before une?	.	.	.	.	.
QC Is the lot number for membrane filters and the date received recorded?	**3.11.5**	.	.	.	.
QC Are the membranes checked to see that they are not brinle or distorted?	.	.	.	.	.
QC Are the manufacturer's specification certification sheets available?	.	.	.	.	.
Are the forceps blunt and smooth-tipped without corrugations on the 3.11.6 inner sides of the tips?	**3.11.6**	.	.	.	.
Culture Dishes (loose or tight lids)	**3.12**	.	.	.	.

MICRO CHECKLISTS

Element	Number	Yes	No	NA	Comments
Hot Air Oven	**3.6**	.	.	.	.
Does the oven maintain a stable sterilization temperature of 170 180'C for at least two hours?	**3.6.1**	.	.	.	.
Is overcrowding avoided?	.	.	.	.	.
Is the oven thermometer graduated in 10°C increments or less, with the bulb placed in sand during use?	.	.	.	.	.
Colony Counter	**3.7**	.	.	.	.
Is a dark field colony counter used to count Heterotrophic Plate Count colonies?	.	.	.	.	.
Conductivity Meter	**3.8**	.	.	.	.
Are meters suitable for checking laboratory reagent-grade water and readable in units of either micromhos/cm or microsiemens/cm?	**3.8.1**	.	.	.	.
Refrigerator	**3.9**	.	.	.	.
Does the refrigerator maintain a temperature of 1-5*C?	**3.9.1**	.	.	.	.
Is the refrigerator thermometer graduated in at least I'C increments and the thermometer bulb immersed in liquid?	.	.	.	.	.

MICRO CHECKLISTS

Element	Number	Yes	No	NA	Comments
Autoclave	**3.5**	.	.	.	.
Does the autoclave have an internal heat source, a temperature gauge 3.5.1 with a sensor on the exhaust, a pressure gauge, and an operational safety valve?	**3.5.1**	.	.	.	.
Can the autoclave maintain a sterilization temperature during the sterilizing cycle and complete an entire cycle within 45 minutes when a 12-15 minute sterilization period is used?	.	.	.	.	.
Does the autoclave depressurize slowly enough to ensure that media will not boil over and bubbles will not form in inverted tubes?	.	.	.	.	.

MICRO CHECKLISTS

Element	Number	Yes	No	NA	Comments
Does observation of glass thermometers indicate no separation fluid columns?	.	.	.	.	.
Are only dial thermometers which can be adjusted used?		.	.	.	.
Incubator Unit	**3.4**	.	.	.	.
Do incubator units have an internal temperature monitoring device and maintain a temperature specified by the method used, usually 35 0.5°C and 44.5”+0.2”C?	**3.4.1**	.	.	.	.
For non-portable incubators, are thermometers placed on top and bottom shelves of the use area and immersed in liquid as directed by the manufacturer (except for electronic thermometers)?	.	.	.	.	.
When aluminum block incubators are used, do culture dishes and tubes fit snugly?	.	.	.	.	.

MICRO CHECKLISTS

Element	Number	Yes	No	NA	Comments
1. PERSONNEL					
Supervisor/Consultant	**1.1**	.	.	.	.
Does the supervisor of the microbiology laboratory have a bachelor's degree in microbiology, biology, or equivalent	.	.	.	.	.
Has a supervisor with a degree in a subject other than those listed above had at least one college-level microbiology laboratory course in which environmental microbiology was covered?	.	.	.	.	.
If a supervisor is not available, and a waiver has not been granted as per Section 1.3, is a consultant with the same qualifications substituted?	.	.	.	.	.
Can the laboratory document that the consultant is acceptable to the State, and present on-site frequently enough to satisfactorily perform a supervisor's duties?	.	.	.	.	.
a supervisor's duties? Can the laboratory supervisor demonstrate that a laboratory personnel have the ability to satisfactorily perform the analyses to which they are assigned"	.	.	.	.	.
Can the laboratory supervisor demonstrate that all data reported by the laboratory meets the required quality assurance and regulatory criteria?	.	.	.	.	.

MICRO CHECKLISTS

Element	Number	Yes	No	NA	Comments
2. LABORATORY FACILITIES					
Does the laboratory have facilities that are clean and temperature and humidity controlled, and with adequate lighting at the bench tops?	.	.	.	.	.
Does the laboratory maintain effective separation of incompatible testing areas?	.	.	.	.	.
Does the laboratory control access where appropriate, and minimize traffic flow through the work areas?	.	.	.	.	.
Does the laboratory ensure that contamination does not adversely affect data quality?	.	.	.	.	.
Does the laboratory have bench tops and floors that are easily cleaned and disinfected?	.	.	.	.	.
Does the laboratory have sufficient space for processing samples; storage space for media, glassware, and portable equipment, floor space for stationary equipment; and areas for cleaning glassware and sterilizing materials?	.	.	.	.	.
Does the laboratory have provisions for disposal of microbiological wastes?	.	.	.	.	.

MICRO CHECKLISTS

Element	Number	Yes	No	NA	Comments
3. LABORATORY EQUIPMENT AND SUPPLIES					
Dees the laboratory have the equipment and supplies needed to perform the approved methods for which certification has been requested?	.	.	.	.	.
pH meter	**3.1**	.	.	.	.
Are accuracy and scale graduations within 10.1 units?	**3.1.1**	.	.	.	.
Balance (top loader or pan)	**3.2**	.	.	.	.
Does the balance have a readability of 0.1 g?	**3.2.1**	.	.	.	.
Does the balance have a sensitivity of at least 0.1 g for a load of 150 g. and 1 mg for a load of 10 g or less?	**3.2.2**	.	.	.	.
Temperature Monitoring Device	**3.3**	.	.	.	.
Are glass, dial, or electronic thermometers graduated in 0.5'C increments (0.2°C increments for tests which are incubated at 44.5°C) or less, except as noted for hot air ovens (Section 3.6.1) and refrigerators (Section 3.9.1)?	**3.3.1**	.	.	.	.

Check list of Water Analyzis laboratories
Exploration Audit

Audit General Informations

Laboratory:
PO Box:
Street:
Street, State, PO Box:
Lieu de l'audit (s'il est différent): Laboratoire Central
Téléphone :
Electronic Address:
Structure Lead of Audit: AAE -Projet Afrique-CAP:
Auditors/Signatures:
Date(s) of audit:

MICRO CHECKLISTS

Element	Number	Yes	No	NA	Comments
Are cotton or foam plugs used?	.	.	.	.	.
Sample Containers	**3.15**				
Are sample containers wide-mouth plastic or non-corrosive glass bottles with non-leaking ground glass stoppers or caps with nontoxic liners, sterile plastic bags containing sodium thiosulfate, or other appropriate sample containers?	**3.15.1**	.	.	.	.
Is sample container capacity at least 120 ml (4 oz) to allow at least a 1-inch head space?	.	.	.	.	.
Are glass stoppers covered with aluminum foil or char-resistant paper for sterilization?	**3.15.2**	.	.	.	.
Are unsterilized glass and plastic bottles sterilized by autoclaving or alternatively, by dry oven for glass bottles?	**3.15.3**	.	.	.	.
Are empty containers moistened with several drops of water before autoclaving to prevent an “air lock” sterilization failure?	.	.	.	.	.
If chlorinated water is to be analyzed, is sufficient sodium thiosulfate added to the sample bottles before sterilization to neutralize any residual chlorine in the water sample?	**3.15.4**	.	.	.	.
Ultraviolet Lamp (if used)	**3.16**	.	.	.	.
Is the germicidal unit disconnected monthly and the lamp cleaned by wiping with soft cloth moistened with ethanol?	.	.	.	.	.
Is the longwave unit used for fluorometric tests kept clean?	**3.16.2**	.	.	.	.
QC Is the germicidal unit tested quarterly with a UV light meter or 3.16.2 agar spread plate?	.	.	.	.	.
QC Is the lamp replaced if it emits less than 70% of its initial output or if an agar spread plate containing 200 to 250 microorganisms, exposed to the UV light for two minutes, does not show a count reduction of 99%?	.	.	.	.	.
Spectrophotometer or colorimeter (if used)	**3.17**	.	.	.	.
Are wavelengths in the visible range?	**3.17.1**	.	.	.	.

African Water Association (AfWA)

Côte d'Ivoire - Abidjan - Cocody Riviera Palmeraie,
Rond-Point place de la renaissance, immeuble SODECI, 2ème étage
25 BP 1174 Abidjan 25, Phone: (+225) 27 22 49 96 11
Email: contact@afwa-hq.org / Website: www.afwa-hq.org