African Association of Agricultural Economists. *Shaping the Future of African Agriculture for Development: The Role of Social Scientists*. Proceedings of the Inaugural Symposium, 6 to 8 December 2004, Grand Regency Hotel, Nairobi, Kenya

Household Water Coping Behaviour and Costs in the Volta Basin of Ghana

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Abstract: Ghana is abundant in water resources but frequently experiences seasonal and periodic water scarcities. Households therefore adopt coping strategies and various activities to ensure continuous flow of adequate safe water at the household level. These strategies involve opportunity costs and some amount of financial outlay. Using revealed preference data for 20 randomly selected rural communities in the Volta basin of Ghana this paper employs the coping costs approach to derive the costs of coping with water insecurity. Explicit costs in the form of investments in water storage facilities and costs of water treatment are estimated. Implicit costs (opportunity cost of time) associated with water collection, which varies by season and ecological zone, is valued using the average basic hourly wage of rural women engaged in agriculture. The results of the study show that costs of coping with water insecurity are higher in the dry season and for forest ecology households. The often-stated claim that rural households cannot and should not pay for the full cost of water delivery is not supported by this study. The paper concludes that rural consumers are paying at least as much as their urban consumers for unimproved water. Hence, this paper is of the view that rural consumers have the ability to pay for improved water but may not be willing to do so probably due to their perceptions and attitudes concerning the public good nature and benefits of improved water supply.

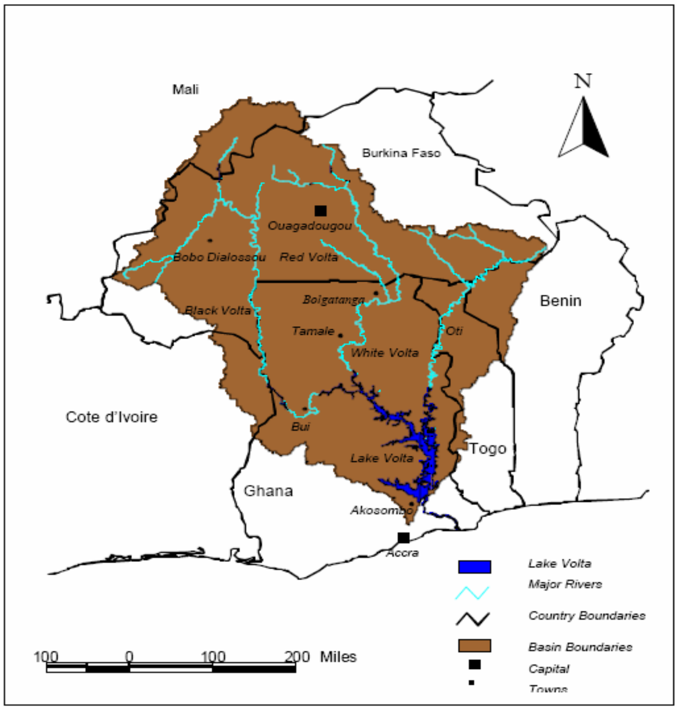
1. Introduction

Freshwater is gradually becoming a scarce commodity in Ghana. In 1955, per capita available renewable freshwater was 9,204m^3. This declined to 3,529m^3 in 1990 (Karikari, 1996) which still makes Ghana a water-abundant country. However, water scarcities especially in the dry season has eventually become a perennial problem, thus suggesting the inadequacy of macro-level data to reveal seasonal and spatial variations in water scarcity in the basin. Karikari (1996) estimates that by 2025 the per capita renewable freshwater will further decline to 1,400 m^3, which will be within the water-stress range (1000-1667 m^3/person/year).

Prevalence of periodic water scarcities bring into question issues on water availability and accessibility all year round in the Ghanaian part of the Volta basin (Figure 1). It is clear that accessibility is inadequate as gleaned from a national water supply and sanitation survey conducted in 1993 indicating 46% and 76% potable water coverage for the rural and urban populations respectively. Ghana's new Vision 2020 with respect to the rural water sector seeks 100% coverage in all urban areas and over 90% coverage in rural areas with the expectation that by the end of 2004, there would be 80% coverage in rural Ghana. The rural target has been revised by the Community Water and Sanitation Agency (CWSA) to 85% coverage by the year 2009.

The inadequacy of rural water supply coverage in the Volta basin results in water coping strategies or behaviour such as the use of multiple water sources, investments in water storage facilities and the treatment of water to enhance it quality. Commuting long distances to access water, boiling of water, purchase of chemicals and filters and the reuse of water for other household chores are some activities that go along with these coping strategies. Thus, explicit (financial) and implicit costs (opportunity costs) and for that matter coping costs are forced on rural households amidst water insecurities. Opportunity costs have agricultural productivity implications where time devoted to water collection, assuming employment opportunities exists in these communities, could have been channelled into productive activities to improve household welfare. The extent to which these households cope financially with water insecurity in the Ghanaian Volta basin is not exactly known although this is a relevant issue (as compared to only estimating water demand) that will inform policy makers on the current policy debate on rural water sector reforms to enhance their thinking on water pricing, cost recovery, households' ability to pay (ATP) and hence the affordability of rural water delivery systems.

Figure 1: **The Volta basin and the six riparian countries.**



Source: From the GLOWA-Volta project (2003): http://www.glowa-volta.de

The main objective of this paper is to derive the costs of coping with water insecurity in the Volta basin of Ghana. Attempt is made to compare the results with the current water tariff paid by urban consumers for potable water. The aim of this paper is to raise the awareness of "hidden" costs associated with water insecurity in rural Ghana by bringing to the fore various coping mechanisms and financial burden that rural households already incur to access water. The rest of the paper is organised as follows. Section 2 highlights the methodology adopted for this study and the working hypothesis being tested. Section 3 discusses various water coping strategies and activities and presents the results of the coping costs estimate. Section 4 concludes by summarising the main findings and policy implications highlighted.

2. Methodological Approach

2.1 Sampling criteria

This study uses socio-economic household survey information conducted in 2001 by the GLOWA-Volta that seeks to examine in a holistic manner the sustainable utilisation of water under changing land use, rainfall reliability and water demands in the Volta basin. The selection of communities (or enumeration areas) relied on the sampling criteria of the Ghana Living Standards Survey 4 (GLSS4), a nationwide survey conducted by the Ghana Statistical Service (GSS) in 1998/99 with assistance from the World Bank. Principal Components Analysis (PCA) and Cluster Analysis (CA), two multivariate data reducing techniques were employed to select the various communities. Households were randomly selected in each community and questionnaire-based interviews conducted. Table 1 shows the number of communities and households interviewed in each administrative region in the Volta basin.

Table 1: Location of surveyed communities in the Ghanaian Volta basin

Region	*No. of communities*	*No. of households*
Ashanti	*4*	*99*
Brong Ahafo	*4*	*97*
Eastern	*1*	*26*
Northern	*4*	*98*
Upper East	*4*	*107*
Upper West	*1*	*27*
Volta	*2*	*47*
TOTAL	***20***	***501***

Source: GLOWA field survey, 2001

The sample consists of 501 households in 20 systematically randomly selected rural communities across the Ghanaian part of the basin, the focus of this study.

2.2 Water coping costs

Working on the premise that rural households in the Volta basin may consume smaller quantities of water compared to urban households due to difficult water accessibility, securing water is a priority for even the smallest and poorest household. Water coping cost, which is a composite of explicit and implicit costs, depend to a larger extent on the quality of water and quantities consumed domestically for drinking, bathing, cooking and hygiene.

2.2.1 Explicit costs

Explicit costs come in the form of fixed and variable costs, the former being equivalent to the initial capital investment in water storage facilities whilst the latter could be seen as recurrent costs (such as electricity charges, fuel cost for the electric pumps, and water filters). Explicit costs are much higher for wealthier households who can afford piped connections into their homes, who may invest in water storage tanks, electric pumps and water filters. Households using boreholes, protected and unprotected wells or collecting water from rivers, ponds and streams will incur variable costs when they boil, filter and use chemicals to improve water quality (these constitute water treatment cost). The magnitude of these costs will depend on the water quality, type of water connection and financial position of the household.

2.2.2 Implicit costs

Rosen and Vincent (1999) list three kinds of implicit cost when water is collected a distance away from home for domestic use: health damages resulting from the physical damage of carrying water; the expenditure of energy on carrying water; and the opportunity costs of time in fetching water. Due to data limitations, this paper concentrates on the opportunity cost of time spent securing water. Time is a major resource available to rural farm households but unfortunately is channelled into commuting long distances and queuing to source water. As productive time is lost in fetching water, an appropriate rural wage rate could be used to value this time.

Once employment opportunities exits in rural communities, either in the form of on-farm or off-farm employment, time devoted to water collection activities may imply losses in wage income. Wages for casual labour may be very low in rural communities but definitely not zero. If children do the fetching of water, their time should be valued because they could use that time productively (investing in human capital (schooling), leisure, work or care taking). A percentage of this time could be used for children or when it is difficult to find jobs in a particular community. This opportunity cost is the product of the time spent fetching water (in hours) and a monetary value of that time. One easier way of deriving the opportunity cost is to use the observed labour wages of households in these communities with piped connection as proxy for the opportunity cost of time for the other households without piped connection. However, this procedure was not necessary because of the lack of piped connections in these communities. In this study, coping costs (measured in Cedis/m^3/month) is defined as follows:

Coping cost = Explicit costs (Investment in water storage facilities + [cost of chemicals + cost of filters + cost of boiling water]) + Implicit costs (opportunity cost of time spent fetching water)

Economic costs are also associated with water insecurity and these include losses in wages due to sickness from consuming poor quality water and time spent in boiling water for health reasons.

2.3 Hypothesis

Although water could be considered a social good in that it is a basic human need and must be delivered to all on the grounds of public health, it is viewed as a commodity that has economic value as it has to be produced and delivered to households at a cost. This paper uses the coping costs estimation to test the often-claimed hypothesis that rural dwellers cannot pay for the full cost of water delivery. It is instructive to note that coping costs indicate what consumers are already paying (ability to pay) in order to cope with water insecurity. In other words, coping costs give an indirect estimate of demand and represent the lower bound of willingness to pay for water (Choe and Varley, 1997).

This study is of the view that rural households may be paying at least as much as urban consumers in securing water and for that matter have the ability to pay (ATP) (but may not be willing to pay) for improved and reliable water supply. Comparison will be made on the cost per cubic meter of water delivered to urban consumers in the capital city of Accra. This figure in urban areas, including the city of Accra, is US$0.30/m^3 (Kariuki and Acolor, 2000).

3. Results and Discussions

3.1 Water coping strategies and activities in the Volta basin

Eight communities (39%) are located in the forest zone, 12 communities in the savannah zone. The average family size for the study area is 8.5 persons with the savannah ecology having a higher household size. The household survey revealed three major strategies of coping with water insecurity: the use of multiple sources (to enhance water reliability), water treatment (enhance water quality), and investments in water storage facilities (ensure continuous water availability). Accompanying activities, such as commuting long distances to collect water (accessibility), storing water (to enhance reliability), and water reuse (for conservation purposes) form an integral part of strategies to overcome household water insecurities.

3.1.1 The use of multiple water sources

Table 2 shows sources of domestic water supply used by Volta basin households.

Table 2: Water supply sources used by sampled households (in % of households) in the Ghanaian Volta basin, 2001.

Water sources	*Source used*	*Most important source*	*Second most important source*
Piped water in the house and compound	*2.6*	*2.6*	*0.5*
Public Tap /standpipe	*7.8*	*5.4*	*1.0*
Private water vendor	*5.4*	*1.4*	*2.0*
Water from neighbours	*3.0*	*2.2*	*1.0*
Hand dug well	*18.6*	*12.0*	*7.4*
Borehole	*42.7*	*32.5*	*8.4*

River, streams and ponds	*57.1*	*42.1*	*18.8*
Rain water	*64.3*	*1.2*	*60.5*
Other	*0.8*	*0.6*	*0.5*

Source: GLOWA field survey, 2001

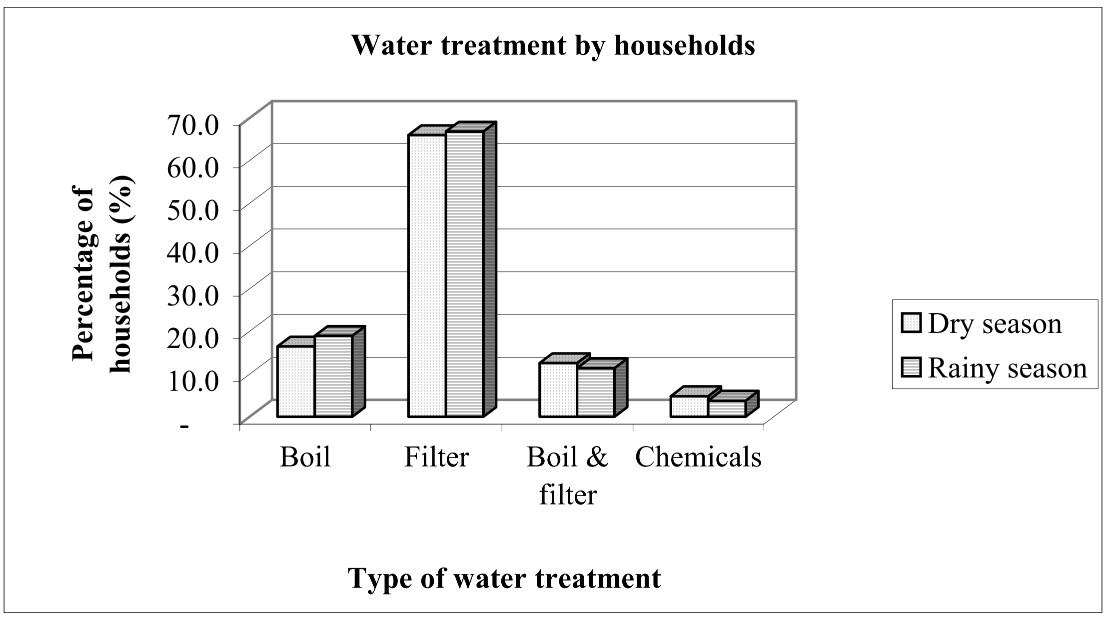
Note: Percentages may not add up to 100 as households use multiple water sources for various purposes.

The survey found that rural households depend on multiple water sources available, ranging from public pipes to the harvesting of rainwater, for various consumption needs. Majority, constituting 64% use rainwater whilst rivers, streams and ponds serve as the most important and traditional water source for roughly 42% of sampled households.

3.1.2 Water treatment

Approximately 27% of rural households treat water either by filtering, boiling or adding chemicals (for example alum) or a combination of these to enhance its quality. The commonest method of water treatment is simply by filtration (Figure 2) where over 60% of households do this. The use of chemicals is the least method preferred perhaps due to budgetary constraints. As some disease-causing micro-organisms are not eliminated during filtration, this method does little in reducing the effect of these organisms on the health and productivity of households.

Figure 2: Methods of treating river water by households in the dry and rainy seasons



Source: Field survey, 2001

One observation worth mentioning is the fact that slightly more households filter and boil water in the rainy season than in the dry season and this may be explained in part by the turbidity of this water sources necessitating the need to at least filter.

3.1.3 Travelling long distances (accessibility)

Time allocations would differ among households and communities depending on the available water sources, ease of accessibility, distances to these sources, and household characteristics such as size and gender, which influences the number of carriers. The time spent and distances commuted to access water from rivers and streams (their most important water source) is shown in Table 3. Time budgets are based on recall by the household head, the spouse or the carriers depending on the situation. On the average, households spend more time accessing water in the dry season than in the rainy season. Real hardship is encountered in some communities in the dry season where a maximum round trip distance of about 4.8 km is commuted, corresponding to an average of 1.82 hours devoted to making a round trip per water carrier in the dry season. This figure is on the higher side when compared to 0.50 hours per trip to a public tap located within 34-meter radius of households or 2.9 hours per day in Dehra Dun, South Africa (Choe and Varley, 1997).

Assuming 2 water carriers per household (usually women and children) make 2 return trips per day during water scarce periods, this amount to 7.3 hours per day. Thus, time is a major resource for rural consumers, which is evidenced by the considerable amount of hours allocated to water fetching. In one community in the savannah ecology, a maximum of 6 hours per carrier (round trip) is allocated to water collection in the rainy season.

Table 3: Average distances commuted and time spent to access water from rivers

Community	*Distance (meters)*		*Average time (round trip) (minutes)*	
	Dry	***Rainy***	***Dry***	***Rainy***
Abrakaso	*442.9*	*442.9*	*37.1*	*28.1*
Akutuasi	*566.0*	*580.0*	*61.8*	*58.8*
Ejura	*595.3*	*660.7*	*35.6*	*34.8*
Kyebi	*525.0*	*500.0*	*22.5*	*20.0*
Ayerede	*1,441.7*	*1,437.5*	*48.3*	*47.5*
Kwagyeikrom/Bredi	*443.5*	*426.1*	*79.3*	*39.1*
Koduakrom	*1,585.7*	*491.3*	*81.4*	*25.0*
Miawoani	*1,510.0*	*689.6*	*77.6*	*49.2*
Nsuta	*472.4*	*401.4*	*36.7*	*42.9*
Gbangbanpon	*857.7*	*694.2*	*52.7*	*38.3*
Bagabaga	*1,375.0*	*1,500.0*	*42.6*	*44.0*
Kaladan Barracksa				
Kusawgu	*1,073.9*	*1,073.9*	*61.5*	*61.5*
Dusabligo	*550.0*	*466.7*	*20.3*	*16.7*
Gowrie	*721.0*	*931.5*	*26.7*	*33.5*
*Kologo Tangabisi**				
Biu	*700.0*	*700.0*	*37.0*	*37.0*
Korobognuo	*1,200.0*	*1,200.0*	*55.0*	*45.8*
Nkonya Wurupong	*783.3*	*700.0*	*38.3*	*28.3*
Kpando Torkor	*680.6*	*702.9*	*28.9*	*30.1*

Source: GLOWA field survey, 2001

a This community does not have access to river/stream water

** This community does not use stream water even in the rainy season because they have access to boreholes that are closer to their homes. Moreover, the stream does not flow always and not reliable.*

A t-test (with equal variances) was performed to statistically establish any difference in round trip time allocations accessing water from rivers in the dry and rainy seasons. The results indicate a statistical significance between dry and rainy season water collection times at the 1% significance level where more time is expended in the dry season, with an average of 0.9 hours per carrier compared with 0.7 hours in the rainy season (Table 4). This analysis yields similar results when time expenditure is disaggregated into forest and savannah ecological zones.

Table 4: Test for time differences in dry and rainy seasons

Variable	***Observations***	***Mean***	***Std. Err.***	***Std. Dev.***
Dry season	*245*	*0.8710*	*0.0418*	*0.6549*
Rainy season	*241*	*0.6590*	*0.0393*	*0.6108*

More insight is gleaned when average time allocated to water collection from all available sources is considered against ecological zone season. Time allocations in the rainy season are similar irrespective of the ecological zone. Contrary to expectations, forest zone households devote more time in the dry season collecting water (Table 5) and this difference is statistically significant at the 1% level (but not shown in Table 5).

Table 5: Average time (hours) spent collecting water, by ecology and season

Ecology	*Season*	*Observations*	*Time*	*Water carriers (average)*
Forest	*Rainy*	*189*	*0.57*	*3.08*
	Dry	*189*	*0.98*	
Savannah	*Rainy*	*278*	*0.58*	*2.60*
	Dry	*278*	*0.75*	

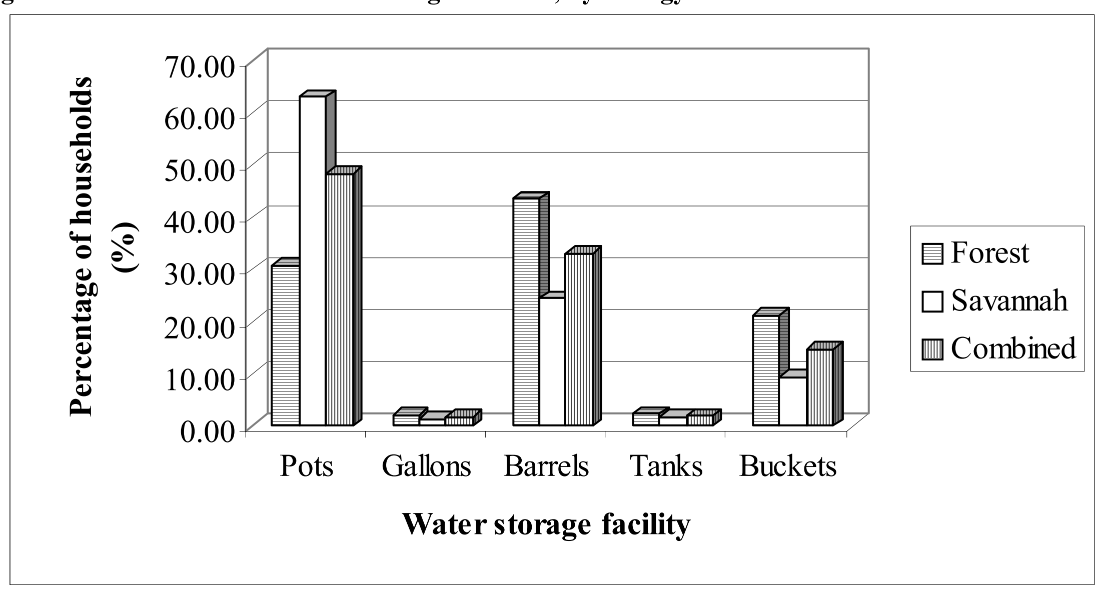
Source: Derived from the GLOWA Volta field survey, 2001

This difference may not be attributed to the number of water carriers as the difference in the average number of water carriers is not statistically different as revealed by a t-test. The issue of differences in household size may not be tenable as the survey revealed larger household sizes for savannah than for forest zone households. a plausible explanation may be the fact that communities in the savannah zones have received intervention by Non Governmental Organisations (NGO's) by providing boreholes in almost every community, thus making accessibility much easier.

3.1.4 Investment and storage in water vessels (reliability and quantity)

Ninety five percent (95%) of respondents in the basin store water in various storage facilities regardless of the source. Prominent sources of water stored are rainwater (54%) and river water (46%). This activity is to enhance water reliability for domestic purposes such as drinking, cooking, sanitation and hygiene. The cistern (pot) is the most important water storage facility used by 48% of households. It is the commonly used facility by 63% of households in the savannah zone while the barrel features prominently in the forest ecology by 44% of households (see Figure 3).

Figure 3: Household water storage facilities, by ecology



Source: Field survey, 2001

Quantities of water stored depend on household characteristics such as household size, sex, number of water carriers, the season, and indirectly depends on amounts needed for domestic chores such as drinking, bathing, cooking and domestic hygiene. The survey revealed that households in the Volta basin on the average use 24.7 litres of water per person per day (l/c/d) in the dry season compared with 30.8 (l/c/d) in the rainy season. These quantities exceed the World Health Organisation (WHO, 1996) estimated amount of 20 litres of safe water per capita per day needed for metabolic, hygienic and domestic purposes.

Although the basis for the WHO standard has been questioned by Rosen and Vincent, (1999), estimates by Gleick (1996) puts this figure at 50 litres per person per day: 25 litres for drinking and sanitation and another 25 litres for bathing and cooking. Going by this latter estimate, quantities of water usage by households in the basin are insufficient irrespective of the season. It is important to note that most of this water comes from traditional or unsafe sources such as from rainwater, rivers, streams, and unprotected wells. The survey indicated an average monthly household water consumption of 7.18m^3 (7180.9 litres) in the rainy season and a slightly less amount of 7.05m^3 (7050.8 litres) is consumed in the dry season.

3.1.5 Water conservation

Another way of coping with water insecurity is through water conservation. At least 55% of respondents intentionally conserve water by compromising on good hygienic practices. For example, 40% use less water for laundry and 34% economize on the desired amount necessary for adult bathing. Water is reused by 8% of respondents all year round. The use of less water for important domestic needs, especially for personal hygiene may be a recipe for water-washed diseases that results in many skin and eyes diseases (Rosen and Vincent, 1999).

3.2 Water coping costs estimations

Household water coping behaviour comes at a cost and these are estimated utilising information from respondents, constituting 95%, who categorically indicated they store water. Such households would make conscious efforts to invest in water storage facilities. However, deriving the implicit costs included all households.

3.2.1 Explicit costs

3.2.1.1 Equipment amortization

Explicit cost is the sum of the initial investment costs of storage facilities and the cost associated with treating water. Five main storage facilities of varying sizes are identified, namely, cisterns (clay pots), gallons, barrels, tanks and buckets. The values of these facilities are amortised, indicating the amount of money that would have been paid by households per month for each storage facility over its economic life. The salvage value of the facility was not considered. A real interest rate of 13% was used. This was based on end of second and third quarter of 2001 average inflation rate of 34% (survey span across these quarters) and a nominal interest rate of 47% for the same period. The real interest rate is then calculated as the nominal interest rate minus the inflation rate. It was assumed that the economic life of these storage facilities equals their expected usage life. To remove the effects of inflation, the real price of the storage facilities was computed by using the consumer price index (CPI) with 1997 as the base year. The average monthly amortization of each facility is shown in Table 6. A household storing water in a barrel, for example, would be paying a monthly fee of ¢52.00 for the next 15 years. On the average, the monthly amortisation for all storage facilities equals ¢51.18.

Table 6: Monthly amortization of storage facility over its estimated economic life

Storage facility	*Average economic life(years)*	*Average monthly amortization of storage facility (¢)*	*Standard deviation (¢)*
Clay pots	*12*	*19.81*	*48.47*
Gallons	*8*	*12.48*	*11.88*
Barrels	*15*	*51.60*	*103.73*
Tanks	*21*	*23.06*	*25.83*

Buckets	*13*	*15.23*	*21.41*

Source: Authors calculation from field data, 2001

3.2.1.2 Costs of water treatment

The cost of chemicals (such as chlorine for purifying water), cost of filters and cost of boiling water constitute water treatment cost. The cost of boiling water is excluded for lack of data. Given an average exchange rate of US $ 1=¢7,176 in 2001 between the US Dollar and the Ghanaian Cedi, the estimated average monthly expenditure on treating water from the sample equals ¢1,749.53 (US$ 0.24). The average monthly explicit cost associated with water insecurity amounts to ¢159.44 (US$ 0.02).

3.2.2 Implicit cost (opportunity cost)

Time lost to water collection activities (opportunity costs) could have been used productively to earn wage income even in rural settings hence time is imputed. The idea is to estimate the value of the time that water carriers, who are usually women and children, could have potentially earned. Valuation of this time using an appropriate wage rate represents implicit costs indirectly associated with water collection.

3.2.2.1 Determination of an appropriate wage rate

This study draws on the employment data of the Ghana Living Standards Survey fourth round (GLSS4) conducted in 1998/99 to compute an appropriate wage rate for these communities. Over 70% of the economically active population (age 15 and above) in rural Ghana are employed in the agricultural sector (GSS, 2000) hence the use of rural agricultural wages for this computation. The average basic hourly wage in 1999 was ¢381 for women and ¢598 for men while the daily minimum wage was set at ¢2,900. The daily minimum wage increased to ¢5,500 in 2001, representing an annual growth rate of 37.7%, which was then used to adjust for the women hourly wage, resulting in a value of ¢722.53 (US$0.1) for the year 2001. This value represents an opportunity cost of ¢722.53 per hour. With an average of 0.6 hours per carrier per day collecting water in the rainy season gives an average opportunity cost of ¢419.0 (US$0.06) per day. The equivalent values for the dry season are 0.9 hours per day for a water carrier with an average opportunity cost of ¢614.0 (US$0.09) per day.

3.2.3 Implicit cost scenarios

3.2.3.1 Households collect water 5 days per week

The two scenarios that follow assume 1 round trip per water carrier. The results are similar but with significantly higher values associated with dry season water collection. Given that households collect water 20 days in a month (that is, 5 days per week) gives an average opportunity cost of ¢8,388.52 (US$1.17) per month in the rainy season and ¢12,279.19 (US$1.71) per month in the dry season. Estimates of household water usage in the Volta basin indicate an average monthly water consumption of 7.18m^3 and 7.05m^3 in the rainy and dry seasons respectively. These levels of water consumption are equivalent to monthly wage losses valued at US$1.17 and US$1.71 respectively. Thus, in the rainy season, households on the average pay $0.16/$m^3$/month for water consumption whilst this increases to $0.24/$m^3$/month in the dry season.

3.2.3.2 Households collect water 7 days per week

An average monthly opportunity cost of ¢12,582.78 (US$1.75) is expended in the rainy season and ¢18,418.79 (US$2.57) in the dry season assuming households collect water on a daily basis. The average monthly water consumptions imply monthly wage losses valued at US$1.75 and US$2.57 respectively. Households on the average thus pay US$0.25/$m^3$/month in the rainy season whilst it amounts to US$0.37/$m^3$/month in the dry season.

When the number of water carriers is considered and still assuming one return trip on a daily basis, the monthly opportunity cost increase substantially. This gives a cost of ¢36,566.23 (US$5.09) in the rainy season, equivalent to US$0.71/$m^3$/month. In the dry season, this amounts to ¢55,328.89 (US$7.72) or

US$1.09/ m^3/month for consuming water. One can imagine the costs for making 2 return trips in the dry season. Comparing these estimates to US$0.33/$m^3$/month, the current average tariff for potable water delivered to urban (domestic) areas including the city of Accra (Kariuki and Acolor, 2000) suggests that rural households are paying at least twice the tariff that urban households pay and even exceeds the estimated economic tariff of ¢1.750/ m^3 or US$0.63/$m^3$ that will achieve full cost recovery by the utility companies or ensure viability in the urban water sector (London Economics, 1999).

3.2.4 Coping costs

Coping cost estimations are based on of coping is based on varies substantially between seasons. Coping costs on a monthly basis in the rainy season equals ¢34,595 (US$4.82), which is equivalent to paying an average tariff of US$0.68/$m^3$ of water. This tariff increases to US$1.04/$m^3$ in the dry season, which is equivalent to monthly coping cost of ¢52,670 (US$7.35). Again, these estimated costs of water insecurity exceed the current tariff rate and the estimated full cost recovery tariff. Going by these conservative estimates, rural households without piped connections and collect water from distant sources pay more for water than urban consumers. This suggests that poor rural consumers may have the ability to pay for potable water. Their willingness to pay for this service is a completely different issue that requires further investigation. Nevertheless, studies by Singh *et al*. (1991) in India and Atlaf (1994) in Pakistan indicate that consumers are willing to pay substantial amounts for improved water supply when service is reliable.

4. Conclusions and Policy Implications

By employing revealed preference data, this paper has examined the extent to which households in the Ghanaian Volta basin cope financially with water insecurity and the survival strategies and mechanisms adopted to cope with this perennial problem. Much time is allocated on a daily basis to source water usually unsafe in quality. Contrary to expectations, households in the forest ecology devote more time collecting water from all available sources in the dry season compared to savannah zone households. There is therefore the need to increase the number of improved water sources especially in the forest ecology to save time. Time saved by locating potable water within few metres radius from households has the potential of increasing household welfare if that time saved is invested productively, either by channelling into agricultural activities or even for leisure.

Conservative estimates of costs involved in coping with water insecurity suggest that rural households are already paying high rates per unit of water consumed. This indirectly demonstrates the ability to pay for improved water delivery. The average monthly household water coping cost or tariff is US$0.68/$m^3$ (rainy season) and US$1.04/$m^3$ (dry season). Estimates of coping costs could serve as a proxy for the price of water in situations where the price of water in communities shows no variations or are non-existent. These costs far exceed both the Ghana Water Company Limited (GWCL) current domestic tariff of US$0.33/$m^3$/month in urban areas and its estimated full cost recovery tariff of US$0.63/$m^3$. The often stated assertion that poor rural households do not have the ability to pay for potable water delivery is not affirmed by this study when opportunities costs are considered. As the possibility exists that rural households may be unwilling to pay for quality water that ultimately would enhance their health status and agricultural productivity, rural households may require informal education to bring about changes in their attitudes and perceptions towards such laudable efforts by governments to supply potable water at a cost. Their unwillingness to pay may be partly due to ignorance or placing less importance on the value of time.

Acknowledgements

This research was fully funded by the Federal Ministry of Education and Research (BMBF) and the Ministry for Schools, Science and Research of North Rhine-Westphalia of Germany and formed part of the GLOWA-Volta project that aims at analysing the physical and socio-economic determinants of the hydrological cycle to develop a scientifically sound decision support system for the assessment, sustainable use and development of water resources in the Volta Basin. The project is based at the Centre for Development Research (ZEF), University of Bonn, Germany.

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