THE TECHNICAL MANAGEMENT AND SUSTAINABILITY OF SMALL-TOWN WATER SYSTEMS: EXPERIENCES FROM THE NORTH GONJA DISTRICT, GHANA

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ABSTRACT

Many interventions have been implemented for the technical management and sustainability of Small-Town Water Systems, but the expected results are few. Small-Town Water Systems are fraught with challenges, leading to the unsustainability of most of them in sub-Saharan Africa. Therefore, this study assessed the technical management and sustainability of Small-Town Water Systems using experiences from the North Gonja District in Ghana. A qualitative approach to research with a case study design was adopted. A total of 53 participants were purposively sampled and were seen as key stakeholders with in-depth knowledge of the Small-Town Water Systems in the District which they shared for this study. Interviews and focus group discussions were used to collect data from the participants. The data were analysed by thematic analysis. The results revealed that the Small-Town Water Systems needed rehabilitation with innovative technologies, maintenance and repairs were reactive, small-towns recovery mechanisms from major breakdowns were weak, resulting in long Small-Town Water Systems downtimes, Water System Management Teams technical know-how was low, and there was limited technical support services. Small-Town Water Systems should be revamped with modern and digital technological designs and operated professionally. The study concludes that the current technical management of Small-Town Water Systems by the Water System Management Teams poses a threat to their sustainability. The study recommends an establishment of a linkage between technical management and the operations of Small-Town Water Systems to ensure sustainability.

Keywords: Technical Management, Small-Town Water System, Sustainability, Potable Water, Ghana

INTRODUCTION

Potable water issues became an international concern, leading to the implementation of the International Drinking Water Supply and Sanitation Decade (IDWSSD) from 1981-1990 (Armah et al., 2018). Afterwards came the Millennium Development Goals (MDGs), particularly MDG7 which challenged the global reduction by half the proportion of people without sustainable access to potable water by 2015 (UNICEF & WHO, 2015). The Sustainable Development Goals (SDGs) succeeded the MDGs. SDG6 desires universal access to and sustainable management of potable water. The MDGs focused on coverage rates, especially in sub-Saharan Africa (SSA), and that of the SDGs focus on service delivery standards.

In the context of Ghana, from the early 1990s the National Community Water and Sanitation Programme (NCWSP) was implemented as a national step taken to address potable water issues. The NCWSP brought about institutional restructuring and the establishing of new institutions to handle potable water supply issues in Ghana (Braimah & Kheni, 2013). Some of these key institutions are Ghana Water Company Limited (GWCL) and the Community Water and Sanitation Agency (CWSA). The latter is responsible for rural communities and small-towns while the former is in charge of urban areas. The NCWSP is operated by the principle of community ownership and management (COM) (Braimah & Fielmua, 2011). The technical management and sustainability were now in the hands of communities and small-towns where potable water supply systems are found. Where water and sanitation management teams (WSMTs) and district water and sanitation teams (DWST) are established to be responsible for the Small-Town Water Systems (STWSs). Unlike in the urban subsector of potable water supply where beneficiaries are kept away from being engaged in the management of potable water systems , in the rural subsector, the case is different (Laminu et al., 2021). The use of WSMTs for potable water supply systems management is a common phenomenon in SSA (Chowns, 2015; Harvey & Reed, 2007).

The technical component of these STWSs is important for their management and sustainability. This considers the physical conditions of these STWSs and whether they are in a good state for sustained potable water delivery. This is also seen as the hardware of the STWSs (Whaley & Cleaver, 2017). Technical management is a technical tool responsible for all the technical aspects of SWTSs, such as maintenance, technical support/expert services, and modern technologies to ensure improved goods/services delivery, that is, quality sustained potable water delivery (Shamsuzzoha & Anniina Syrjälä, 2024). The technology used, spare parts, design and construction, operation and maintenance are handled by the technical management and sustainability (Borja-vega et al., 2017; Osumanu et al., 2022). Hence, ~~By~~ technical management simply refers to the identification of STWSs technical challenges, renovation, modernisation of technologies, programming of adequate measures and their implementation to ensure that there is a sustained supply of potable water from STWSs (Gajzler, 2021).

However, most rural water supply systems are poorly maintained and eventually break down, leaving them with unreliable and disrupted water supply systems (Kumasi, 2020). If issues of technical management and sustainability of STWSs are not properly attended to, there will be a threat to sustained delivery of potable water. There are many arguments in the contemporary period to support the consequential effects of poor technical management of STWSs on the supply of potable water. For example, it is estimated that at any given time, one-third of rural water supplies in SSA is non-operational due to technical challenges (Awoke, 2012). Others have identified high operational failures and unreliability of rural potable water services caused by poor technical management (Chowns, 2015; Harvey & Reed, 2007;Chan & Ameyaw, 2013).

Indeed, some water management scholars have embraced technical matters in water management on the premise that it allows uninterrupted supply and/or operation of potable water, as well as prevents frequent breakdowns, intermittent supply of water, waste of productive hours and the use of unsafe water sources (Fielmua & Mwingyine, 2018; Bazaanah, 2019). At the same time, others focused on the sustainability of rural water programmes, community ownership, management and sustainability of STWSs, the effectiveness of local management of STWSs, multidimensional approach to STWSs, the effect of management models on the sustainability of rural water supply systems and factors influencing sustainability of community drinking water systems (Sanders & Fitts, 2011; Braimah & Fielmua, 2011; Harvey & Reed, 2007; Braimah et al., 2016; Muniruzzaman et al., 2017; Toan et al., 2023; Bazaanah, 2019). The central argument of this paper is that, improved technical management of STWSs induces sustained provision of rural potable water services. However, there are limited research studies on the link between technical management and the sustainability of STWSs.

This paper seeks to address this knowledge gap by investigating the technical management and sustainability of STWSs. Specifically, we seek to explore how the technical component of managing the STWSs in the North Gonja District (NGD) of the Savanna Region of Ghana is shaping their sustainability. It is revealed that 68% of the potable water supply services are either underperforming or broken down and not functioning at all in the Savannah Region (Bazaanah, 2019). In the case of the NGD, the study area, it is noted that 50% of the STWSs are non-functional (CWSA, 2015). In the NGD, there is a problem of technical failures of STWSs leading to non-sustained potable water supply from the STWSs to their beneficiaries. This necessitates this study in the NGD.

Though, sustainability relates to various aspects of STWSs, such as social, environmental, financial, managerial and technical dimensions, the central focus of this study is on the last two dimensions of sustainability, for no particular reason other than the fact that effective managerial capacity and enhanced technical know-how are crucial factors that make STWSs sustainable (Lockwood & Gouais, 2014; Adank et al., 2013). However, about 35% of all rural water supply in SSA (including Ghana) is not functioning, and despite the frequency with which this has been discussed, the reality of technical management and sustainability of rural potable water supply remains elusive (Awoke, 2012; Haysom, 2005; Whaley & Cleaver, 2017). In this respect, we do not explore the water coverage, but the sustainability of STWSs based on technically informed management. This type of information is critical for countries such as Ghana that seek to improve access to sustainable rural potable water services, but at the same time thrive for enhanced post-construction maintenance regime (Adeenze-Kangah, 2022; Kumasi, 2020). In this sense, it is a response to the call for establishing stronger empirical evidence about technical management for the sustainability of rural potable water supply to track progress toward SDG6 (Kumasi, 2020).

Sustainable rural potable water supply according to Loucks (2000), implies the design and management of water systems to supply water for present and future generations taking into consideration of the ecological, environmental, and hydrological integrity of small-towns. A sustainable rural potable water supply system provides enough potable water that meets national or international potable water standards, and with a tariff structure that is affordable to all households (van Engelenburg et al., 2020). Thus, STWSs can deliver sufficient potable water to all their beneficiaries over a long time by measures being in place to ensure that there is little or no downtime, taking into consideration all the dimensions of sustainability to ensure the well-being of their beneficiaries.

The systems theory of management underpinned this study. The theory postulates that systems have interrelated and interconnected parts which work together for the systems to survive, that is, to achieve the systems' aims (Bertalanffy, 1950, 1972). According to CWSA (2017) the rural potable water supply subsector is made of stakeholders from the national level to the local level (Ministry of Sanitation and Water Resources, CWSA, District Assemblies, DWST and WSMTs), development partners and donors (UNICEF, USAID, EU, CIDA and World Bank). These are interrelated and interconnected parts of the subsector which need to work synergistically for sustainable rural potable water supply. The theory also presents the input-output mechanism of systems, with this, it suggests that there is a direct relationship between STWSs technical management and their sustainability (Weihrich et al., 2008). Hence, good technical management sequels to the sustainability of STWSs.

The study found a lot of technical management challenges confronting STWSs, and the current technical management of STWSs by the WSMTs poses a threat to their sustainability. The link between technical management and the sustainability of STWSs is weak, resulting in sustainability challenges for STWSs. The rest of the paper is organised into five main sections. Section two reviewed extant literature on STWSs and technical management and sustainability. Section three outlines the methodology. Section four reports the main findings of the study while section five concludes and identifies some key policy implications of the findings.

LITERATURE REVIEW

STWSs Technology and Design
The technology and design of STWSs entail mainly issues of spare parts, the technology used for the construction and management of STWSs, metering, and mode of delivery of potable water from the STWSs to their beneficiaries, referring to the the physical infrastructure (Borja-vega et al., 2017; Osumanu et al., 2022). When STWSs physical infrastructure is in a good state, this will ensure sustained potable water delivery and vice versa. The physical condition of STWSs infrastructure affects their lifespan. The accessibility to spare parts has been identified as a major challenge for rural water supply projects' technical management and sustainability (Braimah et al., 2016; Braimah & Fielmua, 2011; Sanders & Fitts, 2011).

There exist differences in the technological design of STWSs among small towns (Fielmua, 2018; Osumanu et al., 2022). Some of the technologies used in some STWSs design and construction are technically complex for the management and sustainability by WSMTs without the aid of external experts (WaterAid, 2018). Per the design and technology of STWSs, metres are used to determine the quantity of water consumed at a particular time (Fielmua & Dongzagla, 2020; WaterAid, 2018). Bazaanah (2019) revealed the lack of meters in the Savannah Region of Ghana on some STWSs and data on metering from local government entities and CWSA. Digital water technologies are being used in the operations of STWSs (Amankwaa et al., 2022). The delivery of potable water from the STWSs to their beneficiaries is through public standpipes at vantage points and private connections (Fielmua, 2018).

Technical support services of STWSs
The technical support services for STWSs are mainly from the local government structures to which the respective small towns belong, donors, and development partners. It is observed that the major source of technical support for the rural portable water subsector of Ghana comes from donors and development partners (Chan & Ameyaw, 2013; CWSA, 2017). The DWSTs serve as technical backstopping for WSMTs in their districts (Braimah & Kheni, 2013; Braimah et al., 2016), which includes training of WSMTs. It is claimed that DWSTs are often incapacitated in performing their technical backstopping duties for these WSMTs (Braimah et al., 2016; Kumasi, 2018). Post-construction support tends to be portrayed as a techno-managerial concern. It may come in the form of external technical support, which is required whenever technical problems exceed the ability of the community-based management committee and/or support to supply chain and essential service providers, which is decisive if users are to gain access to spare parts needed for operation and maintenance of STWSs (Whaley & Cleaver, 2017). External technical support services are important for the sustainability of STWSs because of the technically complex nature of some STWSs and global technological advancement (WaterAid, 2018) .

Maintenance and Repairs
Because of the COM philosophy of STWSs, the operation, maintenance, and repairs are the responsibilities of the respective small towns and their WSMTs (Braimah & Kheni, 2013; Kumasi, 2020). Chowns (2015) argued that WSMTs rarely do maintenance and repairs, and in instances where they are done, they are slow and substandard. Similar to Chowns's (2015) view, Braimah et al. (2016) posit that some

WSMTs outsource the repairs of their STWS because of inadequate skills and funds. Maintenance and repairs of STWSs in Ghana are in an undesirable state as asserted by Bazaanah (2019), supporting Chowns (2015) and Braimah et al. (2016). The high degree of maintenance culture of STWS leads to sustainable STWSs, which directly affects revenue generation of STWSs (Agyapong et al., 2017; Kumasi, 2018). Cleaning and weeding around STWSs infrastructure are some of the maintenance practices carried out by small towns (Braimah et al., 2016). Scheduled hours of operations for public standpipes by vendors to prevent pressure leading to breakdowns are not also left out. The rationing of potable water is needed when major repairs need to be done or when the STWSs are experiencing technical challenges. Frequent proactive maintenance and repairs result in better technical performance (Chowns, 2015). Per CWSA, small towns are to handle operations, maintenance, and minor repairs of their STWSs while their Metropolitan Municipal District Assemblies (MMDAs) aid with major repairs, rehabilitation and replacement of their STWSs (Agyapong et al., 2017; CWSA, 2017).

Sustainability of STWSs

Sustainability has been defined differently in a wide range of contexts, but in relation to rural water supply systems and water services, it can be perceived as the ability to recover from a technical breakdown in the STWSs, including some notions of minimal external support, community-level financing and the continuation of a beneficial service over time (Haysom, 2005). Sustainability may be defined “as the maintenance of the perceived benefit (including convenience, time savings, livelihoods or health improvements) of investment projects, after the end of the active period of implementation”, (Adank et al., 2013:4). Sustainability of STWSs is the ability of potable water supply systems to be able to deliver their benefits over a long time by enhancing quantity, quality, convenience and continuity of potable water supply without adverse effects on the environment, people and other services (Dominguez et al., 2019). It implies the ability of STWSs to deliver sufficient potable water to all their beneficiaries over a long time by measures being in place to ensure that there is little or no downtime, taking into consideration all the dimensions of sustainability to ensure the well-being of their beneficiaries. Though no definite time limit is set, sustainability requires that rural water supply services deliver benefits continuously. Sustainability is not an end, but a continuous process of improvement that requires constant effort.

The management and sustainability of STWSs become difficult for small towns after being successfully constructed by governments and donors and transferred to small towns (Chowns, 2015; Harvey & Reed, 2007). One of the leading causes of the failures of STWSs is that their managing entities need to respect the concept of sustainability (Bazaanah, 2019; Dominguez et al., 2019). Sustainability in the rural water supply sector entails aspects such as construction quality, administration, operation and maintenance, costs, community management, external support, accountability and transparency (Bazaanah, 2019; Dominguez et al., 2019).

METHODOLOGY

Study Context

The NGD lies between latitude 9o39'01" N and longitude 1o23'23"W. It shares boundaries with the following Districts: Tolon and Kumbungu to the East, Mamprugu, Mogduuri to the North, West Gonja and Central Gonja to the South, and Sawla-Tuna-Kalba and Wa East to the West (NGD, 2016). Figure 1 below is a map of the study area.

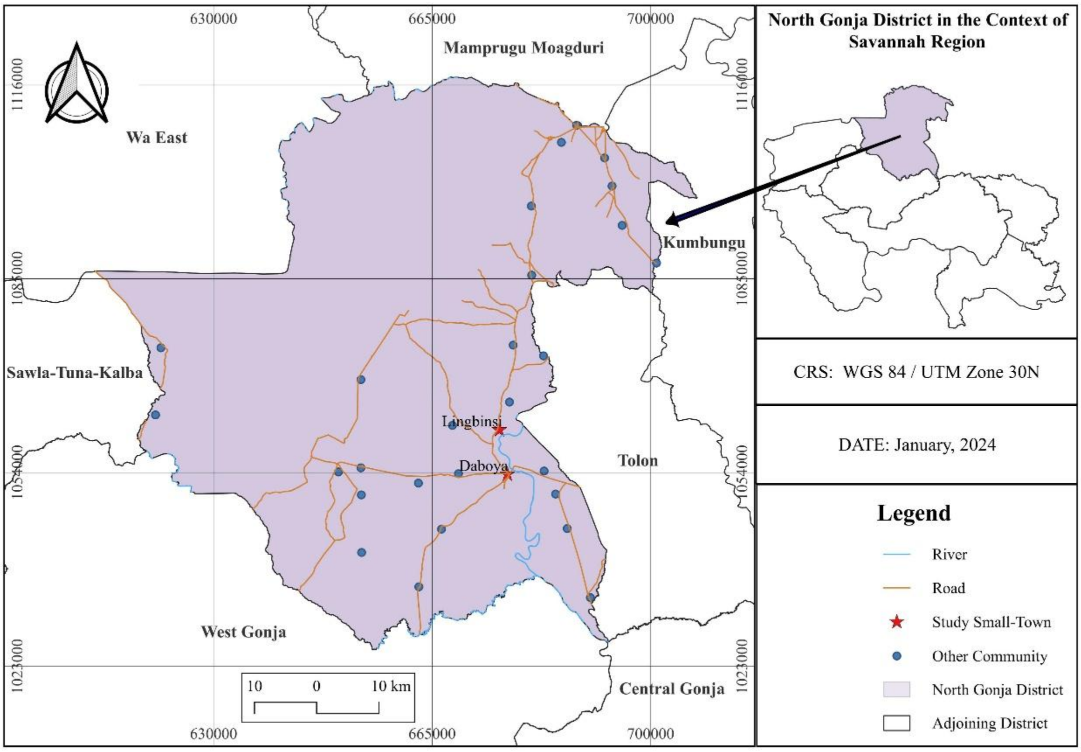

Figure 1: North Gonja District Map Showing the Study Area
Source: Authors' Construct, 2024

The District occupies approximately 4,879 square kilometres of land (Ghana Statistical Service, 2021). It has a population of 61,432 people of which 50.1% are males and 49.9% are females. It has a youthful population structure with a growth rate of 2.19% (GSS, 2021). It is a rural District with a rural population of 70.58%, while 29.42% are urban dwellers living in a few small towns in the District. Topographically, its altitude ranges between 150-200 meters above sea level. The White Volta River serves as the main drainage of the District. It can also serve as a treated surface water supply source for STWSs in the District and beyond. The soil types are sandy-loamy and loamy soil (NGD, 2016). Generally, the soil is fertile for agricultural purposes. The soil types also have high water table levels, which aided in using underground sources of potable water supply for the STWSs. The natural vegetation of the NGD is the Guinea Savannah (Amoako et al., 2018). The rainy season starts in April and ends in October with an annual average of 1000mm. The dry season starts from late November to March which comes with harmattan winds (Amoako et al., 2018).

Contextual Description of STWSs

The NGD has three STWSs in Daboya, Lingbinsi, and Mankarigu. The STWS in Daboya was constructed in the 1990s, while those of Lingbinsi and Mankarigu were in 2006. All the STWSs use treated underground water sources (NGD, 2016). WSMTs were the management entities for all these STWSs. All these STWSs had technical management and sustainability challenges. The downtime for major breakdowns was long. For instance, at the time of conducting this study, the STWSs at Mankarigu have broken down for years without repairs. Because of these technical management challenges and also the change in management arrangement, the CWSA did not only take over the direct management and sustainability of STWS from WSMT in 2019 but also revamped the Daboya STWS (CWSA, 2019). However, the remaining two STWSs at Lingbinsi and Mankarigu are still managed by WSMTs.

Sampling, Data Collection Methods, and Analysis

The study adopted a qualitative approach to research with a case study design (Yin, 2009). This approach and design ensured an in-depth inquiry of the study topic (Creswell, 2014). It was challenging to consider all the STWSs in the NGD and the entire population, hence the need for a sample (Kothari & Garg, 2014). Purposive sampling was used to get both the study small towns and the participants (Kumar, 2011). Two out of the three small-towns with STWSs were chosen for the study. All three STWSs face technical management and sustainability challenges so choosing two will be representative. Those selected were the Daboya and Lingbinsi STWSs. The study participants were purposively chosen because they are stakeholders in the technical management and sustainability of their STWSs (Osumanu et al., 2022). Hence, they had a better insight into the STWSs, which they shared for this study. A total of 53 participants were sampled, as seen in Table 1.

Tabbe 1: Sampled Participants for the Study

Category of Participants	**Participants (Existing)**	**Number of Sampled Participants**
NGD Development Planning Officers	2	1
Assembly Members	3 (one for Lingbinsi and two for Daboya)	3
District Water Sanitation Team Members	4	2
CWSA staff	3	1
Unit Committee Chairpersons	3 (1 Unit Committee at Lingbinsi and 2 Unit Committees at Daboya)	3
NGO staff (Saha Global)	2	1
Water Sanitation Management Team Members in both Small-Towns	14	8 (Lingbinsi;4 and Daboya; 4)
Traditional Authorities in Daboya & Lingbinsi	2	2
Technical Experts/Mechanics	3	2

Vendors at Standpipes	13	6 (Lingbinsi;4 and Daboya; 2)
Focused Groups (FGs) for Focused Group Discussions	FGs, comprising Youth, Adult and Aged categories of which 2 males & 2 females delegates were chosen from each category to form an FG.	Two FGs formed, 1 in Lingbinsi and 1 in Daboya (each Focus Group was 12 members in all 24 participants)
Total		**53**

Source: Authors' Construct, 2024

Interviews and focus group discussions (FGDs) were the methods used to collect data from the participants of the study. These methods gave an in-depth inquiry into the research topic under investigation (Creswell, 2014). The face-to-face interviews offered an opportunity for the researchers to explain and clarify issues that the respondents could not understand (Osumanu et al., 2022). The FGD participants differed from those who participated in the face-to-face interviews. Interviews were used in conjunction with FGD for triangulation and complementing the findings of the study (Alatinga et al., 2022). The data collection instruments were interview and FGD guides. The participants' consents were sought, and anonymity and confidentiality were assured before taking records during meetings' discussions for transcription.

A blend of inductive and theoretical thematic analysis (Braun & Clarke, 2006) was used to analyse the data collected from the FGDs and the interviews. The audio recordings during the interviews and FGDs in English and the local dialects (*Tampulma and Gonja*) were transcribed. The data were assembled, carefully cross-examined, edited, and coded for analysis (Creswell, 2014). The codes were then categorised into themes and making summaries of the views of the participants and, supporting these with relevant direct quotations that captured these views (Kiger & Varpio, 2020). The data were analysed and interpreted manually.

RESULTS AND DISCUSSION

The results are presented under four themes: technology and design, technical support services of STWSs, maintenance and repairs, and sustainability of STWSs. The respective discussion is included under each theme's results presentation.

Technology and Design of STWSs

Under this subsection, the issues considered are spare parts, technology used for STWSs, metering and potable water delivery mode by STWSs. The participants reported that spare parts for the STWSs were relatively easy for them. They indicated that they always message for spare parts from Tamale when the need arises. The major challenge, however, was the unavailability of funds to procure spare parts. A participant had this to say.

> *We had one supplier that we worked with who sometimes agreed to give us spare parts on credit, and when we got the money, we paid him. We did this because sometimes our money would not be enough to purchase spare parts, but potable water is a necessity. We cannot fold*

our hands and sit down and say there is no money (WSMT Secretary, January 2024, Daboya).

The technology used for the STWSs was revealed in the interviews.

Our STWS first came with solar panels as a power source for the system, which management and sustainability were a challenge for us. We tried using generators, but they also could not work (Assembly Member & WSMT Member; January 2024, Daboya).

The source of power that we were using for the STWS was a challenge for us. We could not manage and sustain the STWS because of power challenges. At a point, the STWS was broken down completely and stood for a while until we got electricity. The electricity was then used as a source of power, and the STWS was then operational and working better than the previous sources of power (WSMT Chairman & Assembly Member; Lingbinsi, January 2024).

This was corroborated in the FGDs.

According to the participants, initially, their STWSs had solar panels as a power source, so they needed technical know-how. The STWS broke down due to power source challenges, which they could not repair and eventually, all the solar panels were stolen from the powerhouse in Lingbinsi. When Lingbinsi got connected to the national grid, the STWS was rehabilitated, and electricity was used as the source of power for the STWS in 2015 through one of USAID projects known as Resilience in Northern Ghana (RING) through the NGDA.

On installation of metres on both the private connections and public standpipes, it was revealed that in Lingbinsi, initially, some public standpipes were given metres to determine the quantity of water used and the amount due. But along the line, the metres got spoiled, and they were not maintained till the time this study was conducted. Some public standpipes and private connections, too, lacked metres on them from the onset of their construction, the case of Daboya before CWSA took over the STWS. All private connections were without metres in the study area. As such, the mode of determining water tariffs was a fixed rate for all private connection users. In an interview with the WSMT chairman and an assemblyman it was stated, *"Because there are no metres, we just have a fixed amount (GH₵40.00 monthly) for all those with private connections to pay" (January 2024, Lingbinsi)*.

It was revealed that in Lingbinsi, there was a trained staff member in the WSMT who had technical knowledge about operating the metres. He used to read them to determine the quantities of potable water consumed and the amount due. But he migrated from Lingbinsi to Tamale. In his absence, the metres were not put into use until they finally broke down due to a lack of technical know-how. An old vendor revealed this when the trained staff was operating the STWS.

When Bavug (not his real name) was operating the STWS, he would come and open the metre box, read the metre for the quantity of water consumed out of the pipe every day, and tell you the amount you should have sold within that day. Hence, he was expecting such an amount from you. Because of that, we were not allowing people to

> *fetch water for free and waste water; otherwise, if you did, the metre would expose you (January 2024).*

It was revealed that the design of the potable water delivery mode from the STWSs was the same for both small towns. The sources of water for the STWSs were treated underground sources. Electricity was used as a power source at the STWSs powerhouses. The water was pumped into high tanks and distributed to the end-users through pipe networks by public standpipes at vantage points and private connections on their premises. The private connections were few.
The reason for the limited number of private connections was explained as follows.

> *The people (consultants/contractors of the STWSs) advised us to extend it only a little; otherwise, it would cause problems because the pumping machine cannot supply many places. If not for the paramount chief's palace and some few big people in town, we would not be giving everybody private connections (STWS Treasurer; January 2024, Daboya).*

However, when CWSA took over the management of the Daboya STWS, it was the opposite, as all public standpipes were disconnected, and only private connections were allowed to operate. In an interview with the CWSA manager, he revealed that:

> *Because of the United Nations SDGs, precisely Goal 6, which aims to bring water to people's doorsteps, all public standpipes were disconnected. This will aid in achieving this aim by ensuring that households get private connections to their premises. With this, there will be ease of access to potable water. Again, we need to ensure that water is safe while transporting it from the standpipes to various destinations, and lastly, we need to address the mismanagement of the public standpipes we had in the past (January 2024, Daboya).*

Households without private connections relied on their neighbours' private connections for potable water at the time of conducting this study. In Lingbinsi, the WSMT was hesitant to make private connections. This was due to the STWS's pumping motor incapacity like the case of Daboya, and because of defaulting in the payment of tariffs by private connection end-users. It was revealed that there were 13 private connections in Lingbinsi at the time of conducting this study.

The accessibility of spare parts was not a challenge in the study area. This disagrees with what some studies have asserted (Braimah & Fielmua, 2011; Sanders & Fitts, 2011). Unlike Braimah et al. (2016) claim that spare parts are scarce and expensive for WSMTs, spare parts were accessible to WSMTs of the STWSs, just that the WSMTs were not able to raise the needed funds to procure spare parts on time. The technological design for STWSs in the study area was the same, contrary to the differences in STWSs design in other areas (Fielmua, 2018; Kumasi, 2018). Solar panels as a source of power failed in the study area and brought the operation of STWSs to a halt. Electricity was a source of power that WSMTs were able to manage and sustain better than solar power. The initial technological design, the solar panels for STWSs, was beyond the management and sustainability of WSMTs (WaterAid, 2018).

The STWSs were operating without metres. This confirms what Kumasi (2018) revealed, that some STWSs public standpipes in Kintampo South District did not have meters, making it difficult to know the quantity of water supplied. As ascertained, the issues of illegal connections and a short supply of meters resulted in non-revenue water, which was not different from the study area (Kumasi, 2018; Fielmua et al., 2022). This is in tandem with Bazaanah (2019)'s lack of meters in the Savannah Region of Ghana on some STWSs. This is contrary to an earlier study by Kwashie (2009), which revealed that in his study of small towns in the Volta Region of Ghana, all STWSs were with meters. Because of the lack of meters, determining quantities of water-fetched tariffs from end-users and vendors at public standpipes was not correctly done; hence, there were accountability challenges.

Potable water delivery from the STWSs to the end-users was by public standpipes at vantage points and private connections to end-users' premises, similar to Fielmua (2018). Private connections were limited due to the incapacity of STWSs submersible pumps. This limited private connections, agreeing with the studies of Bazaanah (2019) and Deal & Sabatini (2020) of private connections to households being rare. This makes it difficult for the SDG6 recommendation of households having access to potable water on their premises to be achieved (Obispo, 2017). Unlike in Daffiama where only private connections were in operation (Fielmua & Dongzagla, 2020), the study area was the opposite. The technological innovations of digital potable water supply infrastructure (Amankwaa et al., 2022) are yet to be realised in the study setting.

Technical support services of STWSs

On technical support services to the WSMTs, one of the NGDA engineers from the Works Department, who is the leader of the DWST, revealed.

> *We do offer them technical services in the form of training and some repairs. Sometimes, when the WSMTs experience a challenge with the STWSs beyond their know-how, they report to the DWST for a technical examination to determine the necessary action. If the need arises for experts' services, the DWST assists in finding some for them (January 2024).*

Similarly, the Assembly Member for Lingbinsi said that they always contact the DWST for technical support for their STWS. And that most of the time, the DWST cannot deliver the technical support services by itself. It liaises with other partners. Another technical support service some participants mentioned was in the form of capacity building. A participant stated,

> *"We have received some support from the District Capacity Building Project (DISCAP). They trained us on how to manage and sustain our STWS" (STWS Secretary & Member, January 2024, Daboya).*

The role of District Assemblies holding STWSs in trust of local government structures and serving us technical backstopping (Braimah & Kheni, 2013; Braimah et al., 2016) was the case in the study setting. But practically, the District Assembly could not consistently deliver needed technical support services by itself. It gave recommendations and lobbied donors for technical support. Similarly, Braimah et al. (2016) and Kumasi (2018) found that most of the time, District Assemblies are debilitated with regard to technical support services for STWSs' WSMTs. External technical support services were limited in the study area; this is contrary to what has been asserted (Chan & Ameyaw, 2013; CWSA, 2017). There are instances where the technical management of STWSs exceeds the technical expertise of the WSMTs (WaterAid, 2018; Whaley & Cleaver, 2017), just like in the study setting.

Maintenance and Repairs

The response of WSMT to breakdowns was enquired, and the participants said that their response was not quick, especially when the breakdowns were major and, hence, could not be handled by the WSMT. DWST leader revealed "When we are involved in breakdowns, the response to repairs is always quick given the needed resources" (January 2024). The NGDA had resource challenges in carrying out their roles in maintaining and repairing the STWSs in the District. This was stated; "maintenance and repairs of the STWSs are the responsibility of CWSA and the small towns involved. The District Assembly only aids in soliciting resources for repairs of STWSs" (District Development Planning Officer, January 2024, Daboya). Due to this, STWSs in the District could be broken down entirely without the NGDA taking practical, immediate actions to that effect. For instance, it was revealed, "Our STWS was broken down completely for years without repairs. It was RING which came with their equipment and repaired it" (Assembly Member, January 2024, Lingbinsi). The Daboya STWS, too, was broken down, and CWSA rehabilitated it and took over it from the WSMT.

In a FGD, a member expressed the view that,

> *"maintenance and repairs is a challenge for our WSMT because we experienced about three major breakdowns of which the STWS had to stop for months without we having access to potable water from the STWS" (January 2024). "The way our STWS is managed, I think that there are no regular repair; we use them sometimes till they are broken down completely" (Unit Committee Chairperson, January 2024, Lingbinsi).*

Some participants admitted that the technical know-how of the management entities was enough for managing and sustaining the STWSs since they could do some minor repairs. A participant said, "I think WSMT know about maintaining the STWS because once the STWS is not broken down completely, we can still access water from it" (Traditional Authority, January 2024, Lingbinsi). In contrast, one participant also said, "The knowledge of the WSMT in managing the system 'is finished' (to wit no more relevant)" (FGD, January 2024, Lingbinsi). Training sessions for the WSMTs on best practices for managing and sustaining the STWSs were rarely organised, as revealed by most of the participants. The training that the WSMT received during the construction phase of the STWS was the training some of the WSMT in Lingbinsi could refer to. No training sessions were organised for the WSMT by the DWST, and the WSMT did not organise some for themselves. An assembly member of Lingbinsi said, "It has been a very long time since training sessions are organised. From the beginning of the STWS the WSMT was trained for the STWS. After that, I cannot remember of any training again since then" (January 2024). In the case of Daboya, they admitted that their technical expert/mechanic was going for training sessions on behalf of the WSMT.

Similar to maintenance and repairs, the concern was that STWS was underperforming. Participants reported.

> *The population of the town is now more than the STWS capacity. What used to serve and satisfy us 17 years ago would not be enough for us now. One, too, said, "the time the STWS was constructed, the community size was not like this. Now, things have changed, and the STWS is now small for us. There is pressure on the STWS. The STWS needs rehabilitation (Traditional Authority & Unit Committee Chairman, January 2024, Lingbinsi).*

But with the pressure on the STWS, it was revealed that.

> *Our challenge is the motor's capacity to pump the water into the whole system; otherwise, the pumps are two in number, and the water table is very high. We have been using one pump so far, which can supply enough water for the town if the pump motor is worked on. The private connections also put pressure on the submersible pump capacity. This makes people queue for some minutes at public standpipes to fetch water (NGDA Engineer & Assembly Member, January 2024, Lingbinsi).*

The response of the WSMTs to breakdowns was reactive. There were no preventive maintenance measures. Only when the STWS breaks down do the WSMTs respond. This is similar to what Chowns (2015) revealed in some rural water projects in Malawi, that repairs by WSMTs were rare and not up to standard. The high degree of maintenance culture of STWS leads to sustainable STWSs, which directly affects the revenue generation of STWS (Agyapong et al., 2017; Kumasi, 2018). Breakdowns of the STWSs, which were major, were a big blow to the small towns, and taking months before they were repaired. This contradicts what CWSA (2010a) and Kumasi & Agbemor (2018) asserted: breakdowns of water supply systems should take at most three days.

Due to resource constraints, the NGDA needed to take full responsibility for the STWSs in the district in terms of maintenance and repairs. Major repairs and rehabilitation are the duty of MMDAs in Ghana (Agyapong et al., 2017; CWSA, 2017), as these MMDAs hold these STWSs in the trust of the small towns (Fielmua, 2020). The NGDA needed help to deliver its mandate on STWSs repairs. In tandem, Braimah and Kheni (2013) of MMDAs experiencing resource constraints in delivering their mandate regarding STWSs in their custody was the case in the study setting. Though there is a new policy whereby CWSA manages STWSs directly, not all STWSs have been taken over by CWSA in Ghana.

The technical know-how of the WSMTs for technically managing and sustaining the STWSs is less to be desired. They could do only a few minor repairs. Their technical know-how was substandard and unprofessional (Chowns, 2015; CWSA, 2017; Whaley & Cleaver, 2017). This made maintenance and repairs by the WSMTs undesirable, as indicated by Bazaanah (2019). The STWSs in the study area needed rehabilitation. The STWSs could not meet the maximum requirements of the users.

As years go by, there is a need for STWSs to be rehabilitated to meet the needs of their growing small towns (Osumanu et al., 2022). This will reduce pressure on STWSs and aid in sustaining them. This corroborates what Kumasi (2018) revealed in the East Gonja Municipality in the Savannah Region of Ghana, that some STWSs were old and not performing up to the task. Again, the ageing of potable water infrastructure without rehabilitation could lead to potable water contamination, as Sultana (2018) revealed, which is the case in some USA cities, leading to the poisoning of their water supplies. Because of the lack of rehabilitation, there was low pressure in the flow of potable water through the outlets of public standpipes and private connections, making people queue and spend a lot of time collecting water. This aligns with Braimah and Fielmua (2011) and Fielmua and Mwingyine (2018) studies. It is also affirmed that this affects females because they are seen mostly as potable water carriers for households, especially in rural settings in Africa (Sultana, 2018).

Sustainability of STWSs

Regarding the management of the sustainability of the STWSs, the participants indicated that they are concerned about the long-term benefits of the STWSs.

> *We wish the STWS would work continuously for potable water delivery for us. We want the STWS to last long, but we had challenges keeping the STWS as such (Assembly Member & Unit Committee Chairperson, January 2024, Lingbinsi). We managed the STWS for its long and lasting benefit to the community. We were doing all we could to ensure the STWS is always working. Resources and technical know-how were our problems in keeping the water system functioning always (WSMT Member, January 2024, Daboya).*

Regarding some of the sustainability measures of the STWSs, the participants made some suggestions, such as engaging CWSA to take over the management of the STWSs to ensure their sustainability. They supposed that CWSA has the expertise in technically managing and sustaining the STWSs. This was revealed.

> *When CWSA takes over, they will introduce something new, like skills, management styles, and equipment, to make the water systems work well for a long time. There is no problem with bringing in CWSA so that the water systems work well for the benefit of the entire people. (WSMT Secretary at Lingbinsi, Assembly Members for Daboya & FGDs, January 2024).*

The understanding of STWSs sustainability to entail the lasting benefits of STWSs services was what the study setting had about their STWSs' sustainability (Adank et al., 2013; Dominguez et al., 2019). The study showed that small towns desired to manage and sustain their STWSs but could not do so. The reasons for their inability to maintain their STWSs were always resources and technical know-how challenges. One of the measures the small towns were considering was to hand over the management of their STWSs to CWSA to ensure their sustainability. This does not resonate with CWSA (2019), which asserts that small towns are not willing to hand over their STWSs for professional management. There were not enough practical steps for the management and sustainability of their STWSs. This supports some discoveries (Chowns, 2015; Harvey & Reed, 2007) that the sustainability of STWSs is a challenge for some small towns in the SSA. The small towns did not disregard issues of sustainability of their STWSs, as has been asserted (Bazaanah, 2019; Dominguez et al., 2019). The small towns were mindful of the sustainability of their STWSs, just that they had insufficient means.

CONCLUSION AND RECOMMENDATIONS

There are global concerns about the sustainability of potable water supply systems. One of the key areas in which to tackle this concern is the technical component of STWSs. In line with the global potable water sustainability concern, the paper assessed the technical management and sustainability of STWSs in the North Gonja District in Ghana. The study revealed a lot of technical management challenges confronting STWSs, and the current technical management of STWSs by the WSMTs poses a threat to their sustainability. The link between technical management and the sustainability of STWSs needs to be stronger, resulting in sustainability challenges for STWSs. Key among the findings entails spare parts inaccessibility due to inadequate funds, failure of solar power for STWSs, deficient metres, non-revenue water, limited private connections, limited technical support services, low technical know-how, reactive and poor nature of maintenance and repairs, STWSs under performance with long downtimes, lack of practical steps for STWSs sustainability negatively affected the technical management and sustainability of STWSs. These factors pose a threat to the sustainability of STWSs in the District. The study recommends that management entities of STWSs should harness external support such as funds, technical know-how and services from experts, governments, and developmental organisations in the potable water sector. Consultants/contractors should engage small towns and use technologies and designs that the small towns can technically manage and sustain. The technical capacities of management entities of STWSs should be built continually on their STWSs affairs by their MMDAs and other development partners for professionalism in their operations. Management entities of STWSs should be committed to routine maintenance and repairs of STWSs. This would aid solve the effects of major breakdowns on the users and long downtimes. WSMTs, DWSTs, governments and donors should renovate STWSs that need renovation with modern and digital STWSs technologies to increase the STWSs capacities and performances. This would aid in curtailing issues of deficient meters, non-revenue water and limited private connections. Management entities of STWSs should take practical actions for the sustainability of their STWSs. Improved technical management of STWSs induces the sustainability of rural potable water services.

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