Household Deficiency in Demand for Water: Do Water Source and Travel Time Matter?

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Abstract

Despite the massive commitment by policy makers and stakeholders to increase the supply of water to households in Ghana, many households have a deficiency in their self-reported daily quantity of water required for drinking and for general use. This paper focuses on the effect of water source and travelling time on households' deficiency in demand for water using the Sixth Round of the Ghana Living Standards survey. A Tobit regression analysis of data on 2,843 households reveals that a one minute increase in travelling time increases household deficiency in water demand by about 49 percent. Also, compared to pipe in dwelling/yard/plot, all other sources of water to the households come with greater levels of water deficiency, with unprotected well/spring/river-stream/dam-lake-pond generating the greatest (10.5 litres) levels of deficiency. Other significant predictors of household deficiency in water demand are per capita disposable income, number of rooms in the household, sex of the household head and regular payment of water bills. Government policies aimed at addressing household deficiency in water demand should focus on making more resources available to the Ghana Water Company Limited (GWCL) and the Community Water and Sanitation Agency so as to achieve more coverage of water accessible to both urban and rural households.

Jel Classification: D01, D11, L95, Q31, R22
Keywords: Water Deficiency, Travel Time, Water Source, Shadow Price, Pipe

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Introduction

Water is generally regarded as life and wealth (Arbués, Barberán & Villanúa, 2003). Every living creature therefore depends on water as one of the most important natural resources for survival and for human as a means of prosperity. To humans, water serves agricultural, industrial and domestic purposes, among others. According to United Nations Environmental Programme - UNEP (2008), the agricultural sector is by far the biggest user of freshwater. In the United States, use of freshwater for agricultural purposes account for 49 percent while 80 percent of this volume is for irrigation. In Africa and Asia, use of water for agriculture ranges from 85-80 percent. When it comes to use of water for industrial activities, it explains it explains 20 percent of global water use and withdrawals. For this figure, 30-40 percent for industrial processes, and 0.5-3 percent for thermal power generation. With regard to the domestic water for domestic purposes, users in developed countries, on the average, consume about 10 times more water daily than those in developing countries. By estimable and on average terms, a person in a developed country uses 500-800 litres per day (300 m^3 per year) compared to his counterpart in a developing country who uses 60-150 litres per day (20 m^3 per year) (Shiklomanov, 1999 cited in UNEP, 2008).

In Ghana, the major consumptive uses of water are drinking water supply, irrigation, livestock, watering, and industrial supply (MWRWH, 2010; Nunoo & Acheampong, 2014). Almost one-third (32.3%) of households have their main source of drinking water from wells, with about 28.9 percent having pipe-borne water as their source of drinking water. The remaining 26.7 percent use other sources of water (Ghana Statistical Service, 2013). On the basis of surface water resources alone, the Ministry of Water Resources, Works and Housing (MWRWH) reports that the consumptive water demand for 2010 was estimated at 3.0 billion millilitres, which is equivalent to about 7.4 percent of the annual run off from Ghana alone (MWRWH, 2010). Clearly, this is a reflection of an abundant water resource in Ghana. Interestingly, the Water Resources Commission (2010) report shows that Ghana's water consumption demand for 2020 is expected to hit 5.13 billion millilitres as a result of increased population growth. In rural areas, on the other hand, water supplies are obtained mainly from groundwater sources. The various groundwater development programmes have resulted in the digging of more than 10,000 boreholes countrywide. As of the end of 2010, the Ghana Water Company Limited (GWCL) achieved 64 percent coverage of drinking water in the urban areas while the Community Water and Sanitation Agency (CWSA) achieved 62 percent coverage of drinking water in the rural areas of Ghana (MWRWH, 2010).

Although some progress have been made in the area of water delivery, there is deficiency in the demand for water in Ghana. Human beings according to the UN need 50 litres of water per day per person to meet food preparation and personal hygiene needs. On the average, Africans get by with 20 litres of water less than half what is needed to avoid diseases and improve productivity. Water demanded for drinking and for other domestic services by household, most of the time, falls short of what they actually receive — which results mainly from the high cost in supplying water. Added to the high cost of supplying water, is the issue of under-pricing of water in Ghana as it is in many developing countries. This makes it difficult to extend pipe borne water services to every household (Akpalu, 2012). These factors have caused demand to outstrip supply of water in many parts of the country. About 70 percent of diseases are attributable to lack of clean drinking water and inadequate sanitation systems across the country (Ministry of Health, 2001). In this paper, we estimate households' deficiency in demand for water in Ghana using the difference between households' quantity of water required in a day and their water quantity used in a day. This study utilizes the Ghana Living Standard Survey Round 6 (GLSS6) to analyse the factors that affect households' deficiency in demand for water.

Among the factors that have been identified generally to influence water demand in developing countries include households' demographic and socioeconomic characteristics and the price at which water is sold (Nauges & Strand, 2007; Nauges & Van Den Berg, 2009). The works of Altaf (1994); Briscoe et al. (1990); and World Bank Water Demand Research Team (1993) show that the willingness to pay for improved water service does not depend exclusively on income, but equally on the features of both the existing and the improved supplies. Research in household choice of water sources have found a variety of explanatory variables ranging from piped water pressure level, presence of storage facility in the home, educational level and income (Madanat & Humplick, 1993; Larson, Minten, & Razafindralambo, 2006). Hindman Persson (2002) using multinomial logit model found annual labour income and walking time to the source of drinking water as determining choice of drinking water in the Philippines. Basani, Isham, and Reilly (2008), working on data from Cambodia, found that ethnicity, connection fee and expenditure on water was influential in determining the choice between five sources of water. In estimating water demand in developing countries Larson et.al. (2006) and Strand and Walker (2005) saw that monthly household water use accessed from different sources are influenced by household size and the water hauling time. These were done in Madagascar and 17 cities in Central America respectively.

Review of empirical literature on Ghana has also shown that some works have been done on water demand and the factors influencing it. Asante, Berger, Engel and Iskandarani (2002) in discussing water security in the Ghanaian Volta Basin found that educational level and household income are important in determining the likelihood of households using improved water sources in the Volta basin of Ghana. Engel, Iskandarani, and Pilar Useche, (2005) observed in Ghana that quality perceptions and opportunity costs play an important role in households' choice of water source. Nketiah-Amponsah, Woedem and Senadza (2009) using data from a survey conducted in three Districts in Ghana identified socioeconomic determinants of household sources of drinking water. The study confirmed the influence of factors such as income, residence (rural or urban), educational level of the head and the distance between the residence and water source on household choices.

In examining the effect of travel distance on households' demand for water in Ghana, Akpalu, (2012) found that most individuals travel long distances to fetch water from community pipes, and contract water tankers for domestic use, which constituted high opportunity cost of travel time. The price elasticity of demand for water was found to be between -0.14 and -0.16 with the income elasticity of demand being positive. The relationship between water demand and hours spent washing was found to be positively related to households with flushing toilets. Stoler, Weeks and Appiah Otoo (2013) also utilized household survey data from 2,814 Ghanaian women in Accra to analyse the socio-demographic features of those who made use of sachet water as their principal drinking water source. They found that the use of sachet water was significantly connected with the overall lowering of self-reported health among young people in the Area. Among other things, the use of sachet water was associated with more days of neighbourhood water rationing. What was also revealed from the literature was that households' deficiency in demand for water has not been estimated in any study. It is in the light of this that the current work looks into what is accounting for the shortfall and whether travel time and the sources of water explain this deficiency. The next section explains the methodology used in estimating the deficiency in water demand and is followed with the results and discussion. The paper ends with conclusion and recommendations.

Methodology

Data source and sample design

The paper relied on data from the sixth round of the Ghana Living Standards Survey (GLSS6), which was designed to provide nationally and regionally representative indicators. The survey covered broad range of topics such as education, health, employment, housing conditions, migration, tourism, housing conditions, household agriculture, and access to financial services and asset ownership. The survey also collected information on households' perception of governance, peace and security in the country. In order to cater for the needs of the Savannah Accelerated Development Authority (SADA) areas and also provide nationally representative quarterly labour force statistics, the number of primary sampling units (PSUs) and households were increased from 580 and 8,700 to 1,200 and 18,000 respectively. This represents an increase of about 107 percent over the GLSS5 figures. Accordingly, a two-stage stratified sampling design was adopted. At the first stage, 1,200 enumeration areas (EAs) were selected to form the PSUs. The PSUs were allocated into the 10 regions using probability proportional to population size (PPS). The EAs were further divided into urban and rural localities of residence. A complete listing of households in the selected PSUs was undertaken to form the secondary sampling units (SSUs). At the second stage, 15 households from each PSU were selected systematically. This yielded a total sample size of 18,000 households nationwide (GSS, 2014).

However, in order to obtain adequate information for the analysis in this paper, we merged three files which contain information on the income of the household, household expenditure and housing conditions. All the three files were at the household level and contained the same sample size of 16,722 each. It was observed that source of water as an explanatory variable had the least observation of 3,028. In addition, not all households on which information was obtained on their sources of water had information on all other variables included in the model. This reduced the final sample size for the estimation of the deficiency in demand for water from the original 16,722 to 2,843.

Theoretical Model

We specify a simple model for household's demand for water following the work of Casey, Kahn, Rivas (2006). In this model, a household is assumed to maximize utility subject to constraints.

$$Qd = f(H, Q, Z) \quad (1)$$

s.t.

$$U = u(H, Q, Z) \quad (2)$$

Where Qd is the quantity of water consumption, P is the price variable and Q are factors or a range of shifters of demand for water. These variables include income, household demographics and other characteristics such as weather variables while Z is the composite good (Arbues et al., 2000). Faced with expenditures for both water services (H) and a composite good (Z) subject to the utility constraint, a household as consumers will attempt to minimize the following demand function:

$$Qd_i = f(P_h, P_z, Q, U) \quad (3)$$

Consumers face restricted demand problem where they are offered a take-it or leave-it water service. As a result, consumers are compelled to choose H. P_h in the demand function is therefore replaced with H and the demand function then takes the form

$Qd_i^* = f(H, P_z,\ Q, U)$ (4)

where Qd_i^* is quantity of water demanded which in this paper is represented by households' deficiency in demand for water. Households' deficiency in demand for water is derived in equation 5.

$$DWD = f(H, P_z,\ Q, U) \quad (5)$$

Estimation technique

The data used in this study is censored in nature. Data is said to be censored when information on the dependent variable is lost or limited but not data on the regressors (Cameron & Triverdi, 2005). The idea of censoring is that some data above or below a particular threshold are mis-reported at that threshold. This can occur either through data collection or due to data management. In this study, we define deficiency in water demand as the difference between the quantity of water required and the actual amount of used daily (all in litres) by households. Households with deficiency value less or equal to zero are considered to have sufficient water while those with positive values were classified as being deficient in water demand. In effect, the dependent variable (deficiency in household water demand) is censored to the left which requires that we employ a model that can correct any potential biasness of the coefficients introduced by the censoring. There were a few households that had had more water than they required and thus, had negative values for water deficiency while a lot of households had the exact quantity of water they required thereby giving them zero values for their deficiency. In this case, all negative and zero values for water deficiency were made zero thereby truncating/censoring the values at zero. This resulted in the employment of the Tobit model developed by Tobin (1958) which assumes that the dependent variable follows a normal distribution. This type of model requires the development of moments (mean and variance) of the censored normal distribution. The Tobit model assumes that there is some latent process y_i^* with unbounded support, but we observe only

$$\begin{cases} y_i = 0 \ if \ y_i^* \le 0 \\ y_i = y_i^* \ if \ y_i^* > 0 \end{cases} \quad (6)$$

From the theoretical model, the latent Tobit variable model can be specified as:

$$y_i^* = \beta_0 + \beta_i H_i + \beta_i' Z_i + \varepsilon_i \quad (7)$$

$$\varepsilon_i \overset{iid}{\sim} N(0, \delta^2)$$

In this equation, y captures the amount of water deficiency experienced by household. H_i represents a vector of variables of interest (shadow price, source of water),while Z_i represents vector of other household characteristics. From equation 7, we re-specify the estimated model as:

$$DWD_i = \beta_0 + \beta_1 Shadprice + \beta_2 WS + \beta_3 NR + \beta_4 Agehh + \beta_5 IncPC + \beta_6 SHH + \beta \ \mathrm{Re}\, gBill + \beta_8 \mathrm{Re}\, g + \varepsilon_i \quad (8)$$

Where DWD is the deficiency in household demand for water. *Shadprice* is the log of shadow price of water. WS is the source from which households obtain water, NR is the number of rooms in the household, $AgeHH$ is the age of the household head, $IncPC$ is the log of per capita disposable income, SHH is the sex of household head, $RegBill$ is regular bill for water supply and Reg is the region in which the household is located.

Following theoretical intuition and empirical findings (Arbués, Barberán, & Villanúa, 2000), our a priori expectation is that the shadow price of water, number of rooms (that partly explains household size due to high correlation between them) and regular payment of bills will be positively related to deficiency in demand for water by households. It is also expected that Age of the household head and per capita disposable income will be negatively related to deficiency in water demand. Finally, male, water sources and regional dummies could be either positively or negatively associated with the dependent variable. In Table 1, we provide detailed descriptive statistics on the variables included in the model and follow it up with how each variable was derived.

The price of water per litre was generated by dividing households' daily payments on water by the water quantity used in a day. The daily payments were computed by converting other non-daily payments. These were payments that were made either weekly, monthly, quarterly, half-yearly or yearly. With respect to water quantities, other water quantities apart from those recorded in litres were also converted to litres. In Ghana, the average volume of a gallon used in fetching water is 20 litres so we multiplied them by 20. The 34 cm bucket (christened '34 bucket' in Ghana) is also 20 litres and these were also converted to litres so as to achieve uniformity in the measurement of both quantity of water required in a day and water quantity used in a day. The water deficiency variable was then generated by subtracting the water quantity used in a day from the quantity of water required in a day. A higher value for this variable indicates higher levels of deficiency in water demand and vice versa.

With regard to the shadow price of water, it was generated by adding up two main variables — the price per litre of water and the time taken to get to the water source. This was necessitated by the fact that out of the sample of 2,843 households in this study, only 1,721 were paying financially for their water use and the remaining 1,122 households would be left out if only the financial price of water is used. Economically and theoretically, the time taken to get to the water source (calculated in minutes in the GLSS 6) is used as the opportunity cost of water and added to the price per litre of water so as to get the full price paid per each household (Akpalu, 2012). In the GLSS 6, two forms of time are given — one is time (in minutes) taken to get drinking water and back and the other is time (minutes) taken to get to general use water. These two were added up to arrive at the total time taken to get water for use by the household. The per capita disposable income variable was also generated by dividing households' total net income by the size of the household. To avoid any dummy variable trap in the empirical model, Pipe into dwelling /yard/ plot was used as the base in the water source variable while Greater Accra was also used as the base in the Regional variable.

Description of Variables

Table 1. Descriptive Statistics of Variables used in Estimating the Deficiency in Demand for Water in Ghana

Variable	Obs	Mean	Std. Dev.	Min	Max
Price of water per litre	1721	0.0168	0.1286	0	4
Time taken to get to water source (in minutes)	2843	59.6099	219.3039	0	1998
Water quantity used in a day	2843	133.0563	97.92136	0	1,120
Quantity of water required in a day	2843	149.3113	109.1913	0	1,200
Water Deficiency (Quantity required – quantity used)	2843	16.255	34.0699	0	300
Shadow price of water per litre (time taken to get to water source (in minutes) + price per litre)	2843	59.6201	219.305	0.00028	1998.44
Age of household head	2843	45.956	16.037	15	99
Per capita disposable income	2843	3.00891	2.37735	0.34004	11.6666
Number of rooms in the household	2843	—	—	1	15
Male (=1 ,0=female)	2843	—	—	0	1
Regular bill for water supply (1=Yes ,0=otherwise)	2843	—	—	0	1
Water Source (Base=pipe into dwelling/yard/plot)					
Public tap/standpipe/Bore-hole	2843	—	—	0	1
Sachet/Bottle	2843	—	—	0	1
protected well/rain water collection	2843	—	—	0	1
Unprotected well/spring/river-stream/dam-lake-pond	2843	—	—	0	1
Tanker/Cart/Other	2843	—	—	0	1
Regional (Base=Greater Accra)					
Western	2843	—	—	0	1
Central	2843	—	—	0	1
Volta	2843	—	—	0	1
Eastern	2843	—	—	0	1
Ashanti	2843	—	—	0	1
Brong Ahafo	2843	—	—	0	1
Northern	2843	—	—	0	1
Upper East	2843	—	—	0	1
Upper West	2843	—	—	0	1

Source: Authors' computation using GLSS 6 data

Results and Discussion

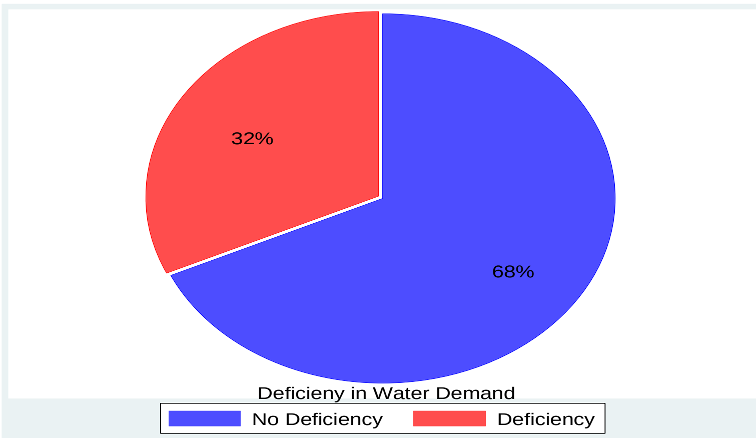

Figure 1: Households with Deficiency in Water Demand
Source: Authors' computation using GLSS 6 data

Figure 1 presents the distribution of deficiency in water demand and non-deficiency among households that were included in the study. From the result, it can be seen that about 33.1 percent of Ghanaian households have a deficiency in their demand for water while 66.9 percent do not have a deficiency. In other words, about 33.1 percent of households fall within the bracket of those that do not get enough water to meet their daily requirements. In Table 2, we present the regional distribution of deficiency in water demand among households in Ghana. The essence of this result is to understand the difference in deficiency in demand for water among households across the ten regions.

Table 2: Households' Deficiency in Water demand (daily Average) across Regions

REGION	Mean	Observations
Western	10.902	316
Eastern	12.4558	327
Volta	14.1043	281
Greater Accra	16.8987	282
Ashanti	17.7667	332
Central	20.5895	261
Upper East	20.6720	238
Upper West	21.3183	227
Northern	32.5756	285
Brong Ahafo	39.6511	294
Total	**20.2179**	**2,843**
Anova: F=15.21 Prob > F=0.000		

Source: Authors' computation using GLSS 6 data

Per the results presented in the Table 2, the region that records the least water deficiency, at the household level, is the Western region, with an average deficiency of 10.902 litres a day. On the flip side, the Brong Ahafo region has its households recording the highest daily deficiency in water demand — recording a demand deficiency of 39.6511 litres. Table 3 presents the Tobit regression estimates of the variables of interest (Water source and shadow price of water) and other control variables.

The linktest was used to test for model specification and the scores for _hat (P>|z|= 0.0o1) and _hatsq (P>|z|=0.224) means that we fail to reject the null hypothesis that the model is correctly specified. The Pseudo R^2 is 0.0134 and looks quite small but does not pose a challenge to the explanatory power of the variables because the small value resulted from the many observations that were censored at zero and also because the Tobit estimation technique employs the Maximum Likelihood Estimation Approach. In this regard, the estimates do not maximize the R^2, as in the case of OLS, but maximize the log-likelihood function (Wooldridge, 2003). This then takes us to the analysis of our Tobit estimation of households' deficiency in demand for water as shown in Table 3.

The estimates of the Tobit regression, as presented in Table 3, shows that once the shadow price is a composition of time and price, it can be inferred that travel time, which is measured in minutes, and the price of water (measured in Ghana Cedis) all have a positive effect on households' deficiency in their demand for water. It can be said that a one percent increase in the shadow price of water causes households' deficiency to also increase significantly (5% alpha level) by 49 percent (0.4898 X 100), holding all other variables constant. Since every household (2,843) in the model recoded a time unit for water and only 60.5 percent (1,122) recorded a price unit for water, the effect of shadow price is tilted towards the angle of travel time than for the price, in relative terms. In sum, the longer the time it takes to get to the source of water, the more deficient the household will be in its demand for water.

The per capita disposable income is inversely related to the deficiency in water demand. A GH₵ 1.00 increase in per capita income reduces the deficiency in water demand by 90 percent at a one percent alpha level, controlling for all other variables. This means that household disposable income per capita has a huge influence in reducing the levels at which households become water deficient. Money as a resource is used in purchasing water so once the household has enough to buy, the more it will be able to satisfy its daily requirement of water. This finding is in line with the works of Larson et.al (2006) and Hindman Persson (2002) which found a positive relationship between income and the choice of household water source. Consistency in the influence of per capita income on choice of water sources and deficiency in water demand of households provides enough justification for policy makers to understand the inequality among households in their ability to meet water demand and the consequent implication for their welfare in general and health in particular.

As mentioned in the methodology section, number of rooms in the household was used to assess the effect of a household's characteristics on its deficiency in water demand. An additional increase in the number of rooms in a household also increases their deficiency in water demand by 0.75 litres at an alpha level of five percent, holding all other variables constant. On the average, the more the rooms, the more the household inhabitants and which also feeds into the household size. Once the rooms are more, the more the household members will also require water for their day-to-day activities. The finding supports the works of Strand and Walker (2005) and Larson et. al. (2006) who also found a positive relationship between household size and water demand.

Table 3: Tobit Model for Household Deficiency in Water Demand (in Litres) Per Day

Water Deficiency (in litres)	Coefficients	Marginal Effects
Log of shadow price of water per litre	1.8641**	0.4895**
	(0.8459)	(0.2215)
Age of household head	0.1453	0.0381
	(0.1234)	(0.0324)
Log of Per capita disposable income	-3.4282***	-0.9003***
	(0.8706)	(0.2286)
Number of rooms in the household	2.8733**	0.7545**
	(1.3565)	(0.3564)
Male	7.4131*	1.9467*
	(4.3314)	(1.1370)
Regular bill for water supply (1=Yes, 0=No)	18.5937***	4.8827***
	(5.0760)	(1.3267)
Water Source (Base=pipe into dwelling/yard/plot)		
Public tap/standpipe/Bore-hole	24.5864**	5.8379**
	(10.0178)	(2.2184)
Sachet/Bottle	22.8947**	5.4007**
	(9.8809)	(2.2236)
Protected well/rain water collection	34.0613***	8.3926***
	(12.8008)	(3.1424)
Unprotected well/spring/river-stream/dam-lake-pond	41.4626***	10.5198***
	(11.0134)	(2.6064)
Tanker/Cart/Other	32.9752*	8.0904*
	(18.9019)	(4.9730)
Regional (Base=Greater Accra)		
Western	-47.3442***	-12.8167***
	(8.4211)	(2.3267)
Central	-42.4206***	-11.6868***
	(8.7904)	(2.4206)
Volta	-47.3464***	-12.8172***
	(9.3116)	(2.5176)
Eastern	-36.1626***	-10.1892***
	(8.3107)	(2.3946)
Ashanti	-24.0308***	-7.0769***
	(7.7188)	(2.3191)
Brong Ahafo	-2.7397	-0.8735
	(8.9285)	(2.8460)
Northern	-7.3204	-2.2940
	(8.9210)	(2.7960)
Upper East	-27.9240***	-8.1069***
	(9.0308)	(2.6285)
Upper West	-35.0735***	-9.9213***
	(10.0091)	(2.7753)
Constant	-58.0751***	
	(12.9571)	
Observations (N) = 2,843		
Pseudo R2 = 0.0134		
Linktest	_hat: P>|z|= 0.001	_hatsq: P>|z|=0.224
Robust standard errors in parentheses		

*** p<0.01, ** p<0.05, * p<0.1 **Source: Authors' computation using GLSS 6 data**

The increment in the number of rooms increases the household's daily water requirement and also stretches the gap between what is required and what is actually used. Even though it is acknowledged that it is not always the case that the number of rooms within a household reflects the household size, the results provides ample evidence that number of rooms also plays a similar role as household size in explaining household's demand for water and its deficiency.

Male-headed households suffer a deficiency in water demand by 1.95 litres more than female headed households, at a 10 percent alpha level. This, in essence, means that households that are headed by males have higher levels of water deficiency than those headed by females. This confirms the work of Akpalu (2012) where male-headed households on the average were found to use less quantities of water in a day than their female counterparts. Women within Ghanaian households are more involved in the drawing of water compared to men. As a result, they are more concerned about water availability in the household. This means that female-headed households are more likely to have access to the required quantity of water than male-headed households.

Households that pay a regular bill for water supply have, on the average, a deficiency of 4.9 litres more than households that do not pay a regular bill for their water supply, at a one percent alpha level after controlling for other explanatory variables. A few reasons can be attributed to this. The first reason is that most households that pay regular bill are those in the urban areas and have items like cars, flushing toilets, gardens/lawns etc that result in greater levels of daily water requirement, which results in higher levels of water deficiency. Secondly, most of the households that do not pay regular bills are those in the rural areas who have more alternatives in addition to their regular sources and as such are likely to get quantities of water that are closer to their daily requirement.

As regards water sources and deficiency in water demand, pipe into dwelling /yard/plot is used as the base. All households with other sources have greater deficiencies compared to households that fall on pipe into dwelling/yard/plot. Compared to households that have pipe into dwelling /yard/plot, households that source their water from public tap/standpipe/bore-hole have a deficiency that is 5.8 litres more at five alpha level; households that use sachet/bottle water have deficiency which is 5.4 litres more at five alpha level; those that used protected well/rain water collection have 8.4 litres more in water deficiency at one percent alpha level; households that use unprotected well/spring/river-stream/dam-lake-pond have a deficiency that is 10.5 litres more at one percent alpha level and households that source their water from tanker/cart/other sources have a deficiency of 8.0 litres at an alpha level of 10 percent. In conclusion, households that source their water from unprotected well/spring/river-stream/dam-lake-pond are those that suffered the greatest (10.5 litres) deficiency in water demand more than households that use pipe into dwelling /yard/plot.

Using the Greater Accra region (the capital of Ghana) as the base category, all households in the Western, Central, Volta, Eastern, Ashanti, Upper East and Upper West regions experienced water deficiencies that were below the levels experienced by those in Greater Accra. This is not surprising because households in the country's capital, on the average, have greater daily water requirements to meet activities such washing cars, watering lawns, flushing toilets, running showers, cooking for commercial purposes and many others. It must also be noted that the facilities, such as sink, water hose, and others result in more water usage than would have been the case if the same activity was to be undertaken in the country side – comparing watering of a lawn with water hose to watering lawns using water in a bucket.

Conclusion and Recommendation

This paper aimed at estimating households' deficiency in demand for water in Ghana using the difference between households' quantity of water required in a day and their water quantity used in a day. The GLSS6 data was used to analyse factors that affect households' deficiency in demand for water and it was found that an increase in the shadow price of water also worsens households' deficiency in demand for water. In terms of sources of water, households that access their water from other sources apart from pipe into dwelling/yard/plot experience greater deficiencies in demand for water. Also, Households that source water from unprotected well/spring/river-stream/dam-lake-pond are those that suffer the greatest (10.5 litres) deficiency in water demand more than households that use pipe into dwelling/yard/plot. The suggestion from this results is that extending pipe water to many communities will reduces the tendency of a household being deficient in water demand. Also, making water available is likely to reduce the travel time that households spend in getting to the source of potable water for the household.

Limitation

The limitation from this study comes from the many households that do not report a financial price for the water on daily basis. If this had not being the case, it would have been easy to come out with the effect of price on water supply rather than resort to the shadow price of water.

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