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Socio-economic Determinants of Sources of Drinking Water: Some Insight from Ghana

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1. Introduction

Drinking water is the basic need of human life and in fact an essential component of primary health care and poverty alleviation. A former UN Secretary General, Kofi Annan noted that"*No single measure would do more to reduce disease and save lives in the developing world than bringing safe water... to all*" (as cited in Water Matters 2003). The World Bank (1994) indicated that inadequate drinking water not only resulted in more sicknesses and deaths but also increases health expenditures, lowers worker productivity and school enrolment.

Some 6,000 people-mainly children under-five die every day from the effects of using contaminated water (Federal Ministry of Education and Research, 2008). Diarrheal diseases are caused by poor environmental hygiene of water and food. Water based disease transmission by drinking contaminated water is responsible for significant out breaks of faeco-oral diseases such as cholera, typhoid, dysentery and diarrhoea.

The Ghana Water and Sewerage Corporation (GWSC), now Ghana Water Company Limited (GWCL) is responsible for the provision, distribution and supply of water for public domestic and industrial purposes. In line with the decentralization structures, the Community Water and Sanitation Agency (CWSA) an offshoot of the then GWSC was set up in 1998 to facilitate the provision of safe drinking water in rural communities and small towns. In Ghana, approximately 94% of the population has access to water, where access is defined for households with a water source less than 30 minutes away. However, only 74% of the population has access to improved water source. Contrastingly, the WHO (2006), put the proportion of the population with improved water source at 64%, a 10 percentage points lower.

Previous studies on Ghana such as Tayeh *et al.* (1993) had looked at drinking water sources and water related diseases such as Guinea worm (dracunculiasis). Asante (2003) examined the socio-economic aspects of access to safe drinking water without delineating the major sources. Osei-Asare (2005) investigated water security and water demand in the Volta Basin of Ghana using Linearised Almost Ideal Demand System (LAIDS) and concluded that price, household size, region of residence and household expenditure on water *inter alia* are significant predictors of the demand for drinking water. McGarvey *et al.* (2008) sought to establish the relationship between socio-demographic characteristics and household drinking water quality in Coastal Ghana and found that variations in community and household socio-demographic and behavioural factors are key determinants of drinking water quality.

This paper fills the research gap by investigating the socio-economic determinants of drinking water from various sources. The health and productivity implications of drinking contaminated water make this study relevant.

2. Materials and Methods

2.1 Data

The study uses primary data from a survey conducted in three Districts (Lawra, Dangme West and Ejisu-Juaben) in Ghana between October 2007 and January 2008. A cross-section of 531 households were interviewed using stratified random sampling technique. Data was elicited from the household head and/or a woman who had experienced a live birth between October 2002 and October 2007. The choice of the three Districts was informed by the poverty and under-five mortality trends as well as the need to capture the ecological zones of Ghana. The sample size of 531 was arrived at by using Cochran's (1977) estimated proportions approach, where under-five mortality per District/Region was the point of reference. The survey includes information on household socio-economic, demographic and District characteristics.

2.2 Methodology (Model)

The multinomial logistic (MNL) regression model was utilized to analyze the factors influencing the sources of drinking water. This model is applicable because the dependent variable, sources of drinking water has more than two categories with no natural ordering, representing the different options households face in terms of access to drinking water. In our model, there are five choice set available to the households: piped into dwelling/compound, public outdoor tap, borehole, protected well and unprotected source.

3. Results and Discussion

Table 1 presents estimation results for the choice of drinking water using multinomial logit model. The model is well fitted and rejects the null hypothesis that all coefficients except the intercept are zero; the chi-square is significant at the 1% level.

Table 1: Multinomial logit estimate of Sources of Drinking Water

Variable	**Piped into Residence**	**Public Outdoor tap**	**Protected Well**	**Unprotected source**
Residence (1=Rural)	-2.2062(-0.0894)***	-1.8432 (-0.3047)***	-1.4649(-0.0370)***	0.3276(0.0131)
Dependency Ratio	-0.2685(-0.0183)]	0.1632(0.0375)	0.0175(0.0017)	0.4499(0.0053)
Log of Household Income	0.5002(0.0333)*	-0.2821(-0.0669)	-0.0929(-0.0020)	-0.0609(0.0001)
Per Capita Public Expenditure	-0.0222(0.0053)	-0.3233(-0.0648)***	-0.2122(-0.00670)***	0.2296(0.0044)
Electricity (1=Yes)	1.3845(0.0611)***	0.4702(0.0374)***	1.4052(0.0735)***	1.8618(0.0198)***
Household Head (1=Female)	-0.5731[-0.0186]	-0.7274(-0.1362)	0.1226(0.0264)	-0.4789(-0.0031)
Age of Household Head	0.0071(0.0006)	-0.0171(-0.0040)	0.0198(0.0017)	-0.0299(-0.0003)
Education level of the Head	-0.0009(0.0001)	-0.0094(-0.0018)	0.0157(0.0013)	0.1198(-0.0015)*
Distance to source of water (Mins)	-0.1043(-0.0057)***	-0.0026(-0.0014)	-0.0063(0.0001)	0.0019(0.0001)
Clean cooking fuel (1=Yes)	0.8141(0.0555)*	0.0071(0.0288)	0.1631(0.0042)	1.2558(0.0243)
Distance to Food Market	-0.0958(-0.0043)***	-0.0547(-0.0098)	0.0118(0.0024)	-0.0838(-0.0008)
Distance to public transport	0.0011(0.0010)	0.0064(0.0017)	-0.0416[-0.0029]	0.0422[0.0054]
Clean Toilet facility (1=Yes)	0.2003[0.0133]	-0.1552[-0.0288]	0.5143[0.0375]	-1.8637[-0.0240]***
Constant	-2.7194(2.3472)	5.1008(2.0255)***	-1.3327(3.4092)	-2.8622(4.3519)
Number of Observations =531 *Pseudo R-square = 0.27* *Log Pseudolikelihood =-500.00* *Wald chi-square (92)=272.14**** *Prob > chi-square = 0.0000*				

Source: Authors' calculation, marginal effects in parenthesis, *** significant at 1%, **at 5% and * at 10%. (Borehole (3) is the base outcome))

In addition, the model explains 27% of the variations in the probability that a particular water source would be chosen for drinking purposes, indicating a good fit for a choice model. According to our econometrics model access to good drinking water is urban biased**.** Rural residents are less likely to have access to piped water in their residence, public outdoor tap and protected well**.** In particular, rural dwellers are 9 and 30 percentage points less likely to have access to piped water in residence and public outdoor tap respectively as compared to boreholes. Although, unprotected well had the expected positive association with rural residence, it was statistically insignificant. Household income, which is a proxy for ability-to-pay is a significant predictor for piped water in residence. Income increases access to piped water in residence by 29 percentage points. In Niger, Bardasi and Wodon (2008) found that the rich are more likely to be connected to piped water in residence and that households connected to piped water pay less relative to the poor who utilize alternative sources. Similarly, Asante (2003) found a significant statistical relationship between income and access to safe/portable water. The finding is also consistent with Iskandarani (2002) who reported that household income is a significant predictor of per capita water demand. However, our result is at variance with Osei-Asare (2005) who established a significant inverse relationship between income and improved water source.

Households with clean toilet facility are two percentage points less likely to drink water from "unprotected sources". However, the variable is insignificant in the case of piped water in residence, public outdoor tap and protected well. Access to Clean cooking fuel is only significant for households who have access to piped water in residence, indicating a strong association between the two variables. Thus households using LPG or other clean cooking fuels such as stoves are more likely to have access to piped water in residence compared with boreholes (the reference category).

In terms of public spending on infrastructure such as water supply, per capita district expenditure is used as a proxy. Granted that safe water has public goods features or yet still a merit good, it was envisaged that public spending will boost its supply to avert or dampen the ill effects of drinking contaminated water. The variable has a puzzling negative and significant effect on public outdoor tap and protected well. The probable explanation for this outcome might be due to the fact that public outdoor tap and protected wells are donor funded and not directly related to central government expenditures. Besides, the level of public spending on piped water might be insignificant to warrant a significant correlation between public spending and water supply. In addition, the variable represents total spending and not only on water. Data on government spending on water at the district level was unavailable for all the districts hence, the use of the total district spending.

Interestingly, access to electricity is invariant with the source of drinking water. All the four alternatives were consistently and positively related to access to electricity. In terms of household headship, there is no discernible statistical relationship between female headed households and source of drinking water. Besides, the age of household head had no significant effect on the source of drinking water.

The study lacks data on cost which is crucial for such analysis. However, it can be argued that other sources such as borehole and unprotected source are sourced at no cost. The inclusion of cost for some alternatives and not for others will bias the coefficients. Hence, the inclusion of distance as a proxy for opportunity cost is appropriate. Since we restricted the study to the source of water to be drunk, information on the volume of water is immaterial; the importance of volume pertains to other domestic and commercial usage. As expected, distance was consistently and inversely related to source of drinking water but for unprotected well, albeit it was only significant for household with access to piped water in residence. Thus the longer the distance to a particular source of drinking water, the lower will be the demand for same. Our finding is consistent with Persson (2003) who found that time cost is an important determinant of household choice of drinking water-source while taste proxied by income had ambiguous effect. Osei-Asare (2005) in his study on water demand in the Volta Basin of Ghana found price of water (opportunity cost) as a significant predictor of the demand for improved water source.

4. Conclusion

The paper highlighted the sources of drinking water in Ghana and concluded that access to piped water is an urban phenomenon and driven by supply rather than demand. Hence, rural dwellers predominantly rely on other alternatives such as borehole and protected well. The predominance of piped water in urban areas is an indication of the generally low level of infrastructure in rural areas. We have demonstrated that income is a significant determinant of the use of piped water in residence. It is also apparent that households with access to clean toilet facility and high level of education will not use unprotected water for drinking purposes. However, access to electricity is invariant with water sources. Since access to piped water, perhaps the safest is an urban phenomenon; there is the need for increased infrastructural development in rural areas with a possible spillover effect on curbing rural-urban migration. Public, community and NGO participation in small town and rural water supply should be encouraged to ensure availability of safe drinking water. In addition, a demand-responsive approach to supply of piped water should be adopted to allow consumer demand to guide investment in domestic water supply.

One limitation of this study is that, the quality of water was not incorporated. However, it is envisaged that piped water is the safest since its supply involves routine chemical treatment. Nevertheless, this limitation by no means invalidates our results.

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