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TOWARDS A SUSTAINABLE ALLOCATION OF POTABLE WATER IN GHANA: EVIDENCE FROM KUMASI

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ABSTRACT: *The provision of potable water for human sustenance both now and in the future is one of the most critical issues in the world today. This paper sought to assess the sustainability of potable water distribution in Ghana through the Contingent Valuation Method in Kumasi, Ghana's second largest urban centre. Willingness-to-pay values were elicited by means of a bidding game technique through administered questionnaire to communities in Kumasi, where potable water supply was either non-existent or very irregular. The analysis shows that Ghana Water Company Limited (GWCL) could increase current tariffs by about 300% without hurting consumers, since, that would rather increase welfare considerably and facilitate sustainable allocation of potable water. A sizeable consumers' surplus exists, which is an indication of households being susceptible to extortion by water vendors. This requires urgent government intervention to save some poor residents of Kumasi from undue exploitation as well as the return to the consumption of unwholesome water that would increase pressure on medical and Health Insurance resources.*

KEYWORDS: *Consumers' Surplus, Ghana, Potable Water, Welfare, Willingness-To-Pay*

INTRODUCTION

Efficient and equitable allocation of potable water is essential for urbanization to drive improved human welfare. Increasing urbanization and population growth have made it imperative for sustainable allocation of potable water to be achieved in Ghana. This requires efficient water distribution to people wherever they live, no matter the cost involved. Where this is not done, long hours and much energy are spent to search for water; which turns out to be labour-intensive, excessively time-consuming and counter-productive. Reasonable access to potable water for a community would mean the saving of time and energy due to reduced walking distance to the source of water or waiting to be served from a distant source. Reasonable access to potable water means a disproportionate part of the day is not spent in water fetching. This releases labour which may be used for productive purposes leading to economic benefits. Even if the economic value of the saved labour is zero, there would be a social benefit from the time saved and drudgery eliminated because more time can be spent with one's family or on domestic activities and leisure (Carruthers and Brown, 1977).

In Ghana, increasing amounts of water is being used to meet the needs of a rapidly growing population. This has resulted in the reduction of the per capita annual availability of water. According to the Ghana Water Company Limited, in 1960, when the population of Ghana was 6.77million, the annual surface water available to each Ghanaian was 4950 cubic metres. By the year 2025, when the population of Ghana is projected to be 35.44 million, the annual surface water that will be available to each Ghanaian would be 950 cubic metres. Ghana would then have reached a theoretical limit for 'water stress' - below the 1000 cubic metres per capita annual water availability threshold (Ghana Water Company Limited, 1995). This insight about Ghana's water resources also calls for a sustainable allocation of water resources to delay or even avoid 'water stresses' for present and future generations.

The current provision of potable water in Ghana, being largely a responsibility of government and even in collaboration with donor agencies is not sustainable, considering the huge capital investments involved, coupled with high population growth rate. It was estimated by the Ghana Water Company Limited (GWCL) that about US$2.0 billion was needed to extend the water sector in Ghana from 1998 to the year 2020.

It is however interesting to know that since the early 1980s, World Bank (IDA) total support to Ghana in credit and grants, the most substantial of all development assistance, had been only a little above US$5 billion (World Bank, 2007). The credit crunch of recent times further makes it unacceptable to rely on development assistance to meet potable water needs in developing countries. It can be asserted that the slow pace at which potable water has been made available to communities in Ghana stems from the fact that the sector does not get meaningful returns from the investments made to sustain the sector (considering the fact that the Ghana Water Company Limited until June, 1999, supplied water at a loss). This is further worsened by the waste and inefficiencies associated with the handling of public property, partly responsible for the 50% unaccounted-for-water rate in Ghana.

Kumasi, the second largest city in Ghana with a population of about 2.0 million (Ghana Statistical Service, 2012) has suffered and continues to suffer from water shortages. This situation has given water vendors the opportunity to sell water to residents of various suburbs at exorbitant prices. Thus public water systems provide a low level of communal service with few functional private connections compared with the current population. The service is heavily subsidized and the monthly tariff of 80p per cubic meter from household connections is too low. Little revenue therefore is generated by the service and the GWCL cannot afford to maintain the system above a low level of service. Therefore, consumers are forced to supplement their potable water with water from traditional, often low quality sources such as shallow wells and vendors. Thus, the water supply is in a low-level equilibrium trap, where poor service generates little revenue thereby ensuring continuing poor service. This study therefore examined how the distribution of potable water could be done to enhance human welfare while at the same time attaining sustainable allocation of potable water resources in Kumasi. This is against the background where about 97% of the budget of the Ministry of Water Resources Works and Housing in Ghana is donor funded (Ministry of Water Resources Works and Housing, 2011).

THEORETICAL FRAMEWORK

The current structure of the distribution of potable water in Ghana is skewed in favor of people who are capable of paying for water. Effective demand encompasses the ability and willingness to pay for an economic good. Since potable water is a merit good, the effective demand need not necessarily include an ability to pay. A merit good is one considered by government as so important for health and well-being that more of it should be provided than what the market mechanism alone will allow. In such a situation the willingness to pay (WTP) is sufficient to warrant government provision. The notion of potable water being a merit good in Ghana does not contradict the 1992 Dublin statement from the United Nations Conference on Environment and Development, calling for the recognition of water as an economic good. There have been several debates on the theoretical and operational implications as well as the economic impact of this call on the poor. Thus this study used the Contingent Valuation Method (CVM) to assess the welfare implications of potable water pricing and provision, to appropriately inform policy, towards a sustainable distribution. Such analysis could to a large extent reinforce the Dublin statement as a step towards sustainable water allocation, particularly for several urban areas in developing countries.

A change in the provision of a good gives rise to a 'full price effect' on the ordinary demand curve where real increases of consumers' incomes are allowed to vary. The Hicksian approach however yields a theoretically more accurate measure of welfare change since it holds real incomes constant (Varian, 2006; Katz and Rosen, 1998). With the change in the provision of potable water, the consumer's utility can be maximized subject to his budget. The assumption here is that the consumer has an exogenous budget Y which is to be spent on some or all of n commodities which can be bought in non-negative quantities at given fixed, strictly positive prices. A change in the provision (distribution) of potable water produces a change in utility whose maximization will bring optimum satisfaction leading to welfare maximization (Johansson, 1987) and hence a sustainable allocation. Environmental Economic methodology describes six phases in the practical application of the CVM which estimates the monetary value of the change in welfare resulting from the change in allocation. These are the market description, elicitation, calculation, estimation, aggregation and validation phases described in the following section.

METHODOLOGY

A hypothetical market was set up for the provision of a 24-hour supply of easily and quickly accessible potable water to communities in the suburbs of Kumasi that had no access to potable water in the description phase of this research. The hypothetical market explained the services that could be made available and at what price. The payment mechanism, modalities of delivering the service, its quality and reliability were also discussed to make the market scenario complete. These are presented in the elicitation scenario as discussed below. The survey used questionnaires that started by describing the problem and the change envisioned - the provision of a 24-hour supply of potable water just around consumers' homes through public taps by private operators. Payment for the commodity would be made through on the spot pay-as-you-fetch principle or arrangement. The questionnaires included questions on the socio-economic and demographic background of the respondents and their families. This was mainly for purposes of cross-checking WTP responses. In each case the respondent was a household head, representing his or her household. The unit quantity of potable water was the bucket. A bucket here refers to an 18 liter volume. The use of bucket emanated from ascertaining which measure was more familiar to households in Kumasi for water. Even though the 'Kufuor galon' is used in some communities in Ghana, households were more familiar and accustomed to the bucket as a measure. This is confirmed by Whittington et al (1992) and Owusu (2009).

The iterative bidding game method was used to elicit responses from respondents. The question asked for the iterative bidding game is, "suppose you are supplied with a 24-hour daily service of potable water just outside your home, how much would you be willing to pay for each bucket of potable water you fetch?" If the respondent's answer was yes to the bid of (say) 7 pesewas (7p) per bucket, then the question was repeated with a higher bid of 8p, if the answer was no, the question was repeated with a lower bid of 6p. This continued until the respondent's maximum WTP was reached. This same method was repeated for 24-hour in-house taps as an alternative commodity. The bidding game approach produces a continuous bid variable which can be analyzed using the Ordinary Least Squares (OLS) method.

In all, 23 suburbs of Kumasi were identified as areas not receiving regular supplies of potable water. Through random sampling from the list 5 suburbs were selected, namely Buokrom Estates, Sepe Buokrom, Asuoyeboa (SSNIT flats area), Kokode (Agric college) and Edwinase. Seventy households were interviewed from the selected suburbs through a second stage systematic sampling procedure in 2010. The starting point bid of 5p per bucket was to give respondents enough room to be realistic since the current 5p per bucket charged by vendors was for water with uncertain purity and wholesomeness.

The Variables

For all households, information was collected on socio-economic characteristics including measures of monthly income, education level, household size, total expenditure on other commodities, proximity of current water source and characteristics of the current water source. The dependent variable for the study was maximum Willingness-To-Pay for potable water (WTP) in each of the two market scenarios depicted, which was regressed on the quantity of potable water demanded to obtain the demand functions. To obtain a quantity dependent variable, quantity of water consumed per day in buckets of water (Q) was regressed on Households' monthly Incomes in cedis (Y), Educational levels in codes of years (E), Ages in years (A), proximity of current source of water (Pc), Expenditure on other commodities(x) and maximum Willingness-To-Pay for potable water (WTP). The functional relationship between maximum Willingness-To-Pay and the remaining variables thus was WTP = f(Y,E,A,Pc,Q, X). Similar functional relationships have been used by Briscoe et al (1990), Hanley and Spash (1993) and Carruthers and Browne (1977). Based on the theoretical framework, respondents' WTP were modeled on a continuous utility framework in which each household head's response represented the indirect utility that the household received from consuming a bucket of potable water.

RESULTS AND DISCUSSION

Plotting midpoint values for willingness- to- pay (in Ghana Pesewas) against quantity of potable water demanded, which here is pegged at two buckets per household member, gives us the Hicksian demand function for potable water supplied through community taps near households' homes. The assumption of two buckets per household member (meaning the demand per household is equal to twice the number of people in the household) is consistent with the findings of Nyarko et al. (2006); Feachem (1973); and White et al, (1972) that city dwellers without taps consume on the average about 30 litres (2 buckets) of potable water per person daily. For community taps near consumers' homes the demand function was

$$WTP_1 = \underset{(13.289)}{756.626} - \underset{(-9.254)}{6.629}Q_d \quad \text{t- values} \qquad (1)$$

$R^2 = 0.966$, R^2 Adjusted = 0.955, F-statistic = 85.629

While for in-house taps, the demand function was

$$WTP_2 = \underset{(8.643)}{639.024} - \underset{(-4.105)}{4.297}Q_d \quad \text{t- values} \qquad (2)$$

$R^2 = 0.849$, R^2 Adjusted = 0.799, F-statistic = 16.853

Total Willingness-to-Pay

To aggregate for Kumasi as a whole, the mean WTP bids for the sample were converted to a population total figure. Here, it is possible to capture all those whose utility would be significantly affected by the change in provision of potable water in Kumasi. Tables 1 and 2 show the computations to obtain the mean total willingness to pay for potable water and the expected total revenue for Kumasi respectively. From Table 1, with the average household size in Kumasi of 4 (Ghana Statistical Service, 2012), if each household member consumes two buckets of potable water in a day, then for one day the TWTP would be GH¢ (4 x 64,130) = GH¢256,520 (US$160,325) for the 500,000 households in Kumasi. The Freshwater Country Profile of Ghana of the United Nations Organization has indicated that it costs Ghana US$0.80 per cubic meter to produce, transport and distribute potable water. This cost could be as a result of the serious efficiency challenges the water sector faces. For instance, in 2006 approximately 60 employees were responsible for 1,000 connections, a figure extremely higher than the international good practice level of less than 4 employees per 1000 connections (Kauffman and Pérard, 2007). This implies 15 times less efficient cost for Ghana.

Table 1: Total Willingness to Pay for potable water in Kumasi for one day

WTP (Midpoints) (a)	Percentage of Households (b)	Number of Households (c)	Cumulative No of Households (d)	% Cumulative Frequency (e)	TWTP (in GH¢) f=(a)×(c)×2
0p	0.1	500	500,000	100	0
0.5p	1.4	7000	499,500	99.9	70
1p	1.4	7000	492,500	98.5	140
5p	47.8	239,000	485,500	97.1	23,900
8p	46.4	232,000	246,500	49.3	37,120
10p	2.9	14,500	14,500	2.9	2,900
Total	100	500,000			64,130

Source: Author's fieldwork, 2010.

Given efficient equipment and systems, the cost therefore should be about US\$0.05/m^3. If the average population of Kumasi of 2 million is considered, then the production cost with efficient production, transportation and distribution would be about US\$100,000. Apart from the fact that consuming 2 buckets a day is limited to those without reasonable access and therefore a minimum (since those with house taps consume about twice this amount), the TWTP of US\$160,325 far exceeds the efficient cost of supply of US\$100,000. The difference, US\$60,325 is the minimum daily net gain that could accrue to any private investor that would efficiently manage Kumasi's water supply system.

Expected Revenue

Table 2 shows the various WTP bids as proposed tariffs alongside the expected revenues which each of them would yield. The tariff that would provide the highest expected revenue is 5p per bucket. This revenue is GH¢194,200 (about US\$121,375) per day. The tariff of 8p, the second highest source of revenue would attract a patronage of just 49.3% of consumers, and would therefore not be socially efficient. The modal tariff of 5p provides the highest revenue to investors - this is so close to the current vendor–tariff. This tariff would provide about 97.1% patronage. This will mean denying access to about 2.9% of the population who cannot afford to pay the tariff of 5p per bucket. Such a measure could have far reaching social consequences on the poor and vulnerable in society. However, this is the fairest deal for both investors and consumers, as explained in the next section.

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Table 2: Expected Revenue for potable water per day in Kumasi

% Frequency Distribution (a)	% Cumulative Frequency (b)	Cumulative No of Households (c)	WTP Midpoints (d)	Expected Revenue GH¢ e = c x d×8
0.1	100.0%	500,000	0p	0
1.4	99.9	499,500	0.5p	19,980
1.4	98.5	492,500	1p	39,400
47.8	97.1	485,500	5p	194,200
46.4	49.3	246,500	8p	157,760
2.9	2.9	14,500	10p	11,600

Source: Author’s fieldwork, 2010.

Consumers’ Surplus

Analysis of consumers’ surplus (CS) for current and sustainable provision of potable water by the Ghana Water Company Limited (GWCL) is shown through Figure 1. Currently the GWLC charges a minimum of 80p per cubic metre of potable water. This comes to 1.44p for a bucket (i.e. 18 litres).

Figure 1 indicates that the current about 72% coverage for Kumasi (Ministry of Water Resources Works and Housing, 2011) produces ABCD revenue with technically no consumers’ surplus at 1.44p per bucket as far as the demand curve GHFJ is concerned. With a price of 5p per bucket, which attracts 97.1% WTP, the new revenue (AEFD) would be about four times the current revenue. The resulting substantial consumers’ surplus (EFJ) which exceeds the current revenue is evidence of better welfare at this new price.

This implies more revenue for GWCL as well as better welfare for residents of Kumasi due to improved access to potable water. This is more so because the 2.9% of residents who could not afford potable water at 5p per bucket could be catered for through a social intervention scheme with only about 8% of the CS to be realized. This means the net gain to society will be 92% of the CS. Hence a tariff of 5GHp will more than compensate the losers to bring welfare improvement for all residents of Kumasi.

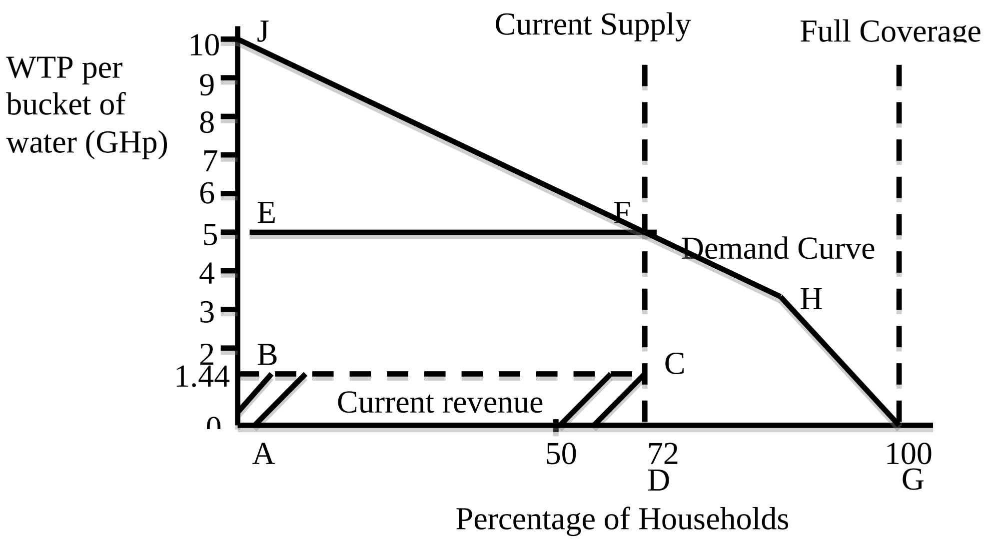

Figure 1: Consumers' Surplus and Revenue for potable water in Kumasi.

Thus, everybody stands to gain eventually if tariffs for potable water are increased by at least 300%. The tariff increase will also provide the GWCL with substantial revenue to address the serious low service and inefficient delivery of potable water, leading to efficient allocation of potable water resources in Kumasi. Private sector exploitation can easily exist since Table 2 shows that over 49% of residents are willing to pay 8p per bucket, which is more than 5 times the current tariff. Therefore, households in Kumasi are willing to pay higher potable water tariffs to secure higher economic welfare than what pertains currently. These payments could also facilitate a sustainable allocation of potable water in Kumasi.

CONCLUSION AND POLICY IMPLICATIONS

In Kumasi, as has been discussed earlier, public water systems provide a low level of communal service with few functional private connections compared with the current population. The service is heavily subsidized and the monthly tariff of 80p per cubic meter from household connections is too low. Little revenue therefore is generated by the service and the GWCL cannot afford to maintain the system above a low level of service. Therefore, consumers are forced to supplement their potable water with water from traditional, often low quality sources such as shallow wells and vendors. Thus, the water supply is in a low-level equilibrium trap in which poor service generates little revenue thereby ensuring continuing poor service. The way out to achieve improved welfare and sustainable allocation is through water tariff increase, if the current level of efficiency is maintained.

It is recommended that the Government Ghana should allow the GWCL to increase tariffs at least by 300%. This would be the most equitable for society's welfare in general

if the efficiency status quo is maintained. An alternative approach however would be to improve upon the efficiency of production, transportation and distribution systems.
Private participation in the water sector must be regulated in terms of tariffs; otherwise the high consumers' surplus can be exploited to the detriment of residents of Kumasi. There is a small percentage, about 2.9% of residents of Kumasi who would still need to have access to potable water at a much lower rate than the proposed tariff, subsidized through gains from the increased tariff. Catering for this group through a social intervention scheme will still result in a substantial net welfare gain to society.

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