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Performance Assessment of Boreholes for Domestic Water Supply in the Tolon District of Ghana

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ABSTRACT

This study was conducted to assess the performance and functionality of boreholes for domestic water use in the Tolon District of the Northern Region of Ghana. A total of 115 boreholes were studied with 75.8% being functional whilst 24.2% were defunct. All the boreholes suffered different levels of breakdowns depending on frequency of use. Some of the causes of the breakdowns were negligence and careless operations coupled with lack of policies on the use of the facilities. Twelve (12) litres plastic containers and stop watch were used to determine the discharge of the boreholes. The discharge of the functioning boreholes ranged from 3 – 18 Lmin-1. The discharge was plotted against the depth in a regression graph, which showed a negative correlation. The boreholes had a minimum and maximum depths of 35 m and 75 m, respectively. The study recommended that there should be more borehole facilities to minimize water scarcity in the district. It is also recommended that the borehole facilities should be fenced to prevent them from being damaged by animals and children. There should be routine maintenance of the boreholes to ensure sustainable domestic water supply in the district. The broken boreholes should be repaired on time to prevent water shortage in the communities. Water and Sanitation Committee (WatSan) should be proactive in the operation and maintenance of the boreholes. Also, women should be included in the water management committees and their opinions should be acknowledged.

INTRODUCTION

Water is one of the most essential natural resources for man, and occupies about 70% of the earth's surface (Eja, 2002). Water suitable for human use is referred to as potable water and should be good and of safe quality, presenting no any significant health risk over life time consumption (WHO, 2006). Although water is essential for life, it also remains an important source of disease transmission and a major cause of mortality in developing countries because of limitations in access and poor-quality standards (Mbah and Muhammed, 2015). It is estimated that 884 million people have no access to potable water supply and that 84% of them lived in the rural area (WHO/UNICEF, 2010).

As a result of insufficient supply of potable water by State-owned Water Supply Companies, most households in Ghana depend on hand dug wells and boreholes for drinking water and for other domestic purposes (Osei, 2014). Boreholes are relatively easy and cheap to install. To bridge the gap in water supply coverage, it is crucial that boreholes are delivered in a cost-effective manner. This should result in borehole continuing to function through their designed lifespan of 20 to 50 years (Olabode and Bamgboye, 2013). Water level in the aquifers also has great influence on the effective performance of the boreholes, which would be achieved if the water level in the aquifers that supplied their boreholes/wells always stayed the same. However, seasonal variations in rainfall and occasional drought affect the volume of the groundwater. The water level in a borehole can also be lowered if other bore holes near it draw more water than the aquifer is recharged. This makes drawdown falls below the pump level (Peter, 2014). In addition, despite their importance, many boreholes do not function optimally and/or are subject to frequent breakdowns, a factor exacerbated in the dry season/drought period due to overuse and poor community management. Efforts should be made to identify which existing systems are non-functional or performing poorly, understand the reasons why and work on rehabilitating and improving them (Swai, 2012).

Ghana Community Water and Sanitation Agency (CWSA) and other organizations constructed over 3,000 boreholes in northern Ghana (Akunai, 2014) over two decades (1990 – 2010). Despite the construction of numerous boreholes, access to water for domestic use remains a very critical challenge. The rate at which water supply facilities, especially boreholes, are falling into disuse is also rapid. There are many reports of abandonment of some of these facilities. Mechanical breakdown of hand pumps comes as no regular repairs and maintenance is being carried out. It has been reported that the non-functionality of hand pumps and abandonment of the boreholes in some parts of the country compel women to rely on shallow dug-wells and other surface water sources for domestic supply, though they are aware these are not clean water sources (WHO, 2002). Eduvie and Olabode (2012) stated that, in some parts of the country there is a high rate of boreholes failure. This can be attributed in part to poor borehole construction and poor maintenance practices (Olabode and Bamgboye, 2013). This study, therefore, assessed the performance and functionality of a number of boreholes in the Tolon District in the Northern of Region of Ghana. The findings of this study will facilitate decision-making for the effective performance of the boreholes to supply to the people in the district with adequate water of acceptable quality for domestic use.

MATERIALS AND METHODS

Study Area

This study was carried out in Tolon District, one of the administrative districts in the Northern Region of Ghana. The district was borne out of the hitherto Tolon/Kumbungu District by the LI 2142 in 2012, with Tolon as its District capital. The district is made up of two (2) town councils and four (4) area councils. The town councils include Tolon and Nyankpala, whereas the area councils include; Kasuyili, Lingbunga, Tali, and Yoggu. The district is located in the Guinea Savannah belt of Ghana, between latitudes 9° 15′ and 10° 02` N and longitudes 0° 53′and 1° 25′ W and shares boundaries to the North with Kumbungu, North Gonja to the West, Central Gonja to the South, and Sagnarigu Districts to the East. The district covers a total land area of 1353.66 km2 with a total human population of 72,990, representing about 3% of the entire population of the Northern Region. The estimated human population is made up of 36,360 (49.8%) males and 36, 630 (50.2%) females (GSS, 2014).

Climate

The climate of the district is in line with the general climate pattern found within the five regions of northern Ghana. It has a single rainy season, which begins in May and ends in the latter part of October. July-September is the rainy period, with an average annual rainfall of 1000mm, and annual floods, since the district is within the flood plains of the White Volta. From November-March the district experiences a dry season. The mean day temperatures ranged from 33 – 39°C, whereas, mean night temperature ranges from 20 – 26°C. Before the onset of the rainy season, temperatures rise to a maximum of 40 °C and fall to a minimum of 20 °C during ‘harmattan’ period (January-February) (Abdul-Ganiyu *et al.*, 2017).

Vegetation, Topography, Drainage, Geology and Soil

The vegetation of Tolon District is mainly grassland, with scattered guinea savannah woodland, characterised by drought-resistant trees such as acacia (Acacia longifolia), mango (Mangifera), baobab (Adansonia digitata Linn), Shea nut (Vitellaria paradoxa), “dawadawa”, and neem (Azadirachta indica). Sheanut, “dawadawa”, and mango are the dominating tree species, which are of economic importance and form an integral part of livelihood of its people (GSS, 2014). Generally, the land in the district is undulating, with a number of scattered depressions. There are no marked high elevations throughout the district. The district is drained by a number of rivers and streams, most prominent being the White Volta. The major rivers and their tributaries exhibit dendrite drainage patterns. Most of these tributaries dry up during the dry season (GSS, 2014).

The soil in the district is generally of the sandy loam type, excluding the lowlands, where alluvial deposits are found. There are also deposits of gravel, which have some economic value. The nature of the soil makes it highly vulnerable to sheet and gully erosion. This happens primarily because of the perennial burning of the natural vegetation, leaving the soils exposed. The continuous erosion over many years has removed most of the top soils and depleted its organic matter content. This situation does not allow the soil fauna to thrive, rendering the soil infertile and leading to low agricultural yields (GSS, 2014).

Methodology

Data for this study were obtained from both primary and secondary sources. Both qualitative and quantitative methods were used to collect data for the study, including: literature, information from internet and data from Community Water and Sanitation Agency (CWSA), Tamale. Structured questionnaires were randomly administered to users of the boreholes in the selected communities. A twelve litre (12 L) bucket was used to collect the water during the field operation (pumping test) and stop watch was used to take the time that it took to fill the graduated bucket from each borehole during the pumping operation.

Sampling Technique

The study applied stratified sampling and grouped the communities in the district into two (2) i.e. communities with boreholes and those without boreholes and purposive sampling was then used to select the communities with boreholes. The study focused on forty (40) communities including; Aseiyili, Botinli, Cheshegu, Dabogshei, Dimabi-yepala, Gbanjogla, Gbanjong, Gbulahigu, Gburimani, Gnaba, Gundu, Gurugu, Jagriguyili, Kangbagu, Kanshegu, Kapalinayili, Kobilmahigu, Kpaligun, Kpendua, Lingbunga, Nafarung, Nagbilgu, Namdu-Gbulahigu, Nyankpala, Nyobilbalga, Nyujagyili, Tali, Tolon, Tunaayili, Tuzeenayili, Vawagri (Lingbung), Vawagri (Yoggu), Wala, Walshei, Wantugu, Wayamba, Yepalsi, Yipelgu, Yizeagu and Zagua, were randomly selected. Six (6) respondents were selected in each community and interviewed using simple random sampling technique. Two (2) boreholes in each community, were considered for this study.

Questionnaire Information

Questionnaire was used to gather information on the views of two-hundred and forty (240) respondents, from the forty (40) communities on their sources of domestic water supply, domestic water use, small scale industrial water usage, reliability and sustainability of the water supply facilities, history of their boreholes, management of the borehole facilities, limiting factors of the borehole facilities and others.

Data Analysis

Data collected from the field was analysed using Microsoft Excel and SPSS version 16.0 and the results were presented in tables and bar charts.

RESULTS AND DISCUSSION

General Characteristics of the Respondents

The results of the age distribution of the respondents, presented in Table 1 indicates that 48% of the respondents fell within the age of 21 – 30, whilst 40% were within the ages of 30 – 40 and only 9%, 2% and 1%, were between the age ranges of 41 – 50, 51 – 60 and > 60, respectively. This confirmed that the youth in the communities was responsible for fetching water and they comprised mainly females (69%) and a smaller portion of male (about 31 %). Akunai (2014) also noted in a study in Northern Region that, fetching water for domestic purpose is the duty of women and children.

The study also found that majority (64%) of the respondents had no formal education, followed by those who had primary level education (17%) and JHS/Middle school level (11%) whereas SHS/Technical/Vocational/Tertiary education was attained by only 8% (Table 1). Education is essential in water supply and management. Access to education helps individuals to make decisions on their own and also allows community participation in the decision-making process on water supply and the management of the water facilities in the district. From the results, the level of literacy among the users of the borehole facilities is low and this could hinder effective management and sustainability of the water supply facilities in the district.

The study also found that 71% of the respondents were involved in farming, while 10% were students and the remaining 19% were involved in other activities such as fashion designing, petty trading and others. The results clearly revealed that Tolon District is a farming district where majority of respondents cannot easily earn money to purchase the spare parts for the boreholes repair. This accounts for the number of broken boreholes. According to GSS (2014), majority of the dwellers in the Tolon District are farmers on subsistence basis (small scale).

Table 1. General Characteristics of the Respondents

Age (years)	Frequency	Percent (%)
21– 30	115	48
31– 40	97	40
41– 50	21	9
51– 60	5	2
> 60	2	1
Sex	**Frequency**	**Percent (%)**
Male	75	31
Female	165	69
Level of Education	**Frequency**	**Percent (%)**
No formal education	154	64
Primary	41	17
JHS/Middle	26	11
SHS/Technical/Vo -cational/Tertiary	19	8
Occupation	**Frequency**	**Percent (%)**
Farming	170	71
Petty trading/ Seamstress/Tailor/	46	19
Student	24	10

Source of Water Supply in the District

The distribution of the water points used by the communities in the Tolon District is presented in Figure 1. The study found that majority (63%) of the people depend on both borehole and dug-outs as their sources of water supply. According to Sungsitthisawad and Pitaksanurat (2013), groundwater is commonly alternative water resources in areas where surface water is not accessible. This confirms the findings that some of these respondents only used the borehole as their alternate source in the dry season, when the dug-outs are dried up. About 23% of the people got their water for domestic usage mainly from boreholes. However, 7% of the respondents used borehole and hand-dug wells, whilst 4% were supplied by boreholes and dam with the rest 3% depend on other unsafe water sources which includes rivers and streams. This falls in line with the finding of Boone *et al.* (2011) which stated that surface or unsafe water usage would increase by 27% if the distance to the safe or clean water sources is far up to 1 km.

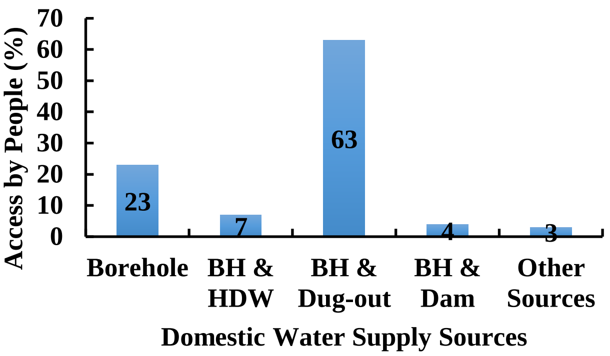

Figure 1. Domestic Water Supply Sources in Tolon District; ***BH – Borehole, HDW – Hand dug well***

Number of Functioning and Non-functioning Boreholes in Tolon District

According to CWSA (2016), Tolon District had about 115 boreholes, of which 75 boreholes, representing 65% were functioning, while 40 boreholes, representing 35 %, were not functioning (Figure 2). A successful borehole should yield a minimum of 13.5 $Lmin^{-1}$ before a hand pump can be installed, the lowest yield should not be less than 10 $Lmin^{-1}$ (CWSA, 2010). Based on the CWSA standards, the study found 12 boreholes recording a discharge of 3–9 $Lmin^{-1}$ and these were considered non-functioning in this survey. This low discharge resulted from the hydrogeological conditions of the study area and also from mechanical faults. Also, it was noted that 22 boreholes and 6 boreholes, respectively, were not functioning due to broken-down parts and capping due to poor water quality. Some of causes of breakdowns include children playing at the borehole sites (Plate 3). In all, 75 boreholes in the district were functioning, with discharges ranging from 10–18 $Lmin^{-1}$. The discharges of the boreholes in the district were very low, when compared to the minimum of discharge of 13 $Lmin^{-1}$ and maximum discharge of 78 $Lmin^{-1}$ recorded in the Upper East Region of Ghana by Akunai (2014). Carrier *et al.* (2009) also stated that about 1,898 boreholes drilled in northern Ghana have been capped, due to poor water quality, as well as low discharge.

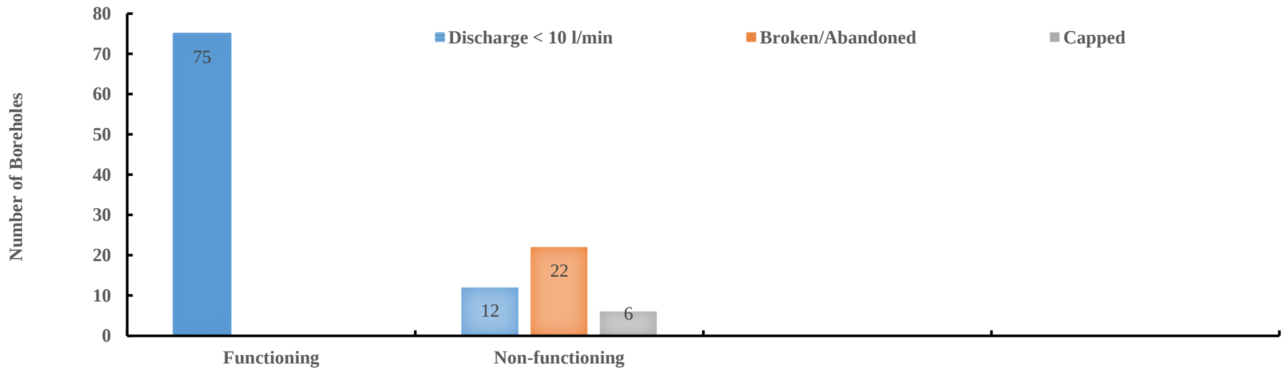

Figure 2. Number of Functioning and Non-functioning Boreholes in Tolon District

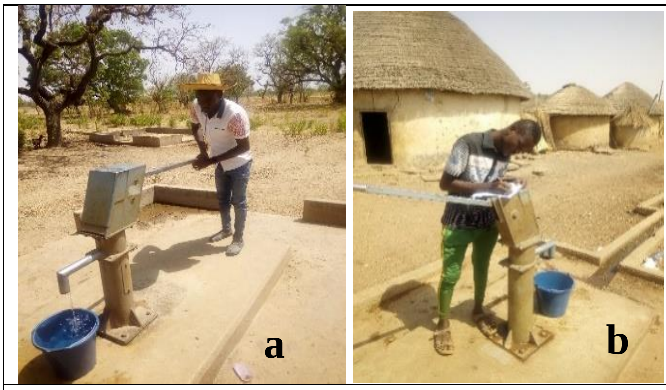

Plate 1. Some Functioning Boreholes in Tolon District

Plate 2. Some Non-functioning Boreholes in Tolon District

*[**a**: borehole at Yepalsi; **b**: Gbulahigu; **c**: Tolon and **d**: Yipelgu]*

Plate 3. Children Playing with the Handles of Boreholes; Causing Breakdowns at Gurugu (e) and Aseiyili (f) communities

Frequency of Breakdown of the Boreholes
All the respondents indicated that the boreholes experienced breakdowns every year. As presented in Table 2, the study found that about 62 % of the boreholes in the district encountered breakdowns at most twice in a year, whilst 26 % experienced 2 – 3 breakdowns in a year. About 8 % were noted for breakdowns between 4 – 5 times in a year and only 5 % encountered breakdowns more than 5 times in a year. According to the caretakers, the common causes of these breakdowns were; careless operation by users, especially children;

overuse, where borehole operates for a long period leading to wearing of bearings and valves; and boreholes not fenced or locked but exposed to children and animals.

Table 2: Frequency of Breakdowns of Boreholes in Tolon District

Number of breakdowns per year	Frequency	Percent (%)
< 2	149	62
2 – 3	62	26
4 – 5	18	8
> 5	11	5
Total	**240**	**100**

Depths of Boreholes in Tolon District

About 96.9% of the boreholes in the Tolon District were drilled by NGOs including World Vision, UNICEF, and Church of Christ. Majority (88.2%) of which were drilled between the year 2001 and 2010, and 11.8% of them were drilled between year the 1990 and 2000. The drilling depth plays a significant role in the borehole yield. In some areas in the northern part of Ghana drilling deep is not necessary, but drilling less than 20 m will not yield any appreciable water. The highest mean yield of 78 $Lmin^{-1}$ recorded in the Upper East Region was obtained at depths ranging from 25 – 44 m. Boreholes drilled in the Upper East Region had a minimum and maximum depths to the water aquifer were 28 m and 76 m, respectively (Akunai, 2014). The study found the minimum and maximum depths of boreholes in the Tolon District to be 35 m and 75 m, respectively, as presented in Figure 3.

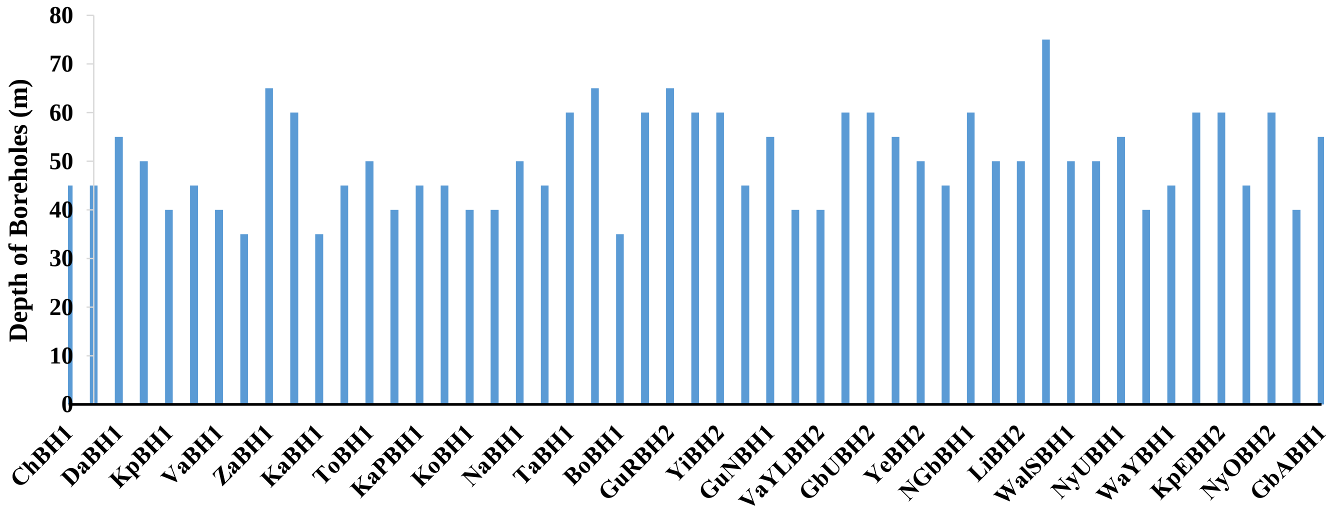

Figure 3. Depths of Sampled Boreholes in Tolon District

Relationship Between Borehole Depth and Discharge

The discharge plotted against the depths of the boreholes showed inverse relationship, but with very weak correlation. This indicates that discharge decreases with depth. As presented in Figure 4, it can be deduced that the highest discharge was obtained from the lowest depth. This finding agrees with Akunai (2014), who reported that there is a direct relationship between borehole yield and discharge, but an inverse relationship between borehole depth and discharge. The author recorded the highest mean borehole yield at the shallowest depth in the Upper East Region of Ghana.

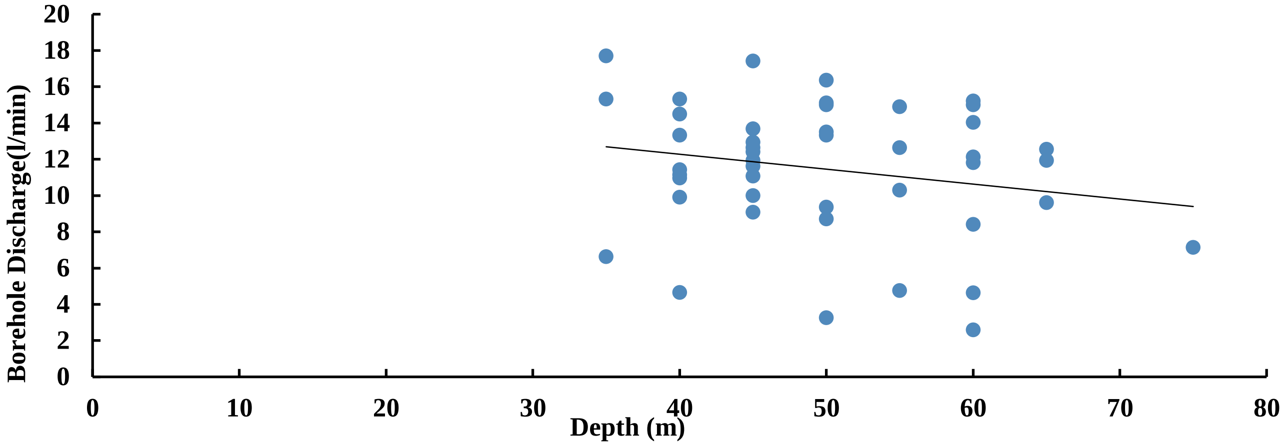

Figure 4. Relationship between Borehole Depth and Discharge

Uses of Borehole Water in Tolon District

Figure 5 presents the common usage of borehole water in the district. Water from boreholes in the study area is used for so many purposes including domestic, livestock watering, industrial and economic activities. Borehole water is not sufficient for irrigation purposes in the district. Majority of the borehole users (64%) used the borehole water for domestic activities including drinking, washing, cooking and bathing. About 11% and 9% of the respondents respectively indicated that they used it for construction of houses and industrial purposes such as processing of rice and "dawadawa", whereas 16% used it for livestock watering. Kortatsi (1994) reported that groundwater use in Ghana is greatly influenced by the groundwater availability and quality. As a result of the low yield of boreholes and the relatively good quality of the groundwater compared to surface sources, boreholes are mainly used for drinking and other domestic purposes in almost all regions with the exception of the Greater Accra regions where there is high level of salt intrusion into boreholes.

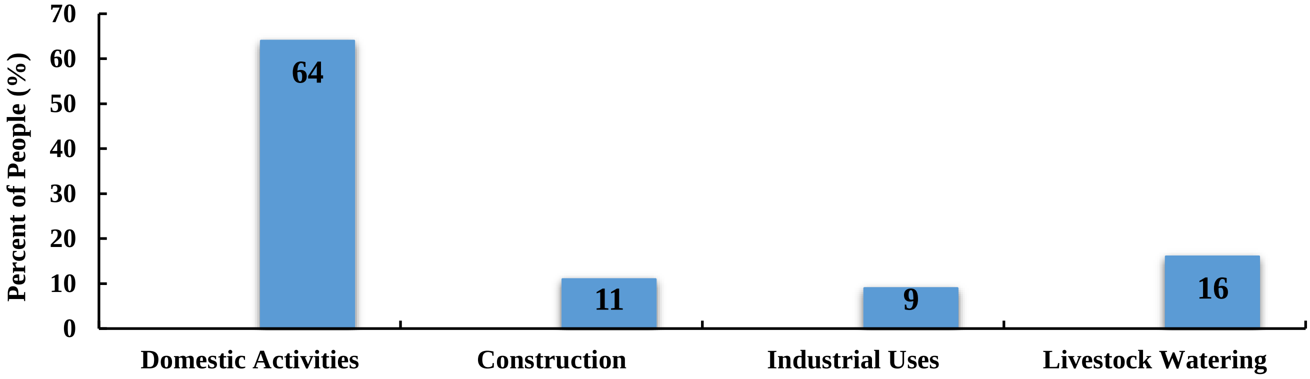

Figure 5. Common Usage of Borehole Water in Tolon District

Relative Distance of Boreholes to Communities and Time Taken to Fetch Water by Users

Due to low groundwater potential and also as a result of spatial variation of groundwater availability in the district, some of the boreholes were sited closer or within the communities, while others were sited at the outskirts of the communities and in some cases in different communities where the aquifer water availability is good. The distance travelled by people in the district to access borehole water ranged from < 100 – 1000 m (Figure 2) with 19% having borehole sited very close to their communities, thus less than 100 m away. Cumulatively, about 64 % of the respondents indicated that they walk between 100 – 400 m before they could access water from borehole, whereas about 17% stated that they travel between 400 – 1000 m to access borehole water. In a similar study in the Nadowli District of Upper West Region, Fielmua (2011) reported a travel distance of 276 – 500 m to access domestic water supply from borehole.

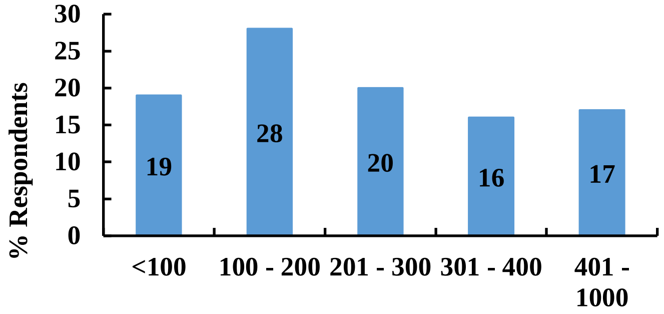

Figure 6: Relative Distances from Communities to Boreholes in Tolon District

Table 3 presents the duration of time respondents spend to fetch water at the borehole point. The time spent by people at the boreholes to fetch water was found to range from 10 – 120 minutes with majority (43%) used about 10 minutes to fetch water, followed by 30% who spent 10 – 15 minutes at the borehole to access water. About 16% of the respondents indicated that they used 16 – 20 minutes. Those who spent 21 – 25 minutes were 8% and the remaining 4% spent more than 25 – 120 minutes. Less time is spent at the borehole point during the rainy season. However, in the dry season, when all the other water sources have dried up, consumers spent time in queues before they could fetch water. This burden is mainly on women, as they are responsible for collecting water for domestic use. Fielmua (2011) also noted that less time is spent at boreholes in the rainy season due to availability of alternative sources such as rivers, hand dug well and dug outs, though such water sources may not be potable.

Table 3. Time Spent at the Borehole Point by People for Water in Tolon District

Time (minutes)	Frequency	Percent (%)
< 10	102	43
10 – 15	73	30
16 – 20	37	16
21 – 25	18	8
26 – 120	9	4

Reliability of Boreholes in Tolon District

Figure 7 presents the period water sources in the communities experienced shortage of water. During the field study, it was observed that almost all the dug-outs in the district only supply water in the rainy season, and dry up after the rain stops. Boreholes supply water throughout the year as 76.8% of the respondents confirmed. However, capacity is being reduced during the dry season when all the dug-out dry up and everybody in the community depends on the boreholes. This finding is in line with Gurudeo and Krishna (2009), who reported that high rate of pumping and low rate of natural recharge of most aquifers results in the groundwater depletion in many irrigated regions. 14.8% of the respondents experienced insufficient supply of water when the rain stops, (February/March), whilst 6.5% experienced this in March/April, followed by 1.3% who experienced it in April/May. Only 0.6% of the respondents indicated that the boreholes run short of water during the dry season. The aquifer is recharged by direct infiltration of precipitation or by infiltration of surface water, hence the volume of recharge depends on surface runoff and precipitation intensity. This implies recharge would be higher in the rainy season than in the dry season (Kovalevsky *et al*., 2004; WMO, 2012).

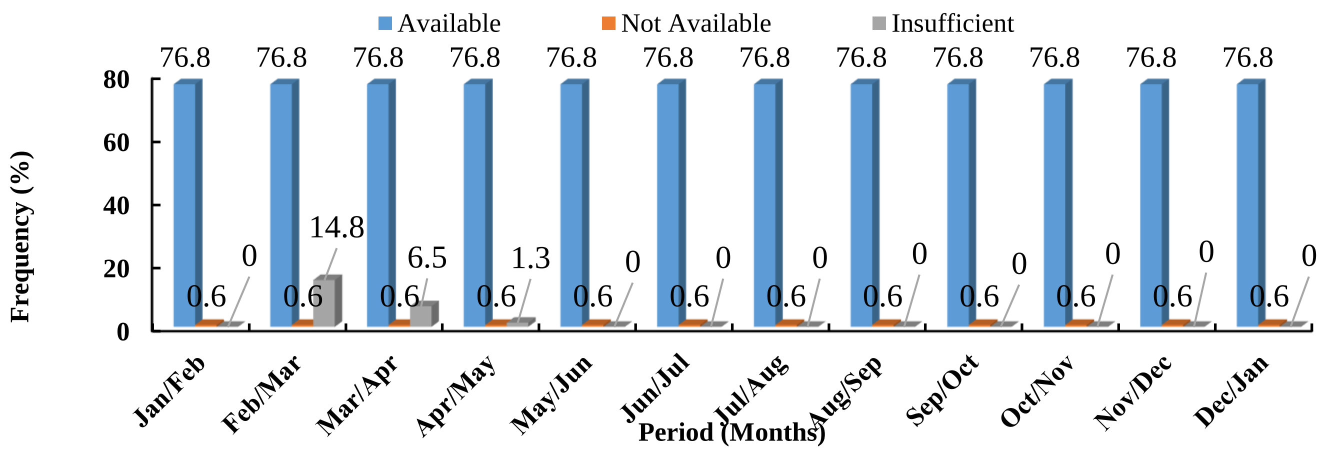

Figure 7. Reliability of Boreholes in Tolon District

Borehole Water Quality in Tolon District

According to Fei-Baffoe (2008), water is a colourless, odourless and tasteless. During the study, about 87% of the respondents indicated that they did not see any changes in the colour and taste of borehole water. However, 13% of the respondents indicated that they noticed changes in the water quality (colour) during the peak fetching periods (morning and evening). Below were some of the changes noticed by the respondents:

- Water with suspended particles is sometimes observed when operating hours are long,
- Water brown or muddy in colour,
- Whitish substances which give the water bad odour,
- "Soap bubbling" in water, and
- Suspended particles in the water suspected to be dead insects.

Taste of Borehole Water

As presented in Figure 8, majority of the respondents (45%), indicated that borehole water tasted slightly salty, followed by 43% whose borehole water did not taste salty. However, 5% of the respondents indicated that borehole water was very salty and 7% also indicated borehole water had some other taste. Water in its pure state is tasteless (Burgess *et al.*, 2010). Dissolved materials can render it unsafe for drinking (WHO, 2011). For example, water containing salt is toxic to crops/plants, and high salinity levels can cause soils to become compact, reducing water absorbing potential.

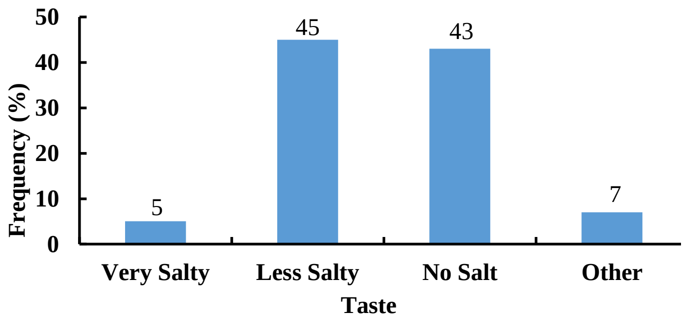

Figure 8: Perception of Borehole Water Taste in Tolon District

Performance and Water Quality Ranking of the Boreholes

According to CWSA (2010), a highly ranked borehole should be able to supply a minimum of 20 litres of water per person per day and the facility should not be located more than five hundred (500 m) from the farthest house in the community and to be able to provide potable water to the community all year round. The boreholes were ranked based on their importance, quality of service and performance, as excellent, very good and good, with percentage of 12, 77 and 11, respectively, as presented in Figure 9. They were ranked using following reasons:

- They are the main source of water to the communities and sited closer to the community.
- They are safer source of drinking water
- Presence of boreholes enhances the school attendance of the students, as they do not spend a lot of time searching for water.
- Well-sited boreholes do not dry in the dry season.
- The water is used for all domestic activities.

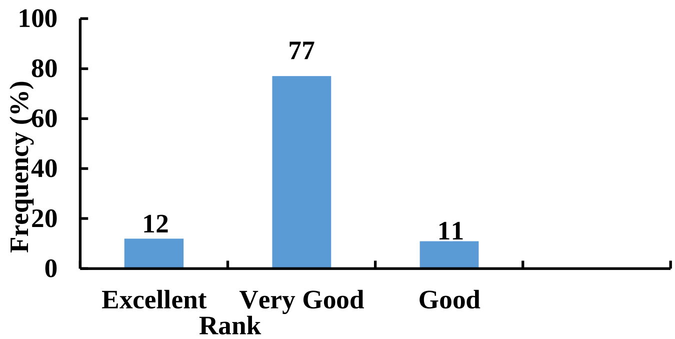

Figure 9: Performance Ranking of Boreholes in Tolon District

Management of Boreholes in Tolon District

Repair and Maintenance

Table 4 presents bodies responsible for the repair and maintenance of the boreholes in the district. Majority of the respondents (72%) mentioned that the repairs and maintenance of the boreholes are carried out by the trained mechanics in the WatSan Committee, whilst 23% and 5% of the respondents, respectively, indicated that the District Assembly and donors NGOs undertake the repairs and maintenance of the boreholes. Largely, the boreholes in the district are left to the management by the community and their water management committee. This often leads to the abandonment of the broken-down boreholes due to lack of funds, resources or skills to fix them. CWSA (2016) stated that lack of funds, equipment, material, and inadequate data on operation and maintenance are some major issues that contribute to the poor repairs and maintenance of the boreholes, especially where users do not pay water levies.

Table 4. Bodies Responsible for the Repairs and Maintenance of Boreholes in Tolon District

Bodies Responsible for the Repairs and Maintenance of Boreholes	Frequency	Percent (%)
Donor NGOs	12	5
Community WatSan Committee	173	72
District Assembly	55	23
Total	240	100

Community Water and Sanitation (WatSan) Committees

It was revealed from the study that almost all the communities had WatSan committee in-charge of the operation, repairs and maintenance of the boreholes. Routine maintenance and repairs of the boreholes are being done by some of the trained members of the WatSan committee to repair the minor breakdowns. There is a general mechanic responsible for repairing the major breakdowns which could not be fixed by these WatSan members. However, sometimes the donors, when the material required to repair the borehole is beyond the affordability for the affected communities.

Committee has the sole responsibility to manage the community water resources and sanitation, however, most of the committees were not effective and gender imbalanced. Women who are the main water collectors were expected to be part of the committee, because they can detect any developed fault immediately. According to Fielmua (2011), communities where more women engage in water management decisions, have opinions and ideas which should be centrally focused.

Some of responsibilities of the community WatSan committee include:

- Repair and maintenance of the boreholes and other water resources
- Supervision of cleaning of the surroundings of the boreholes and clearing the bush
- Levy the community towards the repair of the boreholes
- Reporting problems to donors or district mechanics
- Supervision and monitoring the operations of the boreholes.

It was observed that WatSan committees were not delivering service as expected. No routine maintenance was carried out, WatSan Committees were only doing repairs when there was a breakdown instead of doing preventive maintenance and routing cleaning.

Borehole Water Charges and Levies

The study revealed that about 94% of the water users in the district do not pay for fetching water from the boreholes. Almost all the boreholes in the district were drilled by NGOs and handed free to the communities to manage, so levy is charged to the community to repair them. Some of the reasons given by water users, why they do not pay as you fetch include: they contribute to buy parts or to repair the boreholes when there is a breakdown, and the boreholes were drilled free for the communities by the donors. However, the remaining 6% indicated that they pay a fee ranging from GH¢ 0.5 – 1.0 per head per month towards repairs and maintenance of the boreholes. According to the study by Fielmua, (2011) in the similar communities with boreholes, households contributed to repair the boreholes when the need arose, and cost per head was estimated to be in the range of GH¢ 0.50 – 4.00 depending on the degree of damage.

CONCLUSION

This study assessed the performance and functionality of boreholes in the Tolon District in the Northern Region of Ghana. A total of 115 boreholes were constructed in the district, with 75.8% functioning, whilst 24.2% were not functioning due to breakdowns, no or very low discharge, poor taste and poor water quality. The very low discharge resulted from the hydrogeological conditions of the study area, as well as mechanical faults. The frequency of breakdowns varied from twice in a year to a maximum of more than five (5) times in a year. The estimated discharge of the functioning boreholes ranged from 3–18 $Lmin^{-1}$. The depths of the boreholes in the district were from 35–75 m. The depth of the boreholes was inversely related to their discharge, thus the discharge decreased with depth. Majority (76.8%) of the boreholes were moderately reliable in terms of water supply. Water from the boreholes in the district is used for domestic, livestock watering, industrial and economic activities but not for irrigation due to insufficient quantity. Distance travelled to boreholes from communities, as well as time taken to fetch water from the boreholes was a challenge, as some of the water users have to travel 400 to 1000 m to fetch water and also to spend about 120 minutes at the water point to draw water. There were WatSan committees in each community responsible for the routine maintenance and repairs of the boreholes, though they were ineffective. About 94% of the water users in the district do not pay for fetching water from the boreholes. The boreholes in the district should be fenced to keep them away from animals and children damage. More boreholes should be constructed in the communities with high water table to reduce the problem of water shortage. Routine maintenance of the boreholes is necessary for sustainable water supply. Broken boreholes should be repaired immediately to prevent further damage of the parts. The WatSan Committee should be effective and proactive in their work. Water levies should be collected regularly to ensure timely replacement of broken parts of the boreholes. As women are the primary water collectors in the district and can immediately detect and report any fault in the boreholes, the water management committees should always engage them for their opinions.

CONFLICT OF INTEREST

The authors have declared no conflict of interest regarding the publication of the paper.

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