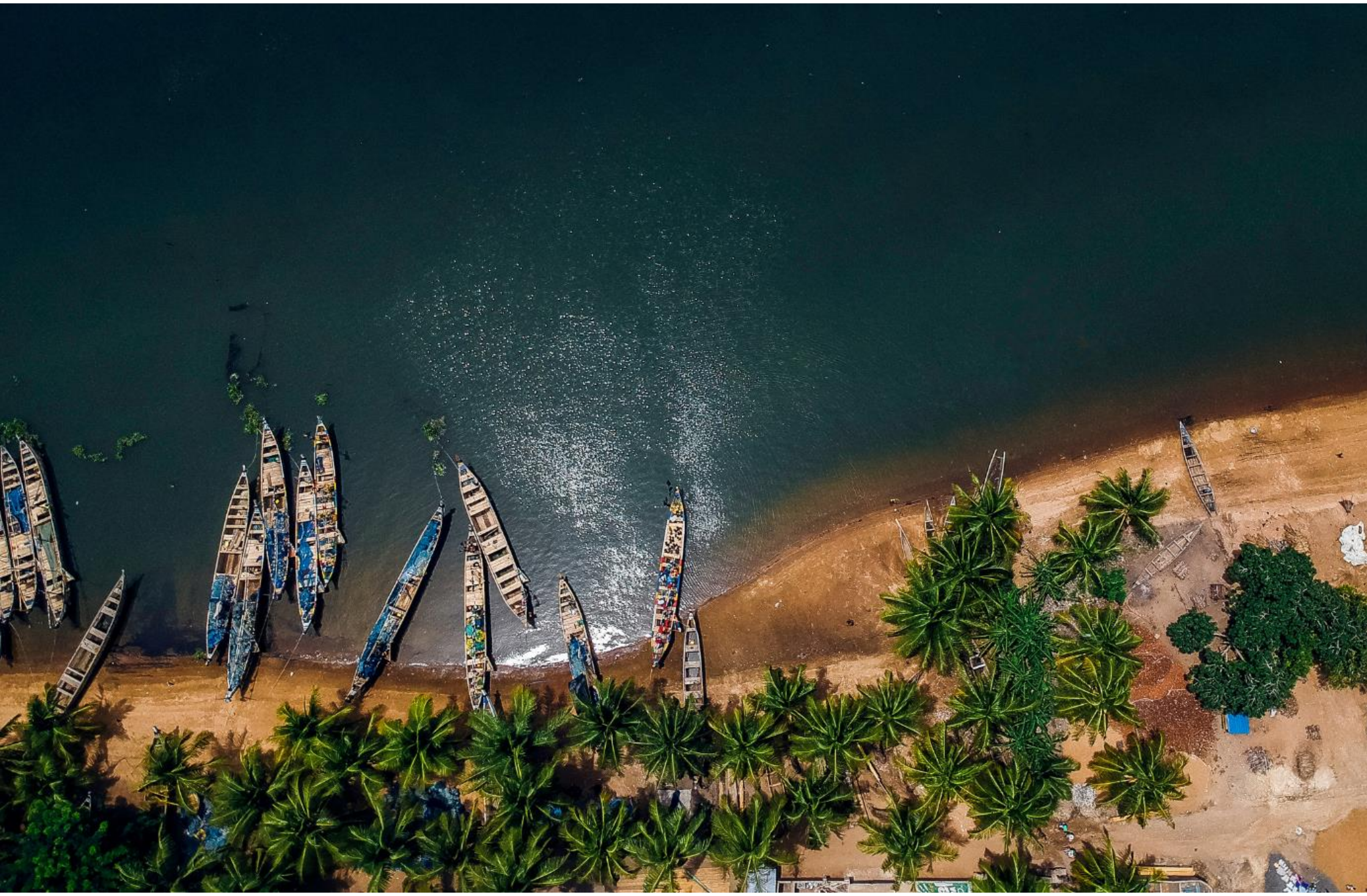

IMAGE: KWAME KWEGYIR-ADDO

SYNTHESIS OF WATER SAFETY PLANNING EFFORTS IN GHANA

July 2023

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ABOUT USAID REAL-WATER

USAID Rural Evidence and Learning for Water (REAL-Water) is a five-year partnership that develops and evaluates strategies for expanding access to safe, equitable, and sustainable rural water services. REAL-Water supports policymakers, development partners, and service providers to make strategic decisions and implement best practices for water management through implementation research. It also ensures coordination with USAID programs contributing to the water, sanitation, and hygiene (WASH) and water resources management (WRM) knowledge base, in alignment with the USAID Water for the World Implementation Research Agenda. For further information about this and other aspects of the project, as well as to access our knowledge products, please visit globalwaters.org/real-water.

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ACRONYMS

CWSA	Community Water and Sanitation Agency
DA	District Assembly
EPA	Environmental Protection Agency
FDA	Food and Drugs Authority
GDWQ	Guidelines for Drinking Water Quality
GoG	Government of Ghana
GSA	Ghana Standards Authority
GWCL	Ghana Water Company Limited
HACCP	Hazard Assessment and Critical Control Points
JMP	Joint Monitoring Programme
MDG	Millennium Development Goal
MMDAs	Metropolitan, Municipal and District Assemblies
MSWR	Ministry of Sanitation and Water Resources
NDPC	National Development Planning Commission
NDWQMF	National Drinking Water Quality Management Framework
PURC	Public Utility and Regulatory Commission
SDG	Sustainable Development Goal
SIGA	State Interests and Governance Authority
SOPs	Standard Operating Procedures
UNDP	United Nations Development Programme
UNEP	United Nations Environment Programme
UNICEF	United Nations Children's Fund
WASH	Water, Sanitation, and Hygiene
WHO	World Health Organization
WRC	Water Resources Commission
WSMT	Water and Sanitation Management Team
WSP	Water Safety Plan

EXECUTIVE SUMMARY

This report provides a synthesis of water safety plan (WSP) implementation efforts in Ghana. It highlights the implementation status, enabling environment, challenges, opportunities, and relevant recommendations for improvement.

BACKGROUND AND CONTEXT

Ghana exceeded the Millennium Development Goal (MDG) water coverage target (7C) to halve the proportion of the population without access to an improved water source by 2015 (Weststrate et al. 2019). By 2008, rural and urban access levels to improved sources were 77% and 93%, respectively (UNDP 2015; Monney and Antwi-Agyei 2018). The Joint Monitoring Programme (JMP) definition of "improved" drinking water sources includes "piped water on-premises" (i.e., a household water connection located inside the user's dwelling, plot, or yard), public taps or standpipe, tube wells or boreholes, protected dug wells, protected springs, and rainwater collection.

Regardless of the water source, this definition does not specify whether the water is of good quality (Satterthwaite 2016), and the incidence of water- and sanitation-related diseases remains high (Appiah-Effah et al. 2019). Diarrheal disease mainly results from drinking fecally contaminated water, and is the third most reported illness by health centers across Ghana (Verhoeven 2018). Afriyie and Ferber (2018) suggest a majority of all illnesses in Ghana are linked to drinking unclean water and other exposures to fecal contamination. Verhoeven (2018) estimated more than 6,600 diarrhea-related deaths each year, over half of which affect children under five.

This challenge is magnified in Northern Ghana, particularly in rural communities, where many people lack access to safe water (Afriyie and Ferber 2018; Verhoeven 2018; Green 2008). In the main northern region alone, more than 32% of the 2.5 million residents lack access to improved water sources.

Studies and national surveys in Ghana have found that many drinking water quality parameters do not conform to the national water quality standards (Ministry of Water Resource, Works, and Housing 2015). In 2015, Ghana developed a National Drinking Water Quality Management Framework (NDWQMF), based on the WSP approach of reducing contamination and other water supply risks. The Ghanaian NDWQMF promotes an understanding of the entire water supply system, including hazards that can compromise drinking water quality and the operational control needed to optimize drinking water quality and protect public health.

WATER SAFETY PLAN STATUS IN GHANA

In the urban sector, WSP implementation has just started. Only one of the Ghana Water Company Limited (GWCL) urban water systems has started implementing a WSP; numerous gaps need to be addressed to achieve the expected outcomes. In addition, there is no effective accountability mechanism from the Ministry of Sanitation and Water Resources (MSWR) and Public Utility and Regulatory Commission (PURC) to encourage GWCL to scale up WSP implementation.

The Community Water and Sanitation Agency (CWSA) has committed to implementing WSPs in most water systems under their management. WSP audits revealed implementation gaps that need to be addressed to yield the expected outcomes. Furthermore, there is a regulatory vacuum with respect to CWSA's new role as a utility. This means that an independent verification role is yet to be assigned to monitor WSP implementation.

Water systems managed by District Assemblies (DAs) and Water and Sanitation Management Teams (WSMTs), lack sufficient capacity to deliver safe water to consumers, particularly in rural areas and communities. WSP implementation in the DA/WSMT-managed systems has yet to start. No regulatory body exists to hold DAs accountable.

RECOMMENDATIONS

Ghana continues to rely upon traditional approaches to water quality management, focused on testing at the point of delivery or point of use. However, the policy framework in place adopts a risk-based drinking water quality management to ensure water safety along the entire water service delivery chain. Recommendations for improving and strengthening the water sector broadly include the following priorities:

- For urban water systems, the MSWR should implement a more robust regulatory mechanism, most likely through the PURC, to incentivize GWCL to implement or scale up WSPs for all customers.
- For rural water systems, clarify the appropriate regulatory mechanisms for CWSA-managed water supplies.
- For rural water systems, establish an independent verification role to monitor WSP implementation and documentation.
- Evaluate the feasibility of requiring WSPs at most point sources. It may be possible to require WSPs for small piped systems managed by DAs, but not as reasonable for community-managed systems.
- Clarify the water quality mandates for Ghana Standards Authority and Food and Drugs Authority, particularly regarding responsibilities for certifying and registering household water treatment and safe storage products (e.g., household filters), which play an important role in safe water service delivery.
- Support human resource development in the water sector via trainings, workshops, and accountability programs that adapt to the local context.
- Develop a gender mainstreaming policy and action plan for the water sector.
- Pay greater attention to efficient water use and water resource protection through wastewater recycling and reuse, reforestation in catchment areas of major river basins, and rainwater harvesting.

INTRODUCTION

OBJECTIVE

This report aims to synthesize Water Safety Plan (WSP) implementation efforts in Ghana. It highlights the implementation status, enabling environment, challenges, opportunities, and relevant recommendations for improving outcomes.

BACKGROUND

Recent nationally representative surveys in Ghana have called for urgent attention to drinking water quality as a key part of expanding access to safely managed drinking water services (GSS 2014, 2018, 2019) required to meet the United Nations Sustainable Development Goal (SDG) target 6.1 by 2030 (WHO & UNICEF 2017; Weststrate et al. 2019). Although Ghana in 2008 exceeded the previous Millennium Development Goal (MDG) water coverage target (7C) to halve the proportion of the population without access to an improved water source by 2015 (Weststrate et al. 2019), water supplies are not always of good quality (Satterthwaite 2016), and the incidence of water- and sanitation-related diseases remains devastating (Appiah-Effah et al. 2019).

Until the early 2000s, Ghana employed traditional compliance monitoring exclusively based on testing water quality at the entry into the distribution system or the point of delivery or use. Test results were compared with acceptable contaminant concentrations set by the Ghana Standards Authority to estimate public health risks. This traditional approach had substantial limitations, as test results are only available after exposure, and water from improved sources can still become contaminated or re-contaminated, particularly when delivered intermittently or through leaky distribution networks (EAWAG/SANDEC 2008; UNICEF 2009). In addition, the water volumes tested are usually not statistically representative and intermittent monitoring results cannot detect short-term fluctuations.

Early approaches to "safely managed drinking-water services" in Ghana started in the 2000s. This period saw the development of water policy and legislative instruments (including the National Water Policy, Water Safety Framework and Public Health Act, etc.) geared toward implementing a risk-based approach to water quality monitoring. These policies set the frameworks and implementation guidelines for ensuring water safety at the source and the point of use or consumption. Though these policies and strategies provided broad guidelines on issues related to safe water, they were fragmented and did not require a risk-based approach. Other challenges in the early approaches included poor coordination of roles and responsibilities of sector organizations regarding drinking water management, lack of distinct and consistent guidelines for drinking-water quality management across suppliers, widespread bacteriological contamination of drinking water, and in many instances, chemical concentrations surpassing national standards.

In 2015, Ghana adopted a risk-based approach to managing drinking water quality by developing its National Drinking Water Quality Management Framework (NDWQMF). The NDWQMF adopted the WSP approach as the primary tool for systematic risk identification, prioritization, and mitigation across the water supply delivery chain. WSPs are a systematic, risk-based approach to managing drinking water quality, applied from catchment to the point of use (Baum and Bartram 2018). They draw on principles from other risk management approaches, such as the multiple-barrier approach for water treatment, sanitary inspections, and hazard analysis and critical control points (HACCP) approach used in the food industry (Macleod, Guenther, and Delaire 2020). WSPs can improve control of hazards, regulatory compliance, microbiological water quality, asset management, communication, staff knowledge of water supplies, and public health outcomes (Baum and Bartram 2018; Gunnarsdottir et al. 2012; Setty et al. 2017). WSPs have been promoted among stakeholders through national stakeholder workshops, conferences, and training. Efforts by the national government and other development partners, such as the United Nations' Children's Fund (UNICEF), have aided the human resource capacity building, development of guidance materials and training modules, and institutional and policy reforms required for national WSP implementation.

Through a Government of Ghana (GoG)-UNICEF water, sanitation, and hygiene (WASH) program (2018–2022), key sector institutions like Ghana Water Company Limited (GWCL); Community Water and Sanitation Agency (CWSA); Regional Coordinating Council, and select Metropolitan, Municipal, and District Assemblies (MMDAs) engaged in consultative events to build capacities, share knowledge and lessons learned from WSP pilot systems, and facilitate understanding, buy-in, and adoption of WSPs. The workshops proved useful in helping service providers understand the WSP approach and its benefits. Engagement also led to the establishment of the Drinking Water Coordination Committee at the national level, inclusion of WSPs in the operational requirements of water utilities, and rollout of WSPs in urban and rural water systems. WSP promotion, however, has not reached the community level.

LEGAL, REGULATORY, AND POLICY FRAMEWORK FOR WATER SERVICE

Policies, strategies, and frameworks are key drivers of national development agendas. They provide legal backing and an enabling environment for developmental plans. According to the World Health Organization (WHO 2014), a regulatory push is the most effective way to ensure the broad implementation of WSP approaches. Table 1 summarizes Ghana's water sector legal frameworks, describing the mandates of various agencies.

Ghana already has in place legal, regulatory, and policy instruments that promote or require WSPs in urban and rural water supplies and private and self-supplies. The 1992 Constitution establishes ownership and management of the country's water resources, which are vested in the president in trust of the people of Ghana. The central government, through the National Development Planning Commission (NDPC), develops the National Development Framework, which serves as a roadmap for the short- and long-term sustainable use of water resources. The main policies governing the development, management, and supply of water resources in Ghana are the National Water Policy, Community Water and Sanitation Policy, and the National Medium-Term Development Policy Framework.

The National Water Policy developed in 2007 is being revised, whereas the Community Water and Sanitation Policy is pending final cabinet approval. The National Water Policy reflects the national aspirations for water resources management and water supply enshrined in the National Development Framework. The policy has a complementary implementation framework: the Water Sector Strategic Development Plan 2012–2025. This plan comprises three distinct strategic planning components: the national Integrated Water Resources Management Plan, the Urban Water Supply Strategy, and the Rural Water Supply and Sanitation Strategy. While the national Integrated Water Resources Management Plan charts the course for sustainable management of all the river basins and related natural resources, the Urban Water Supply Strategy, and Rural Water Supply and Sanitation Strategy define the strategies for the supply of potable water in both urban and rural communities. The Water Use Regulation also gives the legal mandate to the Water Resources Commission to regulate the abstraction of water resources. Additionally, in a timely effort to address climate change issues proactively, Ghana has developed a National Climate Change Policy that provides the blueprint for dealing with the challenges presented by climate change both in the near and long term, including water scarcity. An implementation framework complements it: the National Climate Change Adaptation Strategy.

The CWSA's Water Safety Framework (2010) provides broad guidelines on issues related to the provision of safe water in the rural areas of Ghana. The framework seeks to ensure that water in rural areas is supplied per water safety targets set by the Ghana Standards Board (now Ghana Standards Authority [GSA]) and WHO for domestic water supply. Major components of the Water Safety Framework include water quality testing, water safety risk assessment, water safety risk management, environmental and social surveillance, development of WSPs for water systems, and capacity building for stakeholders (CWSA 2010).

Table 1: Ghana's legal frameworks related to drinking water provision.

ENTITY	LAW	MANDATE
CWSA	Community Water and Sanitation Agency Act of 1998 (Act 564)	Facilitate the provision of safe water and related sanitation services to rural communities and small towns
District Assemblies (DAs)	Local Governance Act of 2016 (Act 936)	Overall development of the districts
Environmental Protection Agency (EPA)	Environmental Protection Agency Act, 1994 (Act 490)	Coordinate the activities of relevant organizations to control the generation, treatment, storage, transportation, and disposal of industrial waste into water bodies
Food and Drugs Authority (FDA)	Public Health Act, 2012 (Act 851)	Regulates packaged and bottled water production through producer inspection and regulation
GSA	Standards Authority Act, 1973	Sets standards for drinking water quality, testing procedures, and equipment
GWCL	Ghana Water Company Limited Act 461 of 1993 as amended by LI 1648 (1999)	Responsible for the planning and development of water supply systems in urban communities in the country and the design, construction, rehabilitation, and expansion of new and existing waterworks
NDPC	National Development Planning Commission Act, 1994 (Act 479)	Prepares national development plans; monitors, evaluates, and coordinates development policies, program, and projects
Public Utilities Regulatory Commission (PURC)	Public Utilities Regulatory Commission Act, 1997 (Act 538)	Economic and quality of service regulation of urban water utility
State Interests and Governance Authority (SIGA)	State Interests and Governance Authority Act, 2019 (Act 990)	Monitoring and evaluating the performance of government entities (such as GWCL and CWSA) through performance contracts
Water Resources Commission (WRC)	Water Resources Commission Act, 1996 (Act 522)	Regulation and management of the use of water resources

Source: Ghana WASH Sector Development Programme 2021–2030 (MSWR 2021)

In areas with communal water points (e.g., public standpipes and hand pumps), safe household handling practices can prevent re-contamination during transport and storage. The Ministry of Local Government and Rural Development has prepared a Household Water Treatment and Safe Storage Strategy to reduce the public health burden of water-related diseases. The strategy sets up a framework and implementation guidelines for water safety at the point of use or consumption. In the document, the GoG reaffirms its priority for accelerating safe practices, especially among the populations most vulnerable to emergencies and waterborne diseases.

The NDWQMF primarily guides communal drinking water quality management in Ghana (Ministry of Water Resources, Works, and Housing 2015). It has six components—commitment to drinking water quality management, water system analysis, verification, emergencies, specific sources, and supporting requirements—all of which are considered good practices for managing water supply systems (Figure 1).

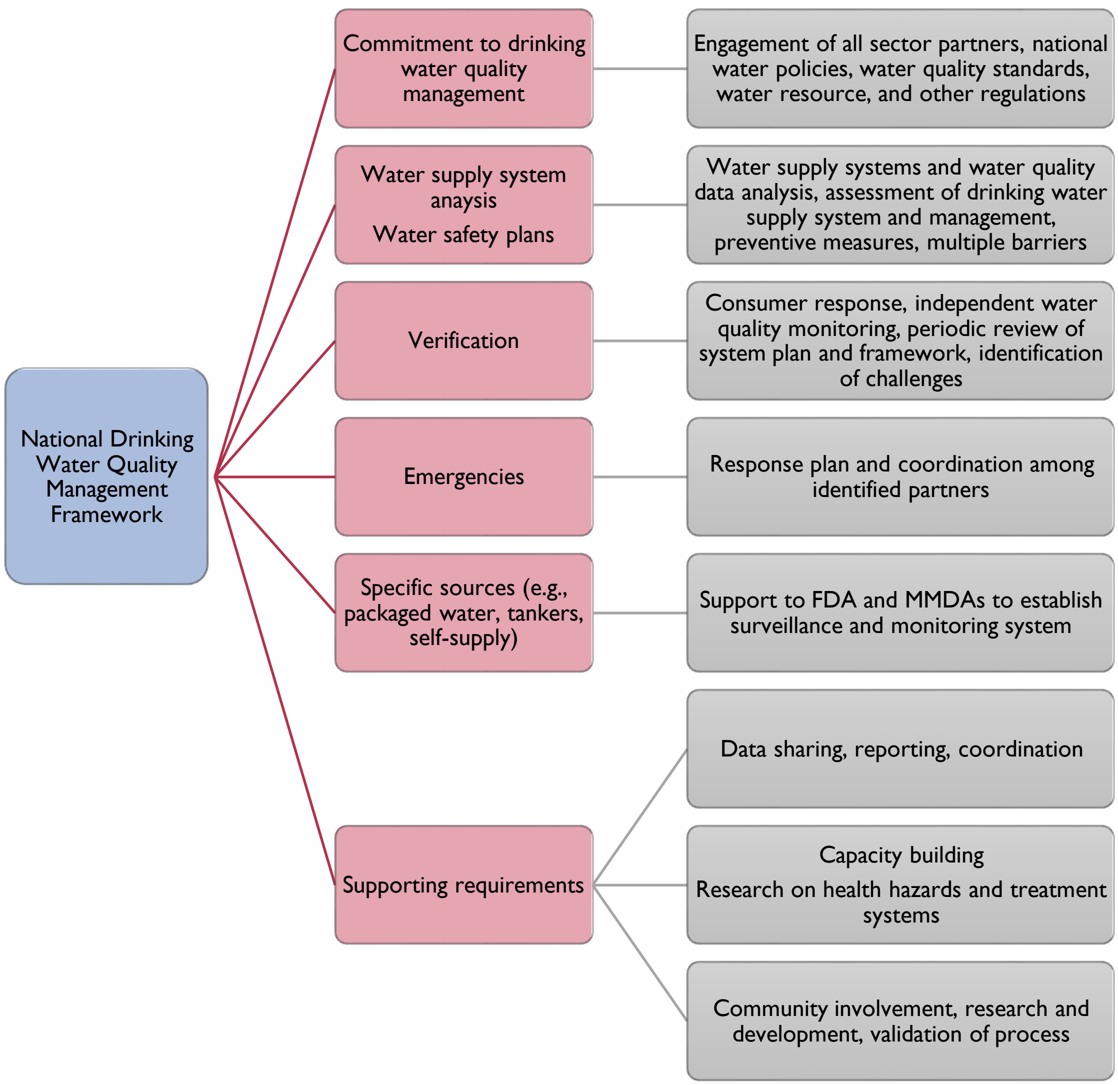

Figure 1: Key components of the Ghanaian National Drinking Water Quality Management Framework (NDWQMF) for ensuring safe water delivery.

Source: Adapted from the NDWQMF (Ministry of Water Resources, Works, and Housing 2015)

FDA = Food and Drugs Authority; MMDA = Metropolitan, Municipal, and District Assemblies

INSTITUTIONAL FRAMEWORK FOR WATER SERVICE

Ghana has a comprehensive and well-organized institutional framework for managing water resources and potable water supply. The framework defines institutional roles and responsibilities for national and sector-specific policy formulation and planning, regulation, and service delivery. The National Development Framework informs policy development and planning among water, sanitation, and hygiene (WASH) actors. The NDPC coordinates short- and long-term development frameworks with development partners who provide financial and technical support.

Under the Ministry of Sanitation and Water Resources (MSWR), the Water Directorate coordinates water service provision in rural and urban areas. It also oversees the activities of the WRC, which, among others, is responsible for regulating water resource abstraction across the country. The PURC ensures the enforcement of urban water quality regulations through a Water Quality Inspectorate, which reserves the right to audit water quality compliance. GWCL continues to function as the primary water supplier in urban areas. Its primary focus is to reduce non-revenue water, expand its customer base, and improve operating performance (Stoler et al. 2014).

CWSA is the lead agency mandated to facilitate the provision of safe water to rural communities and small towns. It has historically provided technical assistance, authored policies, guidelines, and regulations, and developed infrastructure for the rural water sector. It is now transitioning into a water utility for small towns. CWSA's organizational shift has occurred rapidly, but policies have not yet caught up. There are currently no legal provisions regulating CWSA activities as a utility, and the mechanisms for DAs and CWSA to settle water disputes are unclear.

Responsibilities for water service provision in schools and health care facilities fall within the jurisdictions of their respective line ministries, the Ministry of Education and the Ministry of Health. Employees from the ministries' technical agencies are embedded within the MMDAs to manage water service priorities and improvements. The roles and responsibilities of other actors are shown in Table 2.

Table 2: Water, sanitation, and hygiene (WASH) actors in Ghana and their responsibilities.

INSTITUTION	MANDATE OR FUNCTION RELATED TO WASH SERVICES
MSWR	Formulates WASH policies and coordinates WASH development
Ministry of Finance	Leads mobilization of financial resources (both local and foreign) for national development for all sectors, including WASH
Ministry of Gender	Leads gender mainstreaming in national development efforts, including WASH service delivery
Ministry of Local Government and Rural Development	Sets the policy framework and coordinates development programs of MMDAs to ensure sustainable development at the local level
Local Government Service Secretariat	Recruits, places, promotes, transfers, and dismisses all MMDA staff (including officials at the center of WASH planning, implementation, management, monitoring, evaluation and reporting at the MMDA levels)
Regional Coordinating Council	Ensures effective coordination, harmonization, and monitoring of all development activities, including WASH development in the region

INSTITUTION	MANDATE OR FUNCTION RELATED TO WASH SERVICES
MMDAs	Focal point for local development through inclusive and participatory planning, implementation, and monitoring and evaluation of various actions and activities to transform local areas, including WASH development (particularly decentralized community WASH)
Private sector	Contractors, suppliers, water service providers, and consultants who provide various goods and services to accelerate development of WASH facilities and services
Development partners	Both donor (e.g., World Bank) and United Nations agencies (e.g., UNICEF, UN Environment Programme [UNEP], UN Development Programme [UNDP], WHO) that provide technical and financial support to the sector

Source: Ghana WASH Sector Development Programme 2021–2030 (MSWR 2021)

WATER QUALITY MONITORING

MONITORING IN LARGE URBAN SETTINGS

Image 1: Aerial view of Accra, Ghana. Credit: Kwame Kwegyir-Addo

GWCL has protocols for treating and distributing potable drinking water to customers. The company's policies and procedures for water treatment ensure that treated water meets the values set by the GSA for drinking water quality (Appendix 1). The Water Quality Assurance Department ensures that high-quality water is produced and distributed to consumers, although the water quality data are not published. The most frequently tested parameters, *E. coli*, turbidity, pH, color, and residual chlorine, are carried out in all regional and treatment plant laboratories. Appendix 1 presents the minimum sampling frequency for drinking water sources in Ghana. Most laboratories employ portable testing equipment and ready-to-use reagents. Regional directors submit a monthly report on water quality testing data to the Water Quality and Chief Manager at the GWCL head office in Accra. They also submit these reports to the Managing Director of GWCL and PURC for consideration. The daily water quality data are recorded in logbooks and entered into the GWCL database for analysis.

Other water suppliers operate in urban areas, in addition to GWCL. These include self-supply, tanker services, and privately operated boreholes with standpipes. Self-supply refers to residents who have invested in their own water systems, such as boreholes, hand-dug wells, or rainwater systems. Tanker systems rely on GWCL as the water source or other independent water sources, such as private boreholes. Some urban residents also rely upon water from their neighbors. PURC has prepared guidelines to regulate activities of the tanker associations. According to the Water Tankering Guidelines (PURC 2000), GWCL or any service provider, whether under contract to GWCL or otherwise providing a public water supply to consumers, must make provisions that allow licensed tanker operators to fill tankers at controlled filling points. Tanker associations must check that owners use their tankers to only supply potable water and fill them only at approved GWCL filling points. Any business allowing a tanker to transport non-potable water without having it disinfected before filling again with potable water will lose their association license to operate. The tanker associations check for cleanliness of tanks at random times (minimum frequency of every three months) and monitor that tanker owners comply with and keep a record of the six-monthly GWCL disinfection requirement. Associations keep a register of banned operators, which is accessible to consumers.

Regulation of packaged water falls under the purview of the FDA. In response to complaints, the FDA collects samples from the market and conducts tests to assess various physical parameters such as color, turbidity, suspended particles, and fecal coliform bacteria. While studies generally indicate that sachet and bottled water in Ghana meet safety standards and exhibit good quality, concerns have been raised regarding the quality of sachet water and the lack of product registration and labeling in the industry (Appiah-Effah et al., 2021; Dzodzomenyo et al., 2018; Salifu et al., 2019). These concerns suggest quality control and regulatory oversight deficiencies within the sachet water sector. Appendix 1 summarizes the water quality from both packaged and tanker sources. Water from tanker services is often inconsistent in quality, with most samples failing to meet WHO and national standards. Microbial contamination in these water sources further underscores the gaps in quality control measures and monitoring. It indicates that the existing regulations may not be consistently enforced, as demonstrated by the absence of product registration among sachet water producers.

MONITORING IN RURAL SETTINGS

Image 2: A rural farm in northern Ghana. Credit:TG23

In rural settings (small towns and rural areas), the DAs are responsible for providing a safe water supply to the inhabitants. Water supplied in the district must meet the Ghana Drinking Water Standards provided by the GSA. The district must carry out water quality monitoring per the requirements prescribed in the NDWQMF (Dzodzomenyo et al. 2018; Table 3).

Table 3: Water quality sampling frequency required by Ghana's National Drinking Water Quality Management Framework (NDWQMF)

WATER SOURCE	POPULATION SERVED	SAMPLING FREQUENCY
Point source	300	Progressive sampling of all sources over 3–5-year cycle (maximum)
Piped water	<5,000	1 sample per month
	>5,000	1 sample per month for every 5,000 served

Before establishing the NDWQMF, CWSA developed a framework for water quality monitoring in rural areas and small towns, which required monitoring at least two times a year for all water sources (MSWR 2021). Water quality monitoring in CWSA-managed systems (piped schemes) is carried out quarterly or semiannually. Reports generated with monitoring data are analyzed, informing recommendations for additional risk mitigation measures for water systems. The regional and national CWSA offices conduct quality assurance checks on the water quality monitoring reports and oversee integration into the District Monitoring and Evaluation System database.

For community-based systems under the direct management of Water System Management Teams (WSMTs), the extent to which water quality monitoring is carried out is not readily known. According to Afriyie and Ferber (2018), there is currently no system for monitoring water quality at point sources in community-managed water systems besides the initial water quality tests conducted before handing over the facilities to communities.

SAFE WATER ACCESS IN GHANA

NATIONAL AND REGIONAL ACCESS AND DISPARITIES

Ghana has, over the years, made progress in improving access to "basic" water services (improved or protected sources that take 30 minutes or less to collect, round trip), but more is needed to achieve universal access to "safely managed" water services (improved sources that are accessible on premises, available when needed, and free from contamination) (Figure 2). As of 2020, almost 85% of the Ghanaian population has access to at least basic drinking water services, with rural and urban coverages of 72% and 96%, respectively (WHO/UNICEF, 2022; WHO/UNICEF JMP 2020). Nevertheless, more than 4 million Ghanaians do not receive at least a basic level of water service.

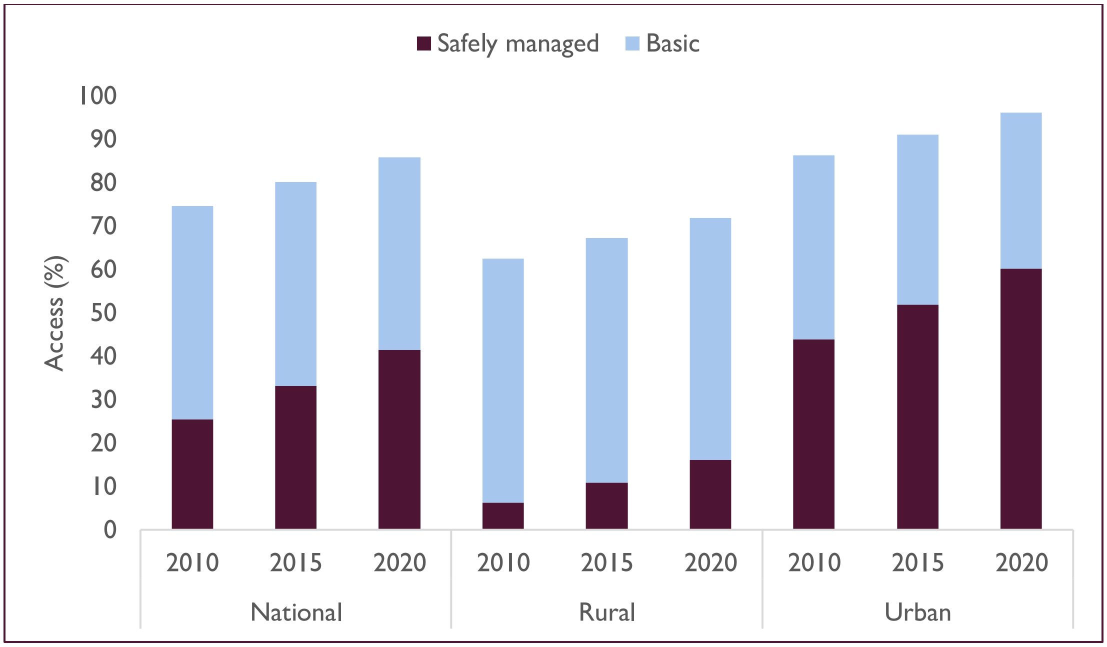

Figure 2: Ghana's national water coverage data for 2010, 2015, and 2020, using the WHO and UNICEF Joint Monitoring Programme (JMP) service ladder categories.

Source: Adapted from WHO/UNICEF JMP (2020)

Administrative data from Ghanaian water service providers indicate lower national access to basic services at 71% (with rural and urban coverages of 62% and 78%, respectively) compared to the WHO and UNICEF Joint Monitoring Programme (JMP) survey data (Table 4). The administrative data from GWCL is based on their estimate of the number of inhabitants served by their water systems through house connections and standpipes. CWSA estimates are also based on the number of inhabitants served by rural water systems.

Table 4: Ghana's JMP and administrative water coverage data

Water Service Level	Survey-based data 2020 (JMP)			Provider-Based Data (CWSA, GWCL, WRC)		
	Rural	Urban	National	Rural	Urban	National
Access (Coverage)	72%	96%	85%	62%	78%	71%

Source: Survey-based data comes from the WHO/UNICEF Joint Monitoring Platform (WHO/UNICEF JMP 2020), while administrative data come from Ghana Water Company Limited (GWCL), the Community Water and Sanitation Agency (CWSA), and Water Resources Commission (WRC) (MSWR 2021). The administrative data are used for national planning but do not align with the Sustainable Development Goal 6 targets.

In both datasets, urban dwellers had greater access to improved water supplies than those from rural areas. Disaggregating water coverage into just urban and rural categories, though, masks the huge spatial disparity across the country. A countrywide survey report by the Ghana Statistical Service (GSS) found that while more than 98%, 89%, and 88% of the populations of the Greater Accra, Ashanti, and Central Regions, respectively, had access to at least basic water supply services, only half (50%) and a little over half (59%) of the populations in the Northern and Volta Regions, respectively, had access to basic water supply services (GSS 2018; Figure 3). Further, the GSS survey found a clear wealth disparity in basic water access, where the wealthy were nearly twice as likely to have access to improved water supplies than the poor.

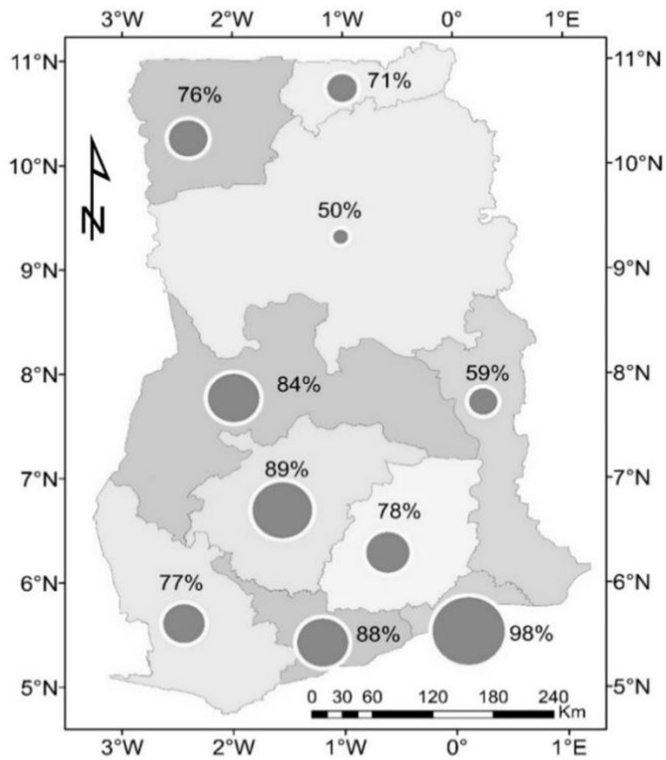

Figure 3: Map of Ghana's water coverage by region, as indicated by the size of the circle.

Source: Adapted from Multi-Indicator Cluster Survey (2017/2018) (GSS 2018); Regional coverage data is based on old regional boundaries due to the lack of data available for newly created regions.

Monney and Antwi-Agyei (2018) attributed regional disparities in drinking water access to a decline in domestic funding, inequitable distribution of water supply projects, and disproportionate donor support across regions of Ghana. This matches the findings of the UNDP Ghana MDGs report, which reflected greater support for water supply and sanitation interventions within the Greater Accra Metropolitan Area and Greater Kumasi Metropolitan Area (UNDP 2015).

The data on safely managed water services (Figure 2) reveal that only 41% of the Ghanaian population receives water from an improved source that is available when needed and free of fecal and priority chemical contamination. Thus, out of a population of more than 30 million, only 12.8 million have safe drinking water in their households. Safe drinking water is unavailable to an estimated 11.2 million rural residents in Ghana, representing 84% of the rural population (WHO/UNICEF 2021; WHO/UNUCEF JMP 2020; Afriyie and Ferber 2018).

MICROBIAL RISKS

Several studies have found that drinking water contamination occurs not only at the household level, but also at sources (Appiah-Effah et al. 2021; CWSA 2010; Dzodzomenyo et al. 2018; GSS 2014, 2018, 2019; Stoler et al. 2014). For example, the 2014 Ghana Living Standard Survey Round 6 found *E. coli* in 44% of improved drinking water sources and 62% of household drinking water samples (GSS 2014). The 2018

Multi-Indicator Cluster Survey found that 48% of Ghana's drinking water is microbially contaminated at the source, and 76% of Ghanaians are at risk of drinking microbially contaminated water at the point of use (GSS 2018; Figure 4). Both surveys found that urban waters (both source and household) are less likely to contain *E. coli* than rural water.

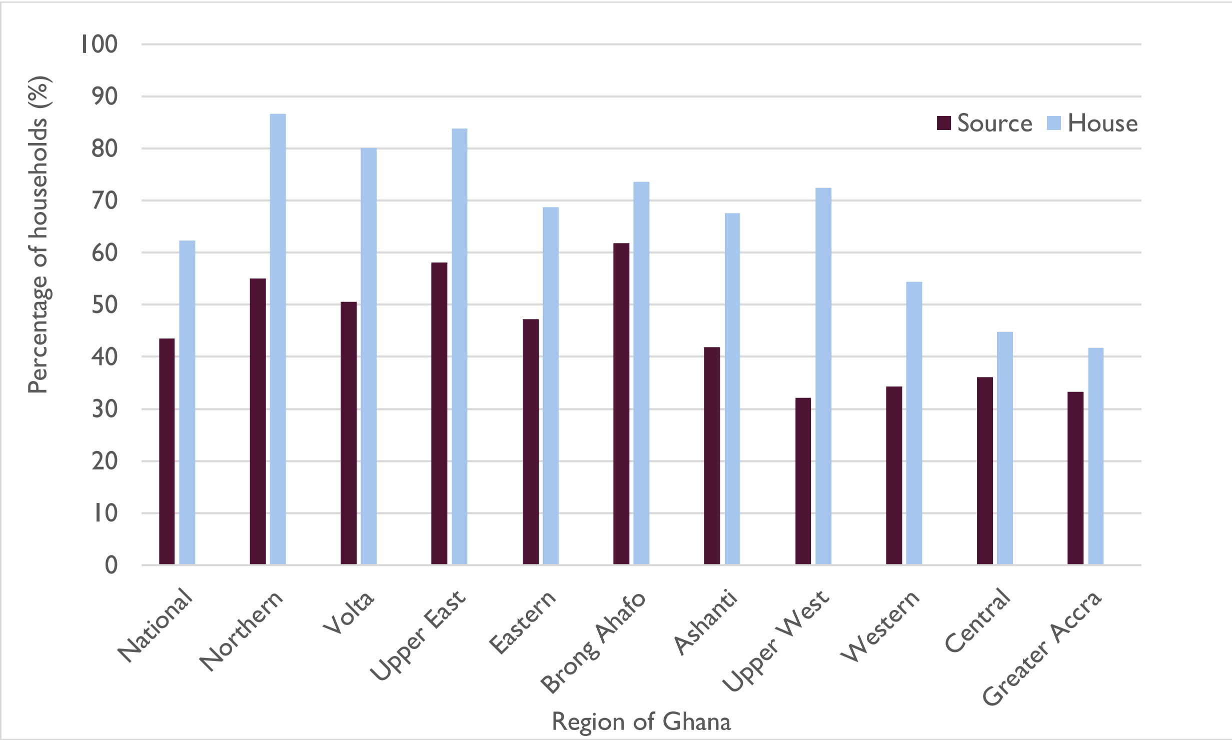

Figure 4: Percentage of households using water contaminated with *E. coli* at the source and the household level
Source: GLSS 6 (GSS 2014)

PRIORITY CHEMICAL RISKS

ARSENIC

Arsenic is a known human carcinogen found in groundwater in parts of Ghana since the 1990s, with a national standard of 0.01 milligrams per liter (mg/L) (Ministry of Water Resources, Works, and Housing 2015). Arsenic is spatially associated with areas of gold mining (e.g., Offin basin, Ankobra basin), with nearly one million people at risk (Ravenscroft 2007). Mining activities may cause the oxidation of sulfide minerals, resulting in the release of arsenic into groundwater. At least 10% of Ghana's rural bore wells have arsenic concentrations that exceed the national standards (Mead 2005). Arsenic was detected in 52 of 207 wells studied by Murcott (Murcott 2012). Concentrations ranging up to 2,000 parts per billion (ppb) were found; the high arsenic waters are associated with Upper Birimian rock, gold-arsenic mineralization, borehole wells, and low-pH, high-total-dissolved-solids waters.

FLUORIDE

Fluoride also occurs naturally in Ghana; the most affected parts are the Upper East, Upper West, and Northern regions. Many countries, including Ghana, have set a standard of 1.5 mg/L (Ministry of Water Resources, Works, and Housing 2015). Small amounts of fluoride (0.5–1.0 mg/L) are generally good for people's teeth; however, higher amounts (>1.5 mg/L) can cause dental and skeletal fluorosis (WHO 2017).

High fluoride in drinking water was identified by the CWSA under the Northern Region Water and Sanitation Project in 2002 during the construction of 700 water points (Saboor and Nyarko 2014). Of the 588 boreholes constructed, 8% (46) contained fluoride beyond the national limits. Similarly, of the 178 rehabilitated boreholes, 12% showed a high fluoride value. A British Geological Survey (2002) found high fluoride groundwater (up to 4 mg/L) in Bolgatanga in the Upper East Region of Ghana. Furthermore, a study conducted by the Ghana Health Service in 1995 indicates that about 33% of school children in the Bongo district suffered from dental fluorosis (Firempong et al. 2013). The study also revealed that approximately 63% of children in the Bongo township suffered from the disease. The study strongly supports the association between dental fluorosis and high fluoride levels in Bongo community groundwater, indicating that about 30% of wells exceeded the national standards for fluoride. The maximum fluoride concentration found was 4.8 mg/L in a dug well, and 28% of the assessed boreholes had an unacceptable level of fluoride.

IRON AND MANGANESE

High concentrations of iron and manganese in groundwater occur in many parts of Ghana. These are generally associated with acidic groundwater and are not directly problematic for human health (WHO 2017). Still, they may cause abandonment of otherwise safe water sources due to unpleasant odor, high turbidity, and taste. They can cause plumbing fixtures or laundry stains and an unpleasant appearance. Many countries, including Ghana, have set a standard for iron at 0.3 mg/L and manganese at 0.4 mg/L (Ministry of Water Resources, Works, and Housing 2015).

The most common sources of iron and manganese in the groundwater of Ghana are the result of weathering from rocks and minerals. High iron and manganese concentrations are often associated with aggressive groundwater (Ofosu 2005). In Hydrogeological Assessment Project areas (Carrier et al. 2011), concentrations of iron and manganese were not correlated with specific geology. The concentrations in the project area generally ranged from undetected to about 20 mg/L for iron and about 6 mg/L for manganese. Iron concentrations up to 65 mg/L have been reported. Out of 1,190 tests, 8% of samples showed iron concentrations exceeding the national standard value of 0.3 mg/L, while 6% showed manganese concentrations above the national standards of 0.4 mg/L.

More than 95% of water provided to small communities and towns comes from groundwater sources (Firempong et al. 2013), of which 20% contain high concentrations of manganese, iron, or both in Eastern, Greater Accra, Central, Northern, Ashanti, Volta and Western regions. Low pH (acidic) groundwater is found in most of the geological formations in these regions. Up to 41.5 mg/L of iron and approximately 10 mg/L of manganese were detected in some boreholes. Saboor and Nyarko (2014) noted that user communities have abandoned about 40% of wells with high iron or manganese levels. About 60% are used only marginally for drinking, cooking, and laundry purposes. This often compels communities to use any available unimproved water sources.

NITRATE AND NITRITE

Data on nitrate and nitrite content can provide some information regarding groundwater contamination and vulnerability to surface contamination. Under the Hydrogeological Assessment Project (Carrier et al. 2011), nitrate values ranged from undetected to concentrations of up to 171 mg/L. The highest concentrations are generally observed near larger communities (e.g., Bole, Walewale, Bongo), suggesting anthropogenic sources. Nitrate values exceeding the national standards were found in 8.7% of groundwater samples (n = 1,133). High nitrate concentrations have been measured in the Black Volta, Oti River, and White Volta watersheds; however, results do not indicate major problems in boreholes. For certain areas, anthropogenic contamination can affect groundwater quality, notably from inadequate sanitation facilities or fertilizers used in agriculture. Available data do not reveal any widespread problems related to nitrate in groundwater, but hand-dug wells could present higher concentrations, as they are usually shallower and less protected from surface influences.

STATUS OF WSP IMPLEMENTATION

WSP IMPLEMENTATION

Ghana is in the early stages of WSP implementation (WHO/IWA 2017). Only a few water systems have piloted WSPs, and they are being implemented to varying degrees.

GWCL, the urban water utility company, rolled out a WSP in only a few of its 88 urban water supply systems (GWCL 2019). The Kwanyarko Water Treatment Plant is in the Central Region of Ghana with a total installed capacity of 35,000 cubic meters per day (m^3/d) (GWCL and IWA 2020). A WSP implementation audit conducted by MSWR and UNICEF (UNICEF/MSWR 2020) revealed a number of strengths, such as a WSP team comprising technical and management GWCL staff and others from health, municipal, and DAs, all with authority to carry out WSP recommendations. Other attributes included sufficient documentation on the system description, hazards, control measures, and customer complaints, as well as an improvement plan and operational management plan. Despite these strengths, the study found critical gaps at various stages of WSP implementation. The WSP team is not complete and should incorporate relevant stakeholders (e.g., chiefs, EPA, WRC, Environmental Health Officers, Assemblies) to ensure communication and collaboration in implementing the catchment action plan. Other gaps noted include the lack of information for the WSP framework, lack of critical improvement plans, and lack of standard operating procedures. The full list of strengths and gaps is listed in Appendix 2.

In rural areas, CWSA claims to have developed WSPs for all of the approximately 177 piped water systems that they operate. These small supplies commonly face challenges that affect water safety planning, including issues related to human and financial resources, training, equipment, geographic remoteness and highly variable water supply system types and management arrangements (WHO/IWA 2017). While valuable resources have been developed to support WSP implementation for small systems, Asirifua Obeng et al. (2020) found that operators usually fail to comply with the schedule for some operation and maintenance tasks. For instance, the study found that some water quality control and monitoring activities, such as the regeneration of filtration units, maintenance of chlorine dosing systems, and regular water quality testing by a recognized laboratory, are not carried out as planned.

A WSP audit and certification exercise carried out by MSWR for two districts in CWSA's rural systems revealed some strengths and areas for improvement (UNICEF/MSWR 2020). The main strengths identified were a highly active WSP team with authority to implement the WSP, a detailed and accurate system description, and relevant documentation. All water quality standards are being met.

Improvements needed include a linkage between the hazards identified and the improvement plan, development of standard operating procedures and consumer satisfaction surveys, and development of an internal audit mechanism for in-house review. A full list of the strengths and weaknesses is presented in Appendix 2.

CHALLENGES AND OPPORTUNITIES

POLICY AND INSTITUTIONAL CHALLENGES AND OPPORTUNITIES

URBAN SYSTEMS

The PURC's regulatory role is clear and explicit, but it does not have a robust mechanism to obligate or provide incentives for GWCL to implement WSPs. Efforts to implement WSPs started in the early 2000s when Aqua Vitens Rand Limited was contracted as a private operator to manage GWCL. The 2015 NDWQMF provided a second push. Still, only one WSP was implemented.

As well, while the roles of the GSA and FDA are well understood, there is a lack of clarity on the mandates or institutions responsible for certifying and registering household water treatment and safe storage products (e.g., household filters), which play an important role in safe water service delivery. It has often been problematic for manufacturers to get authorization for their products because of the lack of clarity around which organization—GSA or FDA—has the mandate to register their products before they hit the market (Graphic Online 2014). This causes unnecessary confusion and delays (Dzodzomenyo et al. 2018).

RURAL SYSTEMS

CWSA's reform efforts, initiated in 2017, are ongoing (CWSA 2020b). Thus, the roles and responsibilities of CWSA and DAs, as well as regulatory oversight of CWSA's activities, remain unclear. CWSA has not officially relinquished its role as a technical advisory agency for the rural water sector, even though its activities in this area have reduced substantially in practice. The WSPs that CWSA has conducted revealed gaps in implementation and documentation, as well as the absence of an independent body to verify the WSPs.

WSP implementation has yet to start for water systems under the management of DAs and WSMTs (small towns and point sources). The same is true for water supplies for schools and health care facilities. The DA is the focal point for local development through inclusive and participatory planning, implementation, monitoring, and evaluation of WASH services; responsible for implementing the NDWQMF in their areas. The DAs also hold responsibility for ensuring safe water supply in institutions such as schools and health care facilities; however, water quality testing in institutions rarely occurs, and many rural water systems fall into disrepair for long periods. The WSMTs likewise do not carry out regular water quality testing, and accountability mechanisms have not been put in place. The largest question here is the feasibility of requiring WSPs at most point sources. There are likely thousands of these point sources that are managed by small water committees. It may be possible to require WSPs for small piped systems managed by DAs, but requiring the same from community-managed schemes and points could be difficult to implement.

HUMAN RESOURCE CAPACITY

Ghana has a considerable deficit in the human expertise required to deliver safe water and WSP requirements. The requisite knowledge and skills required by service provider staff to manage water systems, implement policies, and carry out WSP requirements effectively were found to be low, particularly in rural areas and those under the management of MMDAs (Appiah-Effah et al. 2019; Oduro-Kwarteng, Monney, and Braimah 2014).

On examination in 2014, CWSA did not have enough technical staff to manage rural water systems and implement WSPs (Oduro-Kwarteng, Monney, and Braimah 2014) effectively. According to the study, CWSA temporarily hired technical personnel for specific projects to augment availability when needed, but a larger proportion of personnel was employed in administration and finance compared to technical roles. On the other hand, the urban public water utility (GWCL) had hired technical staff as the majority of its personnel, permitting WSP implementation to be led by high-level technical staff with expertise in water quality.

CWSA's recent reform efforts have recognized this technical capacity gap (CWSA 2020b). The Community Ownership and Management Model has been modified from non-professionals managing water systems to engaging water systems management professionals. In 2017, CWSA employed 834 professional staff to manage the 125 piped water systems under its control at that time. These included engineers, technicians, accountants, water safety specialists, revenue collectors, and community relations officers. In addition, 269 auxiliary staff, made up of plumbers and technical operators, were employed (CWSA 2020a).

The relevance of capacity building for WSPs is reflected in the Reykjavik Principles (World Health Organization and Australia National Health and Medical Research Council 2006), which outline the general requirements for the sustainability of local water supplies in small systems (WHO 2006). A great deal of literature agrees on the importance of capacity development to sustain and accelerate WSP implementation.

GENDER MAINSTREAMING, EQUITY, AND INCLUSIVITY

Women's empowerment is critical to achieving the SDGs and promotes the advancement of the human right to water. The importance of women's participation in decision-making cannot be overstated, particularly in the water and sanitation sub-sectors. Notwithstanding, Oduro-Kwarteng et al. (2014) observed low female representation in the WASH sector. Female employees in GWCL represented 16% of the workforce, with a slightly higher representation in CWSA (21%). A similar observation was made in the private sector and nongovernmental organizations, where women represent about 20% of the workforce.

CLIMATE CHANGE AND VARIABILITY

CHANGES, SURFACE WATER, AND GROUNDWATER

Responding to climate change requires that the WSP framework identify and manage climate-related impacts on water supplies. Climate change is already affecting water resources in Ghana, especially with increased evaporation, variable rainfall patterns, and frequent flood and drought events (USAID and

Sustainable Water Partnership 2021; MESTI 2013; Owusu, Asumadu-Sarkodie, and Ameyo 2016; Asante and Amuakwa-Mensah 2015). Declining rainfall, drought, and rising temperatures, as well as increased pressures from a growing population, urbanization, and industrialization, are likely to compound the challenge of water reliability, particularly in hard-to-reach areas (World Bank Group 2021). Rainfall and evaporation changes impact surface water infiltration and recharge rates for groundwater, which, coupled with low water storage capacity, increases Ghana's vulnerability to unreliable rainfall patterns. This could further decrease the reliability of unimproved groundwater and surface water sources during droughts or prolonged dry seasons (World Bank Group 2021).

Additionally, Monney and Antwi-Agyei (2018) noted that, in some parts of the country, drying of hitherto perennial rivers in the dry season and reduction in groundwater recharge are becoming commonplace due to climate change. This is particularly true in the north, where climate change coupled with rainfall declines between 25% and 52% is predicted to hasten desertification.

Groundwater is widely used for rural water supply, particularly in periods of drought, and often does not require much treatment. Approximately 41% of the Ghanaian population (16% of urban and 59% of rural dwellers) depend on groundwater for household use (USAID and Sustainable Water Partnership 2021; Pavelic et al. 2012). Recent estimates indicate that inter-annual groundwater levels are relatively stable. However, seasonal fluctuations can range from 1 to 7 meters, indicating a high dependency on seasonal rainfall for recharge and potential vulnerability to drought (USAID and Sustainable Water Partnership 2021).

Finally, climate-related risks to drinking water can force water suppliers to shut down water systems temporarily or permanently, reducing access. In areas with high water demand, water companies tend to pump more water during droughts, potentially reducing water levels near boreholes. This leads to increased strain on pump mechanisms, which may cause breakdowns if maintenance is neglected.

VOLTA BASIN

Climate change will reduce water availability in the Volta Basin and increase vulnerability to drought. Climate change is expected to raise average annual temperatures by 1.7–3.5°C by the end of the century. While the impact on total precipitation is uncertain, higher temperatures will increase evaporation and cause water losses. Various research has predicted that climate change will significantly reduce groundwater recharge in several basins in Ghana (Pavelic et al. 2012; Asante and Amuakwa-Mensah 2015; MESTI 2013; USAID and Sustainable Water Partnership 2021). Declining rainfall and higher evapotranspiration rates in Burkina Faso are estimated to reduce the Volta River's annual flow by 24% by 2050 and 45% by 2100 (USAID and Sustainable Water Partnership 2021). Growing water demand in the Volta Basin's uppermost countries will worsen drought impacts and strain northern Ghana's water supply (McCartney et al. 2012). The reduced quantity of water will pose a significant challenge for human consumption as well as use in agriculture, industry, and hydropower.

COASTAL CONCERNS

Rising sea levels are increasing salinization in coastal water sources and wells (World Bank Group 2021). In the greater Accra region, high salinity has limited the use of boreholes for drinking and irrigation in small farming communities. In the Densu Basin, salinity is caused by seawater intrusion as a result of concentrated abstractions (USAID and Sustainable Water Partnership 2021). Sea level has risen more than 60 mm and may rise an additional 75–190 mm by 2100, increasing salinity in coastal aquifers.

CONCLUSIONS

Ghana has made good progress in improving access to drinking water. Nevertheless, this progress is hindered by high levels of microbial and chemical contamination. This is due partly to overreliance on traditional approaches to water quality management, where water quality testing is carried out at the point of delivery or point of use. Faster progress will require a paradigm shift from traditional to risk-based approaches that can ensure water safety along the entire water service delivery chain.

Recommendations for achieving this paradigm shift, and strengthening the water sector broadly, include the following priorities:

- For urban water systems, the MSWR should implement a more robust regulatory mechanism, most likely through the PURC, to incentivize GWCL to implement or scale up WSPs for all customers.
- For rural water systems, clarify the appropriate regulatory mechanism for CWSA management of water supplies.
- For rural water systems, establish an independent verification role to monitor WSP implementation and documentation. As CWSA has transitioned to a new role as a utility, this has left a regulatory vacuum.
- Evaluate the feasibility of requiring WSPs at most point sources. It may be possible to require WSPs for small piped systems managed by DAs, but not as reasonable for community-managed systems.
- Clarify the water quality mandates for Ghana Standards Authority and Food and Drugs Authority, particularly regarding responsibilities for certifying and registering household water treatment and safe storage products (e.g., household filters), which play an important role in safe water service delivery.
- Prioritize the strengthening of human resource development via trainings, workshops, and accountability programs that adapt to the local context. Numerous training materials and approaches exist for WSP capacity building. Through the GoG-UNICEF WASH program, various training materials on WSP documentation, regulation, auditing, and certification have been developed. WHO has also developed a list of WSP guidance and training materials. It is important that the section on materials, approaches, and customization of training materials by relevant stakeholders reflect the target group, local circumstances, and preferred mode of learning. Depending on size, location, and governance structures, customizing training will boost local ownership and contribute to long-term sustainability (Ferrero et al. 2019).
- To address the gaps in gender mainstreaming, equity, and inclusion, work with MSWR to develop a gender mainstreaming policy and action plan. This should encourage more women to participate in decision-making, starting with a target of roughly 30% female representation at all levels and progressively increasing to 50%, particularly in decision areas where women and children are disproportionately affected.
- Pay greater attention to efficient water use and water resource protection through wastewater recycling and reuse, reforestation in catchment areas of major river basins, and rainwater harvesting.

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APPENDIX 1: SUPPORTING TABLES

Table 5: Ghana Drinking Water Standards: primary parameters for routine water quality monitoring

CATEGORY	PARAMETER	UNIT OF MEASUREMENT[1]	GHANA STANDARDS	WHO GUIDELINES
Physical characteristics	pH	N/A	6.5–8.5	N/A
	Color	Hz	5	N/A
	Turbidity	NTU	5	N/A
	Temperature	°C	Not objectionable to consumers	N/A
	Dissolved oxygen	mg/L	Not substantially less than saturation	N/A
Water treatment–related chemicals (if used)	Aluminum	mg/L, max	0.2	N/A
	Residual free chlorine[2]	mg/L, min	0.2	0.2
	Copper	mg/L, max	2	2
Inorganics	Iron	mg/L, max	0.3	N/A
	Manganese	mg/L, max	0.4	N/A
Bacteriological	*E. coli*	CFU/100 mL	0	0

Sources: Ministry of Water Resources, Works, and Housing 2015; WHO 2017c

[1]CFU = colony-forming units; Hz = Hazen units; N/A = not applicable; NTU = Nephelometric turbidity units

[2]At the point of delivery

Table 6: Minimum frequency of sampling for drinking water sources in Ghana

TYPE OF WATER SUPPLY	MINIMUM NUMBER OF SAMPLES
Point sources	At least 2 tests per year for 5 years; additional tests are required if there are environmental changes or suspected contamination events
Piped supplies	
<5,000	1 sample per month
5,000–100,000	1 sample per month per 5,000 population
100,000–500,000	1 sample per month per 10,000 population plus 10 additional samples per month
>500,000	1 sample per month 50,000 population plus 50 additional samples per month

Source: GSA Water Quality – Specification for Drinking Water FDGS 175-1:2013

Table 7: Summary of water quality from packaged and tanker sources

PARAMETER	SOURCE	MEAN	MINIMUM	MAXIMUM	STANDARD DEVIATION	NO. OF SAMPLES	COMPLIANCE RATE	REFERENCE
Heterotrophic plate count (cfu/1 mL)	Sachet	15.6	0	35	10.7	34	60.8%- 80.9%	(Dzodzomenyo et al. 2018)
		63.5	0	443	107.0	78		
Total coliforms (cfu/100 mL)	Sachet	-	0	124	-	45	91%	(Appiah-Effah et al. 2021)
	Bottle	-	0	-	-	2	100%	
	Tanker	-	224	224	-	1	0%	
E. coli (cfu/100 mL)	Sachet	-	0	0	-	45	100%	(Appiah-Effah et al. 2021)
	Bottle	-	0	0	-	2	100%	
	Tanker	-	0	0	-	1	100%	
Salmonella (cfu/100 mL)	Sachet	-	0	0	-	45	100%	(Appiah-Effah et al. 2021)
	Bottle	-	0	0	-	2	100%	
	Tanker	-	0	0	-	1	100%	
Nitrate as nitrogen (mg/L)	Sachet	0.5	0	2.8	0.5	112	-	(Dzodzomenyo et al. 2018)
Chloride (mg/L)	Sachet	3.1	0	16.1	3.2	112	-	(Dzodzomenyo et al. 2018)

Electro-conductivity (µS/cm	Sachet	34.3	0	222.0	32.4	112	-	(Dzodzomenyo et al. 2018; Appiah-Effah et al. 2021; Salifu et al. 2019)
		47.2	3.3	266.7	51.9	45	-	
	Bottle	141.7	110	173.3	44.8	2	-	
	Tanker	-	350	430	-	1	-	
		116	37	322	74	25	-	
Turbidity (NTU)	Sachet	0.32	0.17	0.74	0.11	45		(Appiah-Effah et al. 2021; Salifu et al. 2019)
	Bottle	0.25	0.25	0.26	0.01	2		
	Tanker	-	0.44	0.48	-	1		
		1.7	0.2	17.7	3.6	25		
TDS (mg/L)	Sachet	41.4	7.7	194.7	36.9	45	-	(Appiah-Effah et al. 2021)
	Bottle	109.5	92.3	126.7	24.3	2	-	
	Tanker	-	251.0	308.0	-	1	-	

APPENDIX 2: STRENGTHS AND GAPS FOUND IN THE GHANA WATER COMPANY LIMITED (GWCL) WATER SAFETY PLAN IMPLEMENTATION AUDIT

The audit (UNICEF/MSWR 2020) revealed the following strengths:

- The system has a 19-member WSP team comprising mainly GWCL staff and others from health, municipal, and district assemblies. The team includes technical and management staff with the authority to carry out the WSP recommendations.
- The system description is adequate and accurate. The documentation adequately describes each step in the water supply chain from the catchment to the end-user.
- All significant hazards and hazardous events have been identified and documented at all steps in the water supply chain.
- Necessary control measures have been documented and can mitigate the risks.
- An improvement plan has been developed and documented. The improvement plans are based on system needs and priorities identified by risk assessment. Thus, there is a clear link between the risk assessment and the improvement plan.
- An operational monitoring plan has been documented, addressing routine water quality monitoring and visual inspection at each stage of the treatment process to ensure that key water supply components and control measures continue to work effectively.
- A compliance plan has been documented.
- Customer complaints are documented, and there is a customer care line for complaints and other related issues.

Despite these important strengths, the study found critical gaps at various stages of WSP implementation (UNICEF/MSWR 2020). The improvement opportunities were:

- The WSP team is incomplete and not up to date to reflect core system-level members who have been transferred or newly added members.
- Regular meetings among system-level WSP members should be organized to enhance communication and shared understanding of WSP-related issues.
- All relevant stakeholders (e.g., chiefs, EPA, WRC, Environmental Health Officers, Assemblies) should be well represented on the WSP team to ensure strong communication and collaboration in implementing the catchment action plan.
- The description of the WSP framework is incomplete. The description should contain an up-to-date map of the water supply. The WSP should indicate how the water supply will be used and by whom. The WSP document does not have a section on storage reservoirs.
- The list of hazards should be expanded to include those that have been considered and managed but are not included in the documentation, such as the possibility of people erecting structures on pipelines.
- Critical improvement plans (e.g., repair or procurement of new air valves and provision of washout on various points on the pipeline) that can be implemented in the short term should be addressed.
- Operational monitoring is not being carried out as documented. Although some aspects are being implemented in practice, no record indicates compliance with the monitoring plan.
- The verification, auditing, customer satisfaction, and awareness creation plans are incomplete. It would be valuable to document the WSP auditing plan and all consumer education plans and activities in the WSP.

- There are no documented standard operating procedures in the laboratory. These should be made available to staff at each supply chain section.
- Consumer awareness training plans on the WSP, water quality, point-of-use treatment, and safe water storage and handling practices should be developed and carried out regularly.
- A household survey on user satisfaction, health, and point-of-use practices should be undertaken to inform system management of household training needs.
- WSP review and revision schedules are not yet defined and documented. This has to be done to ensure that the WSP remains up to date and effective through regular review and revision.

APPENDIX 3: STRENGTHS AND GAPS FOUND IN THE COMMUNITY WATER AND SANITATION AGENCY (CWSA) WATER SAFETY PLAN IMPLEMENTATION AUDIT

The audit in two districts (UNICEF/MSWR 2020) revealed the following strengths:

- The WSP team is formed and highly active with people with authority to implement the WSP.
- The WSP is quite detailed and an accurate water system description is provided.
- The water system has current WSP documentation, and implementation was fairly good.
- Risks have been assessed logically and systematically for all hazards identified.
- Improvement plan describes the action, responsible party, and costs to help facilitate the action.
- All water quality standards are being met. In-situ and laboratory analyses of water samples are conducted periodically as stipulated in the standard operating procedure for water quality sampling and testing.

In these districts, the main WSP improvement opportunities were:

- Documentation is needed to serve as evidence (e.g., monitoring plan, emergency plans/contacts, overdose, chemical spillage).
- The list of hazards listed should be expanded to include those hazards identified during the field visit but not captured in the documentation.
- The WSP documentation should ensure that there is a linkage between the hazards identified and the improvement plan.
- Standard operating procedures should be developed for each stage of the water supply chain, especially the treatment processes and pasted at the appropriate locations.
- Consumer satisfaction surveys should be conducted periodically to ensure that customers are happy with the quality of water supplied.
- Appropriate supporting programs must be defined clearly with implementation details, e.g. orientation on the water treatment process, well-defined sampling locations (note short-, medium-, or long-term).
- Each water system should have an internal audit mechanism for in-house review.