



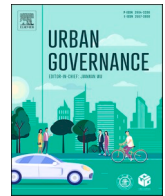
Since January 2020 Elsevier has created a COVID-19 resource centre with free information in English and Mandarin on the novel coronavirus COVID-19. The COVID-19 resource centre is hosted on Elsevier Connect, the company's public news and information website.

Elsevier hereby grants permission to make all its COVID-19-related research that is available on the COVID-19 resource centre - including this research content - immediately available in PubMed Central and other publicly funded repositories, such as the WHO COVID database with rights for unrestricted research re-use and analyses in any form or by any means with acknowledgement of the original source. These permissions are granted for free by Elsevier for as long as the COVID-19 resource centre remains active.



Contents lists available at ScienceDirect

Urban Governance

journal homepage: www.journals.elsevier.com/urban-governance

Domestic water accessibility during COVID-19: Challenges and coping strategies in Somanya and its surrounding rural communities of Ghana

Shine Francis Gbedemah^{*}, Fatima Eshun, Louis Kusi Frimpong, Paulina Okine

Department of Geography and Earth Sciences, University of Environment and Sustainable Development, PMB, Somanya, Eastern Region, Ghana

ARTICLE INFO

Keywords:

Water
Accessibility
Rural and urban communities
COVID-19
Somanya

ABSTRACT

Reducing the spread of COVID-19 partly depends on easy access to water to ensure adherence to good hygienic practices. However, most communities in Ghana face a series of challenges in accessing improved water sources. This study seeks to examine water access and its associated challenges, and the various strategies adopted by households to cope with these challenges in the Yilo Krobo Municipality of Ghana during the early days of the COVID-19 pandemic. Both qualitative and quantitative methods were employed. Communities were stratified into rural and urban, and 400 households were randomly sampled for questionnaire administration. The data was inputted into SPSS and the results were analyzed using chi-square and descriptive statistics. Purposive and convenient sampling was used to select 30 informants for the qualitative interviews and the results were analyzed using thematic content analysis. The findings show that about 68.5% of households have access to pipe-borne water during COVID-19 compared to 8% who use unhygienic sources. Most households (54.5%) depended on pipe-borne water sources outside their dwellings. The main water accessibility challenge during the COVID-19 pandemic was the increased cost of water (41%) even though water provision was supposed to be free during the early period of the pandemic. Most respondents adapted to the situation by storing water using small-sized storage facilities and also had to buy from other vendors at an expensive rate. The study recommends the formation of a water and sanitation board and an increase in the capacity of the pumping station to ensure adequate provision of potable water for the communities on a sustainable basis.

1. Introduction

The COVID-19 pandemic which began in late 2019 has had a debilitating impact on countries and people throughout the world. Many countries went into lockdown in an attempt to curb the spread of COVID-19, leading to the disruption of socio-economic activities and the normal functioning of society. In Ghana, the first cases were recorded on 12th March 2020. As of February 2022, the country had recorded about 157, 917 cases with 1,426 deaths (Ghana Health Service, 2022). Ghana's COVID-19 case management is said to be good when compared with other countries in Africa and those in other parts of the world primarily due to the low fatality reported in the country (Afriyie et al., 2020).

The pandemic has affected the delivery of services to the populace, and in the process has affected livelihoods and overall quality of life (Gondwe, 2020). Key social services that have been affected as a result of the COVID-19 pandemic include education (both formal and informal), social welfare, health care delivery, security, and public transportation to mention but a few. Additionally, environmental services affected by

the pandemic include water supply, sewage, refuse disposal, and sanitation. Concerns have been raised about the likelihood of achieving the global development goals in the light of this circumstance (Shulla et al., 2021). The difficulties with providing water services during the COVID-19 pandemic are of importance to this study. Human settlement management is seen to be critically dependent on water services. The effectiveness of the water service provision is crucial in the context of COVID-19 because it will increase household access to water and, as a result, encourage good hygiene habits, which is one of the most effective strategies to stop the spread of the illness (Ashinyo et al., 2021).

It was estimated that about 700 million people in the world are without access to improved sources of drinking water with about 300 million of these numbers coming from sub-Saharan Africa (World Health Organization/United Nations International Children's Emergency Fund (WHO/UNICEF, 2014). In Ghana, it was estimated that about 87% of the populace had access to safe drinking water while the rest of the 13% did not have access to safe water (WaterAid, 2021). Also, wide disparities exist between rural and urban areas with regard to access to safe

^{*} Corresponding author:

E-mail address: sfkgbedemah@gmail.com (S.F. Gbedemah).

<https://doi.org/10.1016/j.ugj.2022.08.001>

Received 18 February 2022; Received in revised form 5 July 2022; Accepted 4 August 2022

Available online 5 August 2022

2664-3286/© 2022 The Author(s). Published by Elsevier B.V. on behalf of Shanghai Jiao Tong University. This is an open access article under the CC BY-NC-ND license (<http://creativecommons.org/licenses/by-nc-nd/4.0/>).

drinking water. According to United Nations International Children's Emergency Fund/World Health Organization (UNICEF/WHO, 2015), in 1990, about 84% of Ghanaians in urban areas and 39% in rural areas had access to improved drinking water sources. However, there has been a substantial improvement in these figures over the years. For instance, in 2015, about 93% of urban dwellers and 83% of rural people were said to have access to improved water sources.

The management of COVID-19 requires a lot of pragmatic measures including access to improved water sources. Increased access to improved water sources became an emergency strategy to reduce the spread of the COVID-19 pandemic globally. In Ghana, one of the government's responses to the management of COVID-19 included the absorption of water costs for Ghanaians for six months (April to September of 2020). This six-month water absorption was said to have cost the country about GH¢ 161 million¹ (Issahaku & Abu, 2020). Households in urban and rural settlements in Ghana faced a number of challenges regarding access to water supply prior to the COVID-19 pandemic. It was therefore of interest to many how the government's policy of taking up the cost of water supply will circumvent the bottlenecks that constrained water provision and access. In addition to this, water supply, accessibility, and reliability in Ghana are also influenced by the topography of the settlement and the operational efficiency of the service provider at the specific location.

According to the Ghana Statistical Service (2014), the four main sources of water in the Yilo Krobo Municipality are boreholes, streams, public taps, and pipe-borne water. Boreholes happen to be used by about 22.1% of households as drinking water. Just like boreholes, nearly one out of every five households in the Municipality use rivers or streams as their main source of drinking water. Other sources of drinking water are pipe-borne outside dwelling units (18.9%) and public standpipes (18.3%). In rural communities, about 32.0% of households use the river or stream as the main source of drinking water as against 3.7% in urban areas. The above suggests that most of these water sources are not improved. An improved or potable drinking water source can be said to be one that protects adequately the water source from outside contamination. According to improved water sources are piped household water connections that can be found in-house, in compounds or yards of houses, public taps or standpipes, tube wells or boreholes, protected hand-dug wells, protected springs, and harvested rainwater. It is apparent that using unsafe water sources during COVID-19 is dangerous and can lead to other water-related diseases in the municipality. Also, the government's efforts of increasing water access to reduce the spread of COVID-19 will not be achieved.

The purpose of this study is to assess households' access to water supply during the early periods of the COVID-19 pandemic. The study further examines the challenges faced by households in accessing water, and the coping strategies they adopted. This paper contributes to the literature on the impact of COVID-19 on water service provision in Ghana (Agbozo & Jahn, 2021; Ashinyo et al., 2021; Nkrumah et al., 2021; USAID, 2021), by focusing on household access to improved water sources in small urban communities. Indeed, the above studies on the impact of COVID-19 on water provision in Ghana largely focused on households in the larger metropolises such as Accra and Kumasi. There is therefore a dearth of information regarding the situation in rural and small urban settlements with regard to water accessibility situation during the early period of the COVID-19 pandemic. Small urban settlements in this study refer to small towns with population ranging between 5000 and 50,000 (Community Water and Sanitation Agency (CWSA), 2004; Owusu, 2005). According to Pilgrim et al. (2004), small urban settlements are important nodal centres for the delivery of essential services to the surrounding rural settlements. Yet there are lots of particularities and challenges that constrain public service delivery in small urban settlements, especially due to their developmental stage and

infrastructural challenges. The study was conducted in the Yilo Krobo Municipality, hereinafter referred to as the 'municipality'. The municipality was selected for this study because of its municipal status, which means that it has small towns and settlements below the hierarchy of small towns, and also the peculiar challenges the municipality face regarding water accessibility.

2. Water accessibility, challenges and coping strategies

2.1. Water accessibility

Water accessibility in this article refers to getting access to portable water for domestic purposes including drinking and washing among others. Access to water is one of the 17 Sustainable Development Goals (SDGs) and achieving this is a universal priority. Before the COVID-19 pandemic, access to water in most African countries was a challenge and COVID-19 made this situation more pronounced (Ashinyo et al., 2021). COVID-19 protocols require frequent hand washing with soap under running water which became problematic due to inadequate supply and access to improved water sources (Yeboah et al., 2020). Central governments of many African countries came up with strategies to increase access to water to reduce the spread of the virus. For instance, in countries such as Burkina Faso, Gabon, Guinea, and Ghana, governments declared free water supply for some months. This initiative was for domestic and not commercial use which increased water supply by 37% (Smiley et al., 2020). The United Nations Resolution 64/292 asserts that everyone is entitled to sufficient, safe, acceptable, physically accessible, and affordable water for both domestic and personal use (Omarova et al., 2019). Water accessibility challenges are of greater concern and rank ahead of climate change, food crises, and social uncertainties (Dos Santos et al., 2017). Currently, about 844 million people in the world do not have access to safe water and about 79% of these people reside in rural communities (Omarova et al., 2019). Even though the millennium development goals (MDGs) reported the achievement of the target of halving the population without access to good water, access to domestic water remains a challenge the world over (Cassivi et al., 2018), particularly in developing countries. SDG 6 aims at universal access to water by 2030 and about 8 years down the line many people do not have access to potable water (Armah et al., 2018).

Sub-Saharan Africa (SSA) has the lowest coverage in terms of water accessibility and despite the doubling of its population between 1990 and 2015, water accessibility within this period increased by only 6% (Armah et al., 2018). According to Armah et al. (2018), improved water sources encapsulate these three areas: (1) it should be accessible on-premises, (2) it should be available when required, and (3) it should be free from contamination. Improved sources include piped water, boreholes, protected dug wells, rainwater, and packaged water. In Ghana, most people get their household water from surface and groundwater either directly from Ghana Water Company Limited (GWCL) or from other sources such as hand-dug wells, water tanks, boreholes and springs. For the latter sources, the quality usually falls below the pH range of 6.5 to 8.5 according to the Ghana Standard Authority recommendation for drinking water (Salifu et al., 2019). Moreover, springs, dug wells and other unprotected sources are likely to suffer from pollution in the form of household run-offs, and animal droppings among others (Salifu et al., 2019). GWCL is in charge of water provision in the urban areas whereas the CWSA is in charge of rural water supply (Yeleliere et al., 2018). Those in the urban areas except for a few urban poor communities are connected to the national grid where they get their sources from GWCL whereas those in the rural communities usually use hand-dug wells, springs, rivers, and streams.

More often, high-income communities get connected to the national grid than low-income communities, and interventions such as free water or removal of water tariffs usually benefit the rich more than the poor (Amankwaa & Ampratwum, 2020). The poor in the end tend to spend more on alternative sources of accessing water resources (Amankwaa

¹ Equivalent to US\$ 26.8 million

et al., 2014; Cassivi et al., 2018). Also, the urban poor who are not connected to the grid has to find alternative sources of drinking water. Some resort to wells, springs, and remote sources that could be contaminated and lead to water-borne diseases such as cholera, hepatitis, typhoid, and arsenic poisoning (Arcipowski et al., 2017).

2.2. Accessibility challenges

Poor urban homes' lack of access to water has been ascribed to its occupants' informal employment with variable pay, lack of a legal land tenure, and inability to pay their monthly bills, making it challenging for institutions to expand water infrastructure to such places (Boakye-Ansah et al., 2019). Furthermore, uncontrolled urbanization in Ghana has limited the availability of water due to the strain it has placed on water resources (Owusu et al., 2016). Once more, the comparatively low water usage and low investment appeal of small towns and rural areas contribute to the accessibility issues in these locations. In small communities, unemployment and poverty encourage illicit connections, which significantly raise operating costs and decrease the effectiveness of water provision (Boakye-Ansah et al., 2019; Fielmua & Mwingyine, 2018).

Other difficulties with providing water in Ghana include ineffective operating infrastructure, unequal service delivery, and inadequate water distribution caused by broken equipment, which in certain circumstances results in water rationing (Amoah & Yahaya, 2013; Kangmen-naang et al., 2020). Other issues, such as poor water management, the lack of water treatment facilities, poor sanitation, rising water demand, and changes in land use, have an impact on freshwater resources, limiting domestic water supply and output. For instance, the change in land usage and ownership also complicates the availability of water. Additionally, there is a lack of information regarding the availability of better water sources in both rural and urban areas (Desye, 2021).

Moreover, population surges, lifestyle changes, increased pollution, and urban growth increase the gap between the demand and supply of water, particularly in cities and small towns. Those residing in new settlements and fringes of small towns are disproportionately affected. According to Dos Santos et al. (2017), climate variability serves as a stressor on water supply and this is exhibited in prolonged drought conditions. Resources are sometimes used to fund large-scale projects such as the construction of dams instead of low-cost alternatives like rainwater harvesting which can help the majority of residents, especially poor households to access water. In addition, inadequate pro-poor policies for water allocation among different sectors make water accessibility challenges more pronounced (Musingafi, 2013).

2.3. Coping strategies for potable water

Coping strategies in the context of this study refers to behavioural responses to an inadequate water supply. Lyons and Lowery (1989) also viewed coping strategies as exit responses to problems with the supply of public services. According to Abubakar (2018), two forms of response strategies are often adopted by households, namely 'quasi-exit' strategies and 'entrepreneurial exit' strategies. With regards to the former, households often resort to obtaining water from alternative sources including buying water from water vendors. The entrepreneurial exit option involves water storage, use of boreholes, and hand-dug wells. Majuru et al. (2016) opine that these strategies may be temporarily adopted as a result of challenges with the regular supply of water from a national grid.

In Ghana, studies have shown that households have adopted a range of strategies in addressing water supply challenges. Most of these studies however have focused on households in the metropolitan areas. For instance, Nyarko et al. (2008) study in Accra shows that domestic water coping strategies in Accra vary among neighbourhoods, with high and middle-income neighbourhoods resorting to water tanker services, while households in low-income neighbourhoods resort to obtaining

water from their neighbours or private vendors in their residential areas. Relatedly, Senna's (2021) study on water coping strategies in Madina shows that residents resort to the use of storage facilities, and water vendors for their everyday water usage. The issue of water storage as a coping strategy by households in urban metropolises has also been highlighted by Achore (2022).

According to Olson et al. (2017), the absence or failure of water supply systems, the cost that is associated with water, the distance that people have to traverse from a safe water point, the waiting time that has to be spent to fill a small container all encourage or discourage the use of potentially contaminated water sources like river or shallow well. These authors point out that it is important to improve access to potable water in human settlements with several possible options with the main emphasis on the situation and the location, whether urban or rural. In the case of the situation, Olson et al. (2017) highlighted the need to implement temporary potable water transport, storage, and distribution in settlements where the population is dense but with no access to potable water supply systems. At times, there is a need to improve or upgrade the domestic water sources in order to improve the distribution capacity of the facility in order to reduce the waiting time for the water to flow (Hajibabaei et al., 2019). If this is not feasible, the authorities need to install and distribute large containers to communities. The aim is to increase the quantity of water that households can store. This will decrease the temptation of people to go for untreated water sources or decrease the duration of trips to the water points per day.

3. Study area

Yilo Krobo Municipality is located in the Eastern Region of Ghana. The municipality's population as of 2017 was about 95,828. This estimated figure shows a 9% increase from the 2010 population of the municipality, which stood at 87,847 (YKMA, 2018). According to the Ghana Statistical Service (GSS, 2014), about 34% of the population are within the age category of 15–35 years, and about 37% are below the age of 14 years. In terms of sex distribution, 48% of the population are males, while 52% are females. The settlement pattern of the municipality shows that it is predominantly rural. About 212 of the 237 settlements in the municipality have a population of less than 500, and the population of these settlements constitutes 61% of the population of the municipality. This situation poses difficulties for the Municipal Assembly² when it comes to the provision of potable water facilities since it is impossible to provide water and other infrastructure services to this large number of small rural settlements in the municipality. Fig. 1 below is a map of the study area.

According to the GSS (2014), about 27.1% of all households in the Yilo Krobo Municipality depend on rivers or streams for domestic use. Other sources of water used for domestic purposes include pipe-borne sources outside the dwelling (14.3%), public taps/pipes (12.9%), and borehole/tube wells (20.0%). The main sources of water for domestic use in urban areas of the municipality are public tap/standpipes with 20.0% of the populace having access to this water source.

4. Research methodology

4.1. Research design

A mixed-methods research approach (triangulation) was used in this study. According to Creswell (2014), mixed methods research allows for triangulation of different data sources which strengthens the study and

² A municipal assembly in Ghana is the administrative unit of the municipality. The municipal assembly is in charge of the day-to-day administration of the municipality. It is headed by the Municipal Chief Executive (MCE). Other members of the assembly include elected members representing electoral areas of the municipality and civil servants.

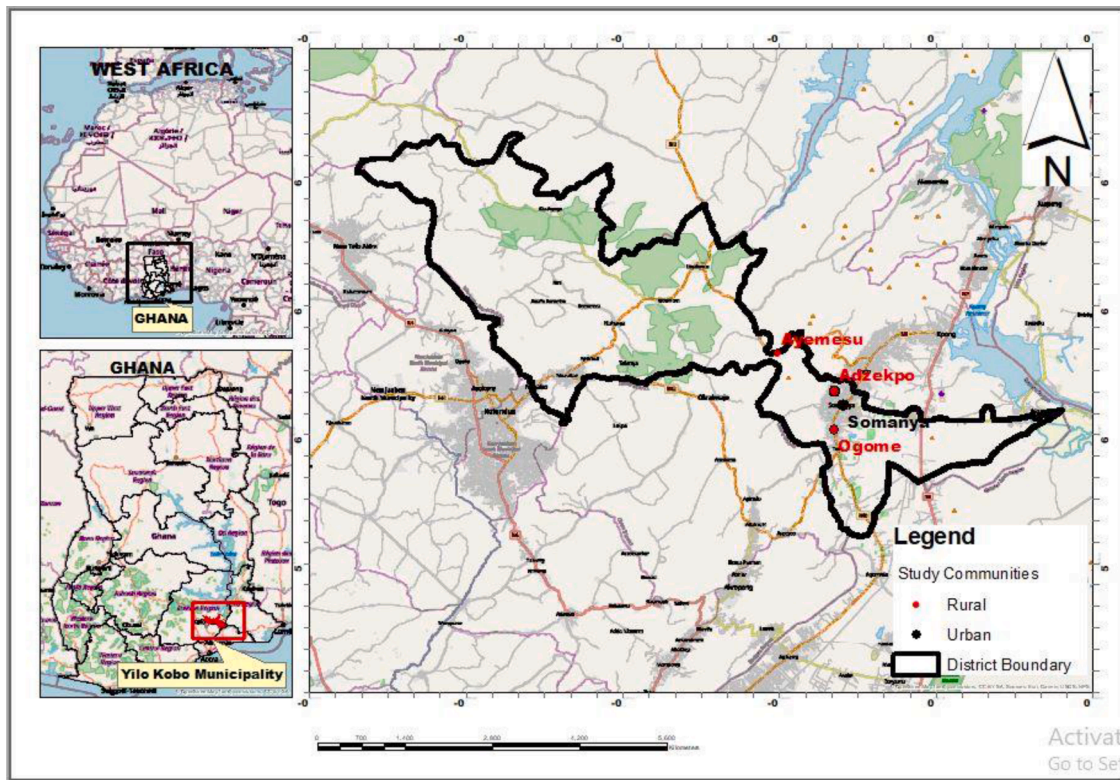


Fig. 1. Map of the study area.

reduces inherent weakness if a single research approach is used. Further, combining different data sources which is the case for mixed methods studies allows for corroboration of different data and also brings different perspectives to a study (Creswell & Plano, 2006). In terms of the specific design, the study used the explanatory sequential mixed-method design (Creswell, 2014). With this design, the study began with a quantitative survey in the study communities, and after analysing the survey results, the research team proceeded with the collection of qualitative data which were mainly interviews with selected participants. This study used the explanatory sequential mixed-method design because the researchers wanted to use the qualitative data to provide further explanation and insight into the quantitative survey results.

4.2. Population, sample size determination and sample design

The target population for the study was heads of households in the study communities. The choice of the head of a household was because they were in a better position to provide information about the water access situation during the early periods of the COVID-19 pandemic and how the household coped with water supply challenges during this period. However, in the absence of the household heads, household members who were above 18 years were interviewed after they gave their consent in adherence to the ethical guidelines of the study. A total sample size of 400 respondents (heads of households) participated in the household sample survey. The sample size was calculated using a confidence level of 95%, an associated margin of error of 5% (see Poku-Boansi & Adarkwa, 2016) from an estimated total number of households of 20,613 (GSS, 2014). This sample size constitutes 2% of the total number of households in the municipality.

Regarding the sample design, different sampling techniques were used in arriving at the ultimate sampling units (i.e. heads of households). The first stage involved stratification of the target population into rural and urban. Each stratum (locality) was then allocated a percentage of the expected total sample. Approximately 60% of the proportion of the

expected sample was allocated to urban and 40% to rural. This proportion was allocated to the rural areas because of the constraints that the researchers expected to encounter in reaching the rural population of the municipality and this included poor roads, government restrictions on mobility, and resource constraints. Three rural communities which include Ayemesu, Adzekpo & Ogome were sampled by the research team. The next sampling strategy adopted was a random sampling of the household heads from dwelling units in rural communities. Random sampling was used because of the small size of the settlements. Approximately 53 respondents were sampled from each of the three rural communities included in the survey.

In the urban community which is Somanya, a multi-stage cluster sampling was used in sampling the respondents (Lohr, 2019). First, Somanya was divided into fourteen clusters using the unit committee demarcated areas³. Indeed, the entire town is divided into thirteen-unit committees to facilitate local government administration. The authors therefore considered it appropriate to use the unit committee spatially defined units as clusters for the sample survey. The second stage involved a simple random sampling of four clusters (unit committee demarcated areas) out of the thirteen clusters from which respondents would be sampled. The four-unit committee areas sampled out of the pool of thirteen were Sra, Kpladey, Salosi and Abokobi electoral areas. The third and final stage involved a simple random sampling of sixty (60) respondents (heads of households) from dwelling units in each of the four clusters selected.

Regarding the qualitative data, a total of thirty (30) in-depth interviews were conducted with informants from the study communities, some of whom were conveniently sampled and some purposively sampled. Five (5) informants were interviewed in each of the three rural

³ The unit committee is the lowest level of decision making under the decentralization governance structure. Each unit committee has a defined demarcated area which is coterminous with the electoral area boundary in the District or Municipality

communities, bringing the number of interviews conducted in the rural communities to fifteen (15). The five informants interviewed in each rural locality comprised three (3) household heads who were conveniently sampled, and the Assembly member and traditional leader of the community both of whom were purposively sampled. In the case of Somanya, a total of ten (10) household heads were conveniently sampled for the interviews. In addition, three (3) Assembly members, the technician at the water pumping station in Akorley and a local government official in charge of environmental health and sanitation were purposively sampled and interviewed.

4.3. Data collection instrument

The survey data was collected using the Kobo collect application and the questions responded to were structured. The questions included the demographic background of respondents, that is sex, age, level of education, marital status, and religious affiliation. Further, questions also included sources of water for domestic use during the early period of COVID-19, availability of pipe-borne water inside dwelling units, challenges encountered in accessing water for domestic use, and household water coping strategies during the early period of COVID-19. The qualitative interviews were conducted using an interview guide and a tape recorder. The questions on the interview guide varied depending on the informant being interviewed. But in all, the information solicited from informants broadly captured water accessibility and challenges during the early period of the COVID-19 pandemic, how this was dealt with and how water access can be improved going forward. Both survey questionnaire and questions used for the qualitative interviews addressed the objectives of the study.

4.4. Analytical procedure and ethics

The survey data analysis involved a chi-square test and descriptive statistics presented with graphs showing the percentage distribution of the responses. The chi-square test was used to assess significant differences in regards to respondents' responses to questions on the research instrument. The questions were sources of water for domestic use, access to pipe-borne water sources, constraints in accessing water, and coping strategies adopted by households in the wake of water supply challenges during the early period of COVID-19. Regarding the analysis of the qualitative data, thematic content analysis was used. This analysis involved first the transcription of the interviews conducted with informants. This was followed by a first reading of the transcripts to get a general overview and insight into the responses provided by informants. The second reading sought to identify responses that fit under specified themes that the researchers came up with. These themes include accessibility, challenges, and coping mechanisms. The qualitative data were presented in the form of quotes extracted from the interviews with informants. The quotes corroborated and/or shed insight on the survey results.

According to Leavy (2017; 23) 'ethics involve morality, integrity, fairness, and truthfulness'. Research ethics can be said to be regulations governing the conduct of research by a given profession or group. Research ethics is very important in our inquiries and it requires that we protect the dignity of research subjects at all times and ourselves (Mustanski, 2011). The regulation governing social science research was rigidly applied in this study. In the first instance, ethics approval was sought from the institution, which was granted with certificate number APP/RSC/0004. Issues related to research participants' rights and welfare and the researcher's obligation to the communities and people that the data were gathered demanded that the study is conducted ethically. Berg and Lune (2017) underlying principles that guide research were adhered to. Some are informed consent of participants, avoidance of deception or misrepresentation, protection of interests of research participants, avoidance of harm, anonymity, and confidentiality to mention a few. The results from the field data are discussed in the next section.

5. Results

5.1. Background of respondents

The result from Table 1 shows that the majority of respondents were females (58.5%). This was the case for both urban and rural communities surveyed as females formed the majority of the respondents sampled. In terms of the age distribution of respondents in the rural communities, the result shows that majority of the respondents were within the 31- 40 age category (37.5%), followed by those in the 41-50 age category (36.2%). Regarding the urban locality, majority of the respondents were within the 18-30 age category (29.3%), followed by those in the 31-40 age category (29.2%). Results on the distribution of respondents' level of education show that in both communities, respondents with secondary level education were in the majority. For instance, respondents from rural communities with secondary level education were 30%, while those from the urban community were 28.5%.

The proportion of respondents with post-secondary education were more in the urban community compared to respondents from the rural communities. There were variations regarding occupation between respondents from rural and urban communities. For instance, respondents engaged in farming were more in the rural communities (21.2%), compared to the urban locality (3.3%). Further, the results from the rural communities also reveal that respondents engaged in other occupations such as teaching, civil service and trading.

5.2. Accessibility to water during the COVID-19 pandemic

The results presented in this section include the main sources of water for urban and rural communities for domestic use, the proportion of households with access to pipe-borne water, the main challenges with pipe-borne water access, and the level of difficulties or otherwise regarding water access during the early days of the pandemic. During this time, the Government of Ghana put in place many measures to curb the spread of the virus. One of the measures was to increase water access

Table 1
Demographic background of respondents.

Background of respondents	Type of settlement		Total
	Rural	Urban	
Gender			
Male	58 (36.2%)	108 (45.0%)	166 (41.5%)
Female	102 (63.8%)	132 (55.0%)	234 (58.5%)
Total	160 (100.0%)	240 (100.0%)	400 (100.0%)
Age			
18-30	8 (5.0%)	70 (29.2%)	78 (19.5%)
31-40	60 (37.5%)	70 (29.2%)	130 (32.5%)
41-50	58 (36.2%)	46 (19.2%)	104 (26.0%)
51-60	20 (12.5%)	20 (8.3%)	40 (10.0%)
60+	14 (8.8%)	34 (14.1%)	48 (12.0%)
Total	160 (100.0%)	240 (100.0%)	400 (100.0%)
Education			
None	10 (6.2%)	16 (6.7%)	26 (6.5%)
Non-Formal Educ.	18 (11.2%)	20 (8.3%)	38 (9.5%)
Primary	4 (2.5%)	12 (5.0%)	16 (4.0%)
JHS/Middle	16 (10.0%)	30 (12.5%)	46 (11.5%)
SHS/O'Level	46 (28.8%)	66 (27.5%)	112 (28.0%)
Voc/Technical	24 (15.0%)	24 (10.0%)	48 (12.0%)
Polytechnic/Nursing	40 (25.0%)	18 (7.5%)	58 (14.5%)
University	2 (1.2%)	54 (22.5%)	56 (14.0.0%)
Total	160 (100.0%)	240 (100.0%)	400 (100.0%)
Occupation			
Farming	34 (21.2%)	8 (3.3%)	42 (10.5%)
Trading	52 (32.5%)	74 (30.8%)	126 (31.5%)
Civil servant	24 (15.0%)	30 (12.5%)	54 (13.5%)
Teaching	8 (5.0%)	34 (14.2%)	42 (10.5%)
Artisan	36 (22.5%)	26 (10.8%)	62 (15.5%)
Others	6 (3.8%)	68 (28.4%)	74 (18.5%)
Total	160 (100.0%)	240 (100.0%)	400 (100.0%)

to enhance effective hygiene practices among the Ghanaian populace. Water from the GWCL was provided freely to all Ghanaians.

Table 2 shows that overall, the majority of the respondents used mainly pipe-borne water during the early periods of COVID-19. This was followed by the use of water from boreholes. Chi-square test conducted shows that there was no statistically significant difference between urban and rural households with respect to access to the various water sources for domestic use ($X^2 = 8.255$ df = 5 p-value = 0.143). For instance, the result shows that pipe-borne water was the main source of water in the two areas, albeit the proportion of respondents in percentage terms was high in the case of the rural communities (72.5%). Pipe-borne water is an improved source of water and therefore the majority of respondents needed to use it as their main water source, especially in a time like COVID-19 when access to quality water sources is important for optimum hygiene practices.

Responses in Table 2 does not imply water access in dwelling units of respondents. Observations during the fieldwork and interviews with respondents revealed that even though a majority of the respondents used pipe-borne water for domestic chores such as cooking, washing, and cleaning, pipe-borne water was accessed by the majority of respondents from water resellers from neighbouring houses.

The above point on pipe-borne water accessed outside of dwelling units of respondents is corroborated by the results in Table 3 which shows that about 55% of respondents did not have in-house pipe-borne water sources. There were however significant differences when it comes to the availability of in-house pipe-borne water between respondents from urban and rural areas ($X^2 = 14.847$ df = 2 p-value = .000). Table 3 shows that the proportion of respondents without in-house pipe-borne water in rural areas was in the majority (66%) as compared to those without in-house pipe-borne water in urban areas (47%). This shows that even though relatively more people in rural areas used pipe-borne water as their main source of water during the early periods of COVID-19, they had to move outside of their homes to be able to access pipe-borne water. Also, some respondents had to pay for water even though water supplied by the GWCL was declared free during this period. Further insight on this finding was shared in the quote below:

‘I heard that water was free so I was expecting that water vendors will make their taps available for us to fetch water for free. Even though we fetched water for free in some houses, this was for three or four months and then they started asking us to pay, which I think was wrong but what can you do. We don’t have taps in our house and we have to depend on those who sell water’

(a 47-year-old man from Adzekpo).

The study also sought to find out from respondents the challenges they encountered when accessing water during the early periods of the COVID-19 pandemic. Overall, the result in Table 4 shows that the increased cost of water was the main challenge influencing accessibility (41%), followed by shortage of water. Nonetheless, there were significant differences regarding accessibility challenges among respondents from urban and rural communities as was shown by the chi-square test result ($X^2 = 26.735$ df = 2 p-value = 0.000). For instance, the majority of respondents in the urban area opined that increased cost was the main

Table 2
Sources of water for domestic use.

Sources of water for domestic use	Type of settlement		Total
	Rural	Urban	
Pipe-borne water	116 (72.5%)	158 (65.8%)	274 (68.5%)
Borehole	18 (11.2%)	36 (15.0%)	54 (13.5%)
Hand-dug well	12 (7.5%)	14 (15.0%)	26 (6.5%)
Rainwater	2 (1.2%)	0 (0.0%)	2 (0.5%)
Dam/river/pond	8 (5.0%)	24 (10.0%)	32 (8.0%)
Other	4 (2.5%)	8 (3.3%)	12 (3.0%)
Total	160 (100.0%)	240 (100.0%)	400 (100.0%)

Table 3
Availability of in-house pipe-borne water.

Do you have pipe-borne water inside the dwelling	Type of settlement		Total
	Rural	Urban	
Yes	54 (33.8%)	128 (53.3%)	182 (45.5%)
No	106 (66.2%)	112 (46.7%)	218 (54.5%)
Total	160 (100.0%)	240 (100.0%)	400 (100.0%)

Table 4
Water accessibility challenges during COVID-19.

Water access challenges	Type of settlement		Total
	Rural	Urban	
Inadequate supply of water	32 (20.0%)	52 (21.7%)	84 (21.0%)
Increase in water cost	44 (27.5%)	120 (50.0%)	164 (41.0%)
Shortage of water	84 (52.5%)	68 (28.3%)	152 (38.0%)
Total	160 (100.0%)	240 (100.0%)	400 (100.0%)

challenge when it comes to water accessibility, while a majority of respondents from the rural communities indicated that shortage of water was the main accessibility challenge they faced.

The quotes below highlight the above challenges as was identified in the two study communities:

‘We were expecting the GWCL to increase the flow of water during that time because of the COVID-19 situation but this did not happen. There was still irregular flow, sometimes the water does not flow for two weeks. So I had to spend more to buy water from water vendors’
(a 50-year-old man from Kpladey in Somanya town).

‘We didn’t see anything different during the early days of COVID-19. There was still an irregular flow of water, sometimes for more than 2 weeks, water does not flow. For us, we didn’t benefit from any free water. Some people also decided to close their taps because they didn’t have water for us to fetch from them for free’
(30-year-old woman from Ogame).

The results and quotes on the challenges with improved water access suggest that the Government of Ghana’s efforts to increase water access and availability as part of measures to reduce the spread of COVID-19 may not have had the intended impact. Discussions from the interviews revealed that even though respondents were aware that resellers who received their supply from GWCL were not supposed to sell water to them due to the government’s free water policy during the time of the study, some of the resellers did sell water to them. In situations where water vendors have been provided water for free by the government, irregular flow of water hampered pipe-borne water access. Adding to the explanation, the municipal officer in charge of water and sanitation had this to say:

‘I received some complaints from residents regarding the challenges they were facing, including the irregularity of flow, and the charges on the water by some water resellers. For the flow of water, it has always been a challenge for Somanya and its environs and I think the government and GWCL need to resolve this as soon as possible. For the charges on water, our investigations show that few water resellers were selling water even though it was illegal to do that’.

Although the government has directed that water was free during the early days of the outbreak of COVID-19 in Ghana, a water vendor in Adzekpo, one of the rural communities asserted that:

‘I was told the government said we should not collect money from people who fetch water from my tank. Let me make it clear to you. I did not collect money for the water supplied by GWCL. Am collecting the money for making sure that, water is available for people to come

and fetch. Water does not flow every day. Am taking money for the water people fetch from my house because of the pipes I laid and storage tank I paid for’.

An assessment was also made regarding the difficulty or otherwise in accessing water during the early periods of the COVID-19 pandemic. Generally, more than half of the respondents indicated that access to water was difficult (that is when we combine responses for ‘access with difficulty’ and ‘access with great difficulty’). About 32% responded that they accessed water with difficulty, while 28% indicated that they accessed water with great difficulty. Similar patterns of responses were observed for both rural and urban communities surveyed and the chi-square test conducted shows no significant difference regarding water access difficulties ($X^2 = 12.698$ $df = 3$ $p\text{-value} = 0.06$). Taking the results as a whole, more people had difficulties in accessing water in the two communities as can be observed in Table 5 below.

The pump supervisor at the pumping station in Akorley also points out that, he has been rationing water to communities around Somanya because of inadequate capacity. The pumping station have a lot of settlements that have to be served. The pumping station in Akorley pumps water as far as Aburi, a community that is not within the YKMA, which is about 40 km from Somanya.

‘The problem is that we have more communities to supply water to but we have only 100, 000 cubic meter water storage capacity forcing us to shut some valves to let the water go to other communities like Aburi, Akropong, Mampong, Gyafiase all on the Akwapim ranges’

(water pump supervisor, Akorley).

In the wake of inadequate and unsustainable water supply to the people of Somanya and its environs which was mainly due to capacity challenges, the coping strategies that are adopted to manage the situation are discussed in the next section.

5.3. Coping with water during COVID-19

5.3.1. Water storage

Residents used a variety of coping strategies to deal with water scarcity and access issues during the early periods of COVID-19. The use of water storage facilities was also one of those coping strategies. Water drums or barrels, plastic and metal tanks, water cans, and even buckets were used to store water accessed from piped water, boreholes, and rainfall. Table 6 shows various water containers used in the municipality’s urban and rural communities during the early periods of COVID-19.

The result shows that water drums or barrels were the most commonly used storage facility by households (48.0%), followed by Jerry cans (26.5%). There were variations however between respondents from rural and urban communities with regards to containers used for water storage and the chi-square test shows a significant difference between urban and rural communities on the use of storage containers ($X^2 = 18.823$ $df = 4$ $p\text{-value} = 0.01$). For instance, a larger proportion (in percentage terms) of respondents from the rural communities used drums and jerry cans as compared to respondents from the urban community. The issue with using these two storage facilities was

Table 5
Assessment of water access difficulties.

Ease or difficulties with water access	Type of settlement		Total
	Rural	Urban	
Easy access	64 (40.0%)	80 (33.3%)	144 (36.0%)
Access with difficulty	60 (37.5%)	66 (27.5%)	126 (31.5%)
Access with great difficulty	32 (20.0%)	80 (33.3%)	112 (28.0%)
No access	4 (2.5%)	14 (5.8%)	18 (4.5%)
Total	160 (100.0%)	240 (100.0%)	400 (100.0%)

Table 6
Storage facilities used by households.

Storage facilities	Type of settlement		Total
	Rural	Urban	
Bucket	6 (3.7%)	40 (16.7%)	46 (11.5%)
Drums/barrels	82 (51.2%)	110 (45.8%)	192 (48.0%)
Jerry can	52 (32.5%)	54 (22.5%)	106 (26.5%)
Tank	20 (12.6%)	36 (15.0%)	56 (14.0%)
Total	160 (100.0%)	240 (100.0%)	400 (100.0%)

that they could not store enough water to sustain households for extended periods. According to informants, water stored in water drums could only be used for a maximum of seven (7) days. The majority of households did not use large water tanks because according to them, they are expensive to purchase. This point was highlighted by respondents in both urban and rural communities studied as shown below:

‘Preferably I should be using a tank even if it is not the large one, the medium one will be okay. But unfortunately, I don’t have the money. Even the smaller tank is about GHC 1000 (US\$ 166) which I cannot afford’

(a 37-year-old man from Sra in Somanya).

Another respondent also points out that:

‘I use two barrels and 4 gallons to gather water and store it to be used when the tap does not flow. It can take me about a week because of my family size. I would have preferred to use a tank but it is expensive and I don’t have that amount of money to buy it’

(42-year-old woman from Adzekpo).

The use of storage facilities such as water drums is critical in ensuring that households have water available for domestic use. However, there were problems regarding the quality of water stored in these water storage facilities for longer periods, especially during a health crisis such as COVID-19 where hygiene practices are instrumental. For instance, respondents indicated that when water is kept for more than a week it becomes contaminated and the scent of the water also changes. One respondent from Ayemesu alluded to this by saying: “when the water remains in the barrel for a long time, you will see some black substances at the bottom of the barrel and the water also develops some scent”.

Further, it was found that storing water in drums and barrels becomes ineffective when the water supply is erratic or when there is water shortage for more than a week. Even though households adopted the use of storage facilities, it was apparent that their use was basically to ameliorate water shortage within a short period. The alternative is to buy water from vendors.

5.3.2. Buying water from vendors

Purchasing water from water vendors within the locality is a commonly used strategy by households to deal with water challenges during the early days of the COVID-19 pandemic (i.e. April - June, 2020). As can be observed in Table 7, approximately 67% of urban

Table 7
Respondents who buy water from vendors.

Obtaining water from vendors	Type of settlement		Total
	Rural	Urban	
Do you buy water from vendors?			
Yes	138 (86.2%)	160 (66.7%)	298 (74.5%)
No	22 (13.8%)	80 (33.3%)	102 (25.5%)
If yes, which vendor do you buy from			
Water tanker	28 (20.2%)	81 (50.6%)	109 (36.5%)
Water resellers in the community	72 (52.2%)	45 (28.1%)	117 (39.3%)
Other	38 (27.6%)	34 (21.3%)	72 (24.2%)
Total	138 (100.0%)	160 (100.0%)	298 (100.0%)

dwellers purchased water from water vendors, while approximately 82% of rural dwellers also purchased water from water vendors. The chi-square test shows that there was a significant difference in responses between urban and rural respondents with respect to water obtained from vendors ($\chi^2 = 19.380$ df = 1 p-value = 0.000). More so, the findings in Table 7 shows that the majority of respondents from rural areas who bought water from vendors actually got water from water resellers from neighbouring houses (52%), while a majority of respondents in urban areas obtained water from water tankers. Those who do not depend on water tankers get their water from people who buy from resellers and deliver it to the houses of their clients using head portage. Their charge is more expensive compared to tanker drivers.

This coping strategy is costly for some respondents, especially during a health pandemic that has had a debilitating economic impact on households. Nonetheless, purchasing water from a water vendor was identified as a reliable method of obtaining water. Respondents who purchased water from commercial mobile water vendors said they had water delivered to them whenever they needed it. However, for respondents who purchase water from neighbouring water vendors or household resellers, supply was limited to the availability or flow of water from GWCL and the volume of water stored in reservoirs. Also, due to quality issues, respondents preferred buying water from vendors who resell from GWCL rather than resellers who use boreholes as their supply source, according to interviews.

An official from GWCL was asked why they do not regulate water vendors on how much they should charge for water. He answered *'that is not the work of GWCL. That work is for the water and sanitation development board (WATSAN) of the community but they do not have an effective one'*. Ghana's institutional arrangements on water for small towns show that Somanya should have water boards to regulate and run the affairs of water issues but Somanya does not have effective WATSAN boards. The unavailability of such an institution makes water vendors sell water at prices that disadvantage the poor who cannot afford large storage facilities during times of water scarcity.

In terms of expenditure of households on water, the study reveals that the difference between urban and rural dwellers in terms of average expenditure on water was not wide, although rural dwellers seem to pay a little more compared to urban dwellers. For instance, 28% of the proportion of respondents in rural areas spent about 25 cedis⁴ on water every month as compared to 23% of urban residents who pay on average the same amount for water. Also, it was revealed that people purchase a Jerry can of water for 50 pesewas in all the four locations of Somanya and in all the rural areas where this study was undertaken.

5.3.3. Use of rainwater

Rainwater harvesting was identified as one of the coping strategies adopted by households in both urban and rural communities in dealing with water challenges during the early days of the COVID-19 pandemic in Ghana. In-depth interviews with informants revealed that rainwater was unreliable and was essentially used to complement their main water sources which were pipe-borne water and water from boreholes. Further, rainwater was only available during the rainfall season making it unreliable. Another problem that was also identified as far as rainwater is concerned was that households had little or inadequate storage facilities to store it even when they are in the rainy season. Thus, in essence, the proportion of water stored for household chores and also to ensure that the necessary hygiene practices were adhered to was insufficient even when respondents had frequent and abundant rainfall.

5.3.4. Resorting to water from streams and ponds

The study also identify that households also resorted to the use of raw water sources such as streams and ponds for domestic use during the early days of the COVID-19 pandemic. This situation was common with

households in rural communities like Ayemesu and Adzekpo. Informants interviewed explained that using water from these sources was not the best due to the low quality of the water for domestic use and the potential of contamination by pathogens. They indicated that in such a health pandemic situation the whole country was confronting, the preferable source of water that should be used is pipe-borne water from GWCL or at worse borehole water. However, households resorted to the use of streams and ponds in times of severe water shortages or in situations where the amount of water available for domestic chores was insufficient and therefore they had to complement water from streams which were essentially used for cleaning and washing.

6. Discussion

Majority of the respondents were females compared to very few males who gave data for the study. This is not new in most parts of Ghana and Africa as a whole. The targeted group for the study are people who access water and women are noted to be people who engage in this activity. This person is supposed to be the one who takes daily decisions on how water is to be accessed. Through household water collection, it has been conceptualized that gender norms have been segmented into objects, activities and roles. Water accessibility and its collection have been and are stereotyped culturally into biological sex roles and women in the study area and Africa as a whole have been found to be responsible for its collection and use (Liben et al., 2002).

The findings from this paper showed that about 72.5% of rural households and 65.8% of urban households in the study communities had access to a good source of water (pipe-borne water). This is a significant improvement looking at the municipal average of persons with access to improved water sources. For instance, the GSS (2014) points out that the main source of drinking water in urban communities of the Yilo Krobo municipality was public tap/standpipe to which about 31.2% of households have access. About 26.8% of households in urban communities of the municipality also have access to pipe-borne water which is not within the houses they occupy (GSS, 2014). This is consistent with our findings which show that 54.5% of respondents have access to pipe-borne water that is not within their houses. The issue of in-house water facilities has assumed prominence in the discourse on access to improved water (Agbadi et al., 2019; Armah et al., 2018). According to Armah et al. (2018), accessibility to water on premises improves water access, and as such more should be done to extend in-house water facilities. As was revealed in the study, one of the factors that accounted for the failed impact of the government of Ghana's free water policy in the wake of the outbreak of COVID-19 was the fact that many people did not have in-dwelling pipe-borne water sources and had to gain access to water through third parties-vendor. Even though the vendors benefitted from the government's free water, people who have to buy water from these vendors were made to pay for the water.

The study found that households faced water accessibility challenges during the early periods of COVID-19. The main challenge that was identified was the cost of water and the limited supply to communities in the municipality. The increased cost of water for households could be attributed to a combination of factors such as the limited supply of water and the dependence on pipe-borne water outside dwellings, usually private standpipes. Since most households did not have their houses connected to the grid, they had to buy water from other private sources. Further, the study also showed that the desire to make profits by private individuals even though the cost of water supply was covered by the government also contributed to the increased cost of water in this situation. The above result is consistent with the argument by Boakye-Ansah et al. (2019) who assert that equitable access to water is a long shot away in developing countries like Ghana due to the high cost of connecting to the main grid. The cost elements include the initial cost of over 1000 Ghana cedis, buying of pipes, and labour cost of digging the trench. Further, this finding is also not far from Amankwaa et al. (2014) finding which also shows that limited access to pipe-borne water

⁴ Equivalent to US\$ 3.00

increases expenditure on other alternative water sources. Thus, the question raised by [Amankwaa & Ampratwum \(2020\)](#) about who benefits from tariff removal from water can also be asked in this context. As was evidenced from findings in this study, about 67% of small towns' urban dwellers purchased water from water vendors, while approximately 82% of people in the rural areas also purchased water from water vendors. People who are not able to avail themselves of water from water tank operators have to depend on head portage. These people are also noted to be the poor or disable in the community. It should be noted that head portage is a major form of transporting goods both in rural and urban areas of Ghana. All over Ghana and Africa as a whole, people carry their goods on their heads. Even though, both men and women carry goods on their heads, women were noted to be the main people who use this means of transporting water to the house while men do use bicycles, carts and other technological aids to transport their water and other goods.

The study also showed that those who do not have access to water within their dwellings mix the water sources. Some resort to rivers and other contaminated water sources. The United Nations Resolution 64/292 asserts that everyone is entitled to sufficient, safe, acceptable, physically accessible, and affordable water for both domestic and personal use ([Omarova et al., 2019](#)), however, our study showed that the situation in the study communities like Adzepko, and Ogame was far from the ideal. The population of the municipality is increasing and therefore it is expected that water demand will increase in the future. Access to water is likely to worsen if deliberate efforts are not made to improve the current situation. The findings revealed that only 36% of respondents indicated that they have easy access to water. However, 40% of the respondents who live in rural communities indicated that they have easy access. The above result clearly shows that the campaign to prevent the spread of COVID-19 through improved water access is unlikely to be effective given that about 60% of respondents find it difficult to access improved water sources.

In line with [Nicol \(2000\)](#), we argue that water within the study area is not being treated as an asset and a public good. Further, the institutional linkages are not also in place to ensure the sustainability of water, which refers to people having access to water when they want it, and the water infrastructure should be available to serve the people continuously. COVID-19 protocols call for frequent handwashing with soap under running water. This however is not the case in the study area. At present, water does not flow in the taps of some communities within the municipality which we argue is not sustainable. A community is said to have sustainable access to domestic water when water is available to be used by people for "more than 8 hours of the day" ([GTZ, 2007](#); 25). On sustainable access to water to combat COVID-19, we argue that the frequency of water flows in Somanya and its environs is not sustainable based on the definition of "sustainable access to water" defined by donors like [GTZ \(2007\)](#). It can be said that the water challenges in Somanya are due to the unavailability of effective water and sanitation development board (WATSAN). Since water does not flow when needed, households without access to clean water devised coping strategies to survive. Coping strategies that households used to acquire water on a sustainable basis is to store water. Drums, Jerry cans, and barrels come in handy for most of the respondents but the poor finds it difficult to buy big storage facilities to store water for a long time. They, therefore, have to buy water from their rich neighbours who store water in large water tanks.

The findings also show that people in the study area do not see rainwater as a resource that can be used to supplement the inadequate supply of water to their communities. However, both rural and urban settlements in Ghana have a high level of demand for potable water that is not available to them and rainwater can serve as a supplementary source ([Owusu & Teye, 2014](#)). Even though our current study did not explore reasons for this low affinity towards rainwater, the high cost of the systems needed to harvest the rainwater like roofs, gutters, and storage facilities might be factors that dispel house owners from using

the resource. The main reason might also be the poverty situation in the municipality. Even though most houses are roofed with iron roofing sheets, most of the dwellings are small and cannot gather enough rainfall to be stored and used. Tenancy arrangements in Ghana might also dispel a lot of households from investing in the system.

The merits of the use of both qualitative and quantitative data in this study offer the paper a richness and clarity of the phenomenon being studied ([Rahman, 2017](#)). It can be said to be 'best for both worlds'-qualitative and quantitative methods. The advantage it provides this study is that it helps us to understand this important social phenomenon of household access to improved water in rural and small urban communities in the wake of COVID-19 which has not been dealt with in the urban governance literature from the perspective of the actors involved in water collection and usage. This paper, therefore, adds to the debate in the philosophy of science that argued that both methods should not be separated but can be combined or treated on equal terms ([Hepburn & Hanne, 2021](#)). Also, this paper can be said to overcome the intrinsic weaknesses that are inherent in the use of only quantitative or qualitative approaches. The advantages notwithstanding, it was very difficult to use the two methods not to mention the complexity of gathering and interpreting the research findings. It also has the problem of it being more time-consuming. This problem with the use of triangulation in social science studies was aptly put by [Campbell et al. \(2020; 139\)](#) that "the volume of data to be scanned increased time-to-completion". For instance, it is more time-consuming to gather, analyse, and synthesize data from the two approaches into one research output as done in this paper. However, combining both qualitative and quantitative methods provides this paper with solid tools which helped us to achieve the goal of unraveling water access and coping strategies during the COVID-19 pandemic by households at the smallest unit of analysis rather than the national level.

7. Conclusions and recommendations

COVID-19 has created extraordinary situations that demand critical access to water ([Smiley et al., 2020](#)). This paper examined two important questions: (1) what was the water accessibility situation during the early periods of the COVID-19 pandemic in both urban and rural areas of the Yilo Krobo Municipality in the wake of free water provision by the government and (2) how did residents cope and how did they solve the challenges with water access during this period. The results showed that pipe-borne water was the main source of water for domestic purposes in both urban and rural areas. This is very good to curb the devastating impact COVID-19 is having on people throughout the world. Also, looking at the sources of water in the municipality, one can say that the water situation in the Yilo Krobo Municipality is not bad. However, more than half of the respondents did not have in-house pipe-borne water and had to buy water from water resellers from neighbouring houses or mobile water vendors. Contrary to efforts by the government to increase water supply in this period, the finding showed that there was inadequate water supply, coupled with an increased cost of water access. The intervention by the government such as free water and removal of water tariffs usually benefitted the rich and the water vendors more than the poor. The study also found that different strategies were employed by households to manage water. This includes water storage, buying water from vendors, rainwater harvesting, and resorting to other sources of water such as streams and ponds.

It is concluded here that the situation of COVID-19 necessitated a more effective approach in the provision of improved water sources like upgrading domestic water sources or the installation and distribution of large containers to communities but not just paying for water that does not trickle down to households but rather is enjoyed by water vendors and richer households who have in-house water connections. The capacity of the pumping station in Akorley is not enough to serve the numerous small settlements in its catchment area. This situation is driving GWCL to ration water to the settlements within its catchment

area. The government of Ghana and its development partners should as a matter of urgency increase the capacity of the booster station or construct a new one to serve communities on the Akwapim ridge. When this is done, water will be available to be pumped to settlements around Somanya.

Based on the findings, it can be argued that there is a need for the formation of a WATSAN board. This board will ensure the sequencing and timing of how GWCL opens the valves for people to have access to water in the communities. For access to water on a sustainable basis within the municipality and its environs during emergencies like that of COVID-19, the government alone should not be the sole player or actor. The WATSAN boards are to be supervised by the GWCL, Yilo Krobo Municipal Assembly (YKMA), and the CWSA through the Municipal Water and Sanitation Team (MWST). The GWCL, YKMA, and the CWSA should not interact with the water user groups and Area/Town/Unit committees. Instead, they are to be in touch with WATSAN boards who are to be made to report to the water user groups, Area/Town/Unit committees, and the Municipal Water and Sanitation team (MWST). The water user groups, Area/Town/Unit committees should also interact with the WATSAN boards. The WATSAN boards on the other hand should interact or provide feedback to the GWCL, YKMA, and the CWSA only when the situation demands but normally, this should be done through the MWST. This can be done quarterly, but it should depend on the situation on the ground.

The government can also construct water tanks in strategic points of both urban and rural settlements within the municipality so that, water can be stored and made available when the taps are not flowing. This can bring relief to people especially the poor who cannot afford large storage facilities or get in-house water taps. This study is not able to access how the strategies being adopted have led to the reduction or increase in COVID-19 cases in the study area. It is recommended that further studies should be done to unravel these. Also, further studies should be undertaken on how water is stored for use when the taps are not flowing.

Ethics clearance

This study was approved by the ethics committee of UESD. The ethics clearance certificate number is APP/RSC/0004.

Funding sources

This study did not receive any specific grant from funding agencies in the public, commercial, or not-for-profit sectors.

Declaration of Competing Interest

The authors declare that they do not have any competing conflict of interest.

Acknowledgements

The authors would like to acknowledge the household members, opinion leaders, Chiefs, workers of the GWCL and members of the Yilo Krobo municipality who took time off their busy schedules to participate in this study. Thanks also go to all those who help gather data for the study.

References

- Abubakar, R. I. (2018). Strategies for coping with inadequate domestic water supply in Abuja, Nigeria. *Water International*, 43(5), 570–590. <https://doi.org/10.1080/02508060.2018.1490862>
- Achore, M. (2022). *Coping with water insecurity in urban Ghana: Health implications and intervention outcomes during Covid-19*. Ontario: Queens University. Unpublished PhD Thesis, Retrieved from <https://qspace.library.queensu.ca/handle/1974/30124>.
- Afriyie, D. K., Asare, G. A., Amponsah, S. K., & Godman, B. (2020). COVID-19 pandemic in resource-poor countries: Challenges, experiences and opportunities in Ghana. *The*

- Journal of Infection in Developing Countries*, 14(8), 838–843. <https://doi.org/10.3855/jidc.12909>
- Agbadi, P., Darkwah, E., & Kenney, P. L. (2019). A multilevel analysis of regressors of access to improved drinking water and sanitation facilities in Ghana. *Journal of Environmental and Public Health*. , Article 3983869. <https://doi.org/10.1155/2019/3983869>
- Agbozo, F., & Jahn, A. (2021). COVID-19 in Ghana: Challenges and countermeasures for maternal health service delivery in public health facilities. *Reproductive Health*, 18(151), 1–5. <https://doi.org/10.1186/s12978-021-01198-5>
- Amankwaa, E. F., Owusu, A., Owusu, G., & Eshun, F. (2014). Accra's poverty trap: Analysing water provision in urban Ghana. *Journal of Social Science for Policy*, 2(2), 69–89. Online at <https://www.researchgate.net/publication/274696706>.
- Amankwaa, G., & Ampratwum, E. F. (2020). COVID-19 'free water' initiatives in the Global South: What does the Ghanaian case mean for equitable and sustainable water services? *Water International*, 45(7–8), 722–729. <https://doi.org/10.1080/02508060.2020.1845076>
- Amoah, S. T., & Yahaya, A.-K. (2013). Evolution of water systems and its challenges in the Wa Municipality of Ghana. *Journal of Environment and Earth Science*, 3(7), 15–24. <https://www.iiste.org/Journals/index.php/JEES/article/view/6345>.
- Arcipowski, E., Schwartz, J., Davenport, L., Hayes, M., & Nolan, T. (2017). Clean water, clean life: Promoting healthier, accessible water in rural Appalachia. *Journal of Contemporary Water Research & Education*, 16(1), 1–18. <https://doi.org/10.1111/j.1936-704X.2017.3248.x>
- Armah, F. A., Ekumah, B., Oscar Yawson, D., Odoi, J. O., Afitiri, A.-R., & Esi Nyiekue, F. (2018). Access to improved water and sanitation in sub-Saharan Africa in a quarter century. *Heliyon*, 4, e00931. <https://doi.org/10.1016/j.heliyon.2018>
- Ashinyo, M. E., Amegah, K. E., Dubik, S. D., Ntow-Kummi, G., Adjei, M. K., Amponsah, J., Ayivase, J. T., Amoah, S., Ashinyo, A., Sodzi-Tettey, S., Awekeya, H., Codjoe, A., Tegbey, I. E., Kwakye, A. T. O., & Akoriyea, S. K. (2021). Evaluation of water, sanitation and hygiene status of COVID-19 healthcare facilities in Ghana using the WASH FIT approach. *Journal of Water, Sanitation and Hygiene for Development*, 11(3), 398–404. <https://doi.org/10.2166/washdev.2021.254>
- Berg, B. L., & Lune, H. (2017). *Qualitative research methods for social sciences* (9th ed.). Boston, MA: Pearson Education Ltd.
- Boakye-Ansah, A. S., Schwartz, K., & Zwarteeven, M. (2019). Unravelling pro-poor water services: What does it mean and why is it so popular? *Journal of Water Sanitation and Hygiene for Development*, 9(2), 187–197. <https://doi.org/10.2166/washdev.2019.086>
- Campbell, R., Goodman-Williams, R., Feeney, H., & Fehler-Cabral, G. (2020). Assessing triangulation across methodologies, methods, and stakeholder groups: The joys, woes, and politics of interpreting convergent and divergent data. *American Journal of Evaluation*, 41(1), 125–144. <https://doi.org/10.1177/1098214018804195>
- Cassivi, A., Dorea, C. C., Johnston, R., & Waygood, E. O. D. (2018). Access to drinking water: Time matters. *Journal of Water and Health*, 16(4), 661–666. <https://doi.org/10.2166/wh.2018.009>
- CWSA. (2004). *Small towns sector policy*. Accra, Ghana: Community Water and Sanitation Agency (unpublished)Downloaded on 22-10-2021 at <https://www.ircwash.org/resources/small-towns-sector-policy-operation-and-maintenance-guidelines>.
- Creswell, J. W. (2014). *Research design: Qualitative, quantitative and mixed methods approaches* (4th ed.). Thousand Oaks, CA: Sage.
- Creswell, J. W., & Plano Clark, V. L. (2006). *Designing and conducting mixed methods research*. Thousand Oaks, CA: Sage.
- Desye, B. (2021). COVID-19 pandemic and water, sanitation, and hygiene: Impacts, challenges, and mitigation strategies. *Environmental Health Insights*, 15, 1–7. <https://doi.org/10.1177/11786302211029447>
- Dos Santos, S., Adams, E. A., Neville, G., Wada, Y., de Sherbinin, A., Bernhardt, E. M., & Adamo, S. B. (2017). Urban growth and water access in sub-Saharan Africa: Progress, challenges, and emerging research directions. *Science of the Total Environment*, 607-608, 497–508. <https://doi.org/10.1016/j.scitotenv.2017.06.157>
- Fielmua, N., & Mwingyine, D. T. (2018). Water at the centre of poverty reduction: Targeting women as a stepping stone in the Nadowli District, Ghana. *Ghana Journal of Development Studies*, 15(2), 46–68. <https://doi.org/10.4314/gjds.v15i2.3>
- German Technical Cooperation (GTZ). (2007). *MDG monitoring for urban water supply and sanitation: Catching up with reality in Sub-Saharan Africa*. Eschborn, Germany: German Technical Cooperation.
- Ghana Health Service (GHS). (2022). *Situation update: COVID-19 outbreak in Ghana as at 15 February 2021*. Downloaded on 15-02-2022 from <https://www.ghs.gov.gh/covid19/latest.php#>.
- Ghana Statistical Service (GSS). (2014). 2010 population and housing census. *District analytical report*. Yilo Krobo Municipal Assembly. Accra: Ghana Statistical Service.
- Gondwe, G. (2020). *Assessing the impact of COVID-19 on Africa's economic development*. UNCTAD/ALDC/MISC/2020/3 (pp. 1–21). Geneva: United Nations Conference on Trade and Development. Retrieved on 20-08-2021 from <https://unctad.org/webflyer/assessing-impact-covid-19-africas-economic-development>.
- Hajibabaei, M., Nazif, S., & Sitzenfrei, R. (2019). Improving the performance of water distribution networks based on the value index in the system dynamics framework. *Water*, 11, 2445. <https://doi.org/10.3390/w11122445>
- Hepburn, B., & Hanne, A. (2021). Scientific method. *The stanford encyclopedia of philosophy* (Summer 2021 Edition), Edward N. Zalta (ed.), downloaded on 04-05-2022 from <https://plato.stanford.edu/archives/sum2021/entries/scientific-method>.
- Issahaku, H., & Abu, B. M. (2020). *COVID-19 in Ghana: Consequences for poverty, and fiscal implications*. Nairobi: African Economic Research Consortium. AERC Working Paper.
- Kangmennaang, J., Bisung, E., & Elliott, S. J. (2020). We are drinking diseases?: Perception of water insecurity and emotional distress in urban slums in Accra, Ghana. *International Journal of Environmental Research and Public Health*, 17(890), 1–17. <https://doi.org/10.3390/ijerph17030890>

- Leavy, P. (2017). *Research design: Quantitative, qualitative, mixed methods, arts-based, and community-based participatory research approaches*. New York: Guilford Publications.
- Liben, L. S., Bigler, R. S., Ruble, D. N., Martin, C. L., & Powlishta, K. K. (2002). The development course of gender differentiation: Conceptualizing, measuring, and evaluating constructs and pathways. *Monographs of the Society for Research in Child Development*, 67(2), 1–147. No. 269 <https://www.jstor.org/stable/318153>.
- Lohr, S. L. (2019). *Sampling: Design and analysis* (2nd Edition). New York: Chapman and Hall/CRC.
- Lyons, W. E., & Lowery, D. (1989). Citizen responses to dissatisfaction in urban communities: A partial test of a general model. *The Journal of Politics*, 51(4), 841–868. <https://doi.org/10.2307/2131537>
- Majuru, B., Suhrcke, M., & Hunter, P. R. (2016). How do households respond to unreliable water supplies? A systematic review. *International Journal of Environmental Research and Public Health*, 13(12), 1222. <https://doi.org/10.3390/ijerph13121222>
- Musingafi, M. C. C. (2013). A global overview of potable water resources availability and accessibility In Southern Africa. *Journal of Natural Sciences Research*, 3(2), 26–34. <https://iiste.org/Journals/index.php/JNSR/article/view/4362>.
- Mustanski, B. (2011). Ethical and regulatory issues with conducting sexuality research with LGBT adolescents: A call to action for a scientifically informed approach. *Archives of Sexual Behavior*, 40(4), 673–686. <https://doi.org/10.1007/s10508-011-9745-1>
- Nkrumah, R. K., Andoh, F. K., Sebu, J., Annim, S. K., & Mwinlaaru, Y. P. (2021). COVID-19 water and electricity subsidies in Ghana: How do the poor benefit? *Scientific African*, 14(4), e01038. <https://doi.org/10.1016/j.sciaf.2021.e01038>
- Nicol, A. (2000). *Adopting a sustainable livelihoods approach to water projects: Implications for policy and practice*, 133 pp. 1–35. London: Overseas Development Institute (ODI). <https://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.473.9534&rep=rep1&type=pdf>.
- Nyarko, K. B., Odai, S. N., Owusu, P. A., & Quartey, E. K. (2008). *Water supply coping strategies in Accra* (pp. 417–420). Accra: Proceedings of the 33rd WEDC International Conference, Accra, Ghana, 7–11 April 2008. Retrieved from <https://hdl.handle.net/2134/29846>.
- Olson, D., Fesselet, J-F., & Grouzard, V. (2017). *Management of cholera epidemic*. Cape Town: Médecins Sans Frontières. downloaded on 05-05-2022 from <https://medi-calguidelines.msf.org/viewport/CHOL/english/authors-contributors-23447570.h>.
- Omarova, A., Tussupova, K., Hjorth, P., Kalishev, M., & Dosmagambetova, R. (2019). Water supply challenges in rural areas: A case study from central Kazakhstan. *International Journal of Environmental Research and Public Health*, 16(5), 1–14. <https://doi.org/10.3390/ijerph16050688>
- Owusu, P. A., Asumadu-Sarkodie, S., & Ameyo, P. (2016). A review of Ghana's water resource management and the future prospect. In *Cogent Engineering*, 3. <https://doi.org/10.1080/23311916.2016.1164275>. Cogent OA.
- Owusu, K., & Teye, J. K. (2014). Supplementing urban water supply with rainwater harvesting in Accra, Ghana. *International Journal of Water Resources Development*, 31(4), 630–639. <https://doi.org/10.1080/07900627.2014.927752>
- Owusu, G. (2005). Small towns in Ghana: Justifications for their promotion under Ghana's decentralisation programme. *African Studies Quarterly*, 8(2), 48–69 [online] <http://www.africa.ufl.edu/asq/v8/v8i2a3.htm>.
- Poku-Boansi, M., & Adarkwa, K. K. (2016). Determinants of residential location in the Adenta Municipality, Ghana. *GeoJournal*, 81, 779–791. <https://doi.org/10.1007/s10708-015-9665-z>, 2016.
- Pilgrim, N., Roche, B., Revels, C., Kingdom, B., & Kalbermatten, J. (2004). *Town water supply and sanitation*. Washington D. C.: The World Bank Group.
- Rahman, M. S. (2017). The advantages and disadvantages of using qualitative and quantitative approaches and methods in language “testing and assessment” research: A literature review. *Journal of Education and Learning*, 6(1), 102–112. <https://doi.org/10.5539/jel.v6n1p102>
- Salifu, A., Essandoh, H. M. K., Traore, A. N., & Potgieter, N. (2019). Water source quality in Ahenema Kokoben, Ghana. *Journal of Water Sanitation and Hygiene for Development*, 9(3), 450–459. <https://doi.org/10.2166/washdev.2019.048>
- Senna, R. (2021). Household coping strategies of water scarcity: The Case of Madina, A suburb of the La-Nkwantangan District in the Greater Accra Region. *Journal of Resources Development and Management*, 76, 62–70. <https://iiste.org/Journals/index.php/JRDM/article/view/56680/58526>.
- Shulla, K., Voigt, B-F., Cibian, S., Scandone, G., Martinez, E., Nelkovski, F., & Salehi, P. (2021). Effects of COVID19 on the Sustainable Development Goals (SDGs). *Discover Sustainability*, 2, Article 15. <https://doi.org/10.1007/s43621-021-00026-x>
- Smiley, S. L., Agbemom, B. D., Adams, E. A., & Tutu, R. (2020). COVID-19 and water access in Sub-Saharan Africa: Ghana's free water directive may not benefit water insecure households. *African Geographical Review*, 39(4), 398–404. <https://doi.org/10.1080/19376812.2020.1810083>
- UNICEF/WHO. (2015). *Progress on sanitation and drinking water –2015 update and MDG assessment*. World Health Organization. Downloaded on 10-09-2022 from <https://apps.who.int/iris/handle/10665/177752>.
- USAID. (2021). Assessing the effects of COVID-19 on access to water, sanitation, and hygiene in USAID high priority and strategy-aligned countries: Country Deep Dive Report - Ghana. *Tetra Tech*, 1–34. Downloaded on 10-10-2021 from https://pdf.usaid.gov/pdf_docs/PA00XDMX.pdf.
- Wateraid. (2021). *Ghana: Where-we-work*. Accra: Wateraid. Downloaded on 1-12-2021 from <https://www.wateraid.org/where-we-work/ghana>.
- WHO/UNICEF. (2014). *Progress on drinking water and sanitation: 2014 Update*. Luxembourg: WHO. Downloaded on 14-10-2021 from <https://apps.who.int/iris/handle/10665/112727>.
- Yeboah, A. S., Takyi, S. A., Amponsah, O., & Anafo, D. (2020). Assessing the practicality of the COVID-19 social distancing guidelines to the urban poor in the Ghanaian context. *Social Sciences & Humanities Open*, 2(1), Article 100087. <https://doi.org/10.1016/j.ssaho.2020.100087>
- Yeleliere, E., Cobbina, S. J., & Duwiewuah, A. B. (2018). Review of Ghana's water resources: The quality and management with particular focus on freshwater resources. *Applied Water Science*, 8(93), 1–12. <https://doi.org/10.1007/S13201-018-0736-4>
- Yilo Krobo Municipal Assembly (YKMA). (2018). *Medium-term development plan (2018–2021) under the national medium-term development policy framework (NMTDPF): Agenda for jobs*. Somanya: Yilo Krobo Municipal Assembly (unpublished document).