

When water is scarce: the perception of water quality and effects on the vulnerable

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ABSTRACT

The world has over 1 billion people without access to safe drinking water and it is expected that the number of people living in water-stressed or water-scarce places will increase to 3.4 billion by 2025 and one cannot ignore the effect such a situation will have on the vulnerable groups. The current study among other things examines household water insecurity and assesses its impact on vulnerable groups especially women and children in Dungu, a rural community in the northern region of Ghana. Relying on 125 respondents sampled, the findings show that the main source of drinking water in the community, a dam, fails to fulfil the household water security situation with respect to quantity, quality, reliability and accessibility. Because of the unwholesome nature of the water, the majority of the respondents treat water by using cloth filtering, boiling and the use of alum. Contentiously, the insecurity of water in the community has numerous negative effects ranging from health to economic effects on women and children who have to walk for 2 km in search of water and this could be reduced with the availability of a good quality water source close to home.

Key words | Ghana, household, vulnerable, water insecurity, water management

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INTRODUCTION

Water is a very important resource needed to sustain life, and safe drinking water is a fundamental requirement for human life (UNCHR *et al.* 2010). According to Ariyabandu (1999), easy accessibility, reliability and timely availability of adequate safe water to satisfy basic human needs ensures water security (Asare 2004). Safe drinking water for human consumption, according to the World Health Organization (2006), should be free from pathogenic bacteria, viruses and parasites, chemical and radiological hazards, and it must also be acceptable in appearance, taste and odour.

As of the end of 2011, 89% of the world population used an improved drinking water source (WHO/UNICEF JMP 2013) as against the 1.1 billion people without access to safe drinking water in 2002 (WHO 2005). Despite this achievement, about 768 million people, including 185 million people who relied on surface water to meet their daily drinking water needs, did not use an improved source (WHO/UNICEF JMP 2013).

According to the UN, the number of people living in countries defined as water-stressed or water-scarce (a situation where available water is unable to meet the demand for specific purposes) is expected to increase from the 2005 figure of over a billion to 3.4 billion people by 2025 (UN 2005). In Africa it is estimated that 300 million out of the 800 million people on the continent live in a water-scarce environment (Donkor 2006). This situation can be attributed to a number of reasons such as infrastructural problems (Newman 2008), high population and urbanization (Roudi-Fahimi *et al.* 2002), 'land grabbing' – a situation where countries in sub-Saharan Africa and foreign companies enter into a deal involving the sale of rights to inland water resources (Freitas 2013) – and the rising global temperature that accompanies climate change which ultimately has affected Africa's water situation through changes in the frequency and distribution of rainfall, drying-up of rivers and receding of water bodies, among others (Urama & Ozor 2010).

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The quantity of water collected and used by households has an important influence on health; WHO has noted that a person needs between 50 and 100 litres of water per day to meet basic needs (UNCHR *et al.* 2010). The inadequacy of rural water supply and sanitation coverage has been recognized as a major contributor to human disease and malnutrition in many developing countries including Ghana. For example, diseases like cholera, typhoid, river blindness, hepatitis, shigellosis and malaria are either water-borne or water-related (Asare 2004) and the International Fact-Finding Mission on Water Sector Reform in Ghana (IFFM) (2002) has estimated that about 70% of diseases in Ghana are the result of inadequate rural water supply and sanitation coverage (Asare 2004).

Thus, living in an area where potable water is lacking comes with a lot of consequences including the reliance on other water sources that may even be (perceived as) harmful to the users. In some cases, communities receive the services of authorized bodies that test the water quality of their alternative water sources and proffer advice on how to render the water suitable for human consumption. Other communities that may not be so lucky in having such tests done for them would, based on their own perceptions, devise strategies for dealing with the harmful nature of the water. As a result studies need to be carried out to reveal how households who perceive their water to be unwholesome deal with that. Again the effects of scarce water are likely to be severe on women and children who attend to water issues in households due to their vulnerability, especially in developing countries. Studies that would reveal such effects are therefore imperative. However, studies that have looked at these issues compared with general studies on water scarcity can be said to be limited. As a result, the present study is carried out in a rural community (Dungu) in Ghana to investigate the implications of household water insecurity on women and children and to identify the perceptions of water quality among households and how they deal with such water. The study area, Dungu, is a rural community in the Tamale Metropolitan of the Northern Region of Ghana and it faces the two main climatic seasons in Ghana, namely the rainy and dry seasons. The rainy season is associated with high humidity, slight sunshine with heavy thunder storms, while the dry season is characterized by

dry *harmattan* winds from November to February and high sunshine from March to May. With a population of 1,769, consisting of 771 males and 998 females, Dungu is one of the water-scarce areas in the region with a dam as the major source of water. The only standpipe in the area has not been functional for some time. The common reason offered to explain this by the appropriate authorities is that the Dungu community is situated on high land, so when the water is pumped from the treatment plant, it does not get there. The residents therefore refer to the non-functional standpipe as a waste and for that matter a 'stick'. The women here are engaged in petty trading while the men are mostly farmers. The commonest crops produced by these peasant farmers during the rainy season are yam, maize, millet and groundnut, which they consume, selling the surplus to meet other basic needs.

Studies on the state of water supply in Ghana have been carried out with varying foci. For instance Tayeh *et al.* (1993) looked at drinking water sources and water-related diseases such as Guinea worm. Asante (2003) inspected the socio-economic aspects of access to safe drinking water (Nketiah-Amponsah *et al.* 2009). Again, Akumiah & Rydhagen (2007) examined the relationship between water management and health, and how effective water management through full community participation could help provide adequate safe drinking water, while Arku & Arku (2010) discussed how drought affects the livelihoods of agro-based rural communities in the Volta Region of Ghana, and the survival strategies of rural women and men during drought periods. Again, a few studies such as Addo (2010) illustrated the effects of inadequate water supply on the female child; Arku & Arku (2010) shed light on the effect of drought on women; and Doe (2007) revealed how water crises affect both women and children. A series of studies by WASHCost Ghana (2012) looked into the cost of water and sanitation services.

Household water security in this study is measured by four key dimensions, namely: accessibility, reliability, sufficient quantity and acceptable quality. A water supply facility is said to be accessible if it is cited within a reasonable distance and is without exclusion on grounds of gender, religion, disability or other cause (WaterAid 2012). The distance travelled to fetch water was used as a proxy for measuring water accessibility, and the recommended reasonable distance according to the WHO is 200 metres

(0.2 km). A sufficient quantity of water is necessary to meet the basic needs of humans and to measure this the WHO's recommended average quantity of 20 litres per person per day was used as a measure for the acceptable quantity of water for domestic use. The quality of water is an important indicator of household water security because households cannot be secured from water-borne and water-related disease when the quality is bad. Good quality water among other things must be acceptable to consumers in appearance, taste and odour (WHO 2006). Hence, consumers' perceptions about the appearance, taste and odour of their water source were used as a proxy for water quality. Water supply must be available at all times and of sufficient quantity and acceptable quality all year round in order to provide reliable access. Availability of safe water all year around of adequate quantity and quality was used as a proxy for reliability.

METHODOLOGY

Sampling technique and data collection

The study area, Dungu, was purposively selected for this study based on the fact that it is one of the communities in the northern region with the least access to an improved water supply. This is so because the Dungu dam is their only source of drinking water; it is unreliable and women and children have to travel about 2 km to access the dam. The unplanned nature of settlements and the absence of household sample frames for the selected community precluded the use of any random means of selecting the participating households. Faced with this situation, the convenience sampling approach was used to select the 125 households. Guided by the objectives of the study, a semi-structured questionnaire consisting of both closed and open-ended questions was used in the collection of data from the 125 sampled respondents. The questionnaire was divided into three sections. The first section collected data on the respondent's background, while the second section addressed the water security (thus accessibility, reliability, quantity and quality) situation at the household level as provided by the respondents, which was compared with international recommended standards. The third section

aimed at examining the impacts of household water security on women and children.

A focus group discussion consisting of 12 volunteers made up of five males and seven females was conducted to get a better understanding of how people discuss the water issue as members of a group rather than as individuals. The researchers, with the help of an interpreter and three research assistants, administered the questionnaires from June 2012 to July 2012. Because the questionnaires were written in English, there was a need to interpret in the local language, Dagbani, for those who could not read and write to solicit the needed information from them. Their responses were translated into English appropriately.

Data from the close-ended questionnaire were transformed for analysis by coding them using the Statistical Package for Social Sciences (SPSS) version 16.0. Respondents' backgrounds, pattern of water usage and perception of water quality were analysed through frequencies and percentage distributions. Their perceptions on satisfaction with water quality were probed by using five questions: one on taste, one on odour, two on appearance and one on potential ill-effects of drinking the water. The response to the five questions were coded as 1 = yes and 0 = no. A univariate statistical analysis was also done by using the Pearson correlation to test the strength of relationships between water use and socioeconomic variables (sex coded as 1 = male, 0 = female; age measured in years; household size measured by number of persons per household; and monthly household income measured in Ghana cedis). The effect of water shortage on women and children was ascertained through their response to open-ended questions which were entered into SPSS as string variables.

RESULTS AND DISCUSSION

Demographics

Out of the 125 respondents interviewed, 88.8% and 11.2% were females and males, respectively. The majority of the respondents (56.0%) were aged 26–35 years, followed by those aged 16–25 years at 28.0%. Those aged 36–45 years followed at 12.8% with the 46–55 age group at 4.0%. The level of educational attainment in the Dungu community

seems to be low as 80% of respondents were without formal education, followed by those who have had primary education (12%) and those with secondary/technical/vocational and tertiary education at 4% each. The data further show a slight bias against female education (Table 1). Though not shown in the table, a high number of the respondents (86%) without any form of formal education were females.

The commonest occupation was trading, providing a source of livelihood to 36% of the respondents, followed by shea butter production (28.8%) and farming (15.2%). Four per cent were students and masons and 11% were unemployed (Table 1). Many people are engaged in trading instead of farming as is the general case in rural Ghana due to the land tenure problem and lack of farmland resulting from the keen competition from industry, housing and road construction for land use in the area. Farming in rural Ghana is mainly rain-fed with virtually no serious

irrigation practices to balance crop-water availability. It is associated with a lot of environmental to market challenges and such situations make farming unattractive to a number of people, especially the youth, which may be the reason why low numbers of people move into farming.

Water security at the household level

Water sources, quantities consumed and accessibility

From the focus group discussion, it was revealed that the Dungu dam was the main source of water available to the people. They do, however, have alternative sources from a dam and pipe-borne water at the nearby communities of Datoyili and Sawaba, respectively, although they have to walk for 2.5 km to access them. During the rainy season they also take advantage of the rainwater for domestic activities. The WHO/UNICEF Joint Monitoring Programme for Water Supply & Sanitation (JMP) (2010) classifies sources of water supplies as either safe or unsafe. Standpipes, boreholes, protected dug wells, rainwater collection and protected springs by the use of a pipe system are examples of safe water sources while unprotected wells, unprotected springs, rivers, dams and water from tanker trucks are examples of unsafe water sources. This implies that the main source of water for the Dungu community is from an unsafe water source and hence poses a health risk to the consumers. More so, based on what Howard & Bartram (2003) have pointed to in the literature, the health of the entire Dungu community may be at risk since they journey for more than 1,000 m or for more than 30 minutes to fetch water.

Average daily household water consumption in the study area was 297.6 litres per day and an average of 9.7 litres per person per day (l/p/d) was used. This means that the average per capita water use in the study area is far below the Ghana water service norms of 20–40 litres/person/day for basic service and the WHO's recommended level of household use of 20 litres/person/day. One can conclude that per capita water use in Dungu is too low to maintain the level of personal and domestic hygiene needed for good health. Thus, as shown by some studies (see Howard & Bartram 2003), the quantity of water collected in such cases is often less than 5 litres per person

Table 1 | Demography of respondents

Variable	Percentage (%)
Number of respondents	125
Sex	
Male	88.8
Female	11.2
Age (years)	
16–25	28.0
26–35	56.0
36–45	12.0
46–55	4.0
Educational level	
No formal education	80.0
Primary	12.0
Junior high school	4.0
SHS/Technical/Vocational	4.0
Occupation	
Shea butter making	29.6
Petty trader	36.0
Student	4.0
Unemployed	11.2
Farmer	15.2
Mason	4.0

per day, an amount which is inadequate for good hygiene practices (UNICEF & WHO JMP 2011).

Through the focus group discussions, it was discovered that the distance from their homes to the dam of approximately 2 km was not only too far but also when it rains the path leading to the dam becomes slippery which is also dangerous to their health. Apart from the long distance covered by the inhabitants to get potable drinking water from Sawaba and Datoyili, they also pay GH¢0.10 (US \$0.05) and GH¢0.20 (US\$0.10) per jerry can and locally made bucket, called *Gariwa*, respectively. WHO defines the term reasonable access to a water source as the 'availability of at least 20 litres per person per day (L/capita-day) from a source within one kilometer of the user's dwelling' (WHO 2000) and Ghana water service norms requires the distance to be 500 m or less. The low per capita daily water used and the longer distance travelled in the study area is an indication of low level accessibility to safe water.

Reliability of water supply

Having identified the sources of water and the quantities consumed the study sought to find out the reliability of the water sources available to the community. From the group discussion, it was revealed that the dam may not be a reliable source of water to the community because it dries up two months into the dry season in November and remains in that state until the rains start in June. Again, the water they source from the rain water obviously is not

reliable as this is subject to the vagaries of the weather. A source of water needs to work for 95% of the time to be regarded as reliable according to Ghana water service norms; therefore the dam can also be deemed as unreliable.

Water usage patterns and storage

The respondents made little or no separation of water source for usage purpose. Meaning that water in Dungu, without due regard to the source, is used for drinking, cooking, washing/cleaning, bathing/personal hygiene and other economic activities, particularly shea butter preparation. Households on a weekly basis used most water for washing/cleaning (35.4%), 27% for bathing/personal hygiene and 22.6% for cooking (Table 2). Fifteen per cent of the total water collected was used for drinking weekly and this relatively high percentage can be attributed to the arid nature of the region in which Dungu is located. The strength of the relationship between water use and the age, sex and monthly household income was tested using Pearson correlation analysis and the result showed strong positive coefficients of correlation between daily per capita water use and household size and household income of 0.886 and 0.847, respectively, at 1% level of significance but was insignificant for the other variables (Table 3).

Due the problem of water supply in the community the people are forced to store some of their water to enhance continuous water availability. Four main storage facilities of varying sizes were identified and these were clay pots, *gariwa*, jerry cans and barrels. The clay pot is generally the most important water storage facility used by 81% of households in the study area. This confirms findings by Sobsey (2002), that communities in Africa use traditional African clay pots to store their water. A safe household water storage container for drinking purposes must have some desirable properties as recommended by the Centers for Disease Control and Prevention (CDC) and the Pan American Health Organization (PAHO). Mintz *et al.* (1995) mentioned the

Table 2 | Pattern of water usage

Purpose	Percentage
Cooking	22.6
Drinking	15.0
Washing/Cleaning	35.4
Bathing/Personal hygiene	27.0

Table 3 | Correlation between daily per capita water use and socioeconomic variables

Socioeconomic variables		Sex	Household size	Age	Income
Daily per capita water use	Pearson correlation	- 0.091	0.886 ^a	- 0.016	0.847 ^a

^aStatistically significant at 1%.

CDC and the PAHO recommended qualities that a water storage vessel should have. The recommendations include that the vessel should: (a) be made of translucent high-density polythene plastic or similar material that inter alia is produced locally; (b) hold an appropriate standard volume, have a stable base and sturdy and comfortable handle for easy carriage; (c) have a single opening 5 to 8 cm in diameter; (d) have a non-rusting, durable, cleanable spigot for extracting water; and (e) allow air to enter as water is extracted. However the storage containers used in the community when shown to the researchers by the respondents were observed to fall short of the criteria for water storage facilities as recommended by the CDC and the PAHO.

Perceptions of water quality and treatment

The perception by households of water quality is important in determining households' health, production and water treatment decisions. Water intended for human consumption should be both safe and wholesome. For this study, no analysis or measurement of water was performed; however, the perception of the respondents was used to determine the quality of water. Respondents were asked their opinion on the quality of their main source of drinking water. The majority of the respondents (96.5%) expressed dissatisfaction with the quality of their main source of water (the dam). To examine their perceptions about the factors that are likely to influence households' dissatisfaction with the quality of water, the respondents were asked questions on their satisfaction with the taste, odour and appearance of their main source of water. In response, households expressed much water insecurity with the presence of particles (95%), taste (98%), odour (89.5%), colour of water (97%) and fear of infection (99%). The result from the study suggests that the major source of water in the study area, the dam, is perceived as unsafe and unwholesome by the respondents. According to the respondents the dam water is very turbid, has an unpleasant taste and does not have the clear crystalline colour associated with clean water. The result is similar to that of *Obi et al. (2002)*, who conducted a study in the Venda communities in the Vhembe district of South Africa and revealed that the water from selected rivers in Venda was contaminated, thus rendering them poor, unsafe and unacceptable for human consumption.

Because of the unwholesome nature of the water, the majority of the respondents (98%) treated water by using cloth filtering (84.7%), boiling (14.3%) and the use of alum (1%) (*Table 4*) and this treatment activity is normally done by the women. The widely used method of removing particles and some microorganisms from water samples is filtration (*Sobsey 2002*) and the types of filters used for household water treatment in developing countries reduce turbidity by 90% and bacteria by 60% according to *Clasen & Bastable (2003)*. Alum is a flocculating product or inorganic coagulant used for removing turbidity of water supplies (*Divakaran & Pillai 2001; Jain 2010*) and this was used by only 1% of respondents who treated their water. The possible assigned reason why the use of a chemical (alum) was the least preferred treatment was that the community does not have the requisite skill and knowledge to use it. Also, none of the households reported using solar disinfection and ceramic filters because they said they do not know how the method works and there is a problem of accessibility.

Impacts of household water insecurity on women and children

Lack of clean water is likely to have dire consequences on one's education, employment, physical strength and health as well as on the development of society. When asked to give the consequential effects of lack of safe water, 96% of the respondents said that the situation has negative impacts on women and children in the community.

On the impact of children they mentioned that:

- they are either late or absent from school, the effect of which may be that they drop out
- they risk their lives when crossing the roads to fetch water
- they also suffer from water-borne diseases such as dysentery, diarrhoea and typhoid.

Table 4 | Household water treatment methods

Treatment methods	Percentage
Cloth filtering	84.7
Boiling	14.3
Use of alum	1.0

On women, they mentioned the following as some of the effects of water shortage:

- as caregivers of the household, when children get typhoid, dysentery or diarrhoea a heavy burden is put on them
- loss of time in search of water and treatment of water affects their economic activities
- increase in women's poverty in the area for the above reasons
- there are cases of women slipping and hurting themselves along the path leading to the dam during the rainy season
- stress on their health.

CONCLUSION

The paper has shown that Dungu, a rural community in the Tamale metropolis of northern Ghana, is facing a lot of challenges in accessing safe water. The source of water in the community compared with both national norms and WHO guidelines can be considered as inadequate, unreliable and inaccessible. The absence of water increases the burden on women and children as they have to walk long distances to access water which is normally unsafe in their own estimation. These women and children are deprived of the right to live a happy life as they spend most of the time fetching water. They either wait in long queues for safe water or walk long distances to access unsafe water which causes water-borne diseases. The availability of a good quality water source close to home will offer numerous benefits: improved female and child health, increased dignity, and reduced exposure to both gender-related hazards and water-borne diseases. It will also enhance school attendance and academic performance of children.

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