UNIVERSITY OF CAPE COAST

HOUSEHOLDS' CHOICE OF WATER SOURCES FOR DOMESTIC CONSUMPTION IN THE SHAI OSUDOKU DISTRICT, GHANA.

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BY

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Thesis submitted to the Department of Geography and Regional Planning of the Faculty of Social Science, College of Humanities and Legal Studies, University of Cape Coast, in partial fulfillment of the requirements for the award of Master of Philosophy degree in Geography

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DECLARATION

Candidate's Declaration

I hereby declare that this thesis is the result of my own original research and that no part of it has been presented for another degree in this university or elsewhere.

Candidate's Signature: ..... Date: .....

Name: Pearl Vormawor

Supervisors' Declaration

We hereby declare that the preparation and presentation of the thesis were supervised in accordance with the guidelines on supervision of thesis laid down by the University of Cape Coast.

Principal Supervisor's Name: Dr. Jones Abrefa Danquah

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ABSTRACT

The availability of numerous sources of water for consumption makes it imperative to understand the factors that influences the choice of water sources. This study seeks to determine households' choice of water sources for domestic consumption in Dodowa and Doryumu in Shai-Osudoku, District. The study adopted the systematic and stratified sapling procedures. A sample of 300 households, 4 series of six-member focus group discussion and 5 key informants were engaged in the study. The study employed logistic regression and multinomial regression models and Water Poverty Index in the analyses. The results revealed that for domestic water consumption, households focus on factors such as quality, availability, affordability and accessibility to water sources. The study found that age, educational level and households' daily expenditure are significant and positively related to the choice of improved water sources. In addition, married couples are less likely to use boreholes and tanker services. However, dependency ratio is negatively related to tanker services and positively associated with the use of rain water. Upper Dodowa is the most water stressed community with the highest water poverty index (0.053 $minsl^{-1}$). Pipe-borne water is the preferred domestic source. However, relatively large number of households cannot afford to pay for the cost of connection. The study recommends that the Ministry of Sanitation and Water Resources should collaborate with the Ghana Water Company Limited and the District Assembly to come out with some kind of subsidy package to enable households connect water directly to their homes. Further economic valuation of willingness to pay for water supply infrastructure will facilitate the estimation of realistic subsidies to improve access to water within the case study communities.

KEY WORDS

Access

Choice

Dodowa

Domestic Consumption

Doryumu

Water Sources

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DEDICATION

To my Family and Friends

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LIST OF ABBREVIATIONS

CBOs	Community Based Organizations
CWSA	Community Water and Sanitation Agency
EPA	Environmental Protection Agency
FGD	Focus Group Discussion
GLSS	Ghana Living Standards Survey
GSS	Ghana Statistical Service
GWCL	Ghana Water Company Limited
GWSC	Ghana Water and Sewage Cooperation
IDI	In-Depth Interview
IWRM	Integrated Water Resources Management
MDGs	Millennium Development Goals
MNL	Multinomial Logit Model
MSWR	Ministry of Sanitation and Water Resources
NCWSP	National Community Water and Sanitation Programme
NDPC	National Development Planning Commission
NGOs	Non-Governmental Organizations
PURC	Public Utilities Regulatory Commission
SDGs	Sustainable Development Goals
SPSS	Statistical Product for Service Solution
UNDP	United Nations Development Programme
UNICEF	United Nations International Children Emergency Fund
UN-Habitat	United Nations Human Settlement Program

UNWWR	Unitred Nation World Water Report
WHO	World Health Organization
WPI	Water Poverty Index
WPIWQ	Willingness to pay for improved water quality
WPIWQS	Willingness to pay for improved water quantity supply
WRC	Water Resources Commission
WTP	Willing to Pay
WWDR	World Water Development Report

CHAPTER ONE

INTRODUCTION

Background to the Study

Water serves as one of the fundamental necessities for human life; it can be considered the second most important natural resource after oxygen thus making it important and crucial for human survival (Aulenbach, 1968). According to Simmons (1991), water is the most shared compound on earth, very important for life and has become intertwined with human livelihoods in many complex ways. The importance of water can never be exaggerated since its usage covers every facet of human endeavor, spanning from domestic use through industrial to agricultural purposes. On this account, water resources have major impacts on our social, economic, and environmental wellbeing due to the growing pressure on it.

Notwithstanding the fact that water resources are in abundance, it is unevenly distributed on earth resulting in water scarcity in some parts of the earth. According to Watkins (2006), today's water crisis is not only an issue of scarcity, but also that of accessibility. Available fresh water is also reducing by quantity and quality due to human development processes such as construction projects in water ways and pollution by industrial waste. Thus, the earth faces multiple pressures since human use of water, which is already high and is expected to increase further (Gleick., 2014). According to Hoekstra (2006), water scarcity and lack of access to water supply and sanitation threaten socio-economic development and national

security for countries around the world. The most affected are people in the developing countries, with a greater majority being women and children.

Most people in Ghana especially the urban poor and rural population do not have access to clean water despite the fact that rainfall is not scarce and several rivers never cease to flow (Yussif, 2012). Water supply shortages and quality deterioration are among the problems which require greater attention and action. Various strategies like the provision of boreholes for rural and urban poor by various NGO's and cooperate bodies have been developed to make water accessible to all inhabitants. However, due to insufficient structures coupled with rapid population growth and lack of funds, the gap between demand and supply of water continues to widen (Doe, 2007).

Although Doe cites the huge gap in the proportion of people who have access to water on the global scale, the fate of urban dwellers in Ghana significantly differs from that of those in the rural areas. According to Odonkor (2017), in Ghana, more than half of the population in urban areas have access to potable water, however, dependency on unsafe water sources is higher in rural areas. The drinking of contaminated water results in diarrheal disease which is one of the most commonly reported illness at health facilities across the country and 25% of all deaths in children under the age of five are attributed to diarrhea (United Nations International Children's Emergency Fund, 2012).

To fully benefit from an improved water supply, a household must have indoor access to safe and reliable water sources. While this is almost always found in developed countries, such access is far from a reality in developing countries. In

such developing countries, improved water facilities are often underutilized or abandoned while households choose to continue the use of traditional water sources (Engel, Iskandarani & del Pilar Useche, 2005).

The decision to use a particular water source is influenced by a multiplicity of factors. Studies by Adjakloe (2014), Mahama, Anaman and Osei-Akoto,(2014), Nketiah-Amponsah, Woedem and Senadza (2009) and Sandiford, Gorter, Orozco, and Pauw, (1990) have shown that the choice of water for domestic use is not only dependent on the availability of a particular water source though that is a major factor, but on socio-economic and geographical factors such as income levels, level of education, location and distance to water source, preferences, knowledge, and perceptions about the quality of water as well as the culture of the people just to mention a few. All these factors in one way or the other influence the choice of water source for domestic purposes.

According to Sandiford et al, (1990), there is a positive relationship between wealth and water use. This presupposes that poverty has a negative effect on water use. They also assert that the location of a source of water has a direct relationship with the choice and use of water. This suggests that the farther away a source is located from the house, a household will enjoy less of such water fir its daily usage. They also opined that education has a significant bearing on the use of water. It is expected that as the level of education increases among household members, the level of household awareness about the health benefits of water use also increases.

Increasing the proportion of people with access to potable water and sanitation will require an increase in the degree of empowerment, participation, and

social mobilization of the world's poorest. Water usually flows upstream to the rich and powerful all over the world. The challenge is in ensuring equity in access to, and finding means to channel water supply to, those who are at the bottom of the financial and social power ladder.

Statement of the Problem

The impacts of today's global water crisis on health and the economy are very severe. According to the World Health Organization, more than 3.4 million people die each year from water, sanitation, and hygiene-related causes. As at 2015, an estimated 663 million people still lack access to improved drinking water sources (WHO & UNICEF, 2015).

Ghana like many nations in Africa and the world at large aim at ensuring access to potable water to her citizens as a means of attaining the Sustainable Development Goals (SDGs) of achieving universal and equitable access to safe and affordable drinking water for all by 2030 (NDPC, 2015). Ghana made significant progress in meeting her Millennium Development Goals (MDGs) targets. The proportion of households with access to improved water sources rose from 67 percent in 1993 to 84 percent in 2008. However, 2010 and 2013 recorded a marginal decrease in access which stood at 81.6 and 76 percent respectively (NDPC). Despite the fact that Ghana was able to meet the MDG target in increasing access to improved water source, there continues to be a steady decline in this progress and this calls for the need to ensure that water is evenly distributed and can be afforded by all (Awuah, Nyarko, Owusu & Osei-Bonsu, 2009).

As a country, Ghana has plentiful natural water resources and in relative African terms is considered well off but a large chunk of its population still does not have access to clean water (Hooker, 2008) especially within their homes. Across all the regions of Ghana especially the capital city Accra, one of the most common sights one will notice is people carrying water in yellow plastic gallons popularly referred as the "*Kufuor gallons*". But above all, the burden of collecting water usually falls on the shoulders of women and young girls who spend several hours a day collecting water. The Human Development Report (2015) stipulates that, women in Africa alone spend an average of 200 million hours a day collecting water.

Access to piped water has been a significant factor in health improvements in most developing regions (UN-Habitat, 2009). Most of the localities in the Greater Accra Region depend on rivers, streams and canals for their water supplies and though this region hosts the capital city of the country, it is no exception when it comes to issues surrounding access to water for domestic consumption (Adjakloe, 2014). The unequal distribution of facilities, increasing population resulting in competition between industrial and domestic water demands, has resulted in many communities in this region without adequate supply of water to their homes of which the Shai-Osudoku District is no exception.

With the recent completion of the Kpong water expansion project in Dodowa (see Appendix E), one would think that all areas in the district would receive constant and equitable water supply. Output of Appendix E was obtained during the field observation by the use of a camera. However, this is not the case,

water from this extension project is mainly supplied to Adenta and other communities. Dodowa and Doryumu are still faced with irregular supply of pipe-borne water, therefore these communities might resort to other means of getting water for consumption. Understanding the situation in these communities will provide room for better understanding of the situation in other parts of the district.

Objectives of the Study

The main objective of the study is to investigate the factors influencing the choice of water sources for domestic consumption in Dodowa and Doryumu in the Shai Osudoku District.

Specifically, the study seeks to;

1) Identify the types of water sources available to households in the communities.
2) Assess households' preferred water sources for domestic consumption.
3) Examine households' willingness to pay for improved water supply
4) Estimate water poverty indices in the communities for informed policy formulation.

Research Questions

The study seeks to answer questions such as;

1) What are the types of water sources available to households in the community?
2) What are the households' preferred water sources for domestic consumption?

3) Are households willing to pay for improved potable water supply?

4) How acute is water poverty and level of variability amongst households?

Significance of the Study

This study contributes to the growth of knowledge on the major determinants of households' choice of water source for domestic consumption in the study area. The outcomes of the study will be important in realizing the role of different socio-economic variables and geographical factors that influence water choices among households which must be considered by policy makers for the planning and implementation of water projects in order to assure the acceptability and maintenance of improved systems.

This study will also shed light on the challenges facing the communities in accessing safe, reliable and affordable water sources. The study will also help determine water poverty index for both communities which can be a very important tool that can be employed by policy makers in the planning and implementation of water project for the district.

Finally, this study will add to literature on access to water and choices of water, as well as literature of the study area and may serve as the base for future research.

Scope of the Study

The supply of water to households' hinges on a number of physical, social and economic factors such as geology, temperature, rainfall, land use pattern, level of education, family size, type of household, available water institutions and income levels among others. The scope of this study is however restricted to understanding the determinants of household choices of water supply or sources in the Shai-Osudoku district in Ghana. Also, the district will be divided into rural and urban communities to enable better understanding of the choice of water supply source in relation to the geographical location as well as highlight the disparities among the households within the various communities in the district.

Limitation of the study

Water usually moves hand in hand with sanitation and for the study choosing to completely ignore the relationship between water and sanitation is a setback to the research. It will be interesting to identify the health implications of the choices of water source people use.

Organization of the Study

The study is organized into five chapters. Chapter One is the introductory chapter, including the statement of the problem, objectives of the study, research questions guiding the study and the significance of the study. The second chapter deals with the review of some relevant literature as well as discussion of the

theoretical and conceptual framework underlying the study and the definition of concepts as used in the study.

Chapter Three examines the research methods employed for the study. It covers the study design, target population and sampling procedure, research instrument and data collection procedure, sources of data and data processing and analysis. Chapter Four deals with the analysis of the collected data and discussion of the findings. The last chapter contains the summary and conclusion of the findings as well as some recommendations

.

CHAPTER TWO

LITERATURE REVIEW

Introduction

This chapter comprises the definition of concepts related to the accessibility and choices of water as well as other issues related to the study. It also includes discussion of issues such as the economics of water accessibility, water governance in Ghana and the identification of key institutions as well as stakeholders in the water sector in Ghana. The chapter will also review works on the determinants of choices of water sources, accessibility to potable water, challenges in accessing water, the calculation of the Water Poverty Index as well as the theoretical and conceptual framework which form the basis for this study.

The Economics of Water

The economics of water fundamentally deals with understanding the concept of water scarcity. Water scarcity basically refers to either the lack of enough water (quantity) or lack of access to safe water (quality). Poor water resources management often results in the lack of access to adequate water supply to most people especially the poor, people living in rural areas as well as in developing countries. Water scarcity usually occurs when supply does not meet the demand for water. One third of the world's population is currently experiencing some kind of physical or economic water scarcity (Wahaj, Lubbock, Cleveringa, & Nepveu, 2012).

Demand for water is faced with tough competition from various parts of the economy including agriculture, industry, domestic use, the environment and power generation. Areas known to experience water scarcity equally experience uneven access when it comes to the distribution of the limited water resource available to the residents. This scenario is practically the case for the rural poor where women are primarily engaged in the fetching water (Wahaj et al., 2012).

In developing regions, finding a reliable source of safe water is often time-consuming and expensive. Economic scarcity of water usually occurs when water can be found in an area, but requires more resources to acquire it while physical scarcity on the other hand occurs when the lack of water is a more profound problem. The problem of water scarcity is a growing one and as more people put increasing demands on limited supplies, the cost and effort to build and maintain access to water will increase. The demands for water by humans as stated in Connor (2015) are grouped into five major water use sectors. These include;

- Food and agriculture, which accounts for the majority of water withdrawals globally;
- Energy, for which the quantities of water used (consumptively and non-consumptively) rarely reported and thus are poorly known;
- Industry, which covers an exceptionally broad range of income-generating activities with equally broad impacts on both the quantity and the quality of local water resources and the environment;
- Human settlements, which includes water for drinking and household uses such as cooking, cleaning, hygiene and some aspects of sanitation and

- Ecosystems, whose water demands are determined by the water requirements to sustain or restore the benefits for people (services) that societies want ecosystems to supply.

Each of the water use sectors is driven by a number of external forces (such as demographic changes and cultural values) which in turn dictate their current and future demands for water United Nation World Water Development (2012). Unfortunately, predicting how these drivers will evolve over the years and how they will affect the water demand is not clear given a multiplicity of uncertainties. Future demand for water will not only depend on the amount of food, energy, industrial activity, but also on domestic water-related services of both rural and urban areas since there is the need to meet the requirements of a growing population with changing socio-economic landscapes United Nation World Water Development. Demand for water is expected to increase in all sectors and by 2030, the world is projected to face a 40% global water deficit (Connor, 2015). This revelation calls for a collaborative effort to ensure equity distribution of water across the globe.

Water Governance in Ghana

The important role of water in our everyday lives, has led to the need for water to be given priority in many of Ghana's development policy options. According to the Ministry of Water Resources (2007), the Government of Ghana in the early 1980's introduced several policy reforms in the water sector. The Constitution of the Republic of Ghana, Ghana Water Vision 2025, Ministry of Water Resources, National Development Framework, National Environmental

Action Plan and Ghana Poverty Reduction Strategy are a few of such national commitments towards promoting the provision of safe drinking water for all (Ocloo, 2011).

These were intended to improve the efficiency of urban water supply and irrigation of water as well as reach some measure of environmental protection conservation. The Water Resources Commission (WRC) under the umbrella of the Ministry of Works and Housing in 2002 came out with a draft of the Ghana Water Policy which was later updated in 2004 to include policies specific to urban water supply and community water and sanitation services (Ministry of Water Resources, 2007). The water policy regulates the demand and supply of water in the country and provides the framework for the sustainable development of water resources available in Ghana. It addresses all issues related to water use and is linked to other policies like those of the agricultural, energy, transportation as well as sanitation sectors (Ministry of Water Resources).

Ghana's potential water resources can be grouped under surface water and ground water with the surface water basically fed by three main river systems namely the Volta, Southwestern and Coastal System. (Ghana National Commission for UNESCO, nd). In Ghana, water resources mainly serve consumptive and non-consumptive purposes. The main consumptive uses of water include water supply, irrigation and livestock watering while the non-consumptive uses include inland fisheries, water transport and hydropower generation (WRC, 2016). The Ghana Water Vision 2025 focuses on promoting an efficient and effective management system and environmentally sound development of all water resources. In order to

achieve this vision there is the need to adopt Integrated Water Resources Management (IWRM) which will enhance sustainable management of water resources (Ministry of Water Resources, 2007).

Key water sector institutions

An important aspect of supporting the implementation of the Ministry of Water Resources is ensuring effective inter-institutional coordination and collaboration. In Ghana, there are several institutions performing numerous functions in the various water sectors. Some key water sector institutions responsible for the effective and efficient distribution and supply of water include the following;

- The Ministry of Sanitation and Water Resources (MSWR) is the lead governing institution responsible for water.
- The WRC was established to harmonize water resources management and related issues concerning all consumptive and non-consumptive uses of water in the country.
- The National Community Water and Sanitation Programme (NCWSP) seeks to address the problems of water and sanitation in rural communities and small towns.
- Community Water and Sanitation Agency (CWSA), was established within the GWSC to manage the NCWSP and cater solely for rural water and sanitation.

- The Ghana Water Company Limited, (GWCL) main focus is on urban water supply.
- The Public Utilities Regulatory Commission (PURC) regulates the standard of services including the quality of drinking water provided by the GWCL and also the tariff set by the company for urban water supply.
- The role of the Environmental Protection Agency (EPA) covers among others, protection of water resources and regulation of activities within catchment areas including, effluent standards.

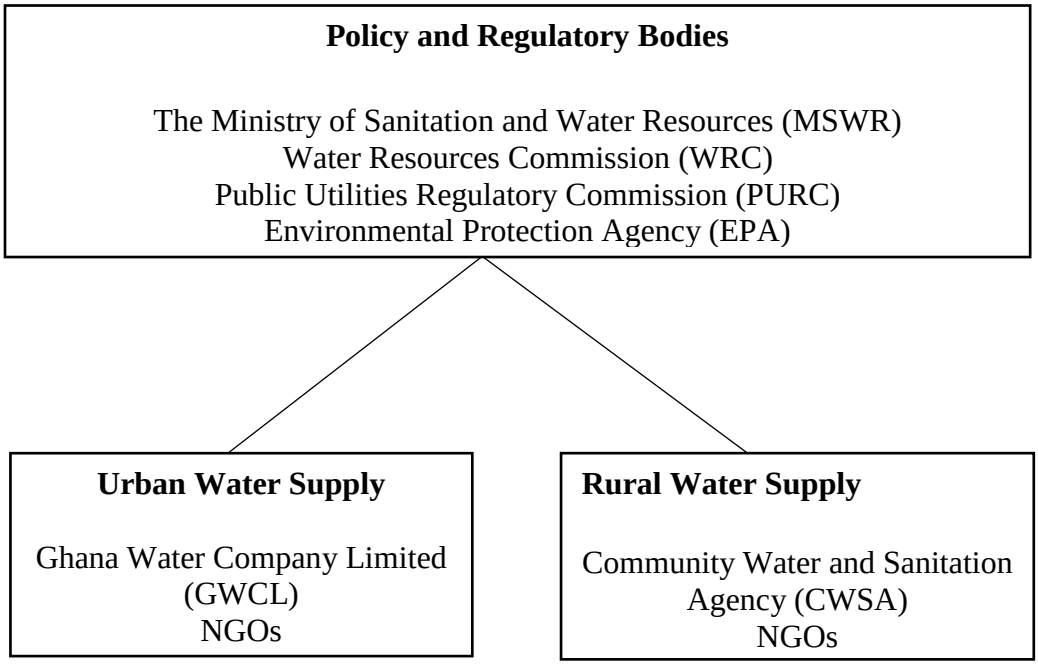


Figure 1. Key Water Institutions in Ghana

Source Author's Construct, (2016)

Water supply system in Ghana

The first attempt to develop a public water supply system in Ghana occurred in 1928 and was operated and maintained by the Public Works Department. This was followed by the establishment of the Ghana Water and Sewage Cooperation (GWSC) in 1965 to supervise the provision of both urban and rural water. In 1996 and 1997, the WRC and the PURC were established respectively to perform set functions. In 1999, the government saw the need to separate rural water supply from the urban supply system so as to increase access to water in rural communities (Yusif, 2012). This led to the replacement of the GWSC with the publicly owned Ghana Water Company Limited (GWCL) to provide urban water supply and Community Water and Sanitation Agency (CWSA) for rural water supply (Lawson, 2013).

The quality, sufficiency, accessibility, affordability and continuity of supply are key areas of consideration in addressing issues related to water and these can be achieved through policy implementation. A valuation of the water sector carried out by Water Aid Ghana (2005), affirms that there was no clearly articulated policy on water in Ghana until the establishment of the Water Resources Commission in 1996 and the coming of donor support in that direction.

The second Ghana Water Forum asserts that though much success has been achieved since the inception of the National Commission for Water and Sanitation Programme, the sector is still struggling with the breakdown of the few available facilities. According to Lawson (2013), some of the existing water supply facilities are not functioning as expected, while there are a few which are totally non-

functional. There is therefore the need to ensure that facilities provided remain functional throughout their designed life and beyond.

Water and sanitation

Access to and use of safe drinking water can make an immense contribution to health. According to Word Health Organization (2004), the improvement of household supply of potable water may reduce up to 25% the morbidity due to diarrhea. This makes it very important to understand what influence households' reliance on potable water for drinking and other domestic purpose given its ability to reduce illness resulting from the consumption of poor water quality.

As said by Mahama et al. (2014), hygiene levels maintained by households are sensitive to the service level, hence households with water piped into their homes tend to use more water for personal hygiene while those who resort to using water sources outside their homes, use smaller quantities for personal hygiene. For example, in studies conducted in Tanzania, Kenya and Uganda, households with piped water connections within their homes use about 16.3 litres per capita for washing dishes and clothes and 17.4 litres per capita for bathing, while those whose sources of water are outside homes use an average of 6.6 litres per capita for washing dishes and clothes and 7.3 litres per capita for bathing (Howard & Bartram, 2003).

Also, Kjellstrom and Mercado (2008) in their study to determine the social determinants of health equity in urban settings, it was shown that the burden of inadequacy of water and sanitation is borne by women and children. Besides the

idea that most women and children without toilet facilities in their households have to travel great distances to relieve themselves, they also delay their sanitary needs during the daytime until night due to modesty and unavailability of water.

Furthermore, the lack of or inadequate water and sanitation facilities also tend to affect the education of children, especially girls, as the burden of water collection is borne by them. More often than not, the number of hours spent in collecting water interferes with their school attendance. Schools with poor sanitary and toilet facilities further discourage children, especially girls, from going to school regularly, which consequently affects their performance and perpetuates the vicious cycle of illiteracy and poverty (Mahama et al, 2014).

Gender and water

In enumerating, global leading challenges to potable water, the UN World Water Report (2012) calls for swift response to the key challenges which widens gender differences in access to and control over water resources. These challenges include the crisis of water scarcity, deteriorating water quality, the linkages between water and food security as well as poor water governance. The UNWWR further recognizes how the various purposes for which local water resources used by different groups of men and women in the community would help to successfully integrate gender considerations. This is not only limited to water resource management but also extends to other sectors such as urban water supply, agriculture, industry and energy.

Women and men assume different responsibilities in the society especially when it comes to using and managing water. In most developing societies, women and girls are usually responsible for the collection of water for cooking, bathing, cleaning, maintaining health and hygiene (Sullivan, 2002). Men on the other hand are mainly responsible for the provision of the financial means of acquiring water. Women play key roles when it comes to water resource management. These tasks include providing, managing and safeguarding water for use by the family. Water is also used by men in building and repair work (for example, in making bricks and in plastering), for crops and food processing as well as in transport. At all levels, women are cited to have more pressing needs for water than men when it comes to economic production, including agriculture and micro-enterprise.

This imbalance extends to the purely domestic arena. All over the world, women and girls undertake time-consuming and dangerous duty of supplying the water needs of their households. According to Chipeta (2013), many women and girls walk long distances to fetch water, spending four or five hours per day carrying heavy containers and suffering acute physical problems. In some mountainous regions of East Africa, for example, women spend up to 27 per cent of their caloric intake in collecting water. In urban areas, women and girls wait hours queuing for intermittent water supplies (Lewis, Huyer, Kettel, & Marsden, 1994).

Many of them have no time for other pursuits, such as education, income generation or cultural and political activities. Sometimes women's needs are in direct conflict with those of men: for example, food production can be an important source of family food and income for women, but women's access to irrigation is

minimal (Elson & Keklik, 2002). Mahama et al, (2014) further indicated that the more time spent in search and collection of water by women, the less time is available to these women to cater for other domestic needs such as cooking, caring for children and pursuit of other income-earning activities.

Uses of Water

The use of water has over the years shifted from the primary use of water for domestic consumption into industrial, energy and agricultural consumption. Though Connor (2015) confirms this shift, it does not signifiy a reduction in people's demand for water resources but only signify the the increase demand for engery, agicultural and industrail services. Below is a narrative on the domestic consumption of water since that is the focus of this study.

Domestic water consumption.

Domestic water consumption includes the use of water by household for drinking, bathing, cooking, washing just to mention a few. Domestic consumption of water does not only compete with other consumption sectors but also tend to compete among the various domestic needs for water. Thompson, Porras, Tumwin, Mujwahuzi, Katui-Katua, Johnstone & Wood (2001) opined that, if a household has a small quantity of water to use, it is likely that all aspects of hygiene from bathing and laundry to washing of hands, food, and dishes will suffer (Thompson et al, 2001)

These sources of water for domestic consumption are generally classified under improved and unimproved sources based on the WHO and UNICEF (2000**)**

definition. According to this definition, improved sources of drinking water includes water piped in homes, yard or a neighbour's house as well as rain water, boreholes and wells. Dar and Khan (2011) also defined Improved water sources as those that are designed such that they are devoid of any contamination, especially from faecal matter. Obeng-Odoom (2012) on the other hand, suggests that water from boreholes, wells and rivers are contaminated with pollutants, such as bacteria, faecal matter and chemicals, hence should rather be considered as unimproved sources.

Fotuè (2013) argues that households in urban areas are more likely to use improved source for both drinking purpose and other domestic usages. However, the poor access to improved sources of water in most rural communities have led to the increased reliance on unimproved water sources in the rural areas. Table 1 catalogues water into the two cited types of water with examples

Table 1. Definitions of Improved and Unimproved Water Supplies

Unimproved Water Supplies	Improved Water Supplies
Unprotected well	Household connections
Unprotected spring	Public standpipes
Vendor-provided water	Boreholes
Bottled water Protected dug wells	Bottled water Protected dug wells
Tanker-truck provided water	Protected springs Rain water collection

Source: WHO & UNICEF (2000)

Access to Potable Water

The importance of water cannot be over stressed as it is used for many purposes including household chores, drinking and for non-domestic purposes. The recognition of the importance of water to humans resulted in the consideration of access to water as an essential human right. This human right seeks to ensure that everyone has access to adequate quantity and quality of water. According to Watkins (2006), WHO pegged the minimum water requirement per person per day at 50 to 100 liters and anyone who consumes less than this range has his or her rights violated. In addition to this range, Smith and Hanson (2003) futher examines this human right violation in terms of time spent in collecting water. According to them, the minimum range within which water should be accessed should range from 5 to 30 minutes and any anywhere above this time frame signifies a violation of human right. This time range includes time to walk to the water source and back, time spent in queuing as well as time spent in drawing the water from the source.

For water to be considered safe for drinking, it should be obtained from a source that is free of disease causing organisms, must have a desirable taste, no odour, colourless, turbidity and should contain no harmful chemicals (WHO, 1958). Sources of water refers to the identified and available water bodies that is used for consumption. Access to improved water source refers to the percentage of the population with reasonable access to an adequate amount of water from an improved source, such as household connection, public stand pipe, borehole, protected well or spring and rain water collection (WHO, 2006).

In this study, access to water refers to the economic and physical access to water. Economic access to water looks at the affordability of water. How much available water may cost and how much consumers are willing to pay for it. It also takes into consideration the pricing mechanism instituted by government for water supply. Physical access to water looks at the physical infrastructures available to supply water to consumers, how accessible are these structures in terms of availability and use. The physical access to water also takes into account the environmental condition surrounding the water source such as how close the water source is to consumers, taking into consideration the distance travelled and the time spent in collecting water. Dar and Khan, (2011) argue that the amount of time involved in getting water is probably more important than the distance covered to the water source as a determinant of access to water. This is due to the reason that there are some areas where scarcity of water is so severe that it takes longer to obtain water than to reach the water source.

Several factors account for an individual's access to potable water. A determinant of access to water is related to how equitably water facilities are distributed. Even though there could be an overall increase in access to water, there is usually inequitable distribution as supply of piped water normally tends to favour high-income neighbourhoods to the disadvantage of poor neighbourhoods. The UN-Habitat (2009) suggests several factors that are required for the achievement of a minimum level of safe and affordable drinking water. These include

- The households must have 20 litres of water per person per day;

- The drinking water must not cost more than 10% of the total household income; and
- It must be available without extreme effort which means less than 1 hour per day for collection of water.

Limitting the definintion of access to coverage only offers a skewed definition since this is not good enough to reflect the true picture of Ghana's situation. Therefore, access to water should rather be considered in terms of the quality and reliability of the supply of water. Quality is based on the premise that drinking water should be safe and free from pollutants, while reliability considers regular flow of water at all times. According to Obeng-Odoom (2012), 46% of households in Ghana with a piped water connection rarely had their pipes flowing while 5% of these households had never had piped water.

Studies by Gleick (1996) as well as Water and Environmetal Health at London and Loughborough (1998) defined the various level of access to water and these formed the basis of Howard and Bartram (2003) definition on the four levels of access to water. Their definition is based on four board service levels which are distinguished on three categories namely; distance the consumer travels or the time spent collecting water, quantity of water collected and the health concerns of water consumers as seen in Table 2. From Table 2, basic access to water offers minimum health protection, and users of this service level will have access to less than 20 litres per day which includes 7.5 litres required for consumption.

Table 2. Service Level of Access

Service Level	Distance to Source & Total Collection Time	Approximate Quantities Collected	Level of Health Concern
No Access	>1000m >30 min. total collection time	Very low Less than 5L/capita-day	Very High Hygiene not assured, consumption needs may at risk. Quality difficult to assure.
Basic Access	100-1000m 5-30min	Low Unlikely to exceed 20L/Capita-day	Medium Not all water needs may be met. Quality difficult to assure.
Intermediate Access	On-plot Eg. Single stand pipe on compound or in house	Medium Around 50L/capita-day	Low Most basic hygiene and consumption needs met. Quality more readily assure.
Optimal Access	Multiple taps in house	Varies Likely to be 100L/capita-day and possibly up to 300L/capita-day	Very Low All uses met. Quality readily assure

Source: Howard and Bartram (2003).

Access to water in urban areas in Ghana have increased over the years since people in urban areas depend mainly on piped-borne water supplied by GWCL. According to Mensah (1999) 59% of households in urban areas had an indoor piped supply connection and these were mostly wealthy households while less than a quarter of such household shared their pipe connections with other households. However, the GSS (2014a) indicates that about 95 percent of urban households

have access to potable water (pipe, borehole and bottled water). Though access to water has increased, people usually have to travel outside their homes to collect water. According to Rakodi (1996) having piped water within one's dwelling depends on the degree of area planning and on the extent of one's wealth.

Also, Ghana is noted for the irregular supply and frequent shortages of water hence the need to store water for later use when the flow ceases. Households have developed various strategies to deal with water supply interruptions and with regards to this, 96% of households are said to store water (Mensah, 1999). This is done with the use of various types of containers including '*Jerry cans'*, plastic bowls and containers, overhead tanks, barrels, gallons and buckets just to mention a few. Other solutions to frequent water shortages include the purchase of water from water vendors and in areas where water flows constantly. Others use water from wells or collect stream water, harvest rain water as well as recycle water within homes.

Factors Influencing Choice of Water Sources

Access to clean drinking water is one of the most important precondition for sustainable development. According to Esrey, Potash, Roberts, and Shiff (1991) and Waddington, Snilstveit, White, and Fewtrell (2009), access to safe drinking water reduce the incidence of waterborne diseases like diarrhea, thus, making it very important and necessary to understand the factors that affect household choice of water source. Sustainable management of water for drinking and other domestic

purposes requires knowledge of the factors which affect the households' demand for water.

Identifying the factors accounting for household's choice of water sources has been featured in many literatures on household water behaviour. These factors can be grouped under social, economic as well as geographical factors. Identifying these factors is key in understanding the choices of water sources and ultimately aid in addressing the issues of water supply to the community. Fotuè (2013) in his study in Cameroon, suggested that the living area, gender of the household head, household size and wealth quintile strongly affect households' choice. However, the health status of the household and the number of children less than five has insignificant effect on the households' choice of water sources for the various domestic uses of water.

Income levels of household

From a household expenditure, income is the fundamental factor since the lack of or inadequacy of household income may compel families to rely on unimproved water sources (Koskei, Koskei, Koske, & Koech, 2013). Economic status of households is closely linked with the affordability of services such as water. Thus, implying that households with no reliable source of income are most likely to use water from unimproved source. Mahama, et al, 2014) from their study of factors influencing households' access to improved water in low-income urban areas of Accra, also supported the view that income levels of households are among the main factors that determine access to water and sanitation facilities and services.

This according to them is mainly as a result of the view that; low-income households can hardly afford the high connection fees to piped water hence resulting in their choice of other water sources besides the piped water. Also, while the higher income households can afford to buy more and also afford private alternatives in times of shortages, these may be too expensive for the low-income households. According to Howard and Bartram (2003), in Ghana, low income communities who depend on public piped water receive less water and face greater shortages than high income communities. The reason for this disparity is high income community's ability to pay more for water services.

Education

Bosch, Hommann, Rubio, Sadoff & Travers (2001) and Fotuè (2013), suggest that the educational achievement of an individual plays a key role in the determinacy of one's access to improved water. To this effect, the lower the educational achievement of an individual, the more they have limited opportunities for better facilities from the authorities since the decision to demand water services also comes with the responsibilities of paying for the services rendered. With low incomes recorded among persons with lower education it is quite difficult to demand and maintain water services.

Location of household

The geographical location of a household has been identified to have the tendency to influence the choice of water sources by households. Households in urban areas are likely to choose improved sources of water like the piped water, whereas household located in rural areas tend to rely more on unimproved water

sources. However, urban households in slums or informal areas though still located in urban areas are more likely to have limited connectivity to piped water partly due to the unplanned nature of their settlements.

Franceys and Gerlach (2008) indicate that though most of the urban poor are housed in slums, many such areas are often denied access or face cumbersome administrative procedures when it comes to connecting them to official water sources partly because of lack of security guarantees for land and pipelines as well as the problems of affordability. More often than not the water and sanitation needs of poor urban communities are hardly incorporated into urban and regional planning.

Although utility prices are cheaper for households connected to the water systems, most of the poor are denied access because they lack formal property rights to where they live. The location of their residence serves as a barrier to getting access to these facilities because of poor building layout as seen in places with poor road network which makes it difficult for households in these areas to get connected to these services (Watkins, 2006).

Howard and Bartram (2003) also demonstrated that the average amount of water a household consumes depends on the location of the water source. Households who have water piped into their homes consume average quantities of about 155 litres per person per day. However, those households who get their water from a piped source in a yard or place outside their homes decrease consumption to about 50 litres per person per day and those whose water source is outside the home further reduce their daily average consumption level.

Distance from Household

Distance from household has been identified as one of the main factors influencing household choice of water source. Thompson et al, (2001) indicated that the addition of a closer but still distant water source, such as a centrally located stand pipe or well, would not necessarily increase household water use. According to Thompson et al. if water must be carried, the quantity brought home varies little for sources between 30 metres and 1000 metres from the household.

Howard and Bartram (2003) further revealed that distance is a crucial factor in determining access to water and sanitation facilities. The further away the source of water is to a household, the less water is consumed. In areas where people walk for more than 1 kilometre, the per capita water use drops to about 5 to 10 litres per day (Howard & Bartram). This may hold mainly for rural areas, however, according to, Bosch et al. (2001), in the urban areas, time taken to get water was more crucial than distance covered to access water, as more people are most likely to reduce consumption of water if they have to walk shorter distances but queue for longer hours to draw the water.

Time spent in collecting water.

Time as suggested by Bosch et al., (2001) is another factor influencing the choice of water sources by a household. Studies by Ako, Shimada, Eyong, and Fantong, (2010) confirmed that the further away a water source is from a household, the more time is spent in sourcing water. The studies put forward that when households have to travel for about 3 to 30 minutes to get drinking water, they will be able to meet their daily requirements of about 15 to 25 litres per person per day.

However, they tend to compromise on drinking water if they have to spend beyond 30 minutes to get access to the water source. In Lesotho, it was revealed that about 25% of households spend about 2.5 hours in collecting water while the majority of households in East Africa and North Cameroon spend close to 5 hours and 6 hours, respectively, per day collecting water for household needs (Mahama et al., 2014).

Willingness to Pay for Improved Potable Water Supply

Varian (1992) defined Willingness to Pay (WTP) as the maximum price at or below which a consumer will definitely buy one unit of the product. It also refers to the highest amount an individual is willing to part with in order to procure a product or service. The price of the transaction will be determined at the point where the buyer is willing to pay for a product or service and the seller is willing to accept the offer made (Wertenbroch & Skiera, 2002).

A consumer WTP for a product depends on a concrete decision to do so. For instance, consumers will to pay more for a soft drink in a luxury hotel resort than a beach bar or a local retail store (Anderson, Jain, & Chintagunta, 1993). Several approaches have been developed to measure consumer WTP and these can be differentiated whether they measure WTP directly or indirectly and whether they measure consumer hypothetical or actual WTP (Miller, Hofstetter, Krohmer, Zhang, & John, 2011).

The direct approach usually involves directly asking consumers to state their WTP for a specific product while the indirect approach involves the choice-based conjoint (CBC) analysis. Here WTP is calculated based on the consumers' choices among several product alternatives and a "none" choice option. However,

both direct and indirect approaches can produce inaccurate results since they both measure consumers' hypothetical, rather than the actual WTP (Wertenbroch & Skiera, 2002). Generally, it has been established that water has to be paid for but the willingness to pay for its improved services is another ball game altogether. According to Mensah (1999) most customers are willing to pay more for an improved service, if the water is purified, clean, and it flows 24 hours a day at a reasonable pressure. Some consumers also argued that, taxes paid to the government should rather be used to pay for improving water sources and that no person should be made to pay any other fee aside what is already been paid (Mensah).

Challenges in Accessing Water

In recent times, water supply coverage in developing countries has largely improved, despite this, there are high proportions of the population without access to reliable water. Governments are confronted with numerous challenges, such as low financial capacity to improve upon the distribution of water supply as well encroachment on water ways. A major problem that has hindered their ability to cater for the water and sanitation needs is the rapid increase in the numbers of people in urban areas, which has led to deepening of the poverty situation in many cities (Kurian & McCarney, 2010).

Another major challenge faced in accessing water has to do with the decline in access to quality water. An increase in population in urban areas results in increase pressure on the available piped water facilities in municipalities which in turn leads

to a decline in access to quality water. According to Mudege and Zulu (2011), the reduction in access to safe drinking water is partly attributed to the increasing pressure on the relatively few available facilities. Also, having to transport water from source to household allows room for the contamination of the water especially in cases where the containers for drawing water has no lid. Furthermore, the problem with access is not just because of scarcity but also due to its unequal distribution and the relegation of people in informal areas and settlement in development plans.

Amuyunzu-Nyamongo and Taffa (2003) in their study conducted in Nairobi, Kenya found that community members have to travel long distances to collect water. They also found that some landlords in the community played a role in limiting tenants access to water by rationing water in such a way that it was only available on specific days of the week and at specific times. The study also found that the price of water paid by residents without piped connections were higher than those paid by households with piped water paid.

In Ghana, the relatively rich people in urban communities usually have direct access to piped water within their houses, allowing them access to subsidized piped water from GWCL. However, the poorer urban communities and rural communities are often served by the government through the CWSA, which charges residents of these poor communities several times higher than the rate of water delivery to affluent areas serviced by GWCL (Mahama et al., 2014).

Furthermore, the health implication associated with access to water from distant sources is another major challenge. According to Bartlett (2003) the further

children have to travel to search for water, the more calories they burn and hence have less energy to undertake other activities in the homes. Further, these children are made to carry heavy containers in order to get more water which can cause some physical deformities and affect the growth of their bones.

Water Poverty Index

Water Poverty defined in the context of this study refers to the condition of not having sufficient water or water of an adequate quality to meet the basic domestic needs of households. Human populations growth is creating an increasing demand for water, and with the rise in standards of living, water consumption per capita is also likely to rise (Sullivan, 2002). This indicates that water resource availability, or lack of it, is linked to economic and social progress, suggesting that development is likely to be influenced by how water resources are managed.

The purpose of the Water Poverty Index is to express an interdisciplinary measure which links household welfare with water availability and indicates the degree to which water scarcity impacts on human populations (Lawrence et al., 2002). In Sullivan's (2002) view, the WPI can be used to measure a community's access to water in relation to other communities and it is crude summation of the challenges faced in accessing water. According to Van de Vyver (2013), WPI is a conventional method that is easy to calculate, cost effective to implement, based mostly on existing data, and it uses processes that are easy to understand.

Sullivan (2002) identified a number of methods that could be used to produce a Water Poverty Index. However, for the tool to be widely accepted and

adopted, it needs to be derived in a participatory and inclusive manner and its calculation has to be transparent, and should be easily used by all countries, at various scales (Sullivan & Meigh, 2007). The various methods of calculating WPI include the conventional composite index approach, the alternative approach, the matrix approach and the simple time analysis approach.

The conventional composite index approach is the most widely adopted approach because the index was built from a series of variables which capture the core of what is being measured Sullivan (2002). The WPI comprise various elements, such as: water availability, access to safe water, clean sanitation, and time taken to collect domestic water. In using this method, it is necessary to define and identify the ‘‘base rate’’ on which to calibrate the index values, and to provide an explanation of what exactly the resultant scores meant. The problem of no common measure between variables does not arise in this method as the index is composed of parts which can be compared as they are all expressed as a percentage (Sullivan & Meigh, 2007).

A simple time-analysis approach though not a popular method is another possible way of measuring WPI. With this approach, time is used as a numeraire for the purpose of assessing water poverty. In this method, the WPI is determined by the time required to gain access of a particular quantity of water. In cases where the water is provided by infrastructure (example; GWCL and water vendors) the value of the WPI would be equivalent to the wage-earning labor time required by residents to pay the appropriate fee for that level of water provision. In less developed areas where infrastructure was less relevant, time is based on the actual

measurement of time required by persons in that household or community, to collect water (Sullivan, 2002). However, this approach is best used to determine the WPI on a much smaller scale like household consumption.

While the other method calculates WPI on a more holistic level by taking into consideration factors such as the whole basin or water catchment of an area, the simple time index approach measures the WPI of an area's water situation with focus on the domestic consumption needs. For this study, the simple time analysis approach was adopted because not only is it simple to understand, it basically reflects domestic consumption issues which is the focus of the study. In this index, the smaller the WPI, the higher the household access to water (Olotu , Akinro , Mogaji , & Ologunagba, 2009).

Theoretical and Conceptual Framework

The study is based on two main theoretical concepts. These are the New Approach to Consumer Theory (Lancaster, 1966; Michael & Becker, 1973) and The Concept of Access (Penchansky & Thomas, 1981). These concepts form the theoretical framework upon which the study sits. The conceptual framework on the other hand is based on the Access framework suggested by Penchansky and Thomas in their 1981 work on "The concept of access: Definition and relationship to consumer satisfaction".

The new approach to consumer

The New Approach to Consumer Theory breaks away from the traditional approach that goods are the direct objects of utility and, instead, supposing that it is the properties or characteristics of the goods from which utility is derived. The theory suggests that, consumption is an activity in which goods, singly or in combination, are inputs and in which the output is a collection of characteristics (Lancaster, 1966). The utility or preference orderings are ranked by the collections of characteristics that they possess. The new approach theory is based on three main assumptions viz;

- The good, per say, does not give utility to the consumer; it possesses characteristics, and these characteristics give rise to utility.
- In general, a good will possess more than one characteristic, and many characteristics will be shared by more than one good.
- Goods in combination may possess characteristics different from those pertaining to the goods separately.

The main proponent of this theory reveals the rational nature of consumers who deviates from the traditional model where goods are bought without any consideration to the properties attached to the goods. The rationality of consumers in this case exposes a major consideration for attributes such the quality of the good, the presence of competition or complementarity in the usage of the good as well as distance for the goods.

In linking this theory to the study, consumers' preference for a particular source of water may be influenced by perceived or factual notion of factors like

water quality, availability and even cost. Though the theory is quite silent on other exogenous factors like the effect of advertisement and level of education on consumers' choice of water supply, it assumes that the rational consumer lives in a world where all other things are kept at constant. Although the constancy of all other variables is deviation of reality, acknowledgement of consumer's ability to make a clear decision based on a series of attributes necessitated the use of this model in the study.

The concept of access

Access is defined as a degree of fit between client and system (Penchansky and Thomas, 1981). It involves the ability (thus monetary cost) and capability (thus distance, time, convenience and energy) of an individual to reach facilities that enhances one's wellbeing. Abane (2005) stated that accessibility involves the facility being located within a safe physical reach with it being affordable and accessible in law. Access also involves the timely use of services according to need.

According to Gold (1998) the concept of access has evolved over time, with the growing need to address it beyond just the utilization of a particular system or product but rather use it as a measure of the effectiveness of services. The concept of access has to be looked at as a set of dimensions that fit into both the consumer and producer system (Dillip et al., 2012). Access may also be considered as the ease of approach to needed facility or services from one location to another (Clark & Coffee, 2011). It is measured using the various components of access. Penchansky and Thomas (1981), identified five main components of access. These are availability, accessibility, accommodation, affordability and acceptability. These

components formed the bases of their framework which was built to examine healthcare services. These measures were meant to satisfy the consumer or user's demand.

Access to facilities and services is fundamental for policy formulation and reformation since it has been realized that people deserve similar levels of quality and quantity of resources (Vander, Grift, Gulle, Holland, Mata, Suarez, 2007). It forms a vital issue where the sustainable livelihood of a community is involved because it aids the access to community assets including public facilities such as healthcare centers (Obrist, Iteba, Lengeler, Makemba, Mshana, Nathan. & Schulze, 2007) and water facilities. Consequently, any constraints to access to facilities will have major effect on the level of its accessibility.

Conceptual framework

Access framework which measures access in five specific areas was derived from Penchansky and Thomas 1981 access framework. The five main components used to measure access include affordability, availability, accessibility, accommodation (mode) and acceptability. These components overlap with each other to some degree. These measures were meant to satisfy the consumer or user's demand (Penchansky & Thomas, 1981). Table 3 presents a definition of the identified concepts stated above.

Table 3: Five components of access by Penchansky & Thomas (1981).

Concept	Definition
Availability	The relationship of the volume and type of existing services (and resources) to the clients' volume and types of needs.
Accessibility	The relationship between the location of supply and the location of clients, taking account of client transportation resources and travel time, distance and cost.
Accommodation	The relationship between the manner in which the supply resources are organized to accept clients (including appointment systems, hours of operation, walk-in facilities, telephone services) and the clients' ability to accommodate to these factors and their perception of their appropriateness.
Affordability	The relationship of prices of services and providers' insurance or deposit requirements to the clients' income, ability to pay and existing health insurance. The clients' perception of worth relative to total cost is a concern here, as is their knowledge of prices, total cost and possible credit arrangements.
Acceptability	The relationship of clients' attitudes about personal and practice characteristics of providers to the actual characteristics of existing providers, as well as to provider attitudes about acceptable personal characteristics of clients.

Source: Penchansky & Thomas (1981)

Penchansky and Thomas (1981) access as a concept comprise five main components. These components form the structure of their access framework. The Penchansky's Access framework was built to examine healthcare services in the context of the livelihood framework. Over the years, many researchers including Liu, Wu, Peng, and Fu (2003), Obrist et al. (2007), Vander-Reis et al. (2007) and Dillip et al. (2012) have gone a step further to explain and build on these

components. Vander Reis et al. opines that, Penchansky's components of access should be looked at from the perspective of the provider and the consumer. Also, the access concept should be made to fit into both the consumer and producer system (Dillip et al.).

Obrist et al. (2007) adapted the concept of access as examined and discussed by Penchansky and Thomas (1981). They built on this framework within the livelihood framework and vulnerability context which helped in addressing very vital issues. Their framework took into consideration factors such as the available assets that people depend on to enable them access the needed facilities. Their model however, failed to address expected satisfaction which is an important drive for access in the first place. Lui et al. (2003) suggests that in examining the challenges faced in accessing resources, there is the need to investigate how the components of access are affected. If there is a problem with any of the components, access to resources may be compromised (Lui et al.) for the reason that the degree of access is dependent on the interaction of the various components of access (Obrist et al.). For instance, if one wants to access the services of a particular facility and the services provided is not affordable to the consumer, one cannot access the facility even though the facility is available and accessible and the quality might be acceptable.

Though other studies have done further research on some of the components, Penchansky and Thomas's, method remains the main underpinning for the definition and understanding access to services. The framework has helped to build concrete understanding of access as used by services providers and the

expected outcomes of services. The access framework of Obrist et al. (2007) was adapted for this study.

The study modified the five main components of access concepts into four components namely availability, accessibility, affordability and quality. Availability seeks to identify the existing facility and the quantity of water that can be accessed from a chosen water source. Accessibility deals with the ease of obtaining water from the source by measuring the distance between domestic water source and residence while the affordability component of the framework measures the monetary cost of water as well as the time spent in accessing domestic water. Finally, the quality component of the framework seeks to evaluate the safety, cleanliness and taste of water from a particular source.

These components of access tend to influence consumer's choice of particular source of water to meet their domestic consumption needs. However, the decision to a particular source may also be influenced by physical and socio-economic factors such as location of the source, income level, time spent in collecting water and in some cases the traditional or cultural practices of the locality of the consumer. These components interconnect to derive satisfaction form the chosen source which eventually leads to improved wellbeing as well as reduce consumer vulnerability.

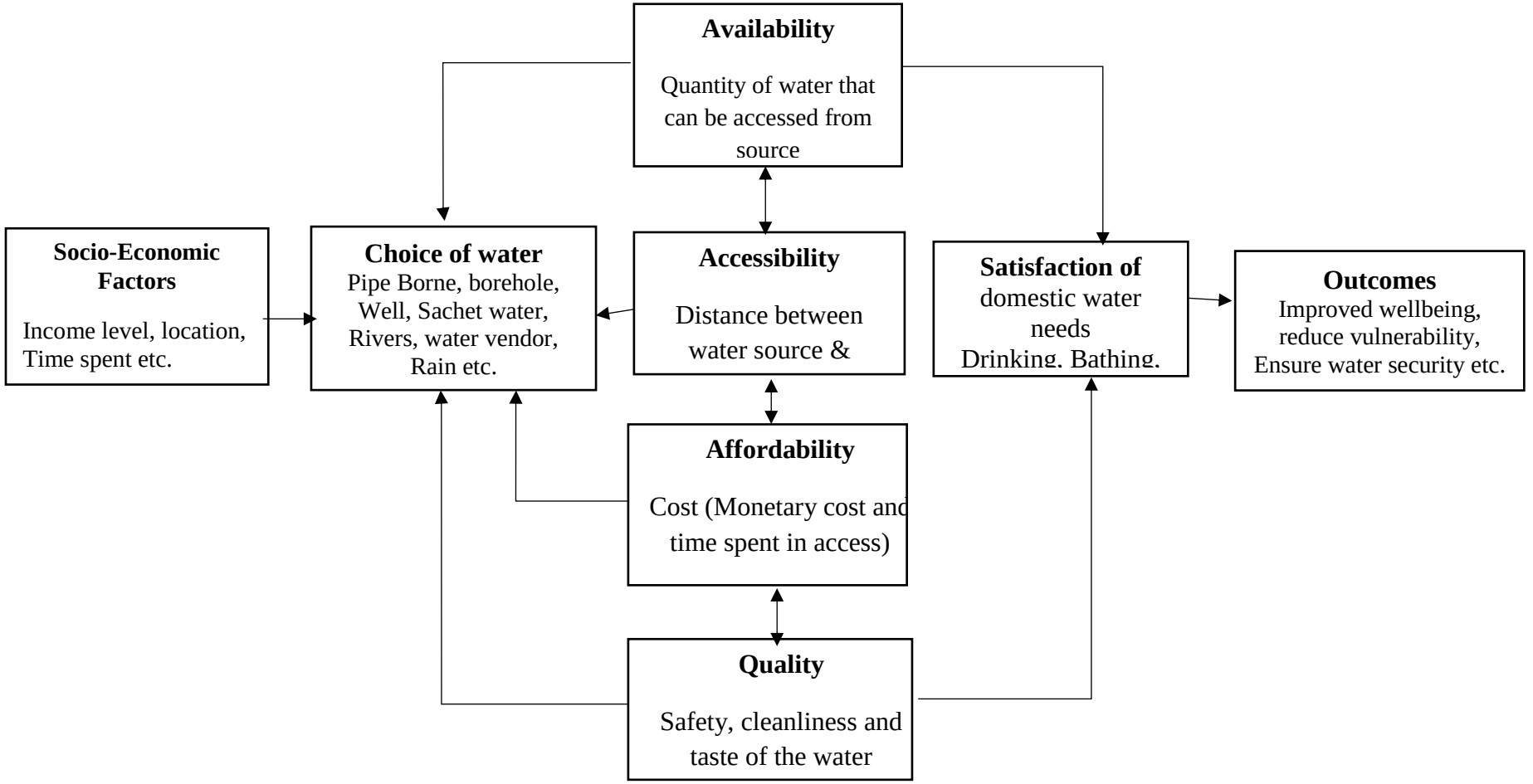


Figure 2: The Access Framework

Source: Adapted from Obrist et al, (2007)

CHAPTER THREE

METHODOLOGY

Introduction

The method used to achieve the research objectives is described in this section. The study is focused on investigating the factors influencing the choice of water sources for domestic consumption. Issues covered in this chapter range from research design and approach, target population, sample size and sampling procedure, research instrument, data collection and analysis to description of the study area. The chapter ends with the narrative on the challenges faced during the fieldwork.

Study Area

The Shai-Osudoku District is one of the 16 districts in Greater Accra region of Ghana, situated in the South-Eastern part of the region. In all, the district occupies a total land area of about 968.361 square km (GSS, 2014) and has Dodowa as its capital. The district was formally a part of the Dangme West District, which was split into two in June 2012 to produce the Ningo Prampram District and Shai-Osudoku District. It shares boundaries with the North Tongu District to the North-East, Yilo and Lower Manya Districts to the North-West, Akwapim North District to the West, Kpone Kantamanso District to the South-West, Ningo Prampram

District to the South and the Ada West District to the East (Figure 3). The Volta River can be found at the North-Eastern portions of the district (GSS, 2014).

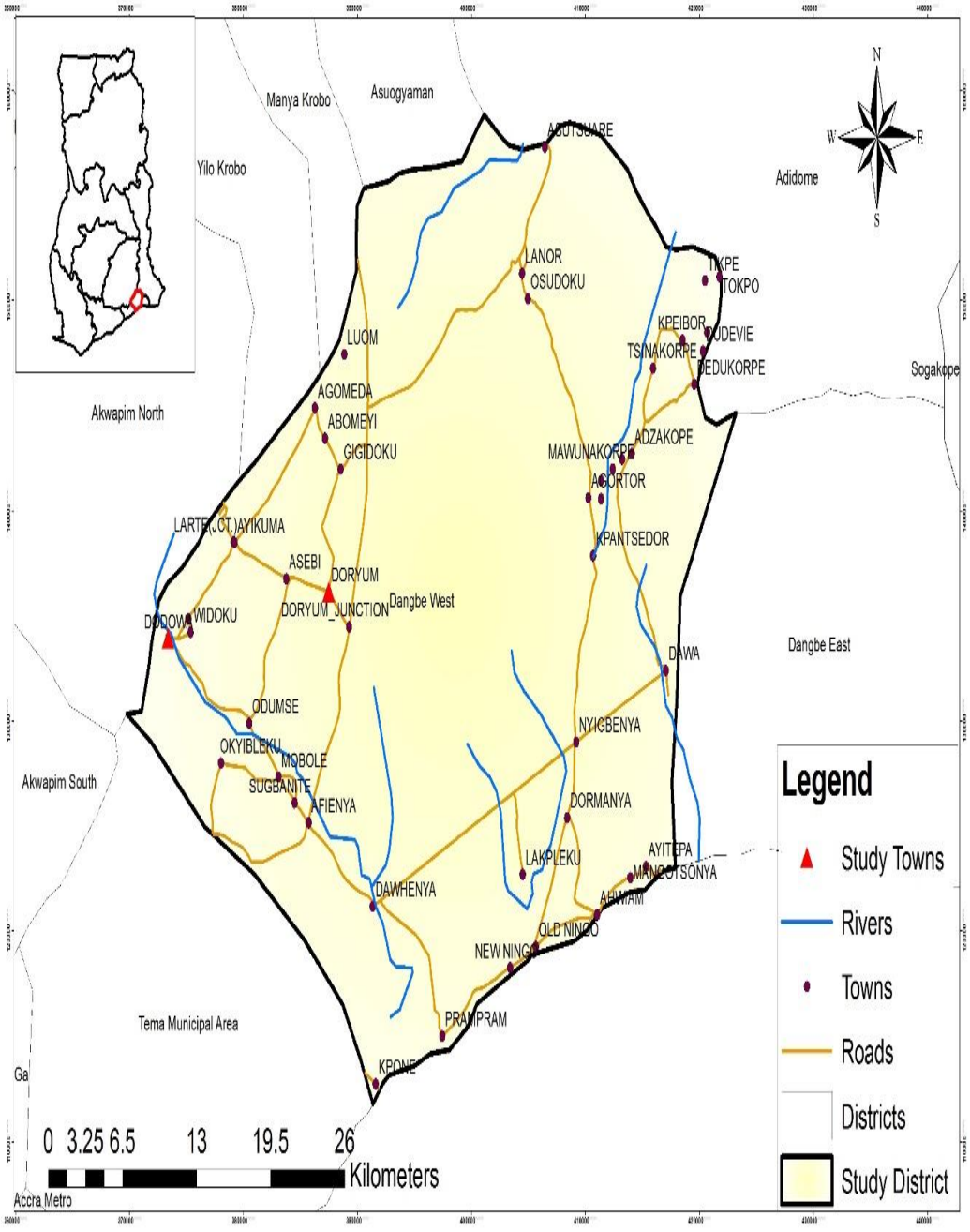


Figure 3: Map of Shai- Osudoku District Showing the Study Towns

Source: Geographic Information System and Remote Sensing Unit, UCC

The population of Shai-Osudoku district according to the 2010 Population and Housing Census is 51,913 and of this number, 51.3 percent are females and the rest, males. The district's population constitutes 1.3 percent of the Greater Accra population. Also, about 76.7 percent of the districts population resides in rural communities and the remaining 23.3 percent resides in the urban communities, indicating bulk of the population in the district reside in rural communities (GSS, 2014).

Shai-Osudoku district forms part of the central portions of the Accra plains. The relief found here is generally gentle and undulating, a low plain with heights not exceeding 70 meters. Prominent relief features include the Yongua inselberg, the Krabote and the Shai Hills. The Akwapim mountain range in the North-Western parts of the district presents a natural relief feature which is also responsible for a micro-rain shadow effect that influences the climate of Dodowa and the immediate surroundings. The general drainage pattern in the Shai-Osudoku District is dendritic with most of the streams taking their source from the Akwapim range and flow lagoons on the coast. Flowing over a relatively low terrain most of the streams have carved wide valleys for themselves which are left dry for most parts of the year. Most of these streams serve as alternative sources of water for consumption (GSS, 2014).

The Shai-Osudoku District, is located in one of the hottest and driest parts of the country. Temperatures are however subjected to occasional and moderating influences along the coast and altitudinal influences affected by the Akwapim range in the North-West. Temperatures are appreciably high for most parts of the year

with the highest during the main dry season (November to March) and lowest during the short dry season (July to August). Along the coast, close to the Akwapim range, temperatures are a few degrees lower than they are over most of the plains. This variation in temperature tend to influence the rainfall pattern for the district (GSS, 2014).

Rainfall in the district is generally very low with most of the rains that are unpredictable in nature coming mostly between September and November. According to the GSS, (2014), the mean annual rainfall increases from 762.5 milliliters on the coast to 1220 milliliters in the North and North-east close to the Akwapim Range. This tend to influence their choice of rain water as a water source mainly in the rainy season and thus the need to rely on other source of water in the dry season.

Theoretical Perspectives of the Research Design

In a social research, there are many theoretical perspectives that influence the direction, structure and process of a research. This research however, adopted the combination of two perspectives (positivist and interpretive) and their respective quantitative and qualitative methods formed the theoretical basis for the methodologies used in this study.

Positivism is a philosophical approach based on experience and empirical knowledge of natural phenomena. Positivists see social sciences as an organised method for combining deductive logic with precise empirical observations of individual behaviour in order to discover and confirm a set of probabilistic causal

laws that can be used to predict general patterns of human activity (Neuman, 2003). Positivist prefer to use quantitative data for their research and often conduct experiments, surveys, and use statistics. They test hypothesis by carefully analysing numbers from the measures thus depending mainly on figures and numbers for which they have been criticised. According to Neuman, positivism reduces people to numbers and that its concerns with abstract laws or formula are not relevant to the actual lives of real people.

The interpretive approach on the other hand, is a type of philosophical approach which involves an organised investigation into the socially meaningful action of people in the society through the direct and detailed observation in order to arrive at understandings and interpretations of how people create and preserve their social world. It is concerned with how ordinary people manage their practical affairs in everyday life, or how they get things done (Neuman, 2003). Interpretive researchers often use participant observation and field research. These techniques require that researchers spend many hours in direct personal contact with those being studied. Others analyse transcripts of conversations or study video tapes of behaviour in detail.

Due to the similarities and differences in the nature and principles of these perspectives, two major methodologies, quantitative and qualitative, have emerged in the social sciences, each of which comprises certain theoretical and methodological principles. Qualitative method of approach is generally descriptive and involves the collection and analysis of data that is concerned with meanings, attitudes and beliefs. The quantitative method is mainly associated with numerical

counts from which statistical inferences can be drawn. Both the quantitative and qualitative methodologies can be employed, not as opposing but rather complementary methodologies. DePoy and Gitlin (1998) affirm that it is becoming increasingly important to combine both ideologies and their attendant methods because such an approach offers the distinct advantage of better understanding the phenomenon under study and helps to even out the negatives of each while complementing the respective strengths.

The combination of two of these perspectives is referred to as the pragmatic approach popularly known as the mixed method approach. It involves using both the quantitative or the qualitative method which appears best suited to a research problem without getting caught up in philosophical debates about which is the best approach. According to Creswell (2009), mixed methods research is an approach that combines or associates both qualitative and quantitative forms.

This approach therefore grants the researcher the liberty to use a combination of methods, techniques and procedures typically associated with quantitative and/or qualitative research. Since each method have its limitations, both approaches can be used to complement each other. Mixed methods research as the third research paradigm can also help bridge the schism between quantitative and qualitative research (Johnson & Onwuegbuzie, 2004). The goal of mixed methods research is not to replace either of these approaches but rather to draw from the strengths and minimize the weaknesses of both in single research studies and across studies.

Agreeing with Johnson and Onwuegbuzie (2004), mixed methods approach is currently not in a position to provide perfect solutions however it is an approach that attempts to fit together the insights provided by qualitative and quantitative research into a workable solution. In some studies, qualitative and quantitative methods are used simultaneously. In others, first one approach is used and then the next, with the second part of the study perhaps expanding on the results of the first. For example, a qualitative study involving in-depth interviews or focus group discussions might serve to obtain information which will then be used to contribute towards the development of an experimental measure or attitude scale, the results of which will be analyzed statistically.

This study employed the use of both qualitative and quantitative instruments for data collection. These instruments namely questionnaires, interview guide and observation check list were used together to obtain the information needed for the study.

Research Design

This study employed the use of both descriptive research and explanatory design. The descriptive survey design is deemed appropriate for studies of either large or small samples selected from a given population. Such a study enables one to make an assessment of the characteristic of the whole population. Descriptive surveys help to identify present conditions and needs of a situation. It is concerned with conditions or interrelationships that exist, opinions that are held, processes that are going on, effects that are evident, or trends that are developing (Creswell, 2009).

The descriptive design gives a picture of a situation as it has occurred in its natural setting without any manipulation. The design helps to portray certain characteristics which describe the picture of the situation. Also, it makes use of logical methods of inductive-deductive reasoning to arrive at generalization (Zalaghi & Khazaei, 2016).

Descriptive studies may be a cross- sectional study which involves a one-time interaction with groups of people or a longitudinal study which follows individuals over time. During a descriptive study, the researcher interacts with the participant, may include surveys or interviews to collect the necessary information. This research in particular employed the cross sectional descriptive method where there was administration of questionnaires a one-time interaction with selected individuals of a various household across the district. The questionnaire however, comprised close-ended questions as well as open-ended questions. Opened- ended questions allow respondents to give feedback and creates the opportunity to gain more insight on the topic and also help in explaining the current trends of the phenomena.

The explanatory type of research design basically tries to understand and explain the current nature, situation or the relationship that exist between phenomena. It is defined as an attempt to connect ideas to help understand the causes and effects of a phenomena. According to Yin (2003), explanatory research is an empirical inquiry that investigates a contemporary phenomenon within its real-life context; when the boundaries between phenomenon and context are not clearly evident; and in which multiple sources of evidence are used. This design

seeks to answer question of "why" phenomena occur the way they do as well as explain what is going on.

The explanatory research usually involves the use of exploratory research to explore something and the use of descriptive research to gain more knowledge about it before seeking to explain the situation. Explanatory research looks at how things come together and interact. It was adopted for the research to help explore and explain the factors that determine and influence the households' choice of water sources for domestic consumption as well as challenges facing households access to water in the Shai Osudoku district of Ghana.

These two designs were adopted for the research mainly because they tend to complement each other. The descriptive research explores and explain the factors that influence the choice of water while the explanatory research looks at how these factors come together and interact.

Sources of Data

This research work made use of primary sources of data. The primary data was collected from key respondents which included some members of the communities, selected assembly members and some opinion leaders. Aside the identified persons, data for the study was derived from the other published and unpublished research articles including online and printed journals, newspaper articles and gazettes. Other sources of materials include various news portals and text book which were also obtained in soft and hard copies

Target Population

Population is a group of individual units with some commonality which is been studied. The target population of a survey on the other hand is defined by Ogula (2005) as "the group of persons, objects or institutions that define the objects of the investigation". For the study, the target population are the female household heads, and other household members either female or male above the age of 18. Members above the ages of 18 were also included in the target population so as to provide alternative respondents for households whose female heads were not available during the time of data collection. The primary criterion used in the selection of respondents is that, such persons must have lived in the study area for at least a year since this would offer them a better appreciation of the water situation and also make meaningful contribution to the study.

Being the main target for this study, the study found it necessary to distinguish the two groups of female household heads namely "de jure" and "de facto". In "de jure" female headed households', women are the legal and customary heads; examples are households headed by widows and unmarried, separated or divorced women. The "de facto" female headed households have on the other hand either a self-reported female head whose husband is present or, more typically, a self-reported male head who is absent for most of the time (Klasen, Lechtenfeld, & Povel, 2011). Women are usually equipped with most of the needed information in relation to the topic under investigation since they are mainly responsible for providing the household with water.

For the focus group discussions, the target population included selected female opinion leaders in the communities due to the key role in collecting water for their households. The in-depth interviews saw the need to interact with the assembly members of the communities since they play key roles in the development of the communities and some selected water vendors and sachet water or "*pure*" water manufacturers, who also play major role in supplying water to the communities.

Sample Size and Sampling Procedure

Sampling refers to a selected proportion of the population under study. A sample is defined as the elements selected with the intention of finding out something about the total population from which they are taken (Mouton, 1996) Working with the entire population is usually very difficult and time consuming hence sampling is done to choose a fraction of the population to represent the whole population. Also, the element of financial constrains contribute to reasons why sampling is done. Consequently, data collected from the sample can be used to represent the stance of the entire population or used in the generalization of the population (Mouton).

The household samples

Household refers to a domestic unit consisting of the members of a family who live together along with non-relatives such as servants. It also refers to a social unit composed of those living together in the same dwelling or those who dwell under the same roof and compose a family. This study was conducted in two

communities in the Shai-Osudoku district of Ghana. These communities are Dodowa, the district capital and Doryumu, the traditional headquarters of the Hiowe Division of the Shai State. From the 2010 population and housing census, both communities were ranked the top two most populated communities in the district and with an estimated population of 15,415, with Dodowa accounted for 78% while Doryumu accounted for the remaining 22% representing. With an average household size 4.4 for the district, the two communities had a total of 3,404 households where an estimated 657 of these households were headed by females.

For the household sample of the study, a sample of 300 households was generated with the help of the formula by Gang (1999):

$$n = \frac{Z \times [p(1-p)]}{d^2} \quad (1)$$

Where n =Sample Size.

Z value represents the confidence level chosen for the study.

d value represents confidence interval and.

p= value represents the percentage picking

The confidence level refers to the percentage of all possible samples that can be expected to include the true population parameter. It is expressed as a percentage and represents how often the true percentage of the population who would pick an answer lies within the confidence interval. The 95% confidence level implies one can be 95% certain of the sample. The 95% confidence level was chosen because it works within 2 standard deviations from the mean thus making it very easy to calculate and a very popular option.

Representing the percentage picking, the *p* value gives the percentage of people who give a particular answer to a question in a survey. For example, if 98% of people select an answer there is no much room for error. However, if 45 or 55% select a particular answer, there is no clear majority and the chance for error gets bigger. One cannot usually anticipate how people will answer, so 0.5 or 50% is used as the worst-case scenario, which covers most cases when estimating sample size. Finally, the *d* value represents confidence interval popularly referred to as the margin of error. It is the plus-or-minus figure that is used to define the lower and upper bounds of the confidence interval. Here it indicates how much error can be accepted and try to ensure that the sample estimate does not differ from the true population by more than this percentage a certain number of times (confidence level).

This calculated sample was further shared between the two communities. In all, 235 questionnaires were sampled from Dodowa because it the larger of the two communities and accounts for 78% of the total population with an estimated population size of 12,070. The figure sampled from Dodowa accounted for 78% of the 300-sample size. The remaining 65 representing 22% of the sample size were collected from Doryumu which also accounts for 22% of the total population with an estimated population of 3,345.

In administering the questionnaires, the study adopted the stratified and systematic sampling procedures. Stratified sampling is a sampling procedure which can be used together with either random or systematic sampling. It can also be used with point, line or area techniques. This method is used when the population or

sampling frame is made up of sub-sets of known size. The sub-sets make up different proportion and therefore sampling is stratified so as to ensure that the results are proportional and representative of the whole.

The stratified sampling procedure saw to the division of the communities into subsets before the sampling was done. Dodowa was divided into two main sections namely Lower and Upper Dodowa based on the demarcation by the district assembly using the river Dodowa. Also, 118 questionnaires were administered in communities located in Upper Dodowa (Ramatown, Wedokum, Kpankpo, Matetse, Apetekyie, and Bletum,) and the remaining 117 were administered in communities located in Lower Dodowa (Apeko, Osroba, Obom, Djabletey, School Town and Zongo). In Doryumu, 33 questionnaires were administered in the Northern section and the remaining 32 administered in the South section.

The next stage of the sampling procedure was the systematic sampling. Here, samples were selected in a systematic manner. The study adopted the system of the Nth number procedure. For the study after selecting a starting point, the third house was then chosen subsequently. This was decided so that the selected houses are not too close together and yet not too far apart.

The female household heads from the selected houses served as respondents for the questionnaire and in cases where the household heads were not available, other adults stepped in to respond to the questionnaire. In situations where the respondent could not read and write, the researcher read out questions to the respondent and wrote down the answers on their behalf.

The next subgroup was the key informants which comprised three assembly members, one from Doryumu and the remaining two from Dodowa (one from each section). Also, one water vendor from Dodowa, one Operations Manager for a sachet water manufacturing company and one Station Manager at the Dodowa Booster Station were interviewed. The sample size for the FGDs comprised 12 women with ages ranging from 50 to 55 years and 12 young girls between the ages of 12 to 16 years. In all, a total of 330 respondents were selected for the study, the breakdown of which is presented in Table 4.

Table 4: Sample framework

Units	Sample size
Households	300
Assembly members	1
water vendor	3
Operations Manager	1
Station Manager	1
FGDs with women in Dodowa	6
FGDs with young girls in Dodowa	6
FGDs with women in Doryumu	6
FGDs with young girls in Doryumu	6
Total	330

Source**:** Field data, 2016

Research Instruments

The instruments used to collect primary data for this study included questionnaires, observation checklist, focus group discussion guide and in-depth interview guide. Findings from the focus group discussions were used to complement and authenticate the findings of the household survey.

Questionnaires

Questionnaires are instruments used for obtaining quantitative data. Questionnaires are easy to analyze and most statistical analysis software can easily process them. It also guarantees precision and validity. The questionnaire was used because of its known advantages of building good rapport, creating a relaxing and healthy atmosphere in which respondents easily cooperate, answer questions, and clear misapprehension about any aspect of a study (Kumekpor, 2002).

The questionnaire (Appendix 1) used for the study comprised both closed and opened ended questions which were to be answered by the respondents. In the case of open-ended questions, the respondents were free to provide their own answers the way they consider to be the most appropriate, in their own way and in their own words. The closed-ended questions were used because, the responses would be fixed and the respondents would be expected to choose the option within which he or she agrees most.

The questionnaire had 78 items, sub-divided into 7 sections (A-G), and covered such areas as sources of water, preferred water sources for domestic consumption, factors influencing choices of water sources, willingness to pay for

improved potable water supply, challenges in accessing water in the communities and water poverty index.

Since most of the respondent could either not read, write or both, the researcher aided the respondent is proving the needed responses. This saw done by translating the questions from English which was the primary language used in drafting the instrument to the local Adangbe. By this, the respondents were able to appreciate the instrument and offered the needs response. On the average, it took between 30 to 45 minutes to complete a questionnaire.

In-depth interview (IDI) guide

The IDI guide (Appendix 2) was another tool used for the study. This guide was used as a guide for the in-depth interviews conducted with the assembly members, operation manager and water vendor. It was more useful to formulate the interview guide, which was the main qualitative research method. The questions were open ended questions which allowed for more changes during the actual data collection on the field. As such it was possible to obtain more detailed information where necessary with the interview.

To ensure validity and reliability, the responses provided by the interviewees were repeated by the interviewers for the interviewees to confirm or modify. This ensured that the interviewees understood the issues very well and that their responses were not misrepresented by the interviewers or the recorders. Also, in addition to the recorder, a note taker was present to take note of the important points that were derived from the interviews.

Using an unstructured interview guide, the respondents had the opportunity to control the direction of the questions but the researcher insisted that all relevant questions on the interview guide were answered. Time taken for each interview session ranged 70 to 90 minutes.

Focus group discussions (FGD) guide

The FGD guide (Appendix 3) also served as an instrument for collecting more data for the study. With the FGDs, data is collected through a semi-structured group interview. FGDs also provided significant information about the study object and explained trend variances, reasons and causes through the views of respondents. This instrument was used to obtain information from a group of women as well as a group of young girls in the study communities. Four FGDs were conducted and there were 6 participants in each group with two facilitators one as the moderator and the other, as a note taker of responses from participants. In addition to the note taker, a digital voice recorder was used with the permission of the participants. The FGD was conducted to complement the responses of the main respondents in the survey and it also allowed great flexibility in the questioning process. Here the average time sent on every interview session ranged from 50 to 80 minutes.

Observation checklist

The observation checklist was another tool employed. This checklist served as a guide to take note of the available water facilities in the various communities. Study visits were made to the Dodowa Booster Station, district water company office, the Vive mineral water company site, the Chenku waterfall which is the

source of one of the major rivers that flow across the community and surveys through the communities to identify the presence, number and condition of various water sources in both communities as well as the available water storage facilities. By observing, photographs were also taken and used to as evidence to support the study.

Pre-test of research instruments

The instruments were subjected to pretest during a reconnaissance study and improvements were made to meet the requirements for the field survey. The reconnaissance study was conducted to test the instruments as well as get familiar with the study area. According to Sarantakos (1997), the reconnaissance stage of the study gives the researcher familiarity with the environment and also offered the opportunity to practice research in real situation before the main study began. For this research, the reconnaissance survey was done in Bawaleshi a 10 minutes' drive away from Dodowa. This location was chosen due to its proximity to Dodowa hence a high chance of household sharing similar characteristic of water situations to that of the actual study area.

Ethical Considerations and Community Entry Protocol

This study was designed in such a way that it did not pose any threat whatsoever or have the potential of posing any threat to the respondents. The issue of informed consent was provided for in this study by making sure that all respondents for the study were briefed to know the purpose of the research.

The researcher first contacted the Presiding Members with an introductory letter from the Department of Geography and Regional Planning, University of Cape Coast (Appendix 4). The same introductory letter was sent to the Dodowa Booster Station and the Vive mineral water company. They all unreservedly consented to participate before the research was conducted.

The questionnaires did not capture names or personal details of respondents. Moreover, unless the respondent was illiterate, he/she was given the opportunity (under guidance) to answer the questionnaire personally. Afterwards, the report of the findings did not include names of respondents or anything that could lead to their identification.

It should be noted that all the data collection instruments were vetted and approved by the University of Cape Coast review board.

Fieldwork

Before the actual fieldwork began, a reconnaissance survey took place a week earlier to identify the houses to enter, which household within the house to interview, and the routing of field assistants. During this period, the researcher undertook the necessary community entry protocols by informing and seeking the consent of the appropriate authorities in each study area.

The fieldwork for the household survey was conducted in June 2016. The in-depth interviews, the focus group discussions and observations were conducted alongside the household survey. Data was collected by the researcher with the help of field assistants due to the size of the sample and the limited time available. A

training session was conducted for the six field assistants. The training included familiarizing themselves with the research instruments as well as a practice session in administering the questionnaire. The field assistants administered the questionnaires to themselves in turns so that all of them would be able to detect the flaws in the styles of questions when it comes up during the fieldwork.

Field Experiences and Challenges

Obviously, the researcher expected some predictable difficulties in the process of data collection. The first challenge had to do with the weather. Since the month of June is one of the major rainy periods in the country, predicting which day and time to expect the rain was next to impossible. Though the researcher and field assistants put measures to protect themselves and the research instruments from the rains, the weather still posed a major challenge.

There were instances where the researcher had to spend over an hour with a respondent after completing their session because the downpour was too heavy to walk in and also more valuable time was lost waiting for the rains to subside which could have been used to conduct another session. There were days that no data collection was done or had to be rescheduled. Also, during the period of frequent rains, most respondents tend to forget the challenges they face in accessing water hence there was the need to probe further for the situation during the dry season.

Another setback to this study was the difficulty in contacting respondents and unwillingness of some respondents to partake in the questionnaire administration. Language also served as another factor that posed a great barrier to

the data collection method. Most of the respondents speak only the Krobo language hence it was a bit challenging to translate and explain the content of the questionnaire and interview guide to them. However, in addressing this challenge, assistants who are fluent in the Krobo language were employed and there were instances young children with some level of education within the household also assisted with the translation.

Data Processing and Analysis

Various techniques were adopted to help address the various specific objective of the study. The data from the household survey was edited, coded and entered into the Statistical Product for Service Solution (SPSS) version 21. Stata and Excel Xlstat statistical software packages were used to run Kruskal Walis test statistic, multinomial and logit models.

The first objective of the study which sought to identify the available water sources to households in the study area were measured and estimated using descriptive statistics with the help of SPSS. Central tendencies were used to describe variables and in establishing relationships between the available sources and choices of water. The study also employed inferential statistical tools such as cross tabulation and correlation to help establish relationships between the factors influencing the preferred choice of water and the available water sources.

In estimating the second objective which is to assess households' preferred water sources for domestic consumption in the communities, the use of the logit model was employed to help determine the proportion of households that have

access to potable water or not. Here the sources of water were classified under two main categories that is potable and non-potable water. These categories were assigned values thus one (1) for potable water and zero (0) for non-potable water. In determining the factors influencing their preferred water sources for domestic consumption, the multinomial logit was used in order to understand how the factors influencing the choices of water and also the challenges faced in accessing water in the communities, was measured using descriptive statistics with the help of SPSS,

Furthermore, the third objective which sort to examine household willingness to pay for improved potable water supply was measured using descriptive statistics with the help of SPSS and Stata. Also, the chi-square (χ^2) statistic was employed to identify the relationship between respondents' willingness to pay for improved potable water supply and the different socio-demographic or economic variables.

The last objective that sought to estimate variability in water poverty indices within the case study communities was accomplished with the use of the Water Poverty Index simple time analysis and Excel. This index allowed the study to assess the magnitude of water poverty amongst the communities. The tool explicitly identifies the most water poor or affected communities for social interventions.

The data gathered from the interviews thus both the IDIs and the FGDs conducted was analyzed manually. The data was transcribed, coded and categorized under specific theme and used for the analysis. The results from the IDIs and the FGDs were categorized into appropriate themes and analyzed. Frequencies, percentages and cross-tabulations were generated and interpreted.

Analytical Framework and Empirical Models

1. Water Poverty Index (WPI)

WPI provides a better understanding of the relationship between the physical extent of water availability, its ease of abstraction, and the level of community welfare. It provides bases for prioritizing water needs. Moreover, WPI is welfare tool to monitor progress made in achieving Millennium Development Goals in the water subsector. In addition, the index is primarily designed to help policymakers to identify communities facing poor water endowments and poor adaptive capacity in a bid to improve their lot (Centre for Ecology and Hydrology, 2017; Lawrence, Meigh, Sullivan, 2002). There are various approaches that can be used to estimate WPI. In this study, a simple time-analysis approach was adopted due to its computational simplicity (Sullivan, 2002):

$$WPI = \frac{T}{1000\,m^3} \tag{2}$$

$$WPI = \frac{T}{V}(\min\ sl^{-1}) \tag{3}$$

Where T denotes time required by individual household to collect a quantity or volume of water (here, 1000 m3). In economic sense, T can also be seen as wage rate for labour under condition whereby water infrastructure is available and second party water service provision is possible or the total time (in minutes) spent per person in a day to collect water. V is the volume of water collected in litres. The smaller the WPI index value, the less water stress the community and higher value suggests a more stressed situation (Olotu et al., 2009). In estimating water poverty indices in the communities, the households based on their location were then

grouped under the various sections of the communities; thus, Lower and Upper Dodowa and North and South Doryumu.

2. Logistic Regression Model

The household decision to use improved and unimproved water sources can be estimated as dichotomous dependent logit model. This model has its theoretical bases in utility maximization. The household decision to use improved water sources can be represented by variable Y, where Y is equal to 1 if the household uses improved water and 0 otherwise (i.e. unimproved water sources) (see. Danquah, 2015). However, Y is influenced by sets of environmental and socioeconomic attributes of the household denoted as X.

The utility function for using improved water sources is given as $U_{i1} = \beta_i X_i + \varepsilon_{i1}$ and the function for unimproved sources is given as $U_{i0} = \beta_i X_i + \varepsilon_{i0}$, where ε epsilon the error term with logistic distribution (Danquah ,2015). The probability (Pi) of selecting improved over unimproved water is equal to 1, if $U_{i1} > U_{i0}$ and probability for choosing from unimproved water sources is 0, if $U_{i1} < U_{i0}$. The probability Pr (Pi =1) of utilizing improved water sources for domestic activities or production decisions is a cumulative distribution function F with a set of explanatory variables X and vector β with unknown parameters (Danquah, 2015). This is specified as follows (Zbinden & Lee, 2005):

$$P_i(Y_i = 1) = \frac{e^{\beta_i X_i}}{1 + e^{\beta_i X_i}} \quad (4)$$

$$P_i(Y_i = 0) = 1 - p(Y_i = 1) = \frac{1}{1 + e^{\beta_i X_i}} \quad (5)$$

The reduced form of binary logistic estimation is given as follows (Zbinden & Lee, 2005).

$$Log\left[\frac{p_i}{1 - p_i}\right] = \beta_0 + \sum_{i=1}^{n} \beta_i X_i \quad (6)$$

Empirical Model

$$\ln\left[\frac{p}{1-p}\right] = \beta_0 + \beta_1 Age + \beta_2 Householdsize + \beta_3 Educationallevel + \beta_4 Income + \beta_5 DailyLabour + \beta_6 Expenditure + \beta_7 DependencyRatio + \varepsilon \quad (7)$$

Where $\beta(s)$ are parameter estimates in the model, ε is the error term, $p_i = 1$ denotes use of improved water sources and $P_i = 0$ unimproved water sources.

1. Multinomial Logit Model (MNL)

Let Y be random variable representing sample of households within Shai-Osudoku district of Ghana. The randomly selected households can take on set of values = {1, 2, 3, 4, 5…..n} with choice decision options of (j= 0, 1, 2……J) for various water sources available within the communities. The choice decisions of the households for water sources are influence by socioeconomic and environmental conditions of the households and this denoted by vector X_i of dimension K x 1(see, Danquah, Kuwornu, Baffoe-Asare, Ananor-Frempong, & Zhang, 2015). However, X_i influences the probability (Prob (Y_i=j|X_i) of choice

decision j= 0, 1, 2, 3…..J. Hence the conceptual multinomial logit model is specified as follows (Green, 2003):

$$\Pr ob(Y = j \mid X) = \frac{e^{\beta_i X_i}}{1 + \sum_{K=0}^{J} e^{\beta_i X_i}} \tag{8}$$

To overcome problem of indeterminacy the equation (6) is normalized by setting $\beta_0 = 0$. If j =0, then J log-odd ratios of the model becomes (Greene, 2003):

$$\ln\left[\frac{P_{ij}}{P_{ik}}\right] = X_i(\beta_j - \beta_k) X_i \beta_j \tag{9}$$

The reduced linear form of equation (6) is given as Danquah et al (2015) and Ocheing, Owuor, Bebe, & Bo (2012) indicated;

$$Y = \beta_0 + \sum_{j=1}^{J} \beta_j X_i + \varepsilon \tag{10}$$

Where β_0, βj, and β_k in MNL model are vectors of parameter estimates that are of policy significance, ε denotes the error term and X_i are household characteristics that influence their water choice decision behaviour.

CHAPTER FOUR

RESULTS AND DISCUSSION

Introduction

This chapter presents the results and discussion of the study and is organized under the following headings: socio-demographic background of respondents, available water sources, preferred water source for domestic consumption, factors influencing choice of water sources, challenges in accessing water, willingness to pay for improved potable water supply and water poverty index for the communities.

Socio-Demographic Background of Respondents

This section presents the socio-demographic characteristics of the respondents from Dodowa and Doryumu, all in the Shai Osudoku District. Analysis based on respondents' socio-demographic characteristics provides some insights on other exogenous variables that may account for respondents' choice of a particular element hence the need to include this in the discussion.

Sex composition of respondents in the communities

The sex of respondents indicates the gender dimension of usage and preference of water as well as the factors that influence their choices. From Table 5, 31.7% of respondents were males while 68.3% represents females. This suggests

that there are more females than males in the communities and this is also in accordance with the Population and Housing Census of 2010 which indicates a proportionate increase in the number of women relative to men at the national and district level of which the Shia Osudoku is part (GSS, 2014). Interestingly, the Ghana Living Standards Survey Round 6 (2014), shows that female headed household record less poverty incidence than male headed households. The majority of the respondents were females because they are mainly responsible for the collection and management of water for the household. However, males also play a direct or indirect role such as part taking in the physical role of collecting water as well as providing the financial means for acquiring the water for household consumption

Table 5: Sex composition of respondents in the communities

	Communities		
Sex	Dodowa (%)	Doryumu (%)	Both (%)
Male	34.0	23.1	31.7
Female	66.0	76.9	68.3
Total	100	100.0	100.0

Source: Field data, 2016

Age distribution of respondents

Age distribution reveals the generational dimensions of respondents' choice of water in the two communities. Age distribution may not paint a perfect picture

of respondents' decision but give a fair indication of their water choices. From Table 6, a large proportion of the respondents representing 57.3% and 23.3% were between the age categories of 20 years and below and 41 to 60 years respectively. Twelve percent (12%) of the respondents were above the age of 61 years. However, it was observed that in Dodowa, more respondents (63%) fall within the youthful age range of 21 to 40 years as compared to the majority (37%) of respondents in Doryumu who fall within a much older age range of 41 to 60 years. The observed age difference may be attributed to the various degree of economic activities undertaken in both communities. While Dodowa is an urban community with some more vibrant activities which houses most financial and other formal services, Doryumu on the other hand is a peri urban community with less economic activities and thus does not attract the youthful population.

Table 6: Age composition of respondents in the communities

	Community		
Age	Dodowa (%)	Doryumu (%)	Both (%)
20 years and below	7.2	4.6	6.7
21 to 40	63	36.9	57.3
41 to 60	19.6	37	23.3
61 and above	10.2	21.5	12.7
Total	100	100	100

Source: Field data, 2016

Marital status of respondents

In drawing a better understanding of respondents' choices, with regard to water usage and preference, marital status offers a better demographic perspective since it affords us the opportunity to understand issues of water usage and preference. From Table 7, the 50.6% and 55.4% of respondents in Dodowa and Doryumu respectively accounted for married couples within the study area. Other marital status identified in the study include respondents who are single. This group represents 32.8% and 15.4% of total respondents in Dodowa and Doryumu respectively. Though the Ghana Statistical Service (2014) reveals a much smaller proportion (39.8%) of respondents are married, this proportion is preceded by single persons who accounts for (40.7%) of the national population. The difference in figure from the study and that of the district figures may be attributed to the sampling approach used since the district exercise covered the entire population while the study only reviewed a proportion of only 2 communities in the district.

Table 7: Marital status of respondents.

	Communities		
Marital Status	Dodowa (%)	Doryumu (%)	Both
Married	50.6	55.4	53.0
Single	32.8	15.4	24.1
Divorced	2.1	6.2	4.15
Separated	4.3	4.6	4.45
Widowed	10.2	18.5	14.3
Total	100.0	100.0	100

Source: Field data, 2016

Educational Status of Respondents

The educational background of respondents was deemed key to the study since it formed the basis to evaluate respondents' choice of water. On the account of the highest level of education attained by respondents, the study found that 12.8% and 26.2% of respondents in Dodowa and Doryumu respectively have not attained any form of formal education. The difference in the number of respondents who have never attained any form of formal education is that, while Dodowa has a youthful population and urbanized, Doryumu on the other hand has a more aging population and is also a peri urban community. On another score, 36.2% and 29.2% of respondents in Dodowa and Doryumu respectively had completed Junior High School. For respondents who have attained tertiary education, it was observed that while Dodowa had 20.9%, Doryumu recorded only 3.1% (see Table 8).

According to Mahama, Anaman, and Osei-Akoto,(2014), the level of education of household heads is significant in positively influencing access to improved water for domestic uses and this is also in line with findings of Boone, Glick and Sahn (2011), who in their study of household water supply choice and time allocated to water collection in Madagascar found that the educational level of the household heads is positively associated with the choosing of pipe born water and is negatively associated with choosing well as a preferred source of water. Their study further revealed that the higher the educational level of the household head the lower the water collection time for children in urban areas.

Table 8: Education Status of Respondents

	Communities		
Highest educational Level	Dodowa (%)	Doryumu (%)	Both (%)
No education	12.8	26.2	19.5
Primary	7.2	11.4	9.3
Middle/JHS	36.2	29.2	32.7
SHS/Technical	21.7	19.4	20.6
Tertiary	20.9	3.1	12
Other specify	1.3	10.7	6
Total	100	100	100

Source: Field data, 2016

Employment Status of respondents

In discussing respondent's choices when it comes to the usage of water, the study deemed it fit to discuss the source of economic power of respondents to acquire water since acquisition of water comes at a fee which is either paid at the spot or over a period of time usually a month. From Table 9, private informal sector accounts for 75% and 83.1% of respondents' employment types in Dodowa and Doryumu respectively. This data is similar to that of Ghana Statistical Service (2014) which indicates that the private informal sector accounts for over 70% of the total active labour force in the country and 80.6 % in Shai Osudoku district of which the study area is part. The categories of jobs highlighted in this employment group include farmers, food vendors, artisans and dress makers who are usually

low-income earners. Other employment types from the study include respondents in the public formal sector who are largely employed and paid by the government and fall within the middle to high income earning group. This account for 14.6% and 4.6% of respondents in Dodowa and Doryumu respectively. The income levels of households tend to influence the choice of water (Obeng-Odoom, 2012). In Howard and Bartram's (2003) view, low income household have less access to improved water as compared to high income households. WHO/UNICEF (2008) further estimates that households on lower incomes are 5.5 times more likely to lack access to improved water as compared with households on higher incomes in the same country.

Table 9: Employment Status of respondents

	Employment status		
Level	Dodowa (%)	Doryumu (%)	Both (%)
Public (Government)	14.5	4.6	12.3
Private Formal	7.2	1.5	6
Private Informal	75	83.1	69.7
Unemployed	12.3	10.8	12
Total	100	100	100

Source: Fieldwork, 2016.

Monthly expenditure on water

The amount of money spent on water offers some indication on what proportion of our income is spent on water (Behera & Ali, 2015). In this view, higher demand for water services is usually associated with areas that experience water shortage as compared to those which have reliable water from the Ghana Water Company Limited. In Table 10, 45.3.7% of the respondents spend at most GH₵ 20 on water every month, followed by those who spend between GH₵ 21 and GH₵ 40 and those who spend between GH₵ 41 and GH₵ 60 (14.7%). Only 5.7% of the respondents spend more than GH₵ 100 a month on water.

Table 10. Monthly expenditure on water

	Community		
Amount (GH₵)	Dodowa (%)	Doryumu (%)	Both (%)
20 and below	46	43.1	45.3
21 to 40	28.1	27.7	28.0
41 to 60	13.6	18.5	14.7
61 to 80	3.4	1.5	3.0
81 to 100	3.8	1.5	3.3
101 and above	5.1	7.7	5.7
Total	100.0	100.0	100.0

Source: Field data, 2016

Household Size

One socioeconomic factor that plays a leading role in determining how much household spends on water is the number of individuals in the household. This offers a better indicator to examine the level of financial burden families endure in accessing water in the study areas. From Table 11, 46.8% of the respondents had household sizes ranging from 1 to 5 people while a little above a third (41.1%) of them had between 6 and 10 people per household.

Table 11. Household Size

	COMMUNITY		
Household size	Dodowa (%)	Doryumu (%)	Both (%)
1 to 5	53.6	40.0	46.8
6 to 10	34.4	47.7	41.1
11 to 15	6.4	10.8	8.6
16 and above	5.6	1.5	3.4
Total	100.0	100.0	100.0

Source: Field data, 2016

Respondents with In-House toilet facility

In accounting for respondents' usage of water in their homes, the study went further to use the presence of toilet facilitates as a basis to measure the extent of water consumption by households as suggested by Atuahene (2010) and Asiedu (2013). From Figure 4, 52.7% of the respondents have direct access to toilet

facilities within the house while the remaining 47.3% of the respondents did not have toilet facility in their homes. Out of the 47.7% of respondents who do not have toilet facilities, 40% relied on public toilets. Here, respondents pay a fee between GH 20p to GH 50p per visit. The remaining 7.3% relied on the bush (open defecation) as an alternative to the public toilet either because they do not have the money to pay the fees or they do not want to pay the fee for using the toilet facilities. These results are relevant given Atuahene's view that households with toilet facilities use more water since some substantial amount of water is used in flushing or keeping the toilets clean as well as relying on the water to wash hands and do other auxiliary activities associated with using the toilets.

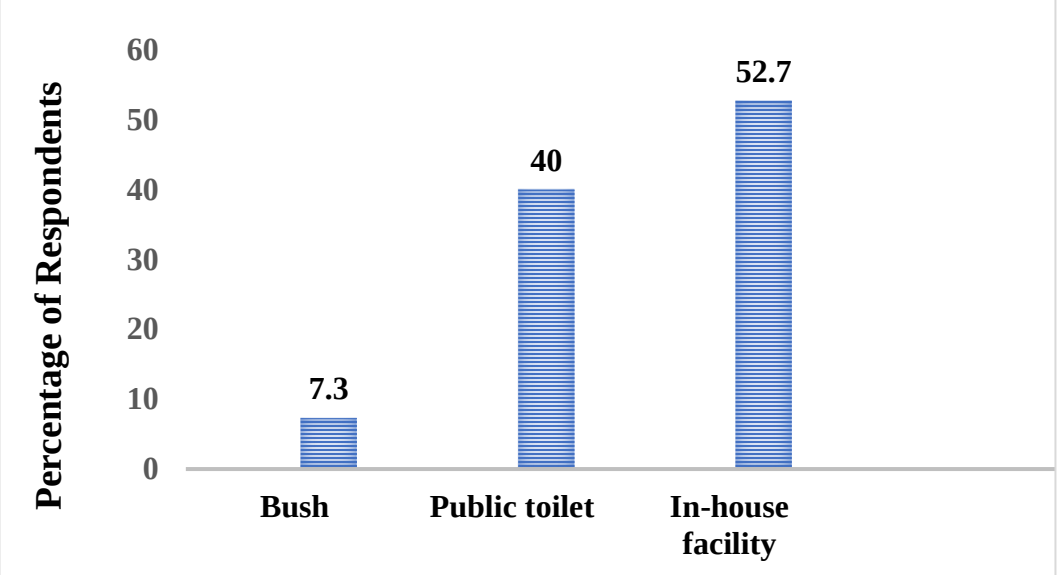


Figure 4: Places of Convenience

Source: Field data, 2016

Available Sources of Water for Household Consumption

In pursuance of the first objective of the study, respondents in both communities identified the available sources of water for household consumption. The study found that there are numerous but similar sources of water available for consumption in both Dodowa and Doryumu. Also, the presence of many sources enabled respondents to combine several sources to meet specific domestic needs. Based on the responses, uses of water were categorized under three main purposes. These include, Drinking, Cooking and Cleaning/ Washing Purposes.

The study found that a little over a third (35.5%) of the respondents use pipe borne water as their main source of water for domestic consumption, followed by sachet water/ bottle water (23.2%), rain water (20.5%) and water from wells (7.7%). This finding is in line with the views of Karikari (2000), who in his work in Appollonia, Baabianeha and Brofoyedure noted that the main sources of water for households are pipe-borne water supply (treated sources) and untreated water from boreholes (ground water sources), shallow boreholes, wells, and ponds, springs, lakes, rivers and streams.

Likewise, Asante, Berger, Engel, & Iskandarani (2002) also analyzed access to different types of drinking water sources and the choice among sources for households in the Volta Basin in Ghana. Their study found that between 25-75 percent of households in the region use improved water sources. However, according to WHO/UNICEF (2008), sachet/bottled water, rain water and well-water are not to be considered as improved source of drinking water since it is

difficult to vouch for their production. In identifying available sources of water to respondents, a 42-year-old assembly woman from Dodowa revealed that;

> *For this area, the main water we use is the pipe borne water. Some individuals have dug boreholes in their homes, and the recent rains are another opportunity for more water. There are also tanker services which supply water; for example, about two weeks ago, the taps were not flowing and I had to buy water from them. We also drink sachet water*

Some of the respondents attested to the fact that they tend to combine two or more of the available water sources to meet their various consumption needs. In Table 12, 76.9% of the respondents use sachet water for drinking while 23.1% depend on pipe borne water for drinking purposes. Similarly, for cooking purposes, pipe borne was the most used source (75%), followed by wells (17.3%). For cleaning and washing purposes, again, pipe borne leads with 53.8% followed by rain water (3.3%), wells (2.7%) and boreholes (2.0%). However, sachet water was never used for cooking, cleaning and washing since it requires the use of several sachets to achieve that purposes which only add up to cost.

Table 12: Sources of water and their corresponding uses.

Sources of water	Access to water (%)	Domestic Use of water		
		Drinking Purposes (%)	Cooking Purposes (%)	Cleaning and Washing Purposes (%)
Pipe Borne	35.5	23.1	**75.0**	53.8
Sachet water/ Bottle water	23.2	**76.9**	0	14.5
Rain	20.5	0	3.9	**3.3**
Wells	7.7	0	**17.3**	**2.7**
Borehole	4.9	0	3.8	2.0
Public tap/standpipe	3.9	0	0	5.3
Tanker supply/ Vendor provider	2.8	0	0	9.8
River/ Stream	1.5	0	0	8.6
Total	100	100	100	100

Source: Field data, 2016

Persons responsible for household water collection

With people having to travel outside their homes to access water, the study deemed it necessary to identify the particular person who is responsible for collecting water for the household. From Figure 5, the study found that children (43.10%) and women (37.9%) constitute the majority of persons responsible for collecting water for the household. With reference to the sexes, the study found that females of the various age groups in the children group were tasked with the responsibility of fetching water. With the de jure and de facto family system as practiced in that part of the country, this finding was deemed a true reflection of the study area since water fetching was skewed in the direction of females. The findings from this study conform to those of Chipeta (2013), Sullivan (2002) and Lewis et

al. (1994), who opined that, the task of collecting water for households usually fell on women and children (usually the girl child).

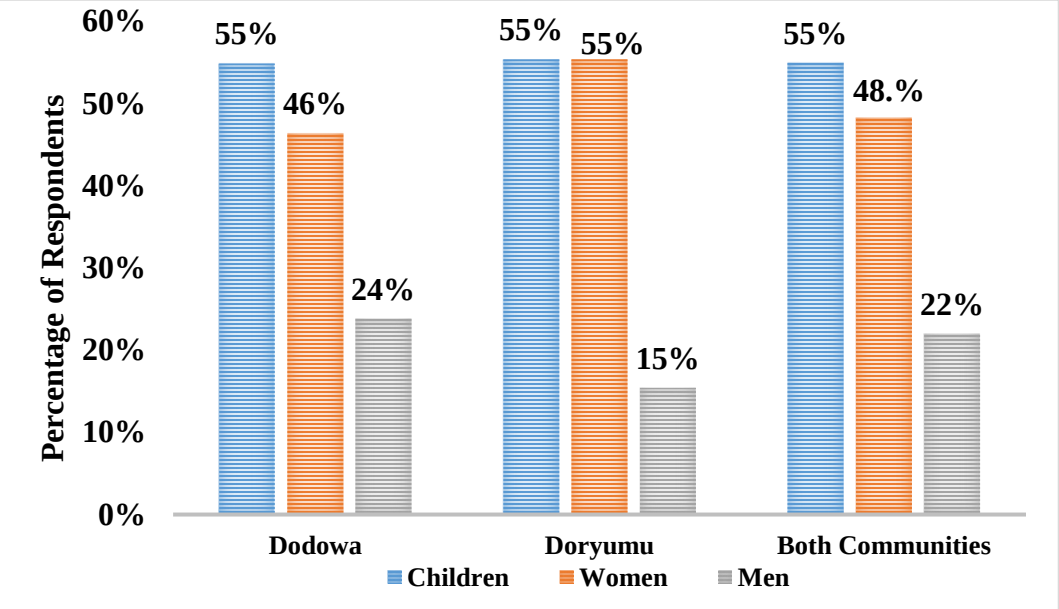


Figure 5: Persons responsible for household water collection

Source: Field data, 2016

The study also found out that, there were situations where people have direct access to water source within the house or get water delivered to their homes by tanker supply services hence, no one is solely responsible for the collection of water to the households since everybody (children, women and men) can get their own water for use. However, in Dodowa, more children than women are responsible for the collection of water for households unlike in Doryumu where both women and children are equally responsible for water collection. Again, residents of Dodowa, are more likely to pay others to fetch them water or depend on tanker supply services which is not the case in Doryumu since Dodowa is a relatively urbanized

and high-income community where people were willing to offer such services for a fee.

In both communities, 43.8% of the respondents collect water three or more times within a week. while about a quarter (24.2%) of them collect water daily (see Figure 6). This was also confirmed during the FGD in Dodowa, when a 32-year old female participant attested that;

> *I fetch four of the medium sized black bowl for 60 pesewas and use it for about 3 days; so, I fetch water every 3 days, and that within a week I can fetch water three times.*

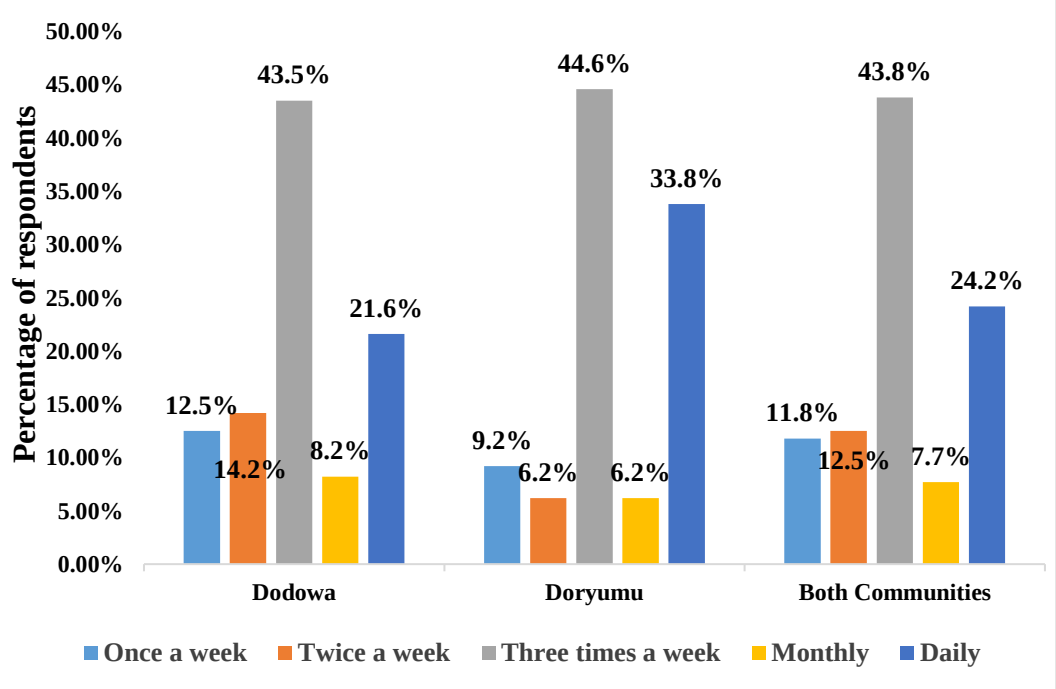


Figure 6: Frequency of fetching water for domestic use.

Source: Field data, 2016

Some respondents said their household size determines the number of times they collect water. Thus, the larger the household size, the higher the number of times they collect water. Others attributed it to their available water storage facilities as seen in Figure 7 which indicates the various storage facilities in respondents' homes. This data was obtained by the use of camera during field observation. Households with huge *poly tanks* may collect water monthly while those with relatively small storage facilities like barrels, plastic containers and bowls will collect water several times within a week depending on the household size. Those who collect water daily are usually households who do not store water or have smaller storage containers, and thus collect water as and when they have to use it. This was confirmed during the FGD with some young girls in Doryumu when a 13-year-old girl said;

> *We store our water in the big black plastic bowls and plastic containers, so we have about eight of them. It does not last long so we go and buy from the lady who has a poly tank near our house.*

Built structure for storing water

Clay and cement pots for harvesting and storing rainwater

Different containers for storing water

Water tanks for storing water connected to rain gutter for havesting rainwater

Figure 7: Some containers for storing water
Source: Field data, 2016

Table 13 shows that, the most prevalent sources of water available to household in the various communities include Pipe Borne, Public tap/stand pipe, Bore-hole/pump/tube well, Sachet water/ Bottled water and Rain. Pipe borne water is the most available sources of water to households in the communities. This is in accordance with the GSS, (2014) which stated that the main source of drinking water in the Shai Osudoku District is Pipe-Borne water and which was also used for other domestic chores. The predominance of pipe-borne water in the district is as a result of the Osudoku Water Project that helped in extending water into the district (GSS).

Though pipe borne water is the most available source of water, majority of the people do not have direct access to it in their homes and hence tend to move outside their dwellings to get to it. The use of the Sachet water/ Bottled water rated high since it serves as the preferred source of water for drinking while the other sources are used for other domestic consumption purposes like bathing, washing and cooking. This is mainly as a result of the perceived notion by consumers that the Sachet water or Bottled water are the safest sources of water among the sources since it has been treated and therefore best for drinking. Rain water also serves as an alternate source of water especially in the rainy season. Figure 8 shows some identified sources of water in the communities which was catured during field observation by the use of a camera.

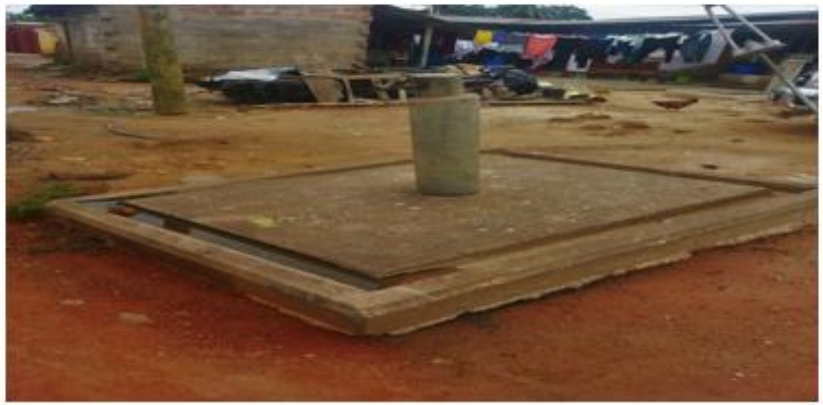
Table 13: Source of water for the various communities

Sources of water	Lower Dodowa (%)	Upper Dodowa (%)	South Doryumu (%)	North Doryumu (%)
Pipe Borne	35.4	40.4	12.9	11.3
Public tap/stand pipe	36.4	45.5	13.6	4.5
Bore-hole/pump/ tube well	33.3	51.5	9.1	6.1
Sachet water/ Bottled water	38.2	43.9	6.4	11.5
Rain water	39.6	36.7	11.5	12.2

Source: Fieldwork, 2016

Government provided water vendor operated by a selected individual in Dodowa

Public Borehole in Dodowa



A Non-functioning Public Borehole in Doryumu

Privately owned water vendor in Dodowa

Figure 8: Some available water sources
Source: Field data, 2016

Households' Preferred Water Sources for Domestic Consumption.

Due to the numerous sources of water available for use in the communities, respondents are presented with the opportunity of choice. Respondents' ability to choose from the available sources are influenced by factors that determine the preference of an individual. Studies such as Abebaw, Tadesse and Mogues, (2010), Fotuè, (2013) and Mahama et al. (2014) found that some socio-economic and demographic characteristics of individuals tend to influence their preference and choice of water. In accord with the access conceptual framework (Obrist et al., 2007), the study found that the decision to use a particular water source was determined by several factors including some demographic and socio-economic characteristics of households.

As indicated in the previous section, households in the communities tend to use a combination of several sources to meet their water consumption needs. Despite the availability and combination of various sources of water for consumption, respondents tend to prefer a particular source among the many sources. Hence there is the need to identify the most preferred source of water among the lot as well as the determinant factors that influence such choices for the selected communities. From Table 14, the most preferred source of water for household consumption is pipe borne water (79.3%), followed by sachet water (11.3%). The most preferred source of water for household consumption in both communities is pipe borne water and this confirms findings of the 2014 Ghana Statistical Service reports on the Shai Osudoku district with regards to their primary source of water.

Table 14: Preferred source of water for consumption

	Communities		
Sources of water	Dodowa (%)	Doryumu (%)	Both Com. (%)
Pipe Borne water	77	86.2	79.3
Sachet water	12.3	7.7	11.3
Borehole	4.3	1.5	3.7
Wells	3.4	1.5	2.7
Rain	1.7	3.1	2.0
Tank supply	1.3	0	1.0
Total	100.0	100.0	100.0

Source: Field data, 2016

Reasons attributed to respondents' choice of water were grouped under four main themes for the purpose of analysis. Those who considered the nature of the sources in terms of safety, cleanliness and taste of the source were grouped under Quality; respondents whose choice of water were based on the available and reliable nature of the source were grouped under Availability. Accessibility comprised the group which preferred a source due to its proximity and time spent in collecting it while Affordability consisted of the group who consider the cost in using a source (Figure 9).

Figure 9 shows that 57% of the respondents prefer a particular source of water due to the perceived quality of the source while 31% prefer a source mainly as a result of the fact that it is available to them. Only 3% prefer a particular source because it is the most affordable source of water. This implies that cost is the least

issue considered by households when choosing a source of drinking water. This might perhaps be attributed to reasons that water is a basic necessity of life and that no matter the cost, people will still have to use it. The identified reasons conform to Obrist et al's, (2007) access conceptual framework which was adopted for this study. The framework suggests that the concept of access evolves around factors such as availability, accessibility affordability and quality and these formed the basis for the analysis.

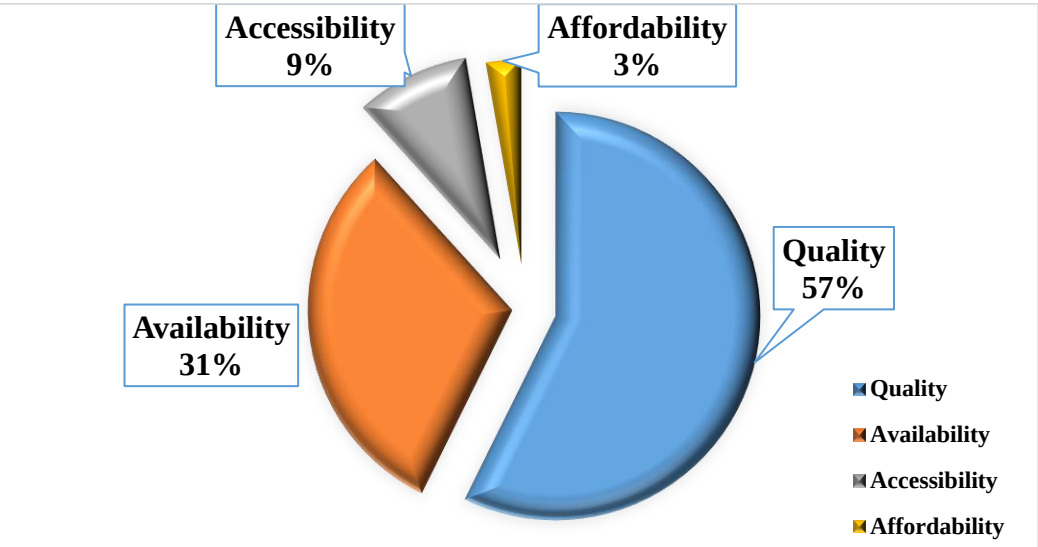


Figure 9: Reasons for preferred choice of water source

Source: Field data, 2016

These same factors are considered when choosing a water source for consumption. However, in most cases a combination of two or more of these factors were taken into consideration before the decision to choose a particular source was made. The study found that there exists a relationship between preferred source of water and the reasons for which these choices are made. Table 15 presents a cross

tabulation between respondents preferred source of water and the reason attributed to their choices. It can be observed that, 45.7% prefer pipe borne water due to its quality, 25.3% was due to its availability, 7.3% because it is accessible and 0.3% because it is affordable. A 50-year-old female participant confirmed this finding during an FGD in Doryumu:

> I*n this community, we got pipe very early. I remember we got pipe water in the community when I was a young girl because there is no clean source of water closer to us. And since we were introduced to pipe water at a very early stage, most of us prefer the pipe water*

The second most preferred source is sachet water (11.3%) which is mainly as a result of its quality (10%). Also, a 70-year-old female water vendor in Dodowa confirmed this view when she said:

> *When the taps are closed for over a week and are opened, the initial flow of water is very dirty. So, for me, I don't drink the pipe instead, I rely on the sachet water for drinking.*

Table 15: Preferred source of water and the reason for the choice

Preferred source of water	Reasons for the choice of water source				Total Preference (%)
	Quality (%)	Availability (%)	Accessibility (%)	Affordability (%)	
Borehole	0	3.3	0.3	0.0	3.6
Pipe Borne water	45.7	25.3	7.3	0.3	78.7
Protected well	0.0	1.3	0.3	1.0	2.7
Rain	1.3	0.3	0.0	0.3	2.0
Sachet water	10.0	0.7	0.3	0.3	11.3
Stand pipe	0.3	0.0	0.4	0.0	0.7
Tank supply	0.0	0.0	0.3	0.7	1.0
Total	57.3	31.0	9.0	2.7	100

*Cronbach Alpha test (0.73)

Source: Field data, 2016

Socio-demographic characteristics and choice of improved water sources

In assessing respondents preferred source of water, the various sources were grouped under Improved and Unimproved sources based on WHO/UNICEF (2008) classification and logistic regression model was used to determine the relationship between some selected variables and access to improved source of water. Table 16 revealed that age, educational level and daily expenditure are positive and significantly ($P< 0.05$) related to improved water sources. The finding that educational level of individuals influence their choice of water is in accordance

with that of Fotuè (2013), which opines that one's level of education has a strong and positive impact on household access to improved water source. One of the possible reasons for this finding is that educated people are more aware about the potential health problems associated with the consumption of unimproved water and for that reason they are more likely to rely on water from improved sources.

The study found that the age of an individual is also a significant factor when it comes to one's decision to use an improved source of water for consumption. The findings suggest that elderly persons are more inclined to use improved sources of water than young persons, possibly because adults are more aware of the dangers of consuming water from unimproved sources than the young ones.

Household daily expenditure on water was found to influence the choice to use an improved source of water. The higher the household's daily expenditure on water, the more likely it depends on improved water sources. Thus, access to improve water usually comes at a higher cost which in tend increases household's daily expenditure. This may be due to high supply fee charged by the vendors or the high connection fees as well as the monthly water bill. Although household daily expenditure is somewhat dependent on household income level. The study found that income level does not have a statistical significant relationship with the choice of improved water source and this confirms Mu, Whittington, and Briscoe's, (1990) findings.

Though not significant, income level has a positive relationship with the use of improved water source as suggested by Mahama et al. (2014). The study argued

that income levels of households are among the main factors that determine household access to improved water. Perhaps income level is not statistically significant because an increase in incomes levels does not necessarily mean an increase in the willingness to pay for improved water. According to Punj (2015), consumers with high income express a lower willingness to pay for commodities and the ability to pay does not translate into willingness to pay for it.

Table 16: Logistic Regression Model to establish relationship between selected demographic characteristics and the choice of improved water source

Variables	Improved source Coef.	Std. Err	z	P> z
Age	.0103685**	.0047403	2.19	0.029
Household Size	.0311914ns	.0199805	1.56	0.119
Educational Level	.1405767**	.0628123	2.24	0.025
Income level	.0001466ns	.0002959	.075	.0454
Daily expenditure	.0115434**	.0050863	2.27	0.023
Labour endowment	.0298325ns	.0328126	0.91	0.363
Dependency Ratio	-.0600906ns	.0401213	1.50	0.134

P < 0.05**; ns: not significant; Log pseudo likelihood = -115.7844

Source: Field data, 2016

Socio-demographic characteristics and the preferred water sources

Besides the social factors that influence the choice of household water for consumption, the study deemed it fit to test if some demographic characteristic of the respondents also plays a role in the choice of a particular source of water for household consumption. This test employed the use of a multinomial regression model to establish relationship between selected variables and sources of water. Table 17 shows that, marital status has a negatively significant relationship with borehole and tanker services. Also, sex of respondents has a negatively significant relationship with tanker services and rainwater. However, household size has a positively significant relationship with well and tanker. The educational level has a positive relationship with the use of sachet water while monthly expenditure has a negative relationship with sachet water, well and rainwater. Labour ratio has a positively significant relationship with Tanker services and the dependency ratio has a negatively significant relationship with Tanker services but a positively significant relationship with rainwater.

The negative relationship between marital status and borehole and tanker services suggest that married couples are less likely to use boreholes and tanker services for their consumption needs as compared to unmarried individuals. A change in marital status from being single to married is an indication of an increase in the number of members in a household hence they may go in for sources that provide easy and affordable access to more quantity of water. Perhaps since the use of borehole usually requires more energy to access water, this source may not be a favourable source for married people seeking more water for their household. Also,

the choice of tanker services usually come at a cost which an increase household size makes this source less affordable. Another reason for this choice may be due to reasons that married people become more health conscious since they may have children and hence tend to prefer water from a more improved source rather than relying on borehole and tanker services.

The sex of respondents has a negative significant relationship with tanker services and rainwater. This suggest females are less likely to use tanker services and store less rain water as compared to males who would prefer water supplied directly to their household rather than going out with containers to get water. Conceivably, females collect water in smaller quantities as compared to males who do not want to make water collection a daily task hence collect water in large quantities thus more inclined to sources that supply water in bulk quantity like the tanker service and rainwater. This finding contradicts the findings of numerous studies such as that by Chipeta, (2013), Sullivan, (2002) and Lewis et al. (1994), who all argue that the task of collecting water hence the choice of water source is usually determined by women.

Household size is one of the significant determinants of the choice of water sources and this finding is in accordance with that of Rauf, Bakhsh, Hassan, Nadeem and Kamran, (2015) who in their work in Punjab, Pakistan found that family size influences the choice of water by households. In this study, the household size has a positive significant relationship with use of water from wells and tanker, which suggest that the higher the household size the more likely households will rely on wells since this source is usually a free source of water.

Also, the use of tanker services increases with an increase in household size since it makes more economic sense to buy water in bulk from the tanker supply rather than purchasing water per bucket for a large household. It also reduces the efforts in fetching water to supply a large household.

The study further found that the educational level of a consumer tends to influence the choice of water and this confirms the views of Fotue, Totouom, and Fondo (2012), who in their work on the determinants of the households' choice of drinking water in Cameroon found that educational level of household head plays a major role when it comes to the choice of water. This study found that though educational level has a positive relationship with the choice of water sources, the most significant relationship is with the use of sachet water. Respondents consider sachet water to be of high quality, and that respondents with higher educational level tend to go in for sachet water especially for drinking purposes. On the other hand, monthly expenditure has a negative relationship with sachet water, well and rainwater. This suggests that the higher the household monthly expenditure, the less likely for it to use sachet water, wells and rain water since these sources are usually cheap and free.

Labour ratio has a positive significant relationship with Tanker services thus the higher the household members above the ages of 18, the higher the chances of the household opting for tanker services. The higher the number of household members within the labour force the higher the probability of them working to contribute for the Tanker services. The dependency ratio on the other hand has a negative significant relationship with Tanker services but a positive significant

relationship with rainwater. High dependency ratio suggests that the household has high number of its members not in the labour force. This usually translates to high household expenditure. With an increase in household expenditure, household members will perhaps choose a relatively affordable or free source of water like rain water which has a positive significant relationship with dependency ratio than choose Tanker services which usually comes at a cost.

Table 17: Multinomial Regression Model to establish relationship between selected demographic characteristics and sources of water

Variables	2	3	4	5	6
Marital Status	-.358 (0.104) ns	-1.95(0.024) **	-.336(0.381) ns	-1.106(0.059) *	-.458(0.126) ns
Sex	-.0010 (0.99) ns	1.150(0.205) ns	-1.862(0.360) ns	-56.13(0.018) **	-1.632(0.022) **
Household Size	-.234(0.424) ns	-.0190(0.805) ns	.172(0.046) **	1.661(0.054) *	.1286(0.100) ns
Educational Level	.340(0.065) *	-.168(0.642) ns	.0126(0.958) ns	.782(0.114) ns	.222(0.394) ns
Monthly expenditure	-.0006(0.078) *	-.001(0.165) ns	-.004(0.033) *	-.001(0.358) ns	-.002(0.069) *
Labour Ratio	.0165(0.954) ns	-.104(0.546) ns	-.157(0.196) ns	2.515(0.085) *	-.319(0.136) ns
Dependency Ratio	.099(0.716) ns	-.055(0.829) ns	.204(0.168) ns	-1.956(0.012) **	.377(0.019) **

P<0.10*; P < 0.05**; ns: not significant; Log pseudo likelihood = -177.51915, Wald chi2(45) = 362.67; Prob > chi2 = 0.0000; Pseudo R2 = 0.1784; Base outcome is Pipe borne water; 2: Sachet water; 3: Borehole; 4: Wells; 5: Tanker services; 6: Rainwater. Figures within the bracket = (p>z); Figures outside bracket = the co-efficiency values.

Source: Field data, 2016

Factors influencing the choice of water sources

This section seeks to examine respondents' perception of the factors influencing their choice of water for consumption. The purpose is to validate the quantitative analysis of the earlier sections. The Cronbach Alpha test showed an acceptable internal consistency (0.734) for all the factors. From Table 18, 94.3% agreed that clean water influences their choice of water source while more than half (62%) of them agreed that their income levels play a major role in determining their choice of water source which confirms Charles and Richard, (2011) findings.

Location of a water source also has some influence on the choice of water source and 73.5% of respondents expressed such a view. Thus, the farther away a source is from the household, the more likely one will switch to alternative sources that are readily available in the community which also supports the views of Engel et al, (2005). Distance from the household to the source of water may influence the time spent in collecting water to a large extent and that it is one of determinants for the choice of water source (62.5%). All things being equal, distance translates into time spent in collecting water from a source and in this light, households may prefer other sources which requires less time in collecting water. During the rainy season, rain water serves as the next best alternative water source and this influences the rate at which they depend on other sources. Rain water also helps reduce the amount of money spent on water. In this regard, 71.7% of respondents indicated that seasonal variation plays an indirect role in determining their choice of water source.

Moreover, 69.3% of respondents indicated that cost involved in purchasing water influences their choice of water source. This is in line with the findings of

Asante et al. (2002) who in their study concluded that the price of water negatively affects household demand and access in Ghana. Thus, those who cannot afford to buy water tend to depend on free alternative sources while those who have no option tend to prefer the least expensive source. Slightly more than half (54.5%) of the households indicated that household size is a strong determinant of their choice of water sources which in line with Arouna and Dabbert (2010), who found out that household size positively affects the choice of both free and purchased source of water.

Finally, the availability of a particular source of water also influenced the choice of water sources by households (85.3%). Households prefer water sources readily available and easily accessible to them. These two factors usually work in tandem to determine household choice of water for domestic consumption.

Table 18: Perception of Factors Influencing the choice of water sources.

Factors influencing choices	Agree (%)	Disagree (%)	Undecided (%)
Clean water influences choice of water source	94.3	5.3	0.3
Income level influences choice of water source	62.0	33.7	4.3
Direct access to potable water in household influences the choice of water source	81.6	12.4	6.0
Location of water source influences choice of water source	73.5	23.8	2.7
Time spent in collecting water influence choice of water source	62.5	33.8	3.7

Table 18 continued

Seasonal variation influences choice of water source	71.7	21.3	7.0
Cost of purchasing water influences choice of water source	69.3	27.3	3.3
Household size influences choice of water source	54.5	41.1	4.3
Availability of a particular source of water influence choice of water	85.3	12.0	2.7

*Cronbach Alpha (0.734)

Source: Field data, 2016

Challenges in accessing water in the communities

Having identified the factors that influence respondents' choice of water and related issues in both communities, this section focuses on the key challenges respondents face in accessing potable water. Using a three-point likert scale, issues discussed include the time spent in collecting water, distance covered to access water, challenges in transporting water from source to household as well as the cost implication of accessing potable water.

These challenges in accessing water are perhaps interconnected where one challenge forms the basis for another. From Table 19, the most pressing issue in accessing water has to do with having to transport water to household with 66% of respondents agreeing to it. This usually requires much energy since water tends to be heavy hence difficult to carry and may pose significant risks to the health of the person carrying it. According to Geere, Hunter, and Jagals (2010), the typical water carrying methods impose physical loading with potential to produce musculoskeletal disorders and related disability. Carrying water over long distances

even poses greater risk hence it has been ranked as the second most perceived challenge by the respondents.

Almost half of the respondents (49.7%) agree that pipe water is usually more expensive hence people tend to supplement it with water from traditional, often low-quality sources such as wells and boreholes. They also agreed to spending much time in collecting water since they have to either travel long distance or in some cases queue for long hours to get water especially in the dry season. However, most respondent (50.7%) disagree with the notion that free sources of water are of poor quality.

Table 19: Challenges in accessing potable water.

Challenges	Agree %	Disagree %	Undecided %	*Rating Scores	Rank
Water is heavy to carry and requires much energy to transport	66.0	32.0	2.0	264	1
Distance to water sources are too far	58.0	38.7	3.3	254.7	2
Piped water is expensive	49.7	48.7	1.6	248.1	3
Too much time is spent in collecting water	49.3	48.3	2.4	246.9	4
Free water is usually not safe or clean.	35.7	50.7	13.6	222.1	5

* An index was developed using a scale to 3, where 3 was assigned to agree and 1 being the least was assigned to Undecided. The rank score was determined by the summation of the values. For example, the score for Water is heavy to carry and requires much energy to transport was determined by, $(66 \times 3) + (32 \times 2) + (2 \times 1) = 264$.

Source: Field data, 2016

Another challenge has to do with the effects of seasonal variations on the cost of accessing water for domestic use as seen in Figure 10. About two-thirds (65.7%) of respondents agreed to spending more money on water in the dry season as compared to the rainy season. The increase in the cost of water during the dry season may be the result of the water shortage that usually occur in the dry season and that one has to travel long distance to buy water. This was confirmed during the FGD sessions when a 52-year-old female participant in Doryumu said

> *During the rainy season, we do not spend much on water because of the rains; in a month, I can spend only 10 cedis on water. However, in the dry season I can spend more than three times that amount. Also, in the dry season we consume a lot of water, since the dry season tends to be dusty so our clothes easily become dirty and hence you have to buy water to wash them. In the dry season, I sometimes spend as much as 100 cedis on water every month.*

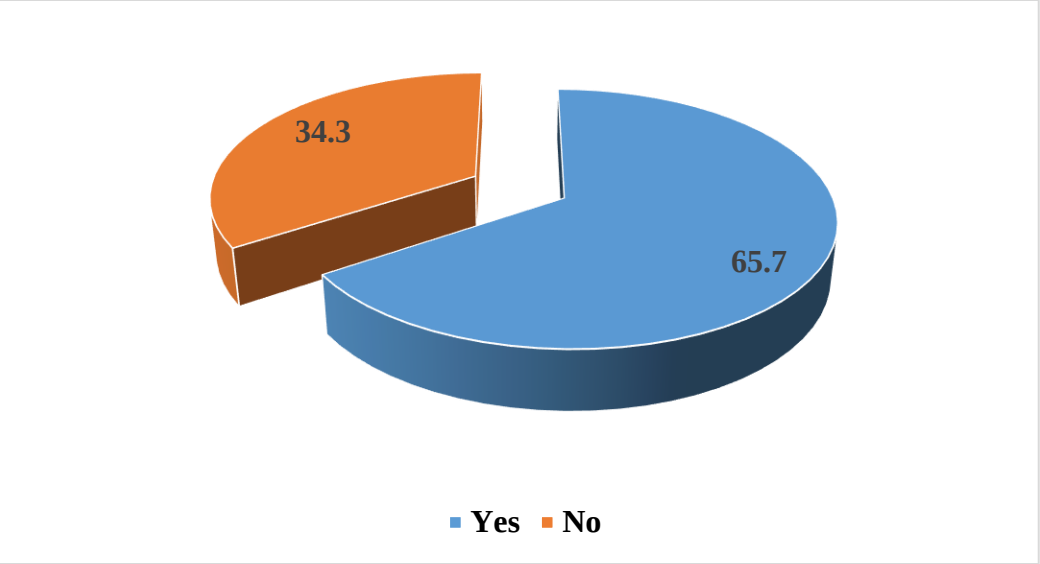


Figure 10: Seasonal variation effect on cost of water

Source: Field data, 2016

Willingness to Pay for Improved Potable Water Supply

In assessing respondents' willingness to pay for potable water supply, the study began by assessing if respondents have direct access to running taps in their homes. Direct access was operationalised to represent respondents who have taps in their homes as well as respondents who had to walk less than 10 minutes to the nearest tap in both communities. The time was deemed relevant since it reflected the average time respondents use in accessing water and it also falls within the WHO accepted time requirement for basic access which suggests a total collection time of 5 to 30 minutes (Smith & Hanson, 2003). This section was considered necessary since it afforded the study the opportunity to isolate the responses of those who have taps from those who do not have taps in their homes and these people became the object of inquiry for other questions.

From Table 20, 45.7% of respondents in both communities had direct taps in their homes while the 54.3% did not have taps and had to walk for longer minutes in accessing water. Further decomposition of the data reveals that 6.7% of those who had direct access to water had the taps in the homes while the remaining 93.3% walked not more than 10 minutes to the nearest stand pipe (Table 20).

Table 20: Direct access to potable water and location of the pipe water source

		Direct access to potable water		
		Yes %	No %	Total %
Location of pipe water source				
Dodowa	In Dwelling	5.5	0	5.5
	Outside Dwelling	37.9	56.6	94.5
	Total	43.4	56.6	100
Doryumu	In Dwelling	10.8	0	10.8
	Outside Dwelling	43.0	46.2	89.2
	Total	53.8	46.2	100
Both Communities	In Dwelling	6.7	0	6.7
	Outside Dwelling	39	54.3	93.3
	Total	45.7	54.3	100

Source: Field data, 2016

From the study, out of the respondents who had access to pipe borne water outside their dwellings, 75% of them are willing to pay for direct water connection to their homes (Figure 11). However, the cost involved in connecting seems to be the main deterrent. In Dodowa for example, a 45-year-old female participant with the direct connection to her house said:

> *It was a bit expensive, we paid about 600 Ghana cedis for the connection. This does not include the pipelines. The 600 cedis is the connection fee which is mainly determined by the distance of house to a main line connection.*

Another participant also shared her experience in seeking direct connection to her home. The 40-year old participant said;

> *Also, when you want to connect to the pipe, from a neighbour's line, they also demand money in addition to the connection fee. All my neighbours are demanding as much as 500 cedis.*

Despite the high cost of direct water connection, 5% of respondents are willing to pay more than GH₵500 for the connection. However, majority of respondents (44.8%) are willing to pay not more than GH₵50 for direct water connection (see Figure 12).

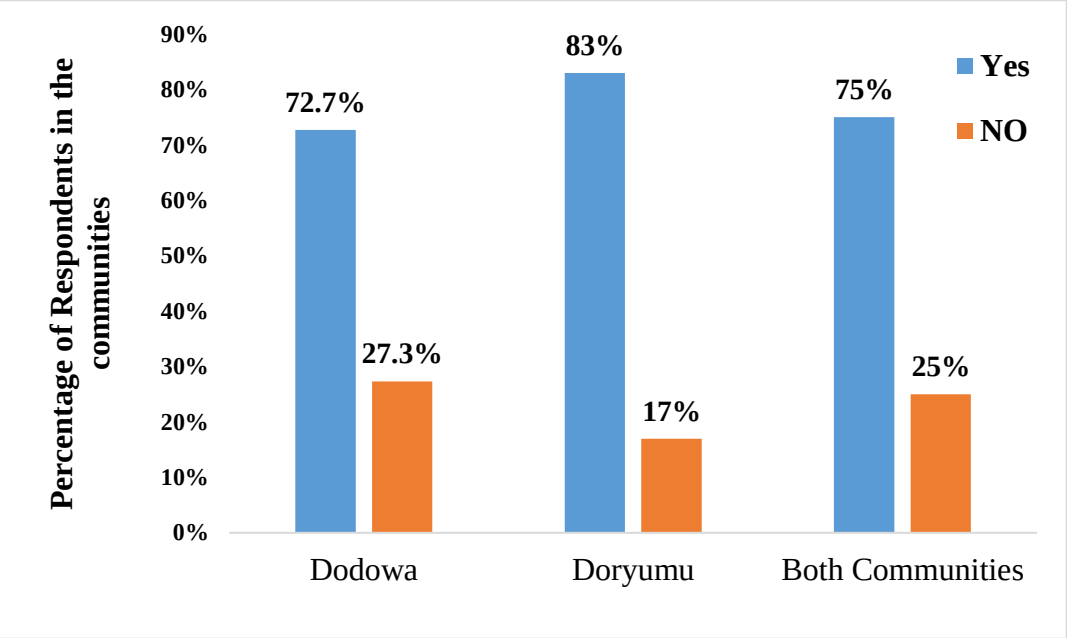


Figure 11: WTP for direct water connection to household

Source: Field data, 2016

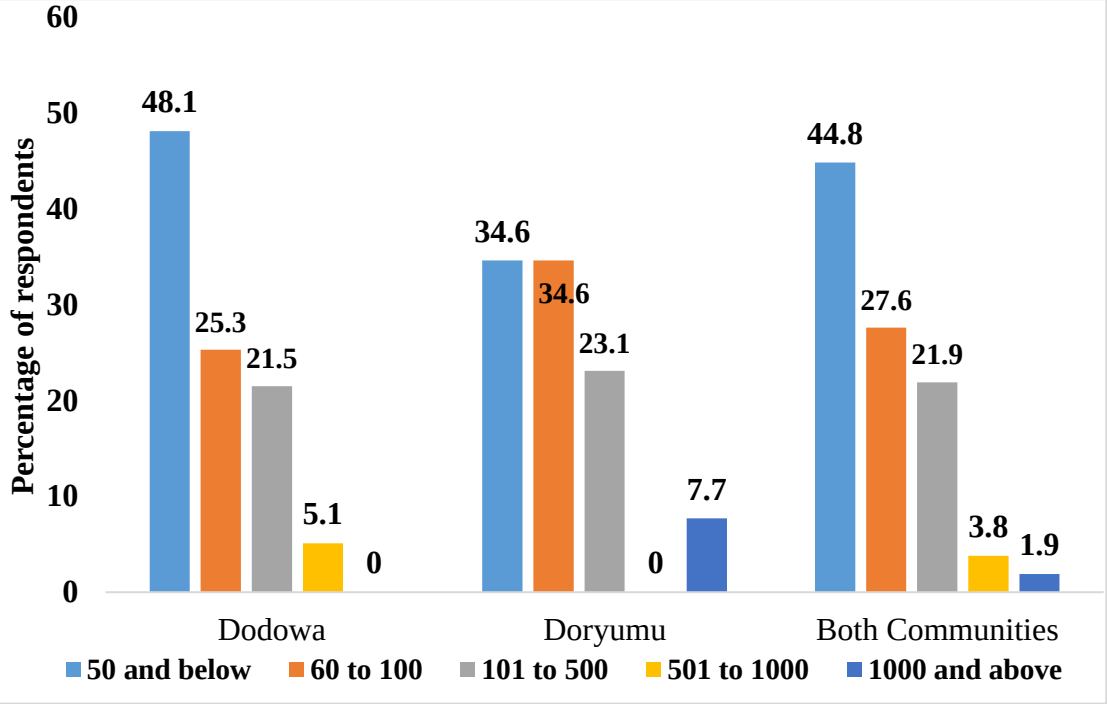


Figure 12: Amount of money (in GH₵) respondents are WTP for direct water connection

Source: Field data, 2016

In spite of respondents' willingness to pay for direct connection of pipe water, it is observed (Figure 13) that the majority (62%) of respondents with access to pipe facilities do not have constant flow of water to their household. This resulted in the need to store water for later use. Water is commonly stored in barrels, drums, tanks (poly and white), plastic containers, big rubber bowls, buckets and gallons. Others still employ traditional means of storing water like the clay pot and the cemented pit wells/reservoirs.

Notwithstanding the irregular supply of water, three quarters of respondents (75%) are satisfied with the current water supply services in the communities. In recounting the factors that inform their satisfaction, respondents cited how often they get water from their preferred choice of water source, the cost of obtaining water from that source as well as the quality of water. Respondents who were not satisfied cited irregular flow of water, high cost of water, and poor accessibility to water in their communities.

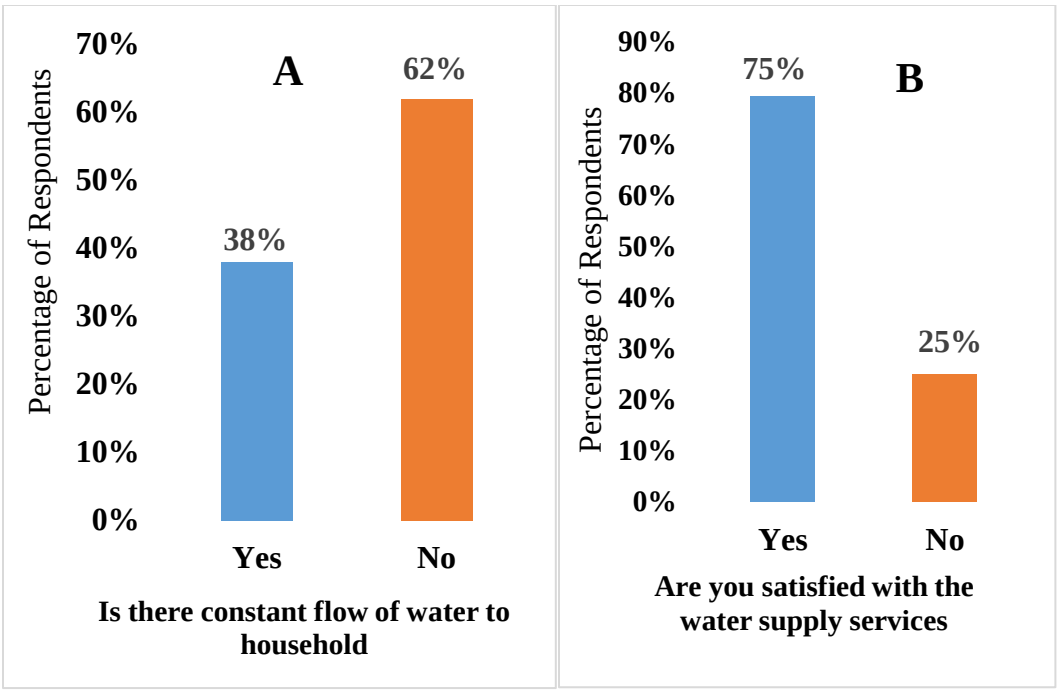


Figure 13: (A) Constant water flow and (B) Satisfaction Level of water supply service

Source: Field data, 2016

Subsequently, the study sought to explore ways through which water supply could be improved in the study communities. From Figure 14, 32.5% suggested the need to ensure constant supply of water, 27.5% wanted a direct indwelling access to the facilities and 17.5% thought services can be improved with regular maintenance work on the existing facilities. A 42-year-old female participant in the FGD in Dodowa suggested that;

> *More wells should be dug so we can use them for other activities. I think it will help reduce our dependency on the pipe which is very expensive. At first our water bill used to be between 5 cedis and 10*

cedis but for the last four months the bill has shot up drastically. We are billed as much as 300 cedis monthly.

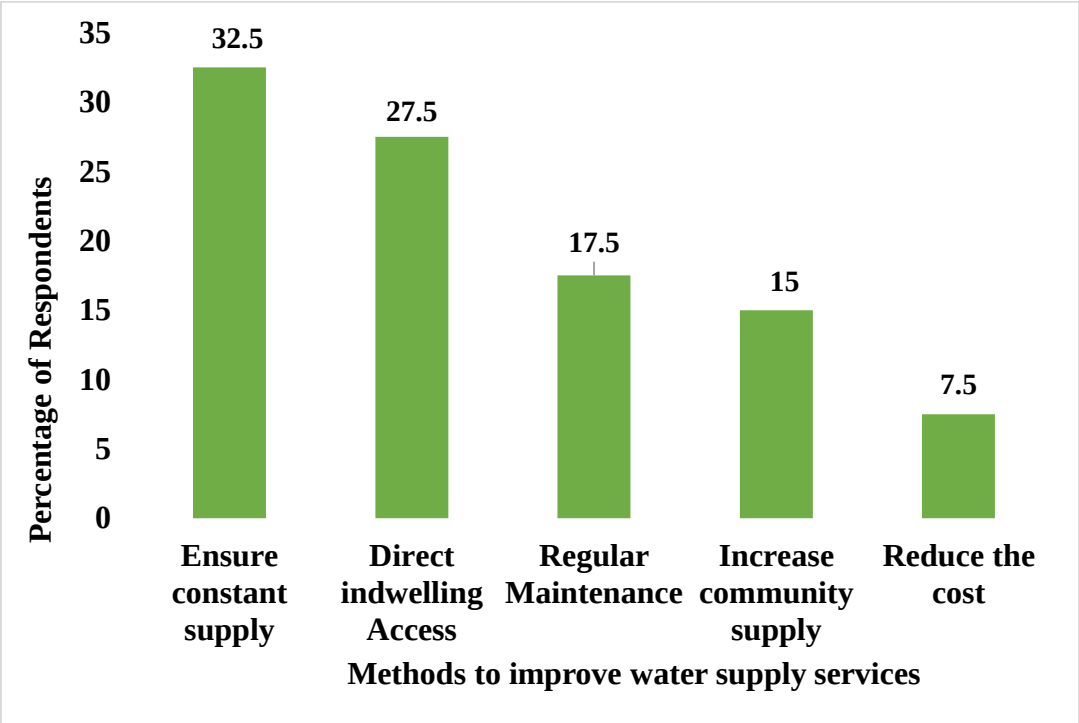


Figure 14. How to improve water supply services in the communities

Source: Field data, 2016

Having explored the respondents' willingness to connect to water to their homes as well as their satisfaction with the current water supply system, the study sought to examine their willingness to pay more for improved water services. From Figure 15, 75.5% and 80.1% were willing to pay (WTP) more for improved water quantity supply and improved water quality respectively. The results show that more people are willing to pay more for improved water quality than quantity supply. However, the WTP for improved water (quality and quantity) supply is

influenced by factors such as income, time spent to fetch water from existing sources, level of education, sanitation facility, perceived quality of current water supply, and sex of the respondent (Twerefou, Tutu, Botchway, & Darkwah, 2015).

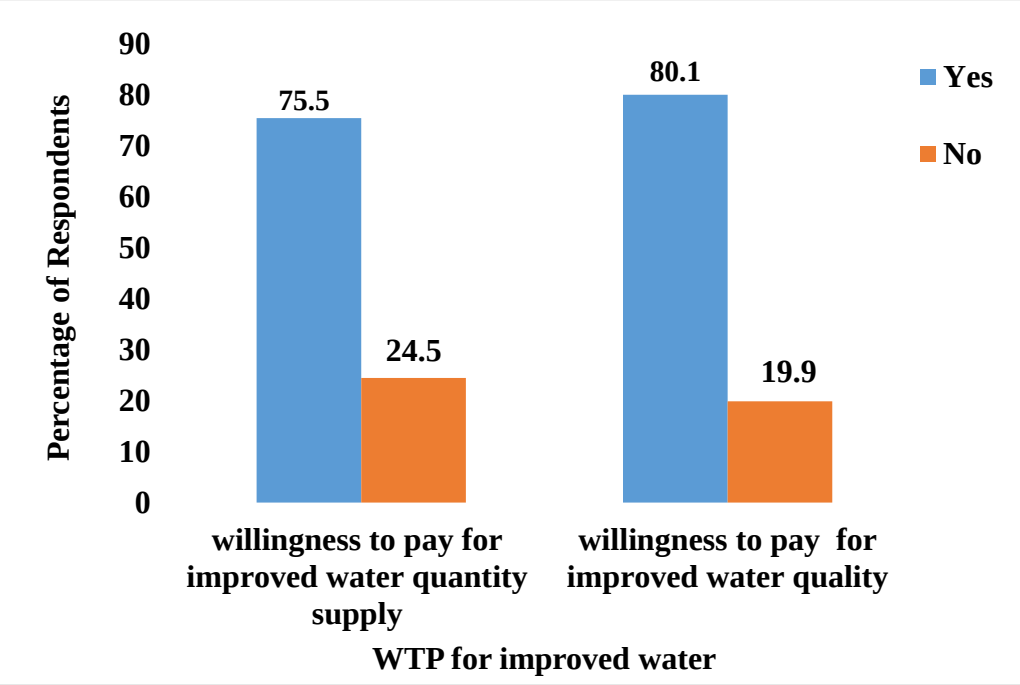


Figure 15: WTP for improved water services to household

Source: Field data, 2016

For those who were not willing to pay more for improved water services, the study sought to explore the reasons behind their decision (Figure 16). Some of the reasons include the fact that respondents were satisfied with the current services (23%), the perception that even if they are to pay more, no change will occur (26%) and that the cost of the services are already high enough (21%) and hence not willing to pay more for it. The main reason for most respondents (30%) was that of financial constraints where they could not afford to pay at all.

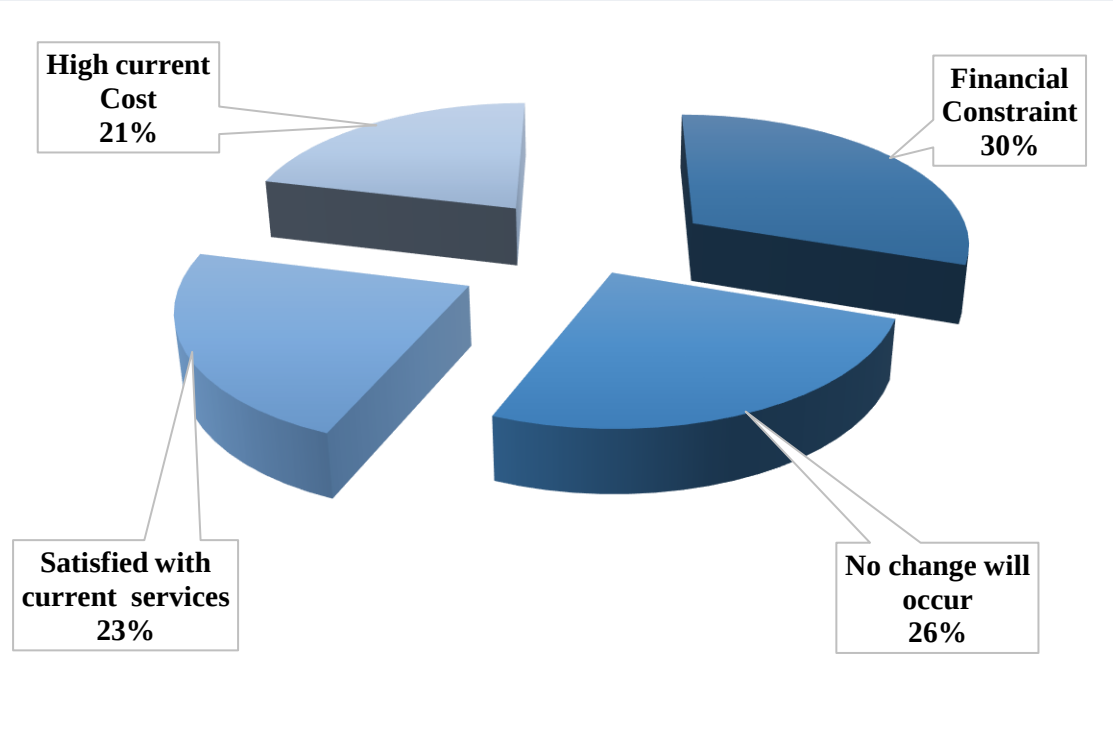


Figure 16: Reasons for not WTP for improved services

Source: Field data, 2016

Water Poverty Index (WPI)

The water poverty index (WPI) is a tool used to measure a community's access to water in relation to other communities; hence the study deemed it necessary to use this tool to estimate the water accessibility for the selected communities. The study adopted the simple time analysis approach which takes into consideration the time spent in collecting water as against the volume of water collected.

Time spent in collecting water is usually dependent on the proximity of the location of the available source of water to the household. Figure 17 shows that,

79.3% of the respondents had their water sources relatively close to their houses. The remaining 20.7% had to travel relatively far from their houses to get water.

Also, 62.3% spent less than 10 minutes in collecting water, 21.7% spend between 10 to 19 minutes while only 7% spend 30 minutes or more in collecting water. The study found that majority of the respondents have access to water since their total water collection time falls within the accepted range of 5 to 30 minutes as prescribed by Smith and Hanson (2003). Though most respondents were found to have access to water, most of them had to travel outside their homes to collect water and this is the main cause of the observed increase in time spent in collecting water. Nankhuni and Findeis (2004), in their study in Malawi found that having access to piped water in the home significantly reduces the probability of and time spent in water collection especially among children, who are usually responsible for the collection of water for the household.

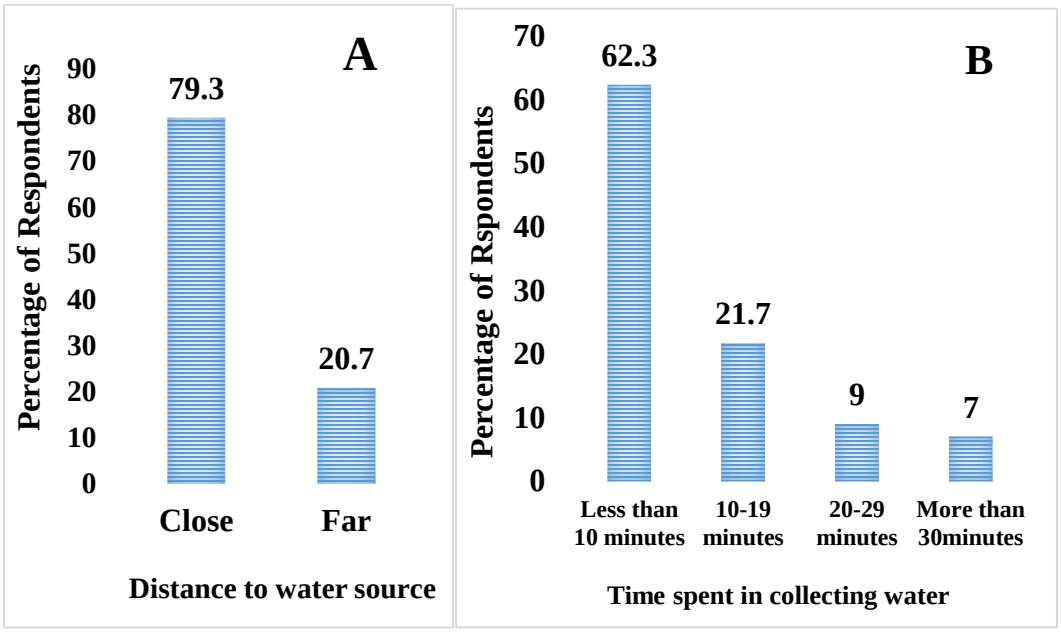


Figure 17: Distance to water source (A) and Time in collecting water (B).

Source: Field data, 2016

In general, all the communities do not face extreme water poverty situation since none of their WPI approaches one (1). Nonetheless, there is variation in the degree of access to water in the communities. Table 21 shows that, North Doryumu had the lowest WPI value of 0.036 $minsl^{-1}$ which indicates that it is the least stressed section of the communities in Doryumu hence households in this section spent relatively less time collecting more liters of water than the other communities. This is followed by South Doryumu, with an index of 0.042 $minsl^{-1}$ and Lower Dodowa with an index value of 0.048 $minsl^{-1}$. Upper Dodowa is most stressed section with the highest index value of 0.053 $minsl^{-1}$. Thus, the study found that most households in Upper Dodowa spend more time in collecting water as compared to the other communities since they tend to travel relatively longer distances from their houses to collect water and this also tend to affect the quantity of water they collect. This confirms Ako et al. (2010) assertion that the farther away one is from the source of water the more time is spent in collecting water and less quantity of water is collected.

Table 21: WPI values for the various community sections

Communities	WPI
North Doryumu	0.036
South Doryumu	0.042
Lower Dodowa	0.048
Upper Dodowa	0.053

Source: Field data, 2016

CHAPTER FIVE

SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

Introduction

This chapter presents summary of the study, conclusions drawn from the study as well as recommendations made based on the conclusions of the study. It also presents some areas for further research.

Context of the study

The main objective of the study was to investigate the factors influencing the choice of water sources for domestic consumption in Dodowa and Doryumu in the Shai Osudoku District. Specifically, the study sought to:

1. Identify the types of water source available to household in the communities.
2. Assess households' preferred water sources for domestic consumption.
3. Examine household willingness to pay for improved water supply.
4. Estimate water poverty indices in the communities for informed policy formulation.

A mixed method design was employed for the study with a sample size of 330 respondents. The study targeted 300 female household heads during the survey with a proportional allocation of 235 respondents to Dodowa and 65 to Doryumu, using multistage probability sampling technique. Also, a total of 12 adult women

and 12 young girls were sampled for an FGD in both communities while 6 key informants were interviewed.

The data collected was analyzed using SPSS, Stata and Xlstat statistical software packages. The data were presented using descriptive analysis, frequencies, percentages and cross tabulations. Also, correlations, Kruskal Walis test statistic, multinomial and logit models were run for the study.

Summary of Key Findings

The summary of the finding has been classified under themes based on the objective of the study.

Demographic characteristics of the respondents

More than two-thirds (68.3%) of the respondents were females, mostly (57.3%) within the age range of 21 to 40 years and married (51.7%). Eighty-four percent of the respondents had attained at least primary education, and though 88% of them are employed, 69.7% fall within the private informal sector. Also, 54.7% of the respondents spend more than GH₵ 20 cedi monthly on water, about half of them live in a household size of 1 to 5 people and 47.3% of them live in housing facilities without in-house toilet facilities.

The available sources of water in the community

The available sources of water for domestic consumption include pipe borne water (in- house pipes and stand pipes outside the house), borehole, wells, sachet and bottle water. Residents also harvest rain water during the rainy season. Though pipe borne water is the most available source of water, it is usually found outside

their homes and hence residents tend to move outside their dwellings to get access to it. Most (43.8%) of the respondents collect water three or more times per week and the persons responsible for collecting water for the household were mainly children (43.10%) and women (37.9%).

Preferred water source for domestic consumption

Pipe borne water (79.35) was the most preferred water source in both communities and in this regard 57% of respondents' choice of a preferred source of water was based on the perceived quality of the source. Socio-economic factors such as age, income levels, direct access to a particular source, location of the water source, time spent in collecting water from the source, cost of purchasing water from a source, household size and availability of another water source as well as seasonal variations all tend to influence the choice of water source. About two-thirds (66%) of the respondents indicated that transporting water to the household poses a great challenge, while 49.7% are of the view that pipe borne water is expensive. As a result, pipe borne water for domestic consumption is usually supplemented with water from traditional, low quality sources such as wells and boreholes.

Willingness to pay for improved water supply

Most respondents (75%) are willing to pay for direct water connection to their house. Moreover, out of this 75%, approximately 44.8% are unwilling to pay more than GH₵50 as pipe-borne water connection fee. Nevertheless, in terms of quality and constant supply of water, 80.1% are willing to pay for improved water quality than increase quantity supplied. The main reason why respondents (30%)

are unwilling to pay more for improved water supply services is due to financial constraints.

Water Poverty Index (WPI)

Majority of the respondents (62.3%) spend less than 10 minutes in collecting water. North Doryumu had the lowest WPI value of 0.036 $minsl^{-1}$ and thus the least water stressed community. However, Upper Dodowa was the most water stressed community with a recorded WPI value of 0.053 $minsl^{-1}$.

Conclusions

Based on the findings of the study, the following conclusions could be made;

The study found that to meet their domestic consumption needs respondents preferred pipe borne water than other sources available in the community. Pipe borne water is either accessed within their homes or from the communal standing pipes. Irrespective of the sources of pipe borne water, it attracts some fee. Those who access pipe borne water outside their homes have to purchase it at a cost determined by the size of the container used and those who access water via metered pipes to their homes are billed monthly by the Ghana Water Company Limited. However, the study found several cases where the taps within the households have been disconnected due to high accumulated unpaid bills.

The study also concludes that in choosing a particular source of water respondents take into consideration factors such as the Quality, Availability, Affordability and Accessibility. The study also identified factors such as age of

respondents, educational level attained and household expenditure significantly influence the choice of water source. Respondents also sometimes face challenges in accessing water especially during the dry season when water supply reduces drastically.

It can also be concluded that households were willing to pay for improved water supply services. This notwithstanding, many households want pipe borne water in their homes but could not afford the connection fee. Moreover, the consumer pays for the materials used for the connection as well as the connection fee. This cost further increases with distance from the main pipeline and if one decides to tap from a neighbour's line, she/he will also have to compensate the neighbour at a cost unregulated and suggested by the neighbour

There is variability in the level of WPI among the communities, with Upper Dodowa being highly water stressed and North Doryumu the least stressed community. The situation however, worsens in the dry season when water becomes scarce and respondents have to travel far to get water, thereby increasing their time spent in collecting water.

Recommendations

With regards to the seasonality of water supply which influences access, the study recommends that the District Assembly should organize educational programs on radio and television to educate people on the effects of human activities that destroy the environment which in the long run affects water supply sources and thus causing the seasonal water shortage as experienced in the study.

Also, the District Assembly can use the same educational platform to educate the people on how to conserve water to reduce water wastage and improve rain water harvesting. Excess rain water can be diverted into reservoirs for later use especially during the dry season.

The District Assembly may partner with water and sanitation NGOs and Community Based Organizations (CBO's) to finance water projects within the communities in a bid to reduce the pressure on GWCL. The District Assembly should invest in solar operated submissive pumps to connect all the boreholes to reduce drudgery of manual pumps during the dry season when the water table is low.

A major challenge with accessibility to water in the communities has to do with physical infrastructure to provide direct water connections to the house. People within the communities are willing to connect their houses to the pipeline, but are faced with the challenge of high cost to connect the mains. In this regard, Ministry of Sanitation and Water Resources (MSWR) has to collaborate with Ghana Water Company Limited (GWCL) and District Assembly to come out with some kind of subsidy package to enable households connect to the main pipe lines.

Finally, the District Planning Committee should ensure that new residential areas that are yet to be developed are turned into service building plots with already available pipe line infrastructure. This will reduce the challenges new neighborhoods go through in order to connect to pipe lines.

Suggestions for Further Research

Further research needs to be conducted into available water resource in the community. Such a study should employ more comprehensive WPI indices to capture multifunctional use of water and watershed within the communities. In furtherance, economic valuation of community willingness to pay for water supply infrastructure to facilitate estimation of realistic subsidies to improve access to water within the case study communities.

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APPENDICES

APPENDIX A

QUESTIONNAIRE FOR HOUSEHOLDS

UNIVERSITY OF CAPE COAST
COLLEGE OF HUMANITIES AND LEGAL STUDIES
FACULTY OF SOCIAL SCIENCES
DEPARTMENT OF GEOGRAPHY AND REGIONAL PLANNING

TOPIC: DETERMINANTS OF HOUSEHOLDS' CHOICE OF WATER SOURCES FOR DOMESTIC CONSUMPTION IN THE SHAI OSUDOKU DISTRICT, GHANA.

I am an M.Phil. Geography second year student from the department of Geography and Regional Planning of University of Cape Coast undertaking a study on the determinants of households' choice of water source for domestic consumption in the Shai-Osudoku district of Ghana. Please take a few minutes to answer questions about the factors influencing your choices of water sources in the community. This questionnaire has been designed for strict academic purposes. You are assured of total confidentiality and anonymity. Counting on your co-operation. Thank you
Please respond to the following questions. Please tick [ ] where appropriate.

SECTION A: DEMOGRAPHIC BACKGROUND OF RESPONDENTS

1. Sex: a) Male [ ] b) Female [ ]
2. Age …….
3. Educational Level a) No Education [ ] b) Primary [ ]
   c) Middle/JHS [] d) Senior High School/Technical [ ]
   e) Tertiary [ ] f) Other specify
4. How many Years of Schooling have you had……..
5. Marital Status a) Married [ ] b) Single [ ]
   c) Divorced [ ] d) Separated [ ] e) Widowed [ ]
6. Religion a) Christian [ ] b) Moslem [ ]
   c) Traditional [ ] d) Other (Please specify)……
7. What is the size of your household……....
8. How many people above 18 years are in your household? ……
9. How people below age of 18 years are in your household? …….
10. Are you in gainful employment? Yes [ ] No [ ]
11. If yes to question 10 above what is your occupation? .....
12. What is your monthly income? .....
13. Do you receive remittances? Yes [ ] No [ ]. If Yes from Whom……

14. What is your daily expenditure? …….
15. What is your monthly expenditure on water? .....
16. For how long have you lived in this community? _____
17. Are you a tenant? Yes [ ] No [ ]
18. If yes how much do you pay monthly for rent? .....
19. Do you have toilet in your house? Yes [ ] No [ ]
20. If no, where do you go to toilet? Bush [ ] Refuse dump[ ]
    Public toilet [ ] Other Specify [ ]
21. If you are using public toilet, how much do you pay in a for a single use day?

SECTION B: SOURCES OF WATER

22. What types of water sources are available in the community?
    a) Pipe-borne [ ]
    b) Public tap/Standpipe [ ]
    c) Bore-hole/Pump/Tube well [ ]
    d) Protected well [ ]
    e) Tanker supply/ Vendor provider [ ]
    f) Sachet water/Bottled water [ ]
    g)River/Stream [ ]
    h) Rain [ ]
    i) Others……
23. What types of water sources are available to you and your household?
    a) Pipe-borne [ ]
    b) Public tap/Standpipe [ ]
    c) Bore-hole/Pump/Tube well [ ]
    d) Protected well [ ]
    e) Tanker supply/ Vendor provider [ ]
    f) Sachet water/Bottled water [ ]
    g)River/Stream [ ]
    h) Rain [ ]
    i) Others……
24. Do you use the same water for all your consumption needs? Yes [ ] No [ ]
25. If No, what source do you use and for what purpose?

.....
.....

26. Do you harvest rain water? Yes [ ] No [ ]
27. Do you recycle or reuse water? Yes [ ] No [ ]
28. If yes, how and why?

    ……
    ……

29. Who is responsible for the collection for water for the household? [Tick all that apply]
    a) Children [ ]
    b) Females [ ]
    c) Males [ ]
    d) Other Specify…….
30. How often do you collect water?
    a) Once a week [ ]
    b) Twice a week [ ]
    c) Three times or more within a week [ ]
    d) Monthly [ ]

e) Other Specify…….

SECTION C: PREFERRED WATER SOURCES FOR DOMESTIC CONSUMPTION.

31. How many sources of water do you usually rely on for consumption?
(a) One source [ ] (b) Two sources [ ] (c) Three and above [ ]

32. What is your preferred source of water for consumption?
.....

33. Why that choice of water source?
.....
.....

34. How safe is your choice of water source?
a) Very Safe [ ] b) Safe [ ] c) Not Safe [ ] d) Not Sure [ ]

35. How easy is it to access your preferred choice of water source?
a) Very easy [ ] b) Easy [ ] c) Difficult [ ] d) Very difficult [ ]

36. How affordable is your preferred source of water?
(a) Free [ ] (b) Cheap [ ] (c) Moderate [ ] (d) Expensive [ ]

37. Is there constant supply of water from your preferred source of water? Yes [ ] No [ ]

38. If No, what is the alternative source of water? And Why that?
.....
.....

39. What are the challenges faced in accessing your preferred choice of water source?
……
……

SECTION D: FACTORS INFLUENCING CHOICES OF WATER SOURCES

40. What is the main source of water for domestic consumption in this household?

a) Pipe-borne [ ]
b) Public tap/Standpipe [ ]
c) Bore-hole/Pump/Tube well [ ]
d) Protected well [ ]
e) Tanker supply/ Vendor provider [ ]
f) Sachet water/Bottled water [ ]
g)River/Stream [ ]
h) Rain [ ]
i) Others……

41. What factors do you consider when choosing a water source for consumption?
……
……

Indicate your levels of agreement to each of the following statements

No.	Statements	Strongly Agree	Agree	Undecided	Disagree	Strongly Disagree
42.	Clean water influences your choice of water source					
43.	Your income level influences your choice of water source					
44.	Direct access to potable water in household influences the choice of water in relation to other sources of water					
45.	The location of water sources influences your choice of water source					
46.	Time spent in collecting water from a source influence your choice of water source					
47.	Seasonal variation influences your choice of water source					
48.	Cost of purchasing water will determine your choice of water source					
49.	Household size influences your choice of water source					
50.	Availability of a particular source of water influence your choice of water					

SECTION E: WILLINGNESS TO PAY FOR IMPROVED POTABLE WATER SUPPLY

51. Do you have direct access to pipe/ tap water in house? Yes [ ] No [ ]

52. If Yes, do you depend on other sources of water besides pipe/tap water? Yes [ ] No [ ]

53. If No, are you willing to pay for water connection to your household? Yes [ ] No [ ]

54. How much are you willing to pay for the connection?.....

55. Do you have constant flow of water to your household? Yes [ ] No [ ]

56. If No, how do you store water for later use?

.....

.....

57. Are you satisfied with the current water supply services to your household? Yes [ ] No [ ]

58. If No, what do you think can be done to improve the supply services?

59. Are you willing to pay more to improve the water supply services? Yes [ ] No [ ]
60. If Not, Why?
……
……
61. Are you willing to pay more for improved the water quality? Yes [ ] No [ ]
62. If Not, Why?
……
……

SECTION F: CHALLENGES IN ACCESSING WATER IN THE COMMUNITIES

Indicate your levels of agreement to each of the following statements

No.	Statements	Strongly Agree	Agree	Undecided	Disagree	Strongly Disagree
63.	Piped water are usually unaffordable					
64.	Distance to water sources are too far					
65.	Too much time is spent in collecting water					
66.	Water is heavy to carry, unstable and requires much energy to transport					
67.	Fee water is usually not safe or clean.					

68. What is your perception of quality **(colour)** of water?

Sources of water	Very clean	Clean	Dirty	Very dirty	Don't know
Pipe-borne					
Bore hole/Pump/Tube well					
Public tap/ Standpipe					
River /Stream					
Protected well					
Tanker supply/ Vendor provider					
Rain					

69. What is your perception of taste of the water?

Sources of water	Excellent	Good	Poor	Bad	Don't know
Pipe-borne					
Bore hole/Pump/Tube well					
Public tap/ Standpipe					
River /Stream					
Protected well					
Tanker supply/ Vendor provider					
Rain					

69. What are the challenges faced in accessing water in the community?

……

……

SECTION G: WATER POVERTY INDEX

70. How far is the main water source to your house?

a) Close [ ]
b) Very close [ ]
c) Far [ ]
d) Very Far [ ]

71. What is the distance from your home to the main source of water?

72. How long do you take in collecting water? .....

a) Less than 10 minutes [ ]
b) 10-19 minutes [ ]
c) 20-29 minutes [ ]
d) More than 30minutes [ ]

73. How much do you pay for a bucket of water?…….

74. How many buckets of water does your household fetch in a day?

75. How many buckets does your household use in a day? .....

76. How much of your income is spent on water in a month? .....

77. Do you spend more on water in the dry seasons as compared to the rainy season?

Yes [ ] No [ ]

78. If yes, explain how

APPENDIX B

FOCUS GROUPS DISCUSSION GUIDE

Welcome and thank you for participating.

Purpose of the session:
To provide insight to the factors influencing your preferred choice of water for domestic consumptions, your access to potable water and the willingness to pay for it as well as the challenges faced in accessing water.

Introductions:
Please tell me your name, how long have you have lived in the community and the role you play in water collection for the household.

Ground Rules:
- Be honest; your individual comments will remain confidential but will be compiled into report
- I will be recording the session in order to write my report but will not share the tape with anyone.
- Be respectful- no personal attacks; if you disagree, please tell us but in a calm and respectful manner
- Stay on the subject

Discussion Questions
SECTION A: SOURCES OF WATER
1. What are the available sources of water in your community?
2. Where do you normally access water for your needs?
3. Do you use water from the same source to meet all your domestic needs?
4. If not what source of water do you use for
   - Drinking
   - Bathing and washing
   - Cooking
5. Has your decision to use different sources of water anything to do with
   - Accessibility
   - Price
   - Any other
6. Do you harvest rain water?

SECTION B: PREFERRED WATER SOURCES FOR DOMESTIC CONSUMPTION.

7. What would be your preferred choice of water for all your domestic needs
8. Why that choice of water source?
9. How safe is your choice of water source?

SECTION C: FACTORS INFLUENCING THE CHOICE OF WATER SOURCES

10. What factors do you take into consideration when choosing a water source for use?
11. How does the following factor influence your choice of water?
    - Income
    - Water Quality
    - Availability
    - Location of Source
    - Distance to Source
12. Do your cultural belief and practices play a role in your choice of water source?

SECTION D: WILLINGNESS TO PAY FOR IMPROVED POTABLE WATER SUPPLY

13. Do you pay for the water?
14. How much do you pay for a gallon or bucket of water?
15. What percentage or amount of your household income do you spend on water:
    - In a day
    - In a week
    - In a month
16. Do you have piped connections to your house?
    - If Yes, how much did it cost to connect to pipe directly to your house?
    - If Not, why and how much are you willing to pay for the connection?

SECTION E: CHALLENGES IN ACCESSING WATER IN THE COMMUNITIES

17. How does the distance from your home to the source of water impart on your other activities?
18. What are the challenges faced in accessing water in the communities?
19. How can water supply be improved in the community?

SECTION F: WATER POVERTY INDEX

20. How far away from your home is the source of water?
21. How long do you travel to the source of water?
22. How long do you have to wait in queue to access the water?

APPENDIX C

INTERVIEW GUIDE

Purpose of the session:
To provide insight to the factors influencing the choice of water for domestic consumptions in the community, access to potable water and the willingness to pay for it by the community members as well as the challenges faced in accessing water in the community.

I will be recording the session in order to write my report but will not share the tape with anyone.

Introductions:
Please tell me a little about yourself, how long have you have lived in the community and the role you play in the supply of water to household.
Discussion Questions

SECTION A: SOURCES OF WATER

1. What are the available source of water in the community?
2. Which of these available sources of water are used for domestic consumption in the community?

SECTION B: PREFERRED WATER SOURCES FOR DOMESTIC CONSUMPTION.

3. What are the commonly used sources of water by the community?
4. How safe are water from this source?
5. What are some of the implications of using water from the various sources of water?

SECTION C: FACTORS INFLUENCING THE CHOICE OF WATER SOURCES

6. What factors influence their choice of water for domestic purpose?
7. Do their cultural belief and practices play a role in their choice of water source?
8. If Yes, which practices are these and how to they influence their choices?

SECTION D: WILLINGNESS TO PAY FOR IMPROVED POTABLE WATER SUPPLY

9. Does the community have a public water supply source?
10. If yes, who was responsible for the provision of such facility?

11. Which category of people rely on or use this facility?
12. Is water from this facility free or is it used at a cost?
13. How far is the coverage for piped water connection throughout the community?
14. How much is charged for the connection of piped water to individual house?

SECTION E: CHALLENGES IN ACCESSING WATER IN THE COMMUNITIES

15. What are the challenges faced by the community in the accessing potable water?
16. How can water supply be improved in the community?

SECTION F: WATER POVERTY INDEX

17. How far away from their home is the source of water?
18. How long do they travel to the source of water?

APPENDIX D

OBSERVATION CHECKLIST

1. Public standpipe
2. Rivers and streams
3. Wells and borehole
4. Water vendors
5. Tanker supply services

APPENDIX E

Entreance to water booster station in Dodowa

Top of the water storing tank

Side view of the storage tank

Air vent on top of the storage tank

Monitoring station where flow monitored and controlled.

Pump station where water is pumped from the tanker to another station.

Figure 18: Water Booster Station at Dodowa

Source: Field data, 2016