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Independent water pricing of small town water systems in Ghana

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ABSTRACT

This paper explored water pricing of small town water systems in Ghana and how households adapt to changes in pricing. Data were collected from four small towns in the Upper West Region through household survey, focus group discussions and key informant interviews. The results of the study showed that small town water systems are semi-autonomous in determining water tariffs. As a result, water tariffs vary among systems although the processes involved in setting tariffs were the same. Tariffs for domestic water use were generally low compared to commercial use. Despite high poverty levels in small towns compared to urban centres, water tariffs in the former were lower than in the latter. It also emerged that most households did not have knowledge on how tariffs were computed. Households without on-premises connections spend 166% higher on water than households with on-premises connections. The empirical analysis shows that unregulated water vending makes households without connection to pay higher tariffs for water. The paper among others recommends that tariffs at which vendors should sell water to customers should be set and closely monitored in order to ensure that households without connections have access to water at reasonable tariffs.

1. Introduction

Efficient water pricing remains pivotal in water supply irrespective of the management model. Over the years, water services delivery in rural and small towns in sub-Saharan Africa, especially in Ghana, is based on community-based management approach. This approach requires community-level actors to collectively make decision on water pricing that will contribute to an efficient functioning of the water systems. Efficient water pricing requires customers to pay a tariff that reflects the real cost of running the water services (Cooper et al., 2014). But some scholars have argued that rural communities are poor and cannot pay for capital replacement cost and other expenses such as operations and maintenance, thus creating a financial sustainability challenge of the water systems (Fielmua, 2018; Gonzalez-Gomez et al., 2011; Harvey and Reed, 2006; Kwangware et al., 2014). It was established that although community-based management appears to hold the key to service sustainability, it is constrained by rural poverty (Opare, 2011; Rouse, 2013; Wendy and Bakalian, 2009). Poverty in Ghana is predominantly a rural phenomenon. Based on an upper poverty line of GH¢1,314.00 ($272.60), the Ghana Statistical Service in 2018 reported that 39.5% of people in rural areas were poor as against 7.8% in the urban areas. The Upper West Region which is largely rural has the highest incidence of poverty. About seven out of every ten persons in the Region are poor (70.9%) (Ghana Statistics Service, 2018). This is significant and raises questions about an efficient pricing of water and whether such pricing will not burden the rural households in the Region.

The focus on rural communities and small towns is as a result of the sharp contrast between water governance structures in rural and urban areas in Ghana. The urban water sector receives subsidies from the state to supplement cost of production and distribution while rural and small towns depend on consumers for the full cost of water production and distribution, including overhead expenses and salaries (Owusu-Mensah, 2017). Moreover, until 2009 the rural and small-town residents in Ghana paid about 5% towards the acquisition of water services. This was intended to inculcate in communities a sense of ownership of the water systems and give them control over decision-making about water pricing, revenue usage and general water management in their jurisdictions. This has often resulted in wide differential tariffs (Foster and Hope, 2017) while leaving poor households with limited choices. It has also been suggested that the multiple functions of water make it difficult and inappropriate to handle water pricing with a market-oriented approach (Heino and Takala, 2015). In community-based water management, revenue from the water systems through user charges constitute the main source of financing operations and maintenance of the water infrastructure (Fielmua, 2018). As a result, there is often pressure on water managers to increase tariffs to be able to cover cost while at the same

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time are required to be fair in water pricing even in difficult times (Heino and Takala, 2015).

Appropriate pricing becomes a key part in achieving target one of the Sustainable Development Goal six. Bhaduri et al. (2016) argued that water services financed through external aid and charity bodies have limited sustainability and user-paid such as tariffs, water fees and taxes are best financing for sustainable outcomes. Thus, appropriate water pricing is an important part of water management decision making to which citizen knowledge of pricing and adaptation strategies to tariff levels are significant, especially in community-managed water systems. However, there is limited emphasis on residents' knowledge of and control over these aspects of water management and how households adapt to water pricing amidst limited choices. This paper discusses pricing of domestic water supply in small towns and compares to the cost of domestic water in urban areas in Ghana. From a user perspective, the paper specifically addresses households' knowledge of water pricing procedures and specific adaptation strategies used by households to maintain access to water.

2. Theoretical perspective on water pricing

Any source of water that is abstracted using modern technology attracts financial cost. The nature of water system technology also has implications on level of finances, especially at the community level (Madrigal et al., 2011). As such, the ability of a community to raise funds to meet its operation and maintenance will have repercussions on the functioning of the water systems. This makes tariffs an important part of water management. Theoretically, tariffs serve two main purposes: the first is to raise funds to operate the water systems and at times to recover the investment cost, and the second is to conserve water usage, because the absence of tariffs can result in anti-conservationist practices (Tortajada, 2010a). Willingness to pay for water services and attitude towards water conservation depends on the level of reasonableness of tariff (Mu et al., 2019). Even though the demand elasticity for water is low, it is not zero, and there is some evidence that substantial increases in water prices can lead to significant reductions in water consumption (European Environment Agency, 2013). This complements the argument that financing services delivery through user fees is an effective mode of raising revenue since it is non-coercive and users can regulate their usage to match with their payment ability (Bardhan and Mookherjee, 2006; European Environment Agency, 2013).

While water availability remains critical to human survival, affordability of consumers is also important especially when water price is set at cost recovery (Mack and Wrase, 2017). It is argued that appropriate water pricing is able to provide affordable water to consumers and also conserve water usage (Sahin et al., 2017). Intriguingly, there is no consensus on the best approach to water pricing because there are contextual factors, such as socio-economic and political which are place specific (Tortajada, 2010b). These factors often result in low and/or arbitrary tariffs that can result in extravagant water usage (Biswas, 2006; Manyena et al., 2008). This, in most instances, benefits the rich. For instance, Rouse strongly argued that "low tariffs do not help the poor: on the contrary, they deny them a decent water supply" (Rouse, 2013:62). The poor are unable to pay for the connections of water to their homes, and thus, rely on water vendors. He further established that the poor pay vendors up to 25 times more for a litre of water than those who have tap water supply (Rouse, 2013). Rouse maintains that the poor cannot save to pay monthly water bills in rural communities, and as such, pay-as-they-go is suitable for them (Rouse, 2013). Therefore, an appropriate system of billing and revenue collection is a prerequisite in water management (Rondinelli, 1991; Tortajada, 2010a).

Two major water ownership and management arrangements often come with high prices. These are: (i) pay-as-you-fetch (PAYF) and this does not depend on the ownership structure; and (ii) privately owned water supply: that is, water systems that are established and owned by non-state actors with profit making motives. In evaluating water sources in rural Kenya, Foster and Hope (2017) established that PAYF comes with higher price of water per consumption, eliminates free-riding and results in higher levels of revenue. Private owned water supply in both developed and developing countries results in higher prices. For instance, in the United States, government-owned entities do set their water rates on a cost recovery basis while the private entities are not compelled to set rates to cost recovery and as such can make profit. This makes rate of private entities higher than the public ones (Mack and Wrase, 2017). Again, in sub-Saharan Africa, governments involvement in water pricing in urban settings is accepted and widely known while water pricing in non-urban settings are often not beyond the purview of local government. Consequently, hybrid and differential tariffs widely exist in non-urban communities based on a host of factors such as purpose of water use, family size, livestock ownership and rainfall season (Foster and Hope, 2017).

3. Principles of water pricing

Water pricing refers to "applying a monetary rate or value at which water can be bought or sold" (European Environment Agency, 2013, p. 16). A set of principles of water pricing are required to maintain a balanced water management. The focus of the principles of water pricing is on tariff and it entails the following: (i) Economic efficiency – the tariffs need to reflect the cost of water services; (ii) Administrative simplicity – this principle requires that tariffs are practical to implement, in that the cost of implementing should match the benefits of tariffs; (iii) Transparency – users need to understand the price determination process and thus can rationalise the outcomes and this is necessary in minimising agitations with water services delivery; (iii) Flexibility – pricing should be able to accommodate changing demand and supply for water and customer preferences; (iv) intergenerational equity and fairness which address concerns about how much pricing impacts on the vulnerable and their ability to pay on the one hand, and how much should be paid by current generation for the upkeep of the water infrastructure for future generation. Fairness is not just about low prices but more related to behaviour and organisational rules – when social norms and trust are strengthened then an increase in price is easily accepted (European Environment Agency, 2013; Heino and Takala, 2015). For existing water systems, the focus of pricing water is on revenue generation and incentives to reduce water demand makes sense only if the water systems operate near the limits of its capacity (European Environment Agency, 2013). In other words, it is easy to devise alternative adaptation strategies than reduce water price.

4. Materials and methods

4.1. Study area

The study was conducted in the Upper West Region of Ghana. The Region was purposively chosen for the study because of several factors. Community-based water management (CBWM) which relies on water fees to finance water operations (Fielmua, 2018) is constrained by poverty (Opare, 2011; Rouse, 2013; Wendy and Bakalian, 2009). As such, the Region which has the highest incidence of poverty (70.9%) (Ghana Statistics Service, 2018), makes it appropriate to examine the strategies that households use to maintain access to water. Additionally, the Region was chosen because the researchers have very good knowledge of the geography and socio-cultural context of the area, and this facilitated data collection.

As at 2018, the Region had a projected population of 829,984, comprising 49.1% males and 50.9% females. The Region is served by various water sources, including boreholes fitted with hand pump, hand dug wells, household piped connections in urban and small towns (herein

refers to as urban and Small Town Water Systems)[1], standpipes, rivers, streams and ponds. In Ghana, two kinds of water technologies are referred to as standpipes; (a) mechanized underground wells and (b) public taps of a water system. The latter is the focus of this study. The number of Small Town Water Systems (STWSs) in the Region increased from 17 in May 2014 to 27 as at September 2018. Out of these water systems, nine were constructed before the water sector reforms in 1994. In 1994, the National Community Water and Sanitation Programme (NCWSP) was launched. The policy of NCWSP is consistent with Ghana's decentralisation policy, which seeks to transfer authority, responsibility and capacity from the Central Government, Ministries and Departments to the District Assemblies. The aim of the NCWSP was to ensure the sustainability of water and sanitation facilities through community ownership and management, community decision-making in water systems design, and active involvement of women at all stages in water services delivery (CWSA, 2007). The remaining 18 water systems were constructed after the reforms.

Out of the 27 water systems, four were purposively selected for the study due to limited fund for data collection. They include Babile water system in the Lawra District, Daffiama water system in the Daffiama-Bussie-Issa District, Busa water system in the Wa Municipality and Gwollu water system in the Sissala West District, as shown in Figure 1.

To enhance reliability of the findings, the four systems comprised of two pre-1994 water sector reforms (Gwollu and Daffiama) and two post-1994 water system (Babile and Busa). Babile and Busa water systems started operating in May 2010. Daffiama and Gwollu water systems started in the late 1960s and completed in 1970. Also, the four systems cut across all the major ethnic groups (Waala, Dagaara and Sissala) in the Region with a good geographic spread, shown in Figure 1.

4.2. Data collection

A mixed methods approach, comprising qualitative and quantitative methods were employed in data collection and analysis to help enrich the findings of the study. Data were collected from households, water and sanitation management teams (governing body of the water systems), operating staff (technical staff responsible for the day to day operation of the water systems), vendors (persons responsible for operating the standposts), the District Water and Sanitation Teams (district level body responsible for water and sanitation issues within the districts) and the regional directorate of the Community Water and Sanitation Agency (CWSA). The main variables collected and analysed from these sources include water tariff structure, household knowledge of water pricing, and household adaptation strategies to water tariff levels. The data collection was done in two rounds: in May 2014 and in September 2018. In the first round of data collection, a total of 150 households were surveyed in the four communities. The samples size was not selected on the basis of representation of the total population and generalisation of findings. The essence is to obtain reliable results on households' knowledge on tariff setting, perspectives on tariff levels, and the adaptation strategies employed to ensure continued access to water. More reliable results are obtained with better planning and small sample size (Delice, 2010). Out of the 150 households, 66 (44%) were households with connections on-premises (within the dwelling, yard or plot) and 84 (56%) were households that relied on public standposts (vendors) to access water. Table 1 shows the distribution of the sampled households.

In each community a list of households with on-premises taps was obtained from the operating staff. The list contains serial numbers, contact names and mobile numbers of the households. Based on the lists, the study targeted 30 households in Gwollu and Daffiama, and 25 households in Babile. Systematic sampling was used to select the households to be surveyed. We chose a random start from the list of households in each community. Based on the total number of on-premises taps (Table 1), every 3rd numbered household (that is, 92/25) on the list was selected in Babile. In Gwollu and Daffiama, every 5th numbered household (that is, 145/25, 141/25) on the list was selected. We then followed up on the selected households using their names and contact numbers to administer the questionnaire. In Busa, the target was to survey the three households but one household declined to respond to the questions because the household water services was disconnected for default payment.

In each community, the initial plan was to survey 30 households who rely on public standposts. The selection of 30 respondents is based on the context of the study: households' perspective on water pricing which may not be dependent on the number of subjects considered. Households close to the standposts were conveniently selected for the survey. The selection of a household was based on the availability of a qualified person (household head/spouse or anyone above 18 years who can respond to the objectives of the study). Data saturation was achieved at 15, 21, 22, and 8 in Babile, Busa, Gwollu and Daffiama respectively (Table 1), where responses from the households were very similar and repetitive.

In addition to the household survey, qualitative data were collected from key stakeholders at the community and district levels in the first round of data collection. At the community level, four separate focus group discussions (FGDs) were held with the operating staff and three separate FGDs were held with the vendors, using checklists. The participants for each FGD with the operating staff ranged from five to nine. The number of participants for the FGD with the vendors were six (two males and four females) in Babile, seven females in Busa and nine females in Gwollu. Apart from Babile where male vendors were recorded, the rest of the vendors in all the communities were females. According to the Water and Sanitation Management Teams (WSMTs), the community members viewed vending as a female-oriented activity and, as such, allowed only females to apply and be appointed as vendors. In Daffiama, there was no FGD with the vendors because the Water and Sanitation Management Team and the operating staff decided to terminate water vending through public standposts because of financial losses at the standposts. Hence, in Daffiama, water from the water system is only accessed through households' on-premises connections. Households without on-premises water connection access water from boreholes fitted with hand pumps. These facilities are located at the various sections of the communities and managed by the respective sections. At the district level, FGDs were held with two District Water and Sanitation Teams (Sissala West District and Lawra District) with five participants in Lawra and six participants in Sissala West District.

In September 2018, a follow-up was made to update the tariff structure using FGD with the operating staff in the four communities. During the follow-up in 2018, an interview was also conducted with a regional staff of Community Water and Sanitation Agency to understand the regulations of water tariffs. Another interview was conducted with a regional staff of the Ghana Water Company Limited to understand tariff structure of urban areas and the approved vending rates in urban areas. The follow up in September 2018 did not include households survey due to the difficulty in tracing the same households and each household's respondent.

For the safety of the data, a high capacity digital recorder was used to complement the field notes during the focus group discussions in 2014 and 2018. Essentially, the use of multiple respondents at multiple levels (community level, district level and regional level) to understand water pricing helped in ensuring reliability of the data. The qualitative data, mostly field notes, were compiled while the audio recordings were transcribed manually. The output of the field notes and the audio recordings were subjected to content analysis. The content analysis focused on similarities and differences between the cases in relation to tariff differentials, households' knowledge of tariffs and copying strategies were critically analysed. As part of the content analysis, we used excerpts from the FGDs to convey strong meaning on specific issues in water tariffs to complement the analysis of the quantitative data. The administered

[1] Treated water from river or mechanised boreholes.

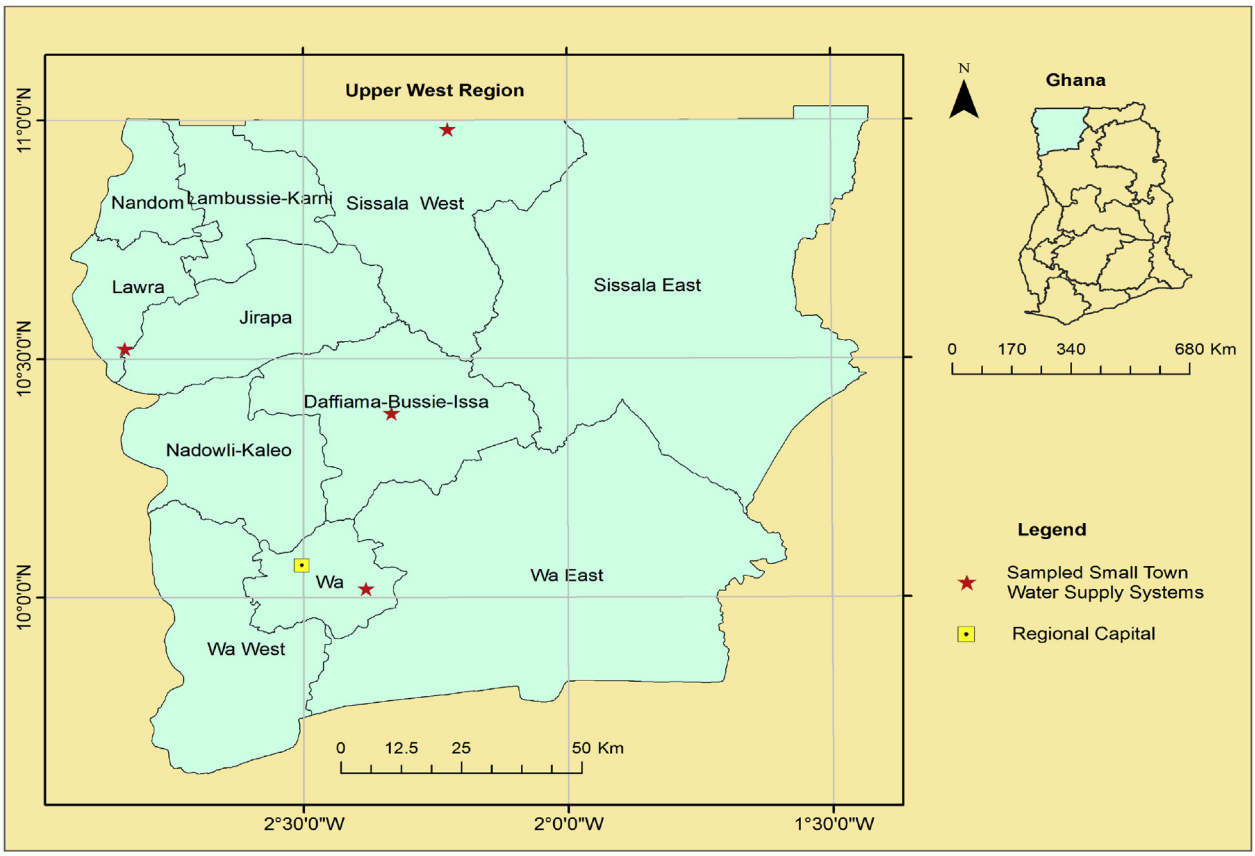

Figure 1. Study area in regional and national context.

questionnaires were edited and entered into Statistical Package for Social Scientists (SPSS version 20) software for analysis. The outputs of the quantitative data were corroborated with the qualitative results. This kind of complementary data collection and analysis greatly improved validity of the results.

The data for this paper is part of the corresponding Author's PhD study in the University of Reading, United Kingdom. To work within the remits of the University, the research ethics protocol of the University was duly followed: the field work was authorised by the Head of Planning Department in the Henley Business School under the exception procedures of the University of Reading research ethics guidelines. However, the University standards procedures as regards consent and confidentiality were adhered to. During the field data collection, the consent of participants was sought and interviews or discussion only proceeded after the participants agreed to take part.

5. Results

This section presents the results of the field work. The results are structured based on the following themes: tariff setting and structure; households' knowledge and perception of water tariff level; and household adaptation strategies to tariff levels.

5.1. Tariff setting and structure

In principle, tariffs in small towns in Ghana are proposed by the water management bodies at the communities and presented to the community for vetting and approval. The community level approved tariff is then presented to the District Water and Sanitation Team (DWST) for further vetting and approval. As such, tariff setting in small towns is regulated by their respective District Assemblies without recourse to other districts. That is, the districts operate independently, although within a broader national framework of small town water delivery. The interviews with the Community Water and Sanitation Agency (CWSA) and the DWSTs further revealed that the essence of the District Assembly regulation is to serve two purposes: (i) to guarantee that customers are not exploited or coerced into accepting the proposed rate; and (ii) to ensure cost recovery in tariffs. Therefore, the structure of tariff setting is to assure customers of value for money, and also prepare the water system, financially, to adapt to any abrupt stress. This arrangement presupposes that the District Assemblies are in close contact with the Water and Sanitation Management Teams (WSMTs) and are abreast of their financial status.

The regulatory arrangement for tariff setting also implies that the presence of many districts creates multiple regulators, as indicated by the regional level interviews. For example, there are eleven autonomous

Table 1. Distribution of sampled households.

Sample characteristics	Babile	Busa	Gwollu	Daffiama	Total
Total population in 2014	4,061	3,256	4,854	3,519	
Number of households	582	390	591	502	
Standposts surveyed	15	21	22	8	66
Total taps on premises (within yard or plot)	92	3	145	141	381
On-premises taps surveyed out of the target sample	23 out of 25 taps	2 out of 3 taps	29 out of 30 taps	30 out of 30 taps	82 out of 88
Sample surveyed: standposts & on premises taps. (% of sample size)	**38** (25.3%)	**23** (15.3%)	**51** (34%)	**38** (25.4%)	**150** (100%)

District Assemblies in the Region. Practically, this suggests that there are eleven different rates in the Region. Although there are multiple regulators within one region, the regulators seldom carry out their role and this was established during the fieldwork. According to all the WSMTs, the tariffs were set without recourse to the District Assemblies and this was confirmed by the DWSTs. Tariff setting is at the discretion of the WSMTs and this has further widened the differences in tariffs levels as shown in Table 2. The regional interview revealed that the fundamental objective of the water system under the National Community Water and Sanitation Programme is to provide potable water for domestic purposes. However, the insurgence of multiple use water services does not limit the consumers' range of water uses. Different water uses come with a different quantity of water consumed. As a result, management staff charged different rates for the different uses (Table 2).

The use of different rates for different water use types in small towns is similar to the urban water tariff structure, although the two settings are independent of each other. Records from the Ghana Urban Water Company show that urban tariff is lower than small town tariff, as shown in Table 2. For example, within the second quarter of 2014, the tariff for urban domestic water consumption was GH¢1.47/m^3 for the first 20m^3 of water consumed, and GH¢2.20/m^3 for consumption above 20m^3. Within the same period, water for domestic use in small towns was sold at GH¢1.50/m^3 in Daffiama, GH¢2.00/m^3 in Babile, GH¢2.20/m^3 in Busa, and GH¢0.70/m^3 in Gwollu. Apart from Gwollu, where the tariff was lower, as shown in Table 2, the other three communities had tariffs above the urban tariff. From Table 2, there are varied tariffs across communities for the same water use type because the WSMTs are independent, and practically tariff setting is unregulated. It is at the discretion of the water management staff at the community level. Interestingly, Daffiama uses a uniform rate irrespective of the consumption type. This practice does not promote conservation of water and the commercial customers tend to gain. According to the operating staff and the DWSTs, the different rates in Table 2 are based on equity principles. That is, those who use water for commercial purposes should pay higher because they are making a profit and they also consume a large quantity of water. However, dishonesty remains a challenge: from the household survey, it was observed that some households subscribe for domestic purposes and later use the water for commercial purposes while they are still billed on the domestic rate. For instance, 46% of households subscribed for domestic purposes, but use the water for food vending and 'pito' (millet beer) brewing. The most affected communities are Babile and Daffiama where pito brewing is prominent among women.

There was a significant percentage change in tariffs between 2014 and 2018 especially in Gwollu, as shown in Table 2. The follow up in 2018 established that the management staff of the water system in Gwollu and Babile were changed. The new staff instituted measures to ensure at least a breakeven tariff structure, leading to a 543% and 100% change in domestic tariff in Gwollu and Babile respectively (Table 2). In all the communities, management staff justified their tariff structure by comparing the cost of a basin of water to the cost of a sachet of water, popularly called "pure water". In May 2014, a sachet of water (about 0.5 L) costs GHp10.00 and this has increased to GHp20.00 in September 2018 and it is patronised in the communities. In 2014, a basin of water (about 20 L) was set at the same amount (GHp10.00) as a sachet of water in Babile, Busa and Gwollu. Prior to the termination of water vending in Daffiama, the cost of a basin was GHp20.00 in 2014. The cost of water from a standpost was higher in Daffiama than the other communities, yet vending was not lucrative to the water system, resulting in a termination of water vending through standposts. According to the management staff, corruption and poor accountability are the primary causes of losses in vending through standposts. The management is unable to impose sanctions on vendors due to strong social bonding. That is, the vendors are either relations or friends of the WSMTs.

In September 2018, water vending was practiced in Busa, Gwollu and Babile and the cost of a basin (20 L) was GHp20.00. Concurrently, a sachet of water (0.5litres) costs Ghp20.00 in all the communities as at September 2018. In setting the price of a basin of water from the baseline of sachet water prices, the management staff failed to acknowledge that: (i) the model of operation (private sector with profit orientation) is different for a sachet water company; (ii) tax is paid by the sachet water producing companies, which is not applicable in community-based water management (CBWM); and (iii) the companies incur costs of refrigeration of the sachet water or retailers in water vending incur cost of refrigeration.

Based on the 2018 tariffs in Table 2, the average cost per cubic meter at a standpost in all the communities is GH¢4.00/m^3 (GH¢4.00/1000litres) while water is vended at GH¢0.20/20liters (GH¢0.01/liter) at the standposts to customers that are without household connections. In effect, a household that relies on a public standpost pays GH¢10.00/m^3 (GH¢10.00/1000liters) consumed while the vendors pay between GH¢

Table 2. Water tariff structure in 2014 and 2018 (GH¢/m^3).

Location/	Year	Category of service consumption (GH¢/1000 L)			Stand post
		Domestic	Commercial	Institutional	
Babile	May 2014	2.00	2.50	2.50	2.00
	Sept 2018	4.00	4.50	4.50	3.00
	% change	100%	80%	80%	50%
Busa	May 2014	2.20	-	-	2.20
	Sept 2018	3.30	4.40	-	4.40
	% change	50%	-	-	100%
Gwollu	May 2014	0.7	1.30	0.8	0.7
	Sept 2018	4.50	5.00	4.50	4.50
	% change	543%	285%	463%	543%
Daffiama	May 2014	1.50	1.50	1.50	1.50
	Sept 2018	3.00	-	-	-
	% change	50%	-	-	-
Urban settings	May 2014	>20m^3 = 1.47 <20m^3 = 2.20	3.13	2.82	1.45
	Sept 2018	>5m^3 = 2.68 <5m^3 = 4.56	7.52	5.85	3.00
	% change	82.3% 107%	140%	107%	107%

Exchange rate: $1.00 = Gh4.02 in May 2014 and $1.00 = 4.98 in September 2018.

3.00/m^3 and GH¢4.50/m^3 to the water system management staff. The profit made by vendors is the difference between GH¢10.00/m^3 (price to customers) and existing tariffs at the standposts (GH¢3.00/m^3 and GH¢ 4.50/m^3). Therefore, a vendor makes a profit of between GH¢5.50 and GH¢7.00 for every cubic meter of water sold. That is, the profit gained from each cubic meter of water sold is between 233% and 122%. Besides this profit, the vendors receive commission (20% of revenue generated in a month). Although vendors complained that they are not well remunerated it is evident from the above analysis that vendors gained financially through water vending.

The tariffs are set in a manner that will enable the Water and Sanitation Management Teams to meet operation and maintenance costs of the water systems. The main factors that determine setting of tariffs are cost of electricity and spare parts (Fielmua, 2018). The WSMTs (during FGD) indicated that cost of electricity and spare parts are the key components of expenditure, and consequently, serve as the main determinants of the tariff levels. However, the financial performance analysis of the water systems revealed that salaries and allowances of the water systems management staff rather take a greater proportion (between 51.5% and 88.4%) of the expenditure (Fielmua, 2018).

5.2. Household knowledge and perception of water tariff

Another focus of this paper is to assess households' knowledge of water tariff setting. This is necessary in community-based management because households' acceptability and willingness to pay tariff is largely dependent on their involvement and/or awareness of the billing method. Household knowledge of the method of billing was generally low across the communities, as shown in Figure 2.

On average, only 24.7% of the respondents understood the method of billing or computation of bills. In terms of community specifics, knowledge ranged from 8.7% in Busa to 37.8% in Babile. In Daffiama and Gwollu, 22.5% and 14% respectively had knowledge of the billing method, as shown in Figure 2. The lowest proportion in Busa is partly due to large dependence on standposts, where the mode of payment is pay-as-you fetch. Hence, the households were not privy to the computation of the bills, as all respondents wished they had knowledge of bill computation. All the communities have higher number of households who have no knowledge of the method of water bills computation than those who have. The analysis of variance of knowledge level shows that there is no significant difference ($P = 0.087$ at 5% confidence level) between the knowledge level among communities.

It is not within the purview of this paper to delve into revenue usage. However, there is a strong desire by consumers to learn the method of computing water bills. This is because there is a strong discernment on the part of customers that operating staff deliberately inflate the bills for subscribers to enable them (operating staff) divert the excess revenue for private benefits. Respondents who have at least a basic education but have no knowledge of billing could easily be educated on the billing method in order to ensure transparency and build trust in billing method. The FGD with vendors in Busa revealed that they do not understand the billing methods as a result of illiteracy: none of the vendors is a literate. However, to ensure transparency, the billing sheets are left with the vendors while copies are kept with the revenue collector. According to the revenue collector (an operating staff) in Busa, this practice is to allow vendors to cross check the computation with the assistance of a literate, if they so desire. This is contrary to what pertains in the other communities, where copies of the billing sheets were not left with the vendors.

Another major focus of the paper is to assess household perceptions of water tariffs and whether the existing water tariffs limit the quantity of water that households can access. Hence, the household respondents were asked of their views on the level of water tariff based on a three-level scale: high, normal and low levels of tariff. Table 3 shows the respondents' views on the existing tariffs.

On average, 60% of the respondents indicated that the water tariff is normal and they can afford to pay. Interestingly, it was only in Gwollu that respondents (8%) mentioned that the tariffs are low, which supports the comparison in Table 2. A cross tabulation of household views on tariff and gender showed that all those who indicated that the tariff was too low were males. For instance, a public servant (household respondent), who had previously worked with the water sector, in southern Ghana, indicated that the tariffs were low and questioned how the water management authority was able to supply water using the existing tariff. Although Busa had the highest domestic tariff, 78.3% of the households said the tariff was normal. A cross tabulation showed that 71.4% of all households who rated the tariff as too high were on-premises tap users while the remaining 28.6% were standposts users. Similarly, 46.7% of the household respondents who rated the tariff as normal used on-premises taps while the rest (53.3%) use public standposts. As indicated in Table 3, an average of 66.7% of respondents indicated that the tariff did not limit their water usage, with a higher proportion (80%) in Gwollu. This is partly due to the relatively low tariff in Gwollu. Interestingly, all households were able to relate tariff adjustment to general inflation, although some households held the opinion that the tariffs were high. The households could not indicate the inflation rate of the country at the time but argued that inflation had affected the cost of water production, and it is necessary to increase the tariff to ensure continuous supply of water. Given the necessity of water amidst of high tariffs households would have to devise adaptation strategies to access water.

5.3. Household adaptation strategies to tariff levels

The household survey revealed that every household, irrespective of the perception on tariff level, developed adaptation strategies for accessing water services. Households were required to indicate the adaptation strategies used to ensure continues access to water. Multiple

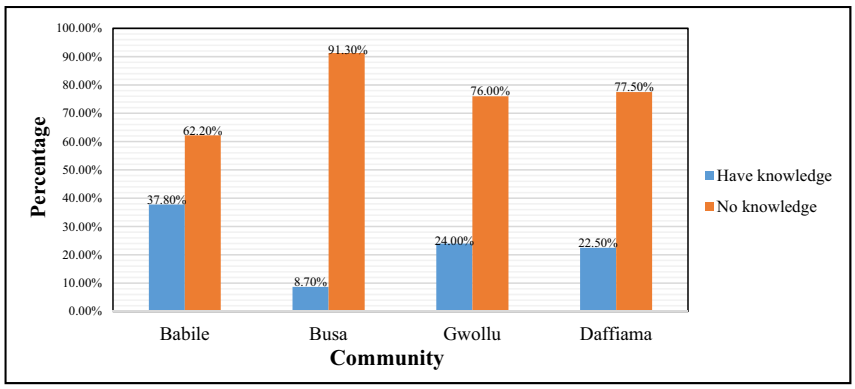

Figure 2. Household knowledge of method of billing water services.

Table 3. Households' views on water tariff.

View	Babile	Busa	Gwollu	Daffiama	Average
High	32.4%	21.7%	30.0%	60.0%	37.3%
Normal	67.6%	78.3%	62.0%	40.0%	60.0%
Low	0.0%	0.0%	8.0%	0.0%	2.7%
Response	**Does the tariff limit the quantity of water used?**				
Yes	35.1%	30.4%	20.0%	50.0%	33.3%
No	64.9%	69.6%	80.0%	50.0%	66.7%

responses of households were collated, analysed and presented, as shown in Figure 3.

The main adaptation strategy, as shown in Figure 3, is the use of alternative sources of water. Besides the piped water systems, the communities have boreholes fitted with hand pumps and hand dug wells. These facilities were managed by the respective geographical sections in which they are located or by households/individuals, depending on the ownership structure of the facilities. All households, especially in Daffiama, pay Gh¢1.00 per monthly for the borehole fitted with a hand pump to enable them to access water anytime they are unable to raise money for the daily pay-as-you fetch. Those having on-premises taps also sometimes use the boreholes fitted with hand pumps and hand-dug wells in order to reduce household water expenses. This was common in Babile and Daffiama. Other adaptation strategies include diversification of livelihood sources, sale of household assets and reliance on remittance. Peasant agriculture is the main stay of all the communities. As such, farming is the main source of livelihood of households. In explaining the need for diversification of livelihood, a woman in one of the communities avers as follows:

> *"now we do not have free water, and as such, we have to find other sources of income to be able to pay for modern water [piped water]. In addition to farming, some of us gather stones, firewood, produce charcoal to sell, and others engage in petty trading. We cannot rely on farming again because we are growing old and weaker. It also rains at the time that we do not expect rains, and stops at the time that we expect it. Can we rely on farming under such conditions?"*.

The above statement implies that farming cannot be totally relied on as a source of livelihood due to the changing rainfall pattern which necessitates the use of other income generating ventures. In order to minimise expenses on water, household members are advised against water wastage. Such people are convinced that judicious use of water by households will reduce the cost of operation and maintenance, and that will eventually reduce the tariff. Remittance is rather relatively a less common adaptation strategy, and the main beneficiaries are the aged. The subscription fees and cost of materials of those households were equally paid through remittance.

6. Discussion

The analysis of tariff structure indicates that rural and small towns incur higher tariffs than their urban counterparts. As such, the tariff structure and setting process push the financial burden of water services to the rural and small-town populace. Unlike the small town water sector, where Districts Assemblies are the regulators of tariffs, the *urban* water sector, for example, in Ghana, has a single independent regulator, the Public Utilities Regulatory Commission (PURC) (Government of Ghana, 1997). The PURC was established by an Act of Parliament (Act 538 of 1997). The PURC examines and approves rates chargeable for provision of utility services, protects the interests of consumers and providers of utility services, and monitors the standards of performance for service provision. The District Assemblies are expected to play similar roles as required by law (Legislation Instrument 2007). Based on variables such as the cost of water production, transmission and distribution, the PURC uses an automatic adjustment formula to review the rates of utilities in every quarter. In small towns, the water and sanitation management teams (WSMTs) are constitutionally mandated to propose tariffs, based on the water production and distribution costs, and seek approval from the District Assemblies (CWSA, 2010, 2014) *before* the proposed tariffs can be implemented. Contrary to these provisions, there is neither technical calibration of the tariff in these small towns, based on any of these parameters, nor an approval from District Assemblies: tariffs are set completely by the WSMTs. This has resulted in different tariff structures in small towns, whereas all urban centres have a uniform tariff. Therefore, the lapses in tariff setting is a "bidirectional failure". That is, while the WSMTs have not submitted proposed tariffs to the District Assemblies, the District Assemblies, on the other hand, have not enforced the specified procedures that require WSMTs to submit proposed tariffs for vetting and possible approval. Hence, higher tariffs are expected in small towns because tariff setting is now entirely at the discretion of the community level water managers. This has led to higher tariffs and it is to the benefit of water managers since greater proportion of the expenditure in these small towns goes into salary and wages (Fielmua, 2018).

The small town-urban tariff differential appears to be the situation in many parts of Ghana because Gbedemah (2010) also found that the tariff of small town water systems in southern Ghana is higher than the urban

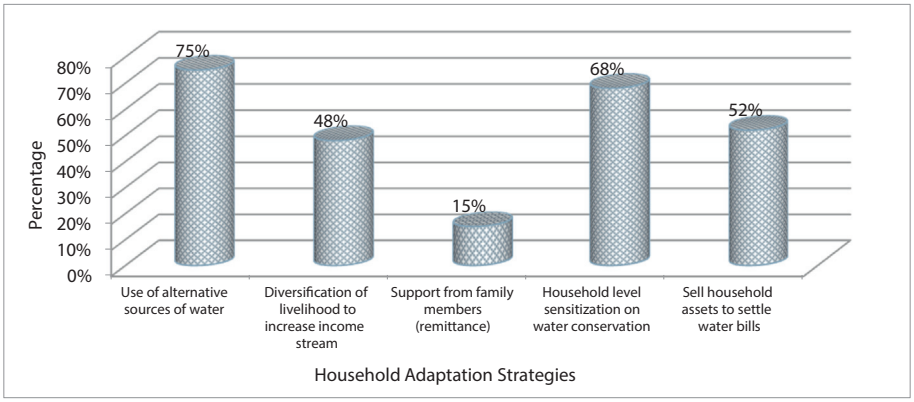

Figure 3. Households' adaptation strategies to water pricing.

tariff. Similarly, in Namibia, it was found that the poor in rural areas were overcharged for water in relation to their urban counterparts (Falk et al., 2009; Neef, 2009). The equity implications are exacerbated in situations where rural and small towns were required also to pay a percentage of the capital cost of the water projects while their urban counterparts do not pay, leaving rural and small-town water customers overtaxed in water services delivery. Therefore, while the essence of a decentralised system is partly to reduce the financial burden on government (Anwandter and Ozuna, 2002), it has excessively shifted the financial burden to communities.

Customer participation has been identified as significant in decision-making in CWBM (Doe and Khan, 2004; Madrigal et al., 2013). It is a means of ensuring transparency because customers' participation in decision-making satisfies their intrinsic psychological needs and makes them feel that, procedurally, there is justice (DeCaro and Stokes, 2013; Rouse, 2013). For instance, it was established that there is a relationship between customers' willingness to pay water bills on the one hand and the state of transparency and tariff setting procedures on the other (Manyena et al., 2008; Prokopy, 2005; Rouse, 2013; Schouten and Moriarty, 2003). Remarkably, despite the presence of arbitrary tariff setting households are committed to paying water bills. This was evident in the fact that in these communities, water fees constitute the only source of financing water services delivery (Fielmua, 2018).

The main pricing instrument in all the communities is tariff. Specifically, the water systems use the uniform volumetric tariff in which a fixed amount is charged for a cubic meter of water consumed. However, each community is somewhat autonomous in tariff setting and this has resulted in differences in tariff structures among the communities. Based on the households' views on the tariff level, it is evident that high tariff is not necessary the central issue in water services delivery. Instead, availability of reliable and quality water services is significant to households because households will always devise adaptation strategies to water pricing. Nonetheless, given that women are the main payees of water and managers of household level water (Fielmua, 2018), policies to ameliorate the financial burden on them is worth exploring. It has been established that introduction of lifeline in the water sector contributes to behavioural change; reduction in water consumption and the proportion of customers within the second block tariff reduces to 20% (Sahin et al., 2017).

Unlike the urban setting where the GWCL has lifeline rate for low water consumption, it does not exist in small towns. The absence of a lifeline rate does not serve as an incentive to conserve water because the same rate is applied irrespective of the quantity of water consumed. However, urban water systems in Ghana have a lifeline rate, which seeks to minimise excessive water usage and to cushion the poor against an increase in rates. The lifeline for domestic consumption was recalibrated from $20m^3$ to $5m^3$ essential minimum consumption. Discussion with the staff of the Ghana Water Company showed that the $20m^3$ did not result in water conservation. Additionally, households using less than $20m^3$ are unable to make savings while high consuming households (mostly the rich) are profiting from the lifeline. This served as an incentive for black marketing in which households sold water at higher prices to households without connections. This led to a review of the lifeline to the existing $5m^3$. As it prevails in urban water systems, an introduction of lifeline rate is recommended for small town water systems to: (i) serve as an incentive for water conservation, especially among large users of water; and (ii) minimise the burden of any further increase in tariff on households, especially the poor and women. The existing tariff has already caused 68% of households to adopt water conservation mechanisms and this supports previous studies findings on the role of water pricing in water conservation (Mu et al., 2019; Sahin et al., 2017; Tortajada, 2010a).

7. Conclusions

This paper reviews the tariff structure and customers' knowledge of tariff setting of community-based managed water systems. This research established that there are variations of tariffs across the water systems due to independence of one water system from another. The absence of an effective regulatory body to regulate tariff setting has further widened the tariff differentials among the water systems. This has resulted in households that rely on public standposts paying higher than those with on-premises water connections. Water pricing, particularly tariff setting, is central to community-based water management that it should not be left unregulated. The absence of lifeline rate has further increased the financial burden of some households, because households in small towns pay higher than their urban counterparts. The relatively higher tariff structure in small towns has resulted in several coping strategies by households in order to maintain access to water. The strategies are further necessitated by the challenges associated with households' traditional income source (farming). Therefore, an introduction of lifeline rate, similar to what pertains in urban water pricing, is recommended to minimise the burden of any further increase in tariff on households, especially the poor. The analysis of tariff levels for public standposts demonstrates that vending is currently a lucrative business in water services delivery. As such, if water tariff is reduced without a vigilant measure to monitor water vending at standposts, the poor who are mostly the households without connection will continue to pay for water at higher prices. This ends up enriching the vendors at the expense of the water systems. We therefore argue for a re-examination of the existing water pricing arrangements in small towns if increasing efficiency in the use of water is to be achieved.

Declarations

Author contribution statement

Nicholas Fielmua: Conceived and designed the experiments; Performed the experiments; Analyzed and interpreted the data; Contributed reagents, materials, analysis tools or data; Wrote the paper.

Alfred Dongzagla: Performed the experiments; Analyzed and interpreted the data; Contributed reagents, materials, analysis tools or data; Wrote the paper.

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Competing interest statement

The authors declare no conflict of interest.

Additional information

No additional information is available for this paper.

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