Water Scarcity in the Tamale Metropolis and the Role of the Informal Water Sector in Urban Water Supply

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A Thesis submitted to the Department of Planning, Kwame Nkrumah University of Science and Technology, Kumasi in partial fulfilment of the requirements for the degree of Master of Philosophy in Planning

April, 2015

DECLARATION

I hereby declare that this submission is my own work towards the MPhil Planning, to the best of my knowledge, it contains no material previously published by another person nor material which has been accepted for the award of any other degree of the University, except where due acknowledgement has been made in the text.

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ACKNOWLEDGEMENT

I am thankful to the Almighty God for his blessing in my life. I wish to acknowledge the support of my supervisor, Prof. Imoro Braimah, for his technical input and words of encouragement to me throughout this work. Also, my sincere gratitude goes to the staff of the Department of Planning especially Prof. K. K. Adarkwa and Mr. Adjei for supporting me throughout my stay at the Department. I deeply appreciate the technical input of Mr. Jacob Anankware. Finally, I am grateful for the Adapanga family especially, Vivian and Vida Awepuga, Christopher Awepuga, Felix and Maxwell Petio for their love and encouragement.

ABSTRACT

The study sought to assess the nature of operations of informal water supply services in the Tamale Metropolis and the effect of these services on household water access and living conditions. The case study design was adopted with the mixed research approach to gather and analyse data using questionnaires administered to households (141), informal water vendors (63), the Ghana Water Company Ltd. (GWCL) and the Metropolitan Water and Sanitation Unit of the Tamale Metropolitan Assembly.

The study revealed that 98 percent of households in the Metropolis face water access challenges due to inadequate coverage, intermittent water supply or lack of documentary requirement for connection to the public water supply network. Consequently, 47 percent of the households were unable to obtain the basic minimum per capita water supply (of 20 litres) required to maintain a healthy life. The poor water supply was due to high water demand from the rapidly growing urban population in the Metropolis vis-à-vis the limited capacity of the GWCL to provide adequate and regular water supply. Overall, 96 percent of the sampled households used alternative means of accessing water supply.

The informal water sector was the main alternative source of water for over 69 percent of the sampled households for over a decade. The study revealed that the informal water sector eased water-related social hardships among the urban households. Water supply from vendors provided vital support for households to send their children to school and on time. Some households that hitherto depended on uncovered wells and other unclean water sources were now privy to potable water supply. Households relied on the sector due to the convenience, availability and the flexible mode of payment for water supply. The vendors sourced water mainly from the GWCL and mechanized boreholes/wells. The informal water sector was not regulated. About 98 percent of the vendors operated without any permit. Financial and technical support was not readily available to vendors.

With reference to the above, it is recommended that the informal water sector be registered and integrated into the formal urban water supply system to ensure support and effective monitoring of the quality of services (especially water) supplied by the water vendors to

urban households. This should be done by the GWCL in collaboration with the Tamale Metropolitan Assembly.

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LIST OF ABBREVIATIONS

ADB	Asian Development Bank
AfDB	African Development Bank
AMCOW	African Ministers‘ Council on Water
AVRL	Aqua Vitens Rand Limited
CBD	Central Business District
CSIR	Council for Scientific and Industrial Research/
CWSA	Community Water and Sanitation Agency
EPA	Environmental Protection Agency
FAO	Food and Agricultural Organisation

FIG	Internatinal Federation of Surveyors
GDP	Gross Domestic Product
GHS	Ghana Health Service
GIS	Geographic Information System
GLSS	Ghana Living Standard Survey
GSGDA	Ghana Shared Growth and Development Agenda
GSS	Ghana Statisical Service
GWCL	Ghana Water Company Limited
GWSC	Ghana Water and Sewerage Corporation
HDR	Human Development Report
ILO	International Labour Organisation
ISSER	Institute of Statistical, Social and Economic Research
IWS	Informal Water Supply
JMP	Joint Monitoring Programme
MDAs	Ministries, Departments and Agencies
MDG	Millennium Development Goals
MMDAs	Metropolitan, Municipal and District Assemblies
MWRWH	Ministry of Water Resources, Works and Housing
MWSU	Metropolitan Water and Sanitation Unit
NDPC	National Development Planning Commission
NGO	Non-governmental Organisation
PHC	Population and Housing Census
PURC	Public Utility Regulations Commission
PWD	Public Works Department
TMA	Tamale Metropolitan Assembly
UN	United Nations
UNDP	United Nations Development Programme
UNECA	United Nations Economic Commission for Africa
UNEP	United Nations Environmental Programme

UNESCO	United Nations Educational, Scientific and Cultural Organisation
UN-Habitat	United Nations Human Settlements Programme
UNICEF	United Nations Children‘s Education Fund
UNSD	United Nations Statistics Division
UW	Unaccounted for Water
WD	Water Directorate
WHO	World Health Organisation
WRC	Water Resource Commission
WRI	Water Research Institute
WSD	Water Supply Division
WWAP	World Water Assessment Programme

CHAPTER ONE BACKGROUND OF THE STUDY

1.1 Introduction

Water is a basic need for the sustenance of all living things in their daily activities. This resource abounds in very large quantities and occupies about 70 percent of the earth crust. Access to clean water is essential for household survival and a need for livelihood and human development. According to the Human Development Report 2006 which focused on water scarcity, society‘s ability to harness the potential of water as a productive resource is a major determinant for human progress as many countries especially the developing world continue to experience increasing crisis of water scarcity. The report argued that the menace of the water crisis stem not from a real scarcity of water resource but as a result of mismanagement, poverty, inequality and unequal power relations in society. With over ten (10) years‘ work at achieving the MDG target of halving the world‘s population without access to clean water, pessimists and critics argue that achieving this target is impossible and the hopes of optimists are dying off on achieving the target.

Though access to clean water is a human right, over one (1) billion people in the world are denied this fundamental right and about 1.8 million children die annually from water and sanitary related diseases caused by consuming unclean water. This makes water related deaths the second largest cause of child mortality globally. The magnitude of the challenge of water scarcity posed to society is deep rooted as water is pivotal for the achievement of the Millennium Development Goals (MDGs) - none of which can be achieved without access to clean water. The impact of access to clean water on national and human development cannot be overemphasized because water has a cross sectorial influence affecting the development and sustainability of major sectors of any economy including health, education, agriculture, industry as well as issues of poverty, gender, vulnerability and inequality in society. Significant achievements cannot be made in education when children are sick and unable to attend school, when girls lose their right to education to travel long distances or join long queues to access water (sometime unclean water) - further exacerbating gender inequality, unemployment and low education (UNDP, 2006).

From a global perspective Sub-Sahara Africa in 2004 was ranked second after East Asia and the Pacific (406.2 million people) with 314 million people without access to clean water reflecting about 55 percent of inhabitants having no access to clean water. Environmental sanitation which is closely related to and affected by the water sector currently faces daunting challenges globally with about half (2.6 billion) of the population in developing countries living under insanitary conditions and less than 20 percent of Ghanaians having no access to adequate sanitation (UNICEF, 2005). These two fundamental services (water and sanitation) together constitute the core causes of illnesses, deprivation and retrogression to development in developing countries. The water scarcity situation among developing countries is very alarming when comparing average daily consumption between developed and developing countries. According to the Food and Agricultural Organisation (FAO), 2006 cited in UNDP (2006) the average American citizen uses 580 litres of water per day as against less than 50 litres used in countries like Ghana, Kenya, Nigeria and Burkina Faso. The situation is far reaching in countries like Haiti, Rwanda, Uganda and Mozambique where daily access is between 0 to 20 litres per person per day which is below the WHO/UNICEF standard of 50 litres per person per day.

The consequences of the water crisis can further be explained based on the substantial amount of resources expended on resolving socioeconomic effects of poor access to clean water and sanitation including high rate of water related disease infections, low agricultural and industrial production and wastage of productive hours on accessing water. Ghana is one of many countries that spend a significant proportion (5 percent) of her GDP on managing implicit and explicit development challenges emanating from poor access to clean water and use of unclean water by a significant proportion of citizens especially poor households living over 1 kilometre away from a clean water source. Ghana together with other Sub-Saharan African countries spend about US$ 26 billion annually on solving water and sanitation related problems. This amount could otherwise have been used to advance human development if universal access to clean water and adequate sanitation prevailed in these countries (UNDP, 2006). Yet perennial water shortages continue to persist even in urban areas within the operational coverage of the GWCL like Tamale.

Available statistics from the Ghana Water Company Limited (GWCL) and the Community Water and Sanitation Agency (CWSA) indicate that water supply coverage stood at 59 percent and 58.9 percent for urban and rural populace respectively at the end of 2009. This is below the set targets for 2015 (of 85 percent (urban coverage) and 76 percent (rural coverage)) by the GWCL and the CWSA respectively. According to the World Bank (2008) cited in ISSER (2013), the Northern Region recorded 58.1 percent urban water supply coverage in 2006 and in 2011, 24.9 percent of the region's population had access to pipe-borne water and 68.4 percent had access to improved water source (Ghana Statisical Service (GSS), 2011). Despite this increased access to improved water source in the region coupled with reports by the GWCL of excess production of water over demand in the metropolis, the issue of water scarcity continues to persist (Tamale Metropolitan Assembly, 2010).

The quest for an efficient system of water service provision that will adequately serve the needs of the urban population has been a major challenge for decades. Successive governments at the national and local levels have and continue to spend huge sums of resources with support from bilateral and multilateral organization in a bid to improve access to clean water by all to promote human development yet much is still desired. The situation has brought to the fore the feasibility, affordability, sustainability and convenience of private sector participation in water service provision as the public sector institutions including the GWCL have been reprimanded for administration and management lapses resulting in operational inefficiencies which much literature suggests are the core issues impeding the country's progress toward making universal access to improved water supply a reality.

1.2 Problem Statement

Developing countries are faced with numerous development challenges making living conditions for the populace, especially those living in deprived communities difficult to cope. The problem of water scarcity in the developing world is much more severe than the developed world. Low capacities and weak governance systems for efficient production and distribution are major factors accounting for the prevailing water shortages in many developing countries (ISSER, 2013). The kingpin role of water in sustainable poverty reduction and development was discussed by the United Nations (UN) in 2003. The

Millennium Declaration. Prasad (2007) explained that target ten of the MDGs, which seeks to _Halve by 2015 the proportion of people without sustainable access to safe drinking water and basic sanitation' clearly declares the profound importance of water in international development and poverty reduction discourse. However, prevailing unsustainable and poor access to clean water supply provides less opportunity for people especially the poor living in urban and peri-urban areas to attain and maintain the needed social services necessary to ameliorate social hardship (UN, 2003).

There is a progressive increase in the rate of urbanisation globally (UN-Habitat, 2013). It is however more pronounced in developing countries with over 50 percent of these countries' population living in urban areas (GSS, 2013). The unparalleled growth in urban populations coupled with unpreparedness of most developing regions to undertake commensurate infrastructural investment has resulted in the inability of urban infrastructure to keep pace with service demands of urban dwellers. Additionally, the water and sanitation sector is faced with underinvestment (allocated only 1.5% of GDP in most African countries) which is further compounded by a relatively high cost of water production than revenues received from tariffs – averaging to a deficit of US $1.8 billion (UN-Habitat, 2013).

In the wake of these challenges, (formal) urban water utilities including the GWCL are saddled with low capacities to adequately serve the urban populace. Challenges faced by providers include: persistent high rate of leakages resulting from poor network layouts and exposure, high unaccounted for and non-revenue water, weak institutional framework and governance, unsustainable financial operations, unstable (electrical) power supply, poor maintenance culture, skills gap and low capacity to adopt advanced technologies. In most areas, service quality continues to decline despite some capital investment and change in operations management (such as contracting out the management of GWCL to private firms). This situation undoubtedly persists due to general concentration on some aspects (mostly ―hardware‖) of the problem thereby providing partial rather than holistic solution to the water supply problem.

The water supply situation is also affected by some natural factors including climate change resulting in water scarcity (physically and economically) which would likely intensify with time. This is further compounded by the impact of rapid urbanisation including industrial waste and fumes polluting water bodies. This phenomenon would gradually and continually increase the cost of water provision thereby worsening the water access situation (UN-Habitat, 2013).

Ghana's urban water sector like most developing regions has undergone several reforms and investment with the aim to improving access. Yet water-related social hardship is not uncommon in urban and peri-urban areas (GSS, 2013). It is no longer a mere perception among consumers that depending solely on formal water provision is a recipe for regular water shortages, intermittent rationing and several days without water supply. Public water supply in Ghana is thereby often described as inefficient, sporadic, unreliable, undesirable and unsustainable. Despite scheduled rationing (mostly intermittent), the GWCL is able to produce and distribute water to about 60 percent of the country's urban population (Peloso & Morinville, 2014). The most affected are the urban poor, who are unable to afford large water storage tanks or engage in self-abstraction. These urban dwellers have therefore sought refuge in alternative water supply mostly from the informal water sector (Engel et al, 2005; Pangare & Pangare, 2008; FAO, 2012; Kooy, 2014; Peloso & Morinville, 2014).

According to the Ghana Statistical Service (2013), substantial proportion of the populace of the Northern Region depend on streams/river/ponds/ and canals for their water supply needs. Statistically, 25 and 29 percent of the region's population depend on these unsafe sources of water for drinking and for other domestic purposes respectively. Meanwhile, in the Greater Accra Region, only 0.6 percent and 1.5 percent of the population depend on similar sources for drinking and other domestic purposes respectively (Ghana Statistical Service (GSS), 2013). In 2008, the Northern region recorded the highest incidence of diarrhea cases (32.5%) which according to the Ghana Health Service (2008) was more severe among children living in households without access to improved source of water. Furthermore, the Tamale Metropolis was dominant with cases of guinea worm infections for which it earmarked GH¢2,340 in 2010 to fighting guinea worm infections in the metropolis (Tamale

Metropolitan Assembly, 2010). In addition to the perennial water shortages, much literature has reported harmful chemical and microbial (including faecal coliform, Pseudomonas aeruginosa, fluoride and iron) content above recommended standard in the metropolis' water resources which poses serious health risk to consumers when consumed without proper treatment (CSIR/WRI, 2008; MWRWH, 2009; Centre for Health Information Management, 2011).

Consequently, households in the region face daily struggles in accessing water. Women and children have been identified as the hardest hit victims of poor access to water supply in most parts of Ghana just like in many other developing countries (Peloso & Morinville, 2014). Women in the Ghanaian household are often charged with the responsibility of ensuring that there is water in the house for household use – spending 3.2 hours averagely in a week collecting water (FAO, 2012b; Ghana Statistical Service (GSS), 2008). Little consideration however is often given to how or where these women get water for the household as men are often less concerned. Women travel long distances and wait in long queues for a chance to fill a bucket and walk back home. Some poor urban households resort to polluted water sources due to the cost involved in acquiring potable water. Apart from the health implications this situation has on women, it also widens the gender inequality gap since women are left with little time to acquire employable skills, better education or leisure. Some households often have to make difficult choices between children going to school late or not going at all in order to search for water for the household (Nauges & Strand, 2013).

In response to this, informal water suppliers have assumed the responsibility of providing water to serve the water needs of people especially in the urban and peri-urban areas. These services take various forms ranging from individual/small scale to medium scale operations making use of locally available labour and technology. There have however been debates on the genuineness and actual benefits of services of informal water vendors to meeting the urban water demand. Debates often centre on the benefits vis-a-vis consequences that consumers are exposed to. The informal water sector however continues to operate despite varied views on the acceptability of the services provided by these informal operators. Their services have been reported to impose high charges on consumers coupled with the low

water quality due to the carting and transfer processes (UNDP, 2006). The question that lingers therefore is: are informal water services useful to the urban household and should these services be encouraged or otherwise discouraged?

1.3 Research Questions

Referring from the problem statement, the study seeks to provide empirical evidence in an attempt to assess the pros and cons of informal water vending to urban residents and the socioeconomics gains and loss associated with water vendor services. The study will be guided by the following research questions:

1. What are the causes and effects of water scarcity in the Tamale Metropolitan area?
2. What is the nature of operation of informal water sector in the Metropolis?
3. What is the effect of informal water supply on urban water access?

1.4 Research Objectives

The crux of this study is to analyse the roles of the informal water supply sector in addressing the perennial water shortages in the Tamale Metropolis. The study will achieve this under the following guiding objectives:

1. To ascertain the causes and effects of water scarcity in the Tamale Metropolis
2. To assess the nature of operations of the informal water sector in the Tamale Metropolis
3. To assess the effect of informal water supply services on urban water access

The results of this study will also reveal the current level of water scarcity in the metropolis, the reasons for the existing situation and provide evidence-based policy interventions to the problem. The findings from the study will also add to the stock of knowledge on the subject under investigation.

1.5 Purpose

Cost benefit analysis on the decision to ensure universal access to clean water within and among countries makes a strong case for countries to direct greater efforts and resources to ensuring universal access to clean water. Human rights and social justice advocates further

support the case for ensuring adequate water supply to all and protecting the rights of individuals to water access which is deep rooted in the goals of the international community. Common to all advocates for ensuring adequate supply and access to clean water is the demand for evidence-based policies to direct the supply and demand of water resources among countries. Inferentially, these goals have influenced the establishment of various institutions overtime to help develop and manage Ghana‘s water resources. Access to adequate information however is a major challenge faced by these institutions thereby impeding effective policy formulation and management of Ghana‘s water resource at the national, regional and community levels (MWRWH, 2009).

Disequilibrium in supply of and demand for water continue to affect the water access situation in urban and per-urban areas. The situation is further entrenched with increasing population growth and urbanisation. Consequently, the already inadequate water access for both domestic and industrial purposes continue to worsen (UN-Water, 2013a). Individuals and organization including the World Bank and ISSER have endorsed the involvement of the private sector in water service provision through public-private partnership or complete privatization of water service provision to enhance administrative and operational efficiency. Similarly, improving access to social services remains a major priority area in development discourse (Goverment of Ghana, 2010). On this backdrop, in 2006, the GWCL contracted the Aqua Vitens Rand Limited (AVRL) to manage water supply (in a five-year contract subject to renewal after the five year period). The objective was to help improve performance, rehabilitate and expand existing infrastructure. The contract was however terminated in 2011 on grounds of unsustainability of gains made (ISSER, 2013). This inspires an empirical undertaking to ascertain why informal water supply persists whereas formal (public and private) utilities have been unsustainable.

In response to the above, some literature opine that privatization of water supply is unsuitable especially for a developing country like Ghana. Arguing further, they believe that dealing with the opposing issues of privatization (associated higher tariffs) and mass poverty is not practical. The high tariffs will affect affordability of water to poor households thereby entrenching poor access. Also, the quality of water provided cannot be effectively monitored

hence the possibility of poor quality water provided which has adverse health implications (Fuest & Haffner, 2007). If these arguments are true, then informal water supply which is associated with high water prices and sometimes poor quality water would not be successful in these same urban areas.

The foregoing discussion presents a major challenge for policy makers on the activities of the informal water sector and how it should be integrated or discouraged. Therefore, conducting empirical research to increase knowledge on the operations of the sector and how it impacts on water access would provide invaluable information for policy makers, researchers and other stakeholders. Collaborative effects between policy-makers and researchers provide surety for integration of empirically identified problems and remedial solutions to reduce socio-economic and environmental related risk associated with water supply (Balaji et al, 2012).

1.6 Scope

With specific reference to the research problem and questions, the study examines the contribution of informal water supply in providing effective and affordable water supply services to meet the demands of individuals and groups. Though the quality of services involves the quantity and quality of water provided to consumers, it should be noted however that the emphasis of the study is on quantity and availability of services hence the quality of the water in terms of metal and microbial content (fluoride, iron and microbes) will not be tested by the researcher but will be assessed based on secondary information. The causes and effects of water scarcity and the sources of water for drinking and domestics use will be assessed from the perspective of households and institutions in the Tamale Metropolitan Area in the Northern Region.

The study was conducted in the Tamale Metropolitan Area in the Northern Region of Ghana. The Tamale metropolis is one of the fastest growing cities in Ghana with intercensal growth rate (of 3.5%) above the national growth rate of 2.5 percent. The metropolis is home to about 371,351 people (the 6th most populous among the 216 districts in Ghana). The population of the metropolis constitutes 15 percent of the region‘s population of 2,479,461 people and it

provides a large array of economic activities and services. Specifically, the study considered only the urban population of the metropolis which constituted about 274,057 (73.8%) of the total population of the metropolis. The metropolis is divided into three sub-metros: Tamale Central (142,450 people), Tamale North (148,099 people) and Tamale South (80,802 people) (GSS, 2013). The metropolis is the largest among the 20 districts in the region and it shares boundaries with the SaveluguNanton district to the north, to the south with West and East Gonja districts, Yendi municipality to the east, to the west and southwest with Tolon-Kumbungu and Central Gonja respectively (Tamale Metropolitan Assembly, 2010).

1.7 Organisation

The entire study is structured into six chapters with each chapter discussing separate components of the study. Each chapter links with the preceding chapter and provides further discussion based on the objectives of the study. In chapter one, a detailed discussion of the background and problem statement gleaning the core development issues which have prompted the study are looked at. The research questions, objectives, scope and the limitations of the research work are also outlined.

Relevant literature on informal water services and urban water supply as well as the legal and policy framework for water provision in Ghana is reviewed in chapter two. The chapter also discusses the conceptual framework of the research, drawing the link on how informal water supply affects urban water supply and the water access situation of urban households. In chapter three, a detailed discussion of the adopted methodology in conducting the study is presented including the research design, sampling, data types and sources, techniques of data collection, analysis and presentation.

Chapter four and five presents and discuss the data collected making reference to the research questions and objectives. Chapter four looks at the water access situation in the Tamale Metropolis and how it affects household access to potable water supply. Chapter five discusses the operations of the informal water sector and its contribution to household water access in the metropolis. Finally, chapter six summaries the major findings of the study and

makes recommendations for policy action and further research. The chapter also provides a conclusion of the study.

CHAPTER TWO

INFORMAL SERVICES AND URBAN WATER SUPPLY

2.1 Introduction

Urbanisation has intrinsic consequences on socioeconomic development especially in developing countries who face challenges in meeting the demands of rapid population growth including increased demand for services and facilities. Essentially, one basic but necessary service is water supply to meet the needs of individuals and groups in society. This chapter reviews literature on issues in water provision, management, accounting and policy. Essentially, it discusses relevant works on alternative water service provision for urban areas with emphasis on informal water vendors.

2.2 Water Resources and Supply

Water is a natural resource which is needed by all living organisms for their survival. About 75 percent of the earth‘s surface is occupied by water. Freshwater constitutes 3 percent of the world‘s water resources with the remaining 97 percent in oceans/seas. A large proportion (68%) of freshwater is stored in icecaps and glaciers with groundwater and surface water (river/lake/streams) constituting about 30 and 0.3 percent respectively.

According to the UNESCO, only 1 percent of the earth‘s water is usable by humans and most of it is groundwater. Surface water (Rivers, streams and lakes) which is the commonest and easily accessible source of water supply for human consumption make up about 0.0067 of the 1 percent with the remaining proportion being stored in the ground as groundwater. Surface water is however highly liable to contamination as compared to groundwater. ―Water resource‖ has been defined as sufficient quantity and quality of water available at a given time in a particular location to meet identifiable demands and use. Therefore not all water stored on earth can be referred to as water resources (UNESCO, 2011).

Water supply for human consumption is mainly from three sources of which two are the most developed and used. Surface and groundwater sources are by far the two major sources of water supply for industrial, agricultural and domestic purposes. Surface water has been considered the earliest and widely used source. However, intensive groundwater abstraction started and gained prominence in the twentieth century (International Water Management Institute (IWMI), 2007). Rainwater harvesting which is the third source of water is currently less patronized due to various reasons including technological and financial constraints in undertaking large scale harvesting schemes (Mashood et al, 2011).

Currently, abstraction of and use of groundwater has gained prominence and serves as a significant source of water for human consumption (Evan et al, 2012). It accounts for almost half of the world‘s drinking water and about 43% of water for irrigation (Siebert, et al., 2010). According to Balaji et al (2012), groundwater is relatively superior to surface water sources because of its quality and stability of depletion. Custodio (2012) however reports that polluted groundwater requires more resources to treat and that controlling surface water pollution is relatively easier. The process (polluting events and actual pollution) of groundwater pollution may take decades to occur and due to the relatively longer turnover time of groundwater, polluted groundwater takes a longer time to recover (Custodio, 2012).

It is estimated that over 75 percent of Africa‘s population depend on groundwater as their main source of drinking water (UNEP, 2010). In Ghana, about 31.2 percent of the population depends on groundwater (boreholes and wells). However, due to acute water shortages, the percentage of inhabitants (44.9%) in the Northern region which relies on ground water is higher than the national figure (Ghana Statistical Service (GSS), 2013). These figures are expected to increase in the near future. More households in rural areas depend on groundwater than urban areas (WWAP, 2012b). Much literature has established that the tendency of groundwater impairment in urban environment is very high due to activities such as fuel and chemical waste from industries, poor water and sewage treatment, chlorinated solvent leakages and high rate of abstraction (FAO, 2012a). The resultant effect is high cost of treating the water to make it wholesome for domestic and industrial uses which high treatment cost is eventually borne by the consumer (Rossiter et al, 2010).

The prospects of using rainwater harvesting have been confirmed by many global and regional organisations including the UN as a viable source of drinking water which can enhance water access especially in Africa. This saw countries like Kenya and Burkina Faso endorsing and building rainwater harvesting systems to supply a significant proportion of their populations since the early 1990s (Mashood et al, 2011). Although, rainwater harvesting is less developed in Ghana, there is evidence of a long culture of usage of rainwater by households especially in rural societies. According to the Ghana Statistical Service (2008), 0.4 and 1 percent of urban and rural households respectively use rainwater as their main source of drinking water. Comparatively, the initial capital outlay for installing rainwater harvesting system is about 3 times higher than providing borehole to serve the same population (Mashood et al, 2011). However, according to Siabi et al (2008) cited in Mashood et al, (2011), the long run operational and maintenance cost together with the lifespan of rainwater harvesting system is much cheaper than using boreholes. The government of Ghana in 2010 therefore as part of its medium term policy framework (GSGDA) indicated plans to develop rainwater harvesting systems (Goverment of Ghana, 2010). However, there exists very little evidence of work done in this regard.

Ghana like many developing countries lack a comprehensive account of its water resource stock, use rate and surface/groundwater aquifer renewal rates (UNSD, 2012). It is estimated, based on current consumption patterns, that by 2020, demand for water will increase to 5 billion m^3 over the 2000 figure of 980 million m^3. This would require about 70 percent increase in groundwater abstraction to meet the demand. Current water resource accounting indicate that groundwater abstraction rate is far below the capacity and renewal rates of the various basins including the Volta basin which is estimated to have about 90 million m^3 of groundwater annually (WWAP, 2012b).

2.2.1 Water Resource Accounting

Water resource accounting is a process of conducting a disaggregated assessment of supply and demand variables to collect information including stock of water resources, the rate of abstraction and quality degradation of water (UNSD, 2012). Designing and operating a

comprehensive and efficient water resource management system requires a good understanding of the spatial and temporal distribution and environmental flow of water overtime in a given region (FAO, 2012a). Water resource accounting keeps recurring in literature reiterating the important role it plays in the policy, legal and technical management of water resources. In-depth knowledge of the hydrologic cycle including: quantity, pattern of flow, variability of the water table, pollution levels and agents, hydrogeology and hydrography are vital for water resource management (WWAP, 2012a; UNSD, 2012). This therefore emphasizes the need for policy-makers to embark on evidence-based solutions to social, economic and environmental related risk of water quality and quantity management (Balaji et al, 2012). Effective and well established technical, institutional and policy frameworks are prerequisites for successful water resource accounting and management (ADB, 2013; FAO, 2012a).

Achieving sustainable water supply to meet the physical and economic needs of consumers requires local content, participation and understanding of the socioeconomic situation and needs of the consumers (UN-Water, 2007; Cheng, 2014; Engel et al, 2005). The Food and Agricultural Organisation proposed adopting supply enhancement and demand management strategies to respond to water scarcity through prudent policy, legal and institutional management (FAO, 2012a). Likewise, contemporary water management strategies try to respond to an array of issues including: alternative means of meeting current and future demands, socioeconomic impact of pricing, combined sector impacts on pollution and water use, conservative demand measures and the dynamics of climate change on water resource availability and accessibility (UNSD, 2012). Designing and implementing effective strategies to deal with these issues therefore requires a comprehensive knowledge on available water resources, seasonal variations in flow and recharge rates, disaggregated sector demand and the operations of service providers including informal sector operations (FAO, 2012a; UNSD, 2012).

Evidence of lack of common measurement standards and proper water accounting systems is visible in varied statistics given by the GWCL and the Joint Monitoring Progrmme (JMP). In 2008 for instance, the GWCL estimated urban water supply coverage at 58 percent whiles

the JMP reported 90 percent. This discrepancy was attributed to different measure standards used for per capita consumption thresholds and variations in the definition of an urban area between the GWCL on one hand and JMP and GSS on the other (AMCOW, 2011).

The foregoing discussion gives credence to the fact that water accounting is vital for effective management of water resources. Essentially, this information provides a database of available water resources, the level of abstraction, rate of pollution and demand by various sectors (municipal, agricultural and industrial) as well as the impact of population and economic growth on water resources (FAO, 2012a). This further enables countries project future demand for water and other related services. As a result, comprehensive formulation and implementation of alternative policy strategies to cater for future changes in water availability and use patterns are critical to mitigate water stress and scarcity.

2.2.2 Water Scarcity and Factors Affecting Water Supply

The concept of water scarcity can be looked at from two different perspectives – physical scarcity and economic scarcity. Physical water scarcity refers to a situation where the quantity and or quality of water available in an area is inadequate to meet the demand for water at a given period. Characteristic of physical scarcity is dwindling groundwater level and environmental degradation. This form of water scarcity is often very difficult to manage through such means as conservation and other management tools. Economic water scarcity on the other hand describes a situation where limited financial, institutional and human resource capacity limits the ability to provide adequate water supply to meet existing demand at a given period despite abundance of water resources in the area. It is characterized by poor infrastructure, inadequate distribution networks, inefficiency/inequality in distribution and low incomes and investment (FAO, 2012a). This situation unlike physical scarcity is said to be manageable using economic policies.

Various models and indicators have been established for determining water scarcity levels of a region. The authors of such indicators include: Falkenmark and Widstrand (1992) and UN-Water (2006) who used threshold figures of $<500m^3$, $500\text{-}1000m^3$, $1000\text{-}1700m^3$ and $<1700m^3$ to indicate various levels of water scarcity (FAO, 2012a). According to their criterion, countries with less than $500m^3$ of annual freshwater renewal rate are experiencing

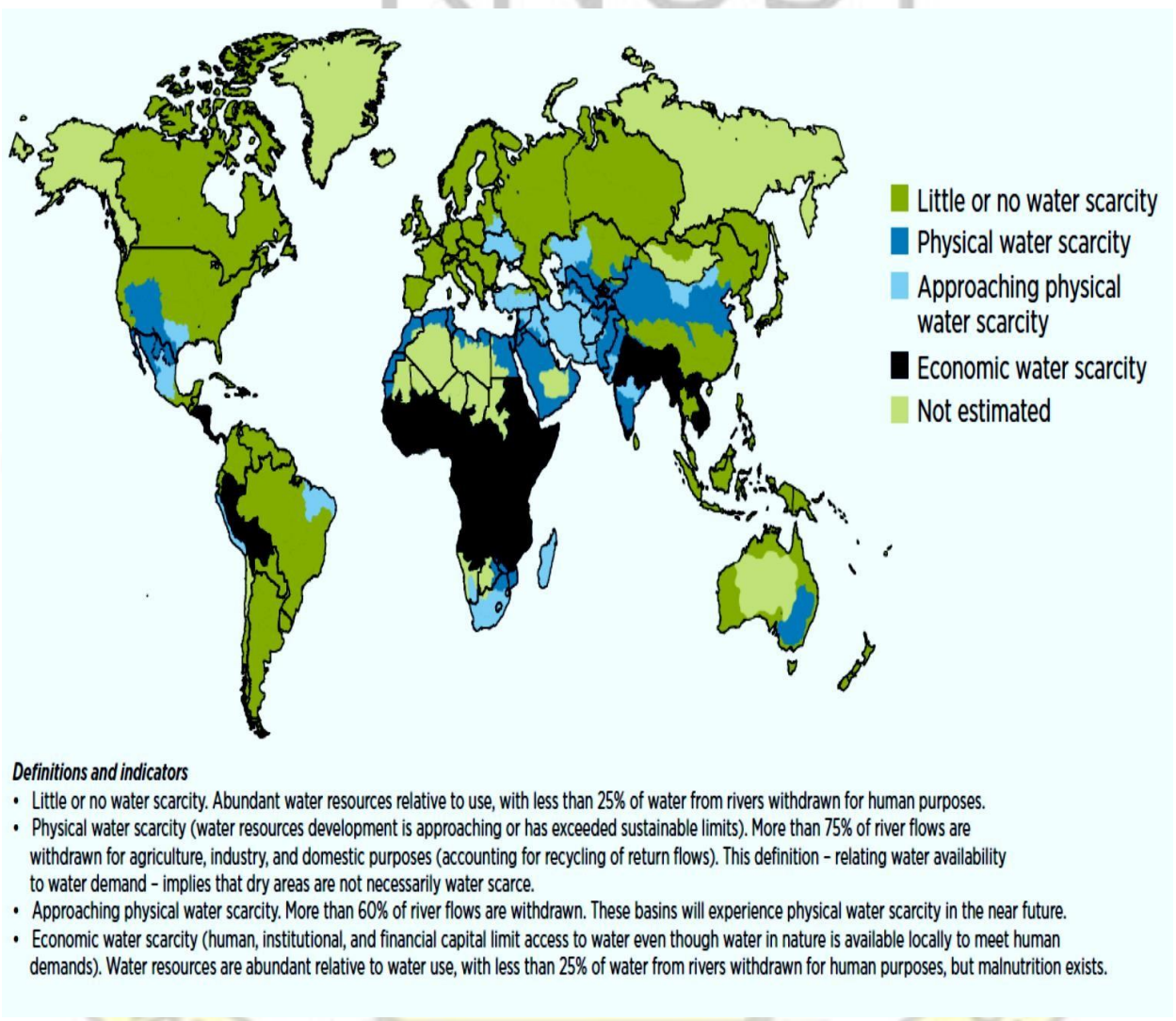
absolute water scarcity whereas <1700m^3 indicates occasional water shortages experienced locally. Despite the wide use and easy applicability of this indicator, it fails to consider such important factors as seasonal variations of renewal, real access and right to water, available technology and water reuse, water resource governance and management and other country/location specific factors which together affect water access. In response to the shortcomings of this indicator, the UN-Water (2007) proposed a new water scarcity indictor which captures overall water use by all sectors (including agriculture, industry and domestic use) as a proportion of total available renewable water resources in the given region. It takes into account such factors that were not considered by previous indicators. Though the new indicator has strong theoretical grounding, it is however impractical due to its large data requirement which (data) is unavailable in most countries (UNSD, 2012). An action oriented indicator was also developed to measure water scarcity with reference to unmet water needs (UN-Water, 2007). This focused on generating remedial measures which use local factors in mitigating water scarcity issues.

As the main source of water for a majority of the world‘s population, UNESCO has reported that groundwater is currently over extracted at a rate faster than it can replenish (WWAP, 2012a; UNESCO, 2011). This situation according to Stellar (2010) is a recipe for water scarcity not just in terms of quantity but also as in the light of its quality and suitability for human consumption. First, quality can diminish through increased concentrations of naturally occurring compounds that become hazardously high as the volume of water dwindles, as in the case of India where millions of people are threatened by fluorosis. Also, quality can be affected by growing salinity levels due to saltwater penetration into coastal aquifers, as experienced in Cyprus and the Gaza Strip (Stellar, 2010). This situation would have adverse effects on the amount of water available for human consumption and even for agriculture and industry purposes (ADB, 2013).

In an earlier study, Custodio (2002) contended that though current water exploitation levels are high, it is inappropriate to use the term overexploitation which is often misleading and connote negativity and high aquifer exploitation than recharge rate which in most cases is false or based on unreliable information. This is due to uncertainties associated with

determining exploitation and recharge rates accurately (FAO, 2012a). Despite varied arguments on the reality and extent of the global water scarcity situation (UN-Water, 2007), much literature indicate that a significant proportion of the world's population especially in developing countries are currently challenged with poor access to potable water and as a result resort to the use of unwholesome water for consumption which has adverse health implications (Ghana Statisical Service (GSS), 2011; Evan et al, 2012; UNDP, 2006).

Human activities including settlement development, industrialization and urbanisation have a bearing on water availability and usability (FAO, 2012a; UNSD, 2012). Water availability in the future is threatened by increasing temperatures and climate change due to global warming which is affecting the hydrological cycle and groundwater recharge (UNSD, 2012; WWAP, 2012a). Climate change poses significant threat to human survival as rainfall, drought and other environmental activities become less predictable and unstable – these could result in increased urban population through rural-urban drift (Stanley & Braimah, 2007). According to a study conducted by the United Nations (2011), some regions in the world including Western Asia and Northern Africa are facing water scarcity due to higher extraction than recharge rate of surface and groundwater resources in these regions. Sub-Sahara Africa however has adequate water resources. Most countries in the sub-region are challenged with poor access to water supply as a result of economic scarcity rather than physical scarcity of the resources (Figure 2.1).



Source: International Water Management Institute (IWMI), (2007)

Figure 2.1: Global Physical and Economic Water Scarcity Map

Ghana is estimated to have about 1,272m^3 of internal freshwater resources which is less than the average figure (4,708m^3) for Sub-Saharan African countries. Access to water supply by the urban population has increased from 87 to 91 percent between 2000 and 2010 which is

higher than the current figure (82.7%) for the sub-region (World Bank, 2013a). However, nine out of ten households in Ghana spend not less than 30 minutes to acquire water from the closest source from the house (GSS, GHS & ICF Macro, 2009). Literature further reports of a similar situation with regard to the proportion of households who treat water before consuming as well as reports of about 17 percent (in 2010) and 23% (in 2008) of the country's population depending on untreated sources of water such as rivers/streams, unprotected wells, dugouts/ponds and unprotected springs (Engel et al, 2005). The Northern Region recorded the highest proportion (17%) of dwelling units that depend on rivers/streams as their main source of water (Ghana Statistical Service (GSS), 2013).

From the foregoing discussion, it is clear that achieving sustainable and full access to water supply by all does not only depend on the availability of the resource (physical scarcity) but it also depends on many other factors including availability of capital, technology, strong institutional, managerial and policy framework to extract, treat and distribute the resource effectively and efficiently. However, the success of all these require accurate disaggregated data on available water resources and patterns of use (UNSD, 2012). The challenges in urban water supply and management in Ghana are partly due to the aforementioned issues (ISSER, 2013; Safe Water Network, 2013).

In response to ongoing water scarcity challenges, recommendations have been put forward to among other things incorporate wastewater recycling, invest in water technology, control water pollution and re-allocate water within and between different sectors/uses (FAO, 2012a; UNSD, 2012; WWAP, 2012b). Ultimately, addressing water scarcity demands cross-sectoral and a multiplicity of strategies that regard equitable economic and social wellbeing with an eye for future use and conservation of existing ecosystems at all levels (UN-Water, 2007).

2.2.3 Determinants of Water Demand and Utilisation

The demand for water remains a stiff competition between various sectors. The types of uses for which water is demanded are broadly categorised into consumptive and nonconsumptive

uses under which the various competing users are grouped. Consumptive uses are defined as categories of uses which require water for immediate consumption or for further production that directly affect the quantity of water available for other users. Agricultural, industrial and municipal (domestic) uses are all consumptive uses of water. Non-consumptive uses are however demands for water to satisfy other needs/wants rather than for its own sake. This does not directly reduce the quantity of water available for other users. These include water for recreational and leisure purposes and hydroelectric power generation (FAO, 2012a).

Water as a commodity exhibits varied characteristics depending on the survival level of consumers and the type of use water is put to. The demand for water is price inelastic when it is required for survival including drinking and other basic consumptive uses. However, when it is required for recreational and other non-survival uses its demand becomes price inelastic as consumers can opt to reduce/increase consumption when price changes (Galiani et al, 2005). Therefore, some consumers continually consume water at very high prices (especially from vendors) irrespective of their income levels when their need for the community is survival-based. Income most cases is not often the main determinant of household‘s demand for water (Engel et al, 2005).

Ultimately, economic growth, population change and urbanisation together influence water demand in space and time (UNSD, 2012). Increased population propels increased demand for goods/services especially water which is both a consumption good and a factor for further production. Similarly, economic growth perpetuates increased demand for water for similar reasons. Also, urbanisation brings with it lavish lifestyles which introduces more and complex non-consumptive water demands including recreation demands and new land use patterns which increase water demand (FAO, 2012a).

Increased demand for water when incommensurate with supply capacity results in water rationing, inequality and inadequacy of water supply to meet the needs of consumers. In an attempt to mitigate the situation alternative supply sources are required at the short to medium term to service unmet water needs of communities and households. Different users

however adopt varied coping measures informed by the purchasing power and available alternatives at their disposal (Pangare & Pangare, 2008) which in most cases are often more expensive than regular/formal water supply systems (Va´squez et al, 2009).

This has been explained in much literature as the genesis of _informality‘ in water supply where private individuals cash-in for profit or for benevolent reasons. Also, consumer expectation and speculation about the nature of services (consistency in quality and regularity) could potentially limit patronage of a given service (public service) and resort to alternatives (such as private vendors) at high prices due to high confidence in the alternative services (Kooy, 2014).

Ensuring good water quality requires adopting various treatment methods which have cost implication translating into high charges for water services. The inability of some consumers to afford the high charges compel them to resort to free sources (including rivers and streams) which are often unhealthy for human consumption (Rossiter et al, 2010). Cost of treatment and distribution are therefore important factors influencing water supply and demand. This study however concentrates on water supply for household (domestic) activities including cooking, bathing and other consumptive purposes.

2.3 Urban Water Supply and Management

A conscious effort at providing water service to the public is reported to have first been introduced in Dublin during the 13th century using street carriers. Other countries including Paris, London and Berlin introduced similar practices during the 1500s. The introduction of water service provision took the form of private service provision and was later centralised (in the 1800s) due to concerns of poor quality, environmental and health issues identified as problems of small scale water service provision. The provision of water as a priced commodity according to literature was first practiced by the Romans who taxed homes that received water supply directly from the aqueducts into their residences. New York practiced a similar system which was short lived and later paved the way for private service provision which was deemed more efficient but failed to live up to expectation as was the case in London (Prasad, 2007).

2.3.1 Impact of Urbanisation on the Urban Waterscape

Cities have been noted to play a vital role in nation building by providing high order social services, employment opportunities and facilities of recreation. These serve as pull factors attracting rural populaces to the urban centres to take advantage of high order services. The emergence and growth of cities is generally a product of urbanisation, a process or state, which is associated with increased job opportunities, investments, increased consumption, modern technology, large markets and concentration of social infrastructure including education, health, electricity and water. Poku-Boansi and Inkoom (2011) alluded to three processes as the causes of urbanisation: natural population increase, rural-urban migration and reclassification of previously rural localities as urban. The process of urbanisation is further noted to be very rapid in developing economies (UN-Water, 2013b; Poku-Boansi & Inkoom, 2011).

A common feature of cities in developing regions is high concentration of population and economic activities within limited space. Infrastructure including housing is mostly inadequate and under pressure from overuse and poor maintenance resulting in adaptive measures that create informal settlements, social disorganisation and emergence of illegal livelihoods within the city (Nyarko et al, 2006). Notwithstanding continued investment on city infrastructure and social services including water and sanitation in developing countries, there is fast deterioration of the physical environment and associated problems such as congestion, uncontrolled physical development, poor waste management and distribution of social services (FIG, 2010). Increased industrial pollution and other dangerous gas emissions pollute and thereby affect the quality and amount of resources needed in treating and supplying water.

It was estimated that over 60 percent of the world‘s population reside in urban areas. The recorded figure for Ghana was 50.9 percent whiles that of the Northern Region was 30.3 percent. Between 1960 and 2010, Ghana‘s urban population increased from 23.1 to 50.9 percent (Ghana Statistical Service (GSS), 2013) which is over 120 percent increase within 40 years. However, as discussed earlier in this chapter, infrastructural development and water supply has failed to keep pace with urbanisation and population growth in developing

countries. This situation if not dealt with could impoverish the increasing number of urban dwellers and compound the inadequate access to basic services including water (Nyarko et al, 2006).

The trend of urbanisation in Ghanaian cities like other developing countries has been characterized by rapid population growth with its attendant effects. However, there is a slow progress in growth of infrastructure which is unable to sustainably support the urban population. This has created an urban waterscape characterized by unsatisfied consumers who resort to alternative means of water supply and access. Among the impacts of urban water supply, the GWCL is unable to fully serve urban areas especially the peri-urban areas and informal settlements. Also, the fast rate of urbanisation implies increasing areas to be served by the urban water supplier (GWCL) whiles industrial pollution associated with urbanisation continuously deplete water resource quality (FIG, 2010). This implies that without adequate and immediate improvement in the public utility, some urban inhabitants without water access will continuously depend on various means including illegal connections to access water which further affects the sustainability of public sector water provision. Meanwhile, majority of these populace turn to the informal water sector for their daily water needs.

It is not just water supply to urban areas but the impact of urban land_use and industrial activity on local aquifers as repositories of waste (FAO, 2012a). The concentrations of urban surfaces, waste and built space are combined with a set of geotechnical impacts resulting in aquifer depletion and pollution which affect the urban waterscape. As urbanisation proceeds, these impacts can be anticipated and planned for if the pace of urbanisation is relatively orderly. Meanwhile, remedial measures in the aftermath of urbanisation are likely to be much expensive. Shen et al (2011) emphasized the importance of adopting sustainability indicators in urban development policy to ensure that urbanisation does not compromise human wellbeing. A set of indicators were proposed for monitoring and measuring sustainability in urban water resource management as outlined on Table 2.1.

Table 2.1: Water-Related Indicators for Sustainable Urban Development

Environmental Freshwater	Proportion of total water resources used and intensity of use by sector/activity
Wastewater	Quality of available freshwater resources Extent of wastewater treatment and proportion of population benefiting from such services
Economic Water cost	Per capita domestic water consumption Price of water
Social Water access	Proportion of urban population with access to clean water supply services Regularity of water supply

Source: Shen et al. (2011)

Expressed danger of water scarcity in urban areas due to fast extraction and pollution of water resources in these areas have been contested on the basis that water resources could be imported from other location to urban areas to meet their demand (FAO, 2012a). Also, Ghana's water resource endowments are enough to support her population satisfactorily (Agodzo et al, 2003). Alberti (n.d) also indicate the possibility of importing resources from other localities to support urban needs and demand if it does not compromise sustainable supply in the source locality. This would however require substantial technological and capital investment which is a challenge faced by developing countries like Ghana (which faces an investment deficit of US$119 million annually) (AMCOW, 2011). This therefore raises concerns of the possible realities of actual depletion of urban water resources (in quantity and quality) such that high investment on urban water supply will likely affect the supply and affordability to poor and middle income urban households thereby further worsening socioeconomic hardship.

In essence, the complexities of urbanisation coupled with increasing pressure on urban social and infrastructural amenities have adverse implication for the urban water sector (see Figure 2.2) (FIG, 2010). These conditions together generate various forms of unsanctioned economic activities and uncontrolled social relations to eke out available scarce resources and opportunities for the survival of the urban population especially those living under severe poverty, insecure livelihoods and infrastructural deficit areas (Kjellen & McGranahan, 2006). Under these conditions, informal activities emerge and exist as an integral and essential source of survival for people (Peloso & Morinville, 2014).

2.3.2 Economics of Water Supply and the Water Access Debate

The choice of management style and pricing/valuing systems adopted in providing water supply services is influenced by the type of good water is perceived to be – whether a public good or a private good, the ideological orientation of the provider – socialist or capitalist orientation, and the market goal of the provider –for profit maximization, cost minimization or equity and affordability concerns. These factors are further influenced by the economic value such as utility, scarcity, rivalry and excludability attached to a good or service (Gunatilake & Jose, 2008). The choice of water pricing strategy adopted, according to Wang et al, (2009), is often informed by the availability of water resources, government policy/institutions and the existing market practices in a region. The pricing of the commodity is either on the demand-side strategies, supply-side strategies or a combination of the two strategies. Supply-side strategies are often associated with market-oriented methods which are informed by cost-revenue analysis to determine price. However, demand-based strategies often inculcate social considerations including affordability and social equity (Wang et al, 2009) which are necessary for consumer welfare.

Despite some advantages of the individual strategies, adopting a combination of supplyled and demand-driven approaches, especially for developing countries, has a high propensity for achieving better outcomes as consumers have the opportunity to participate in determining the type of service and pricing of water - thereby promoting acceptability. Adopting sustainable strategies do not only protect consumers but also offer the provider

(government) opportunity to take some decision to boost quality and sustainability of the service while ensuring efficiency and equity of service to all (UN, 2011).

Some researchers and policy advisors, who share the view that water should be treated as an economic good, argue that sustainability in water provision is only achievable through market-based mechanisms in water pricing which ensures full cost recovery. This approach is believed to not only enhance continuity and efficiency in supply but to further serve as an incentive for efficient resource utilization and conservation (UNSD, 2012; World Bank, 2013; Wang et al, 2009). Despite widespread arguments for PSP in the water sector, literature has identified underlying disincentives which deter private investors from venturing into the water sector especially in poor regions. Cost-benefit analysis and viability assessment indicate that huge capital investment is often required to expand and improve connection networks and increase quality of services in developing areas characterized by poor households (UNDP, 2006). These poor households in most cases are unable to afford services at market prices (Adarkwa, 2011), which is necessary for cost recovery –hence uneconomical for private firms to invest (Safe Water Network, 2013).

Empirical studies on water supply is well over decades old which logically would suggest that decisions on water supply services should be an easy endeavor for policy makers. However, most governments are running out of ideas for achieving sustainable water supply. The Asian Development Bank (2013) attributed the situation to lack of transparency in water economics and inadequate information for water management decision making. It is however unsurprising that most countries still battle with the decision on the ―ultimate method‖ of water service provision. Propositions for public water provision, which is necessary for affordability and equity, is often based on socioeconomic analysis that suggest that water is characterized by price inelastic demand, positive externalities, necessary for human survival and natural monopoly features (Galiani et al, 2005).

Some research on the contrary provides convincing arguments for privatizing and using market-based mechanism of water supply on counts of cost effectiveness, improved service quality, sustainability of service, effective and conservative use of water. Some underlying causes of the water crisis and inability to invest in technology and innovative means of water

supply has been attributed to the low value attached to water and failure to value water as a market commodity (ADB, 2013; Safe Water Network, 2013).

The hanging debate on the best option for efficient and sustainable water supply has in some cases left some localities (including urban communities) without adequate water supply. This often introduces informal water sellers who take up the responsibility of serving the water needs of individuals and groups in such areas. Experience and empirical research has revealed that persons who rely on these water vendors for water however pay high rates for the same quantity of water than beneficiaries of public sector water providers (UNDP, 2006; Bakker, 2008; Pangare & Pangare, 2008; FAO, 2012; Kooy, 2014; Peloso & Morinville, 2014).

The government of Ghana in recognition of the fragility of urban water service provision encouraged a system of water service delivery that satisfies social and economic needs. It further encourages private sector participation in water supply (Government of Ghana, 2007). Inferentially, this situation coupled with recent arguments (especially based on decentralisation) for governments to merely play enabling and regulating roles in service provision implies and emphasizes commercializing water supply (Ahlers et al, 2014). The fact however remains that there is limited agreement on an appropriate choice between formal and informal or both which would effectively and sustainably satisfy urban water supply needs (Kooy, 2014).

2.3.3 Framework for Urban Water Supply in Ghana

Water resource ownership and management has for decades raised enormous arguments among researchers and policy analysts on best practices to enhance universal access and efficient management whiles discouraging wasteful use (Bakker, 2008). Granting the right for use of water resources in Ghana is therefore permissible only when it is considered as beneficial use*: ...the use of water including the method of diversion, storage, transportation and application of the water which is reasonable and consistent with the public interest, including domestic, energy, agricultural, commercial, industrial, municipal, navigation and recreational use* (Republic of Ghana, 1996). Generally, all water resources in the country are the property of the state and therefore she is responsible for regulating the rights, abstraction, application and utilization of such resources for the benefit of the citizenry.

Bakker (2008) argues that the type of ownership style (whether public or private) holds less significance as the institutional framework and governance approach adopted in water resource management. Therefore, accountability, transparency, investment capacity, access and effective operational management are dependent on efficient management. The responsibility for managing water resource extraction, distribution and use has been assigned to identifiable institutions at the national, regional and district levels. However, the key role that water plays in all aspects of human endeavor and sectors of the economy has made it necessary for intersectoral management of the resource. To this end, some other institutions and agencies have been involved in carrying out some functions in water resource management through policy formulation, implementation and or enforcement of water regulations and standards.

The management of Ghana‘s water sector has a long history of well-structured institutional framework that has undergone series of restructuring and reassignment of roles and functions since the 1920s. Since the colonial era, the sector has been valued as an essential aspect of the country‘s development process. The functions of all units and agencies are clearly outlined within instituted legal and policy guidelines that set the legal and operational boundaries of these institutions. The main institutions designated for water resource management include: the Ministry of Water Resources, Works and Housing (MWRWH), the Water Directorate (WD), the Water Resource Commission (WRC), Ghana Water Company Limited (GWCL), Community Water and Sanitation Agency, and Public Utility Regulations Commission (PURC) (AMCOW, 2011).

The physical management including granting of rights for use and regulation of abstraction falls within the purview of the WRC. It was established and mandated by ACT 522 to regulate and manage water resource utilization and coordinate related policies in the country (Republic of Ghana, 1996). The Environmental Protection Agency (EPA) sets and oversees compliance by all stakeholders to water standards at all levels. The GWCL together with private sector operators engage in the production, treatment and distribution of water to end users including the domestic, industrial and service sectors. Some subagencies such as

irrigation management institutions working under given ministries directly manage water use at irrigation sites and other similar areas (AMCOW, 2011).

Metropolitan and Municipal assemblies formulate and implement policies, and collaborate with other regulatory institutions in the water sector at the district level. AMCOW (2011) however observed that unlike formally instituted operational sub-units that ensure community ownership and management in rural and small town water subsector, the urban water subsector lacks similar visible units to help coordinate and improve services to under-served urban and peri-urban poor. Furthermore, Fuest & Haffner in their study of urban water supply in Ghana identified that customer participation through consultation and direct involvement in decision making is generally weak (Fuest & Haffner, 2007).

The policy aspect of urban water management spans a series of coordinated activities from the NDPC that outlines the broad national policy framework. The MWRWH through the Water Directorate oversees the formulation of sector policy and coordinates water related activities of MDAs and MMDAs and other agencies. District specific water sector plans are also formulated and implemented within the framework of national policy at the Metropolitan and Municipal (MMAs) levels. The value of water and water tariffs setting for urban water is performed by the GWCL and reviewed and approved by the PURC.

Water tariffs are therefore subjected to _public' approval through the PURC which is to protect the interest of consumers. Additionally, some guidelines have been developed by the PURC to guide the operations of alternative water service providers (AMCOW, 2011).

Historically, Ghana's water sector underwent various restructuring and reforms. These activities started around the 1920s and still continue to date due to changing population size and water supply demands. Table 2.2 provides a brief summary of various transitional phases in the urban water sector management.

Table 2.2: Some Key Reforms in Ghana's Urban Water Sector Management

Year	Event
1928	Hydraulics Department of Public Works Department (PWD) pioneers delivery of urban water supply
1948	Rural Water Department created within PWD to deal with rural water supply

1958	Hydraulics Department and Rural Water Department merged into Water Supply Division (WSD) of PWD
1965	Ghana Water and Sewerage Corporation (GWSC) established to produce and distribute urban and rural water supply
1994	Separation of urban and rural water supply. Community Water and Sanitation Department (CWSD) created with GWSC
1997	GWSC converted into a limited liability company, the Ghana Water Company Limited (GWCL) with responsibility for urban water supply
1997	Public Utilities Regulatory Commission (PURC—economic regulation) and Water Resources Commission (WRC—management of water resources) established
2005	Private operator (Aqua Vitens Rand) selected for a five-year management contract for urban water supply
2010	Aqua Vitens Rand's contract terminated

Source: AMCOW, 2011

From Table 2.2, it can be observed that conscious efforts at managing and ensuring efficient urban water supply started over 70 years ago. The level of achievement in the urban water sector has however not been very progressive. This is attributed to various factors (see Fuest & Haffner, 2007). This situation gives credence to Nyarko et al, (2006) report of slow pace of infrastructural development vis-à-vis rapid urban population growth.

2.3.4 Water Access and Urban Social Hardship

Globally, it has been established that poor access to quality water presents a multiplicity of effects including health hazards which increase expenditure on health. The high cost incurred in treating water and buying water from alternative sources weaken productive sectors of the economy and degrades the ecosystem (UNDP, 2006). Development and water access have forward and backward correlation. According to Balaji, et al (2012), ensuring a healthy ecosystem through prudent management practices including wastewater treatment has been a major concern of rich (developed) countries than poor (less developed) countries. Water resources in developing countries are therefore very liable to pollution from untreated waste water from industries and other uses that discharge hazardous materials into water bodies.

The entirety of water access for human development is an embodiment of quality and quantity related aspects of water resource available, accessible and usable by humans. The quantity and quality of water are intrinsic issues in the fight for increased availability and

accessibility to water supply. In most cases, access to water supply has often focused on the quantity supplied to meet existing and future demand. Existing water stress in some societies is no doubt a major challenge endangering the lives and development of inhabitants of such societies (Cosgrove & Cosgrove, 2012; AUC; UNECA; AfDB; UNDP, 2012). Attention in such communities therefore rests on getting people adequate (quantity of) water to sustain their lives and livelihoods. This situation has made the quantum of water supplied the priority with resources being channeled to providing increased quantity of water to the neglect of the quality being provided.

According to Stellar (2010) cited in Balaji et al (2012), water quality is as equally important as the quantity supplied. The quality and quantity, he established are linked by evidence of dwindling quality of water when the quantity decreases due to abstraction. Chemical concentration (including naturally occurring compounds) increases to levels harmful for human consumption when water quantity decreases to some extent. Also, the usability of water can be affected by high salinity and metal concentration beyond acceptable levels, which have adverse health implications and reduce the quantity of water available for agricultural, industrial and domestic uses (Rossiter et al, 2010).

According to the MDG Report 2012 on Africa, progress toward achieving MDG 7C which aims at halving, by 2015, the proportion of people without sustainable access to safe drinking water and basic sanitation - is very slow in Africa despite an advanced achievement of the MDG globally. In 2012, access rate in Ghana was pegged at 66% against the target of 78% by 2015. Access in urban areas has experienced a decline from 86% to 85% between 1990-2010 which has been attributed to rapid urbanisation and increased slum development. A wide disparity in access persists between urban and rural areas with the former explained to be 30% better off despite positive progress made between 1990 and 2010. Unlike Seychelles, Niger, Mauritius and Egypt where urban access to potable water is about 100%, access in urban Ghana is a little above 60% (AUC; UNECA; AfDB; UNDP;, 2012; AMCOW, 2011; Peloso & Morinville, 2014).

In a study conducted by Rossiter et al (2010) using WHO guidelines for water quality standards, intriguing revelations made indicated inorganic contaminant concentrations above recommended levels existing in several improved water sources (including boreholes,

wells, standpipes and trucked water) in Ghana. About 90 and 53 percent of water sources countrywide had unhealthy levels of turbidity and pH (*potential of hydrogen* -acidity or alkalinity) levels respectively. Overall, about 38 percent of samples tested failed to meet at least one quality standard. Further analysis revealed that parts of the Northern Region had high concentrations of sulphate (SO_4^{2-} >500mg/L), boron and other chemicals which were attributable to the use of mudstone geology and borate-containing fertilizer for farming in the region (Rossiter et al, 2010). In spite of the relative low propensity of groundwater pollution, it has been established that groundwater sources are not necessarily safe for human consumption (Rossiter et al, 2010; MacCarthy, Annis, & Mihelcic, 2013).

The above issues impact on urban dwellers in various ways. Water rationing, mostly irregular, from GWCL has made urban households adopt alternative methods of storing water. In some instances, taps flow at very odd hours at night therefore consumers are forced to stay late to access water supply. For individuals and households without piped water, relaying on neighbour for water supply (either for free or at a price) is not uncommon in urban Ghana (Peloso & Morinville, 2014). Household members, especially Women and children therefore spend hours searching for and collecting water. This affects women's economic productivity, as it takes away the time available to pursue employment and income-generating opportunities. The education of children in such households is often affected due to late school attendance and or frequent school absenteeism (Nauges & Strand, 2013; Ministry of Education, Science and Technology, 2013). In extreme cases, the child's education becomes an opportunity cost to support household activities (UNDP, 2010).

Despite the common position on the need for some basic water access for every human, there is no common standard figure on the per capita domestic water required per day. Various organisations (including WHO and FAO) and researchers have posited different figures as the minimum per capita water required per day for economic and social development. These are based on different parameters (see Table 2.2). The figures range from as low as 20 litres to as high as 4,564 litres per capita per day (Chenoweth, 2008). Though Chenoweth suggested 135 litres, he conceded that the varied levels of water needs coupled with other factors such as ―virtual water‖ importation contrived different minimum per capita water need in different societies.

Table 2.3: Various Minimum Per Capita Water Access Estimates

Author	Estimate (litres)	Parameters
WHO & UNICEF (2000)	20	Minimum domestic need for healthy life
Glieck (1996)	50	Minimum domestic need for healthy life
Howard & Batram (2003)	100	Overall domestic need for healthy life
Shuval (1992)	342	Non agriculture use and food production
World Water Assessment Programme (2003)	4,654	Drinking water for healthy life

Source: Chenoweth, 2008

From the foregoing, measuring domestic water scarcity requires an understanding of the subject community and context specific components of domestic water use. It is also important to recognise the vital role that human institutions and individual actors within the domestic water value chain play in promoting water access and effective water use practices.

2.5 The Informal Water Sector and Urban Water Supply

2.5.1 Contextualising Informality

Since the conception of the term _informal‘ in the 1970s, its definition and use has been subjected to fierce arguments. This disagreement is more entrenched in areas where the link between _formal‘ and _informal‘ exist as a continuum. From the economic parlance, where the term was first used to describe informal income opportunities, classification of activities as informal are based on: small scale operations, labour intensive and adaptive technology,

unidentifiable legal/institutional framework, unregulated by labour laws, lack of social security, ease of entry, and low skill operations (Awepuga, 2012; Becker, 2004; ILO, 2003; ILO, 1972). Becker (2004) described the informal sector as consisting of small scale units engaged in production and distribution of goods and services with the primary objective of generating employment and income, notwithstanding the constraints on capital, both physical and human, and technical-knowhow. Informal operators in most instances fail to perform their full tax obligations and their output may not be captured in national income accounting (GDP). This sector also operates outside the regulations of the parent sector/state (Burt & Ray, 2014).

With reference to the water sector, especially in developing countries, classifying water suppliers as informal is difficult. It is especially so when dealing with operators such as sachet water producers (some registered and other unregistered) and small-scale private operators who convey water from the official service providers to under-served populations (Stoler et al, 2012). The informal water sector has been explained as individuals and groups involved in extraction, treatment and or distribution of water - whose operations are not sanctioned and regulated by the state. Simplicity of operations, low capital investment, easy entry and low educational requirements have been identified to account for the high growth of informal water enterprises in Ghana (Burt & Ray, 2014). Misra (2014), in contextualizing informality to the water sector however argued that unlike the economic distinction of formal and informal, the informal water sector is less clearly distinguished from the formal sector using such factors as size of operations, technology used, capital intensity, entry conditions and skills level. These sectors are however better distinguished using the _legality' of operations.

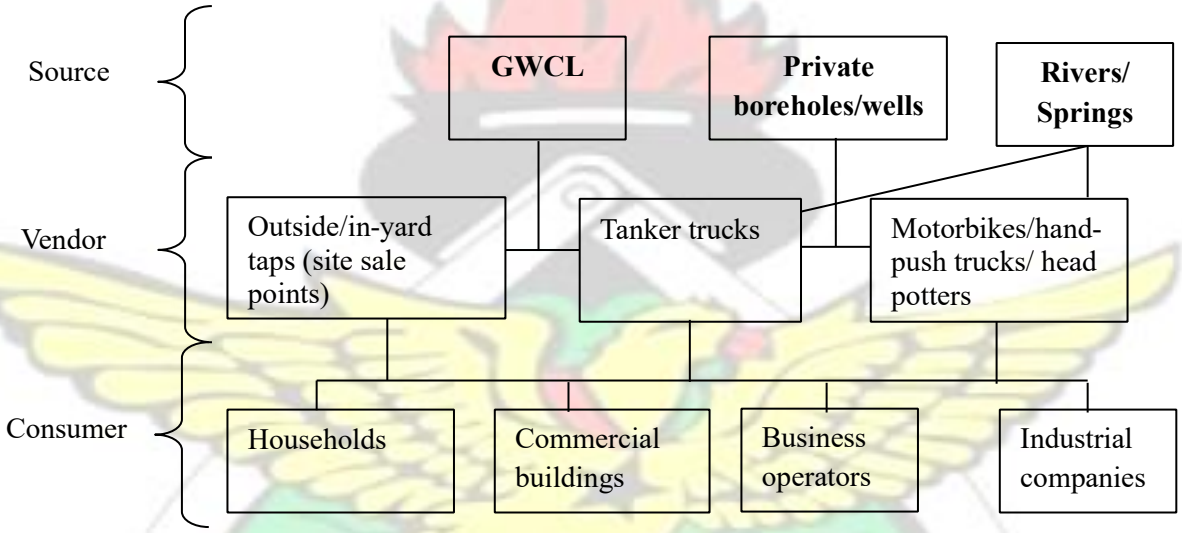
In the mist of varying definitions, Peloso & Morinville (2014), in a study of informal water activities in Ashaiman-Ghana, described the informal water operations as: *extensions of water services that cannot be fully accounted for by the GWCL …* [and] *or private tanker trucks services, such as small-scale water vendors or the local plastic sachet water industry* most of which are not registered to operate. They further acknowledged and empirically suggested that inputs (infrastructure) for the informal water sector transcends activities of individual operators and logistics required for their operations but encompasses the *residents*

themselves who form an important aspect of the infrastructure for the sector. Simone (2004), (cited in Peloso & Morinville, 2014), related the importance of the informal sector in a typical African city to a complex combination of informal and flexible social relation (compared to: *objects, spaces, persons, and practices*) that form the basic infrastructure *providing for and reproducing life in the city*. This suggests that the informal water sector in developing regions does not merely result from the ideas of individuals but the ingenuity and improvisation necessitated by need and poverty – as a means of survival (Engel et al, 2005; Pangare & Pangare, 2008; Peloso & Morinville, 2014).

Meanwhile, Ranganathan (2014), in his ethnographic study of Bangalore's water ―Mafias‖ perceived informality not as a given ―sector‖ but a process that creates an urban environment. This ―*negotiated process"* he argued results in the manipulation of law and authority to produce certain urban practices. The emphasis therefore is not on the ―practices‖ of informality but the ―process‖ that generates such practices (Ahlers, Cleaver, Rusca, & Schwartz, 2014). Informal water operators (―Mafias‖) should not be perceived as mere profit-oriented group of entrepreneurs but ―social workers‖ who though generally unsanctioned, defy state bureaucracies to provide essential services to deprived urban populations (Ranganathan, 2014).

Undoubtedly, establishing a clear dichotomy between formal and informal supply is generally problematic. Therefore, the definition and description of _informal' is context informed and operationalized to suit the purpose of use and background of the author (Awepuga, 2012). The study diverges from the conventional definition of informal as an independent or failure of the formal sector to theorise the informal water sector as the set of activities and operations that provide water supply services to individuals and groups in a locality. These include sanctioned and unsanctioned small/medium scale private water vending activities that provide water supply services to households and businesses. It therefore sides with such studies as Pangare & Pangare (2008); Peloso & Morinville (2014) and Ranganathan (2014). Informal services therefore transcend private tanker services, _fetch-and-pay' services (including boreholes, wells, in-house/out-house pipes, springs sources which are offered to the public at a fee), sachet water services, truck services, and

illegal connections to public water network. Therefore, informal water operators include private tanker truck operators who produce or source water from the GWCL, owners of _fetch-and-pay' facilities, producers and sellers of sachet water and commercial head-porters' services (see Figure 2.3).



Source: Adopted and modified from Pangare & Pangare (2008) **Figure 2.2: Urban Informal Water Supply System**

Pangare & Pangare (2008) identified operators of the informal water sector to include tankers contracted by the public water provider and private individuals, operators of taps serving both tankers and individual consumers directly, private boreholes/wells, motor(cycle) vendors, hand/head potters and water tanks which store and resell water to consumers. In a related study, Kjellen and McGranahan (2006) also put water vendors into three categories: wholesale vendors – who abstract and sell water to distributing vendors (resellers), distribution vendors – who obtain water from wholesales/public suppliers and sell it to consumers (door-to-door), and direct vendors – who are mainly on-site water points

from where consumers visit to purchase water. Direct vendors included household reselling (unofficially) water from the public network, water kiosks and standpipe operators.

2.5.2 The Informal Water Sector

The informal sector has been described as an important industry in developing countries in terms of its contribution to economic growth, employment and satisfying essential needs of poor societies where abject poverty and infrastructure inadequacies abound (UNESCO, 2005; Peloso & Morinville, 2014). The formal and informal sectors coexist in a complementary and interdependent fashion thereby balancing out shortfalls created by each other (Stoler et al, 2012; Misra, 2014; Peloso & Morinville, 2014). An example of the complementary role of the two sectors is how water from formal suppliers gets to unconnected households through private vendors who act as local agents (Misra, 2014).

Using data from 39 countries, Kosec (2013) concluded that PSP in water supply positively correlate with improved health of people especially children in developing regions. Informal water supply should not necessarily be perceived as a result of lack of development, failure of the formal sector, and low level of technology or described as undesirable as contained some in literature (Moretto, 2007). It ought to however be partly understood as a form of practice necessitated by historical factors which accustoms consumers to some sources of water (taste and preference), to avoid the challenges associated with dependence on public services, unfavourable government policies and/or behaviour of some public water officials that further entrench the operations of informal water operators for personal gains (Kooy, 2014; Burt & Ray, 2014). Sehring (2009) recounted this as an ―institutional bricolage‖ which referred to a recombination of elements from the formal institution to those from informal sector to form new arrangement for service improvement.

Also, the sector is not merely a historical or transitional phenomenon capable of being rectified with increased economic development and time but rather as a process through which development would occur (Misra, 2014; Peloso & Morinville, 2014). It is therefore important to note that improved availability of public water supply does not necessarily result in increased use or connectivity (Engel et al, 2005) but factors such as consumer habits, convenience, lack of trust in public service and affordability reasons could make

people resort to alternative water sources (Burt & Ray, 2014). This literature (Burt & Ray, 2014; Misra, 2014; Peloso & Morinville, 2014) therefore recognizes the informal water sector not as an enigma or an undesirable activity but an integral part of society and the process of development that eke out unmet water needs of poor societies and help mitigate social hardship. One feature of informal water providers that literature unanimously points to is the relatively higher prices charged by these operators as compared to the formal supply charges (Engel et al, 2005; Bakker, 2008; Galiani et al, 2005; Kosec, 2013; Burt & Ray, 2014; Kooy, 2014; Peloso & Morinville, 2014; Pangare & Pangare, 2008; Cheng, 2014).

The ontogeny of the informal water sector stems from accessibility and availability gap created by the inability of formal service providers to fully and regularly provide the water needs of consumers (Stoler et al, 2012; Braimah & Adom-Asamoah, 2011). A common feature of the formal water sector in most developing economies is a persistent gap in water supply and demand, sporadic water supply, high unaccounted for water (UW) and leakages, low returns to investment, institutional inefficiencies and low investment in the sector (Bakker, 2008; FAO, 2012; Peloso & Morinville, 2014). These could be summarised into operational, institutional and investment weaknesses which persist despite decades of efforts to improve the sector. Though the accessibility and availability gap often emanate from inefficiency and inadequacy, some communities (especially slums) are sometimes deliberately denied services for illegal occupation, lack of residential permits and or government policy to discourage the growth of such settlements (Ahlers et al, 2014).

In some cases, the emergence of informal water operations (referred to as small-scale providers) particularly in Ghana was an outcome of unclear institutional framework gap created in the definition of peri-urban areas which fall between urban and rural areas. This situation makes it challenging sometimes in identifying the institution responsible for such areas (whether urban provider or community/small town provider) (IRC & Aguaconsult, 2011). However, this view about the genesis of informal water vending is not universal; some empirical evidence makes it clear that informal water vending existed long before the emergence of public network pipe systems (Kjellen & McGranahan, 2006).

Another important determinant of the emergence and persistence of informal water operations is the behaviour and social relations among consumers. Though the informal

water sector is made up of users, providers, policy makers and regulating authorities, the users play a pivotal role in the persistence of informal services especially in areas where formal supply coverage exist. Their selection and combination of service arrangement alternatives is influenced by affordability, flexibility, preference and perception which are in turn affected by the socioeconomic and cultural backgrounds. Some identified operations of the informal water sector include selling to or buying from neighbours, making illegal connections, using informal storage modes and or buying from mobile water vendors (Ahlers et al, 2014; Peloso & Morinville, 2014).

Sub-Sahara Africa had been reported as the world's poorest and least developed region with about 60 percent of its population having access to good drinking water. Despite the adequate water resources in the region, its inability to significantly improve access is attributable to low capacities to adopt effective production and distribution systems. Water scarcity in the region is therefore economic with most urban households still depending on informal water vendors for their daily supplies (UNSD, 2012).

Similar to the characteristics of employment (formal and informal sector) in Ghana, a substantial proportion of the urban poor access water on piecemeal basis - from a combination of informal (sometimes illegal) and formal networks. Connectivity to the public supply network is no guarantee for regular access as water is rationed intermittently (owing to a daily supply deficit of about 60 million gallons) to most urban residents who are therefore compelled to rely on informal services to supplement the public water services (Peloso & Morinville, 2014). The key role of informal water providers is better appreciated from the fact that the official urban water provider (Ghana Water Company Limited) is able to provide about 60 percent of the total urban water needs although these figures sometimes do not take into consideration the unaccounted for water (UW).

Inferentially, the ―unofficial‖ (informal) sector is therefore tasked with providing the remaining 40 percent deficit to help meet the water needs of most urban residents. In the Tamale Metropolis, there was an excess demand of about 7.7 million gallons per day despite existing rationing schedules. Water coverage as reported by the GWCL was 43% and 45% with and without rationing respectively (UNDP, 2010). The informal water sector therefore serves as a safety net for most (peri)-urban residents.

2.5.3 Regulation of Informal Water Operations

The urban informal water sector comprises the interplay of activities and relations between and among users, providers, regulatory authorities and policymakers (Ahlers et al, 2014). The users provide the market and some aspect of labour requirements for the operations of the sector. Providers in a typical setting are a combination of nested informal operations (reselling water from formal providers to end-users) and independent informal operators who abstract, treat, store and distribute water to users using various means. Operations can be in the form of mobile service – where water is conveyed to the consumers or a stationary mode (onsite sale) where consumers personally obtain water from a sale point or kiosk (see Figure 2.3).

Regulatory authorities, made up of various institutions and agencies (for instance, WRC, EPA, WD), engage in monitoring and regulating water resource protection and utilization including abstraction, quality control and pricing of the commodity. They are also responsible for designing standard modalities of operations to govern the activities of stakeholders in the sector. Finally, the activities of all stakeholders in the water sector are conducted within national, regional and local policy frameworks which indicate the nation‘s direction with regard to the water sector. The formulation and implementation of these policies and programmes is undertaken by national level agencies such as the NDPC, the MWRWH and other agencies (AMCOW, 2011).

Ownership and regulation of resources basically comprising land, water and mineral deposits is governed by a complex combination of policy and legal regulations in Ghana. This is partly from the complexity in ownership of these resources between government, communities (stools/skins) and private individuals/families that by law have various levels of ownership and utilization of these resources depending on the ownership type and the policies/legal regulations which apply to such resources.

2.5.4 Impact of the Informal Water Sector

Operations of informal water markets are common phenomena in most cities of low income countries. Their services range from very small-scale individuals undertakings to medium and large scale vendors who engage employees. In some literature, empirical evidence

revealed relatively high employment opportunities created by the informal water sector than the formal sector. The important role of the informal sector as a source of employment was evident in cities like Ouagadougou of Burkina Faso and Bamako of Mali where employees in the sectors ranged from few hundreds to thousands (Kjellen & McGranahan, 2006).

Apart from providing supplementary supply and easing water access challenges faced mostly by the urban poor, regular customers of water vendors have been found to continuously enjoy steady water supply during periods of general water shortage whereas consumers of public tanker trucks and pump-wells seriously suffer during such periods. In addition, informal vendor services are generally more reliable than public services in most low income countries. Vendors providing intermediary services to unconnected households play an important role in increasing water coverage in peri-urban and informal settlements (Peloso & Morinville, 2014). This has been observed to deter the public utility provider from acting against water reselling in cities including Accra where the act is illegal.

The woes of vulnerable groups including women and children who are responsible for sourcing water for household use are eased by services of vendors. Such problems include physical health issues resulting from continuous carrying of water on the head, children staying out of school to help source water for the households as well as lost time in searching for water by women which further entrench vulnerability and poverty among these groups are largely reduced especially where households have the opportunity to obtain doorstep water service from vendors. Health wise, vendor services often prevent poor households from otherwise using poor-quality water (from rivers/streams) for drinking and cooking. Therefore, these households have the option to use poor-quality water for washing, bathing and cleaning while depending on water from vendors for drinking and other uses.

Generally, the urban poor constitute the majority of consumers of vended services. However, some literature report instances where vendors serve as the ‗lender of last resort' during periods of prolonged water shortages or crisis. Patronage of vendor services therefore go beyond the urban poor and dwellers in areas without coverage especially slums.

Though much literature, as discussed, especially recent works have contested pronouncing the informal sector as an outcome of inefficiency of the public network supply that has

cashed in to exploit the urban poor, it is undeniable that vendor services have adverse impact on the consumers. Informal services are generally challenged with low capacity thereby unable to fully satisfy the water needs of households that depend on their services **(**Kjellen & McGranahan, 2006). This is attributed largely to the high cost of accessing such services and the fact that poor households with limited alternative can only afford few buckets at a time.

2.5.5 Challenges in the Informal Water Sector

Generally, informal water supply especially sachet and other packaged water is associated with supernormal profit margins. However, Kjellen and McGranahan (2006) opined that unlicensed direct distributors (resellers) are mostly not privy to any discount for purchasing large quantities from the public network. This is worse when cost per unit increase with increased consumption under flat rates. The utility providers may place resellers on a commercial tariff hence increasing water prices for resale.

Wholesale vendors who use electricity for abstraction are mostly at the mercy of the electricity supplier. Where electricity supply is sporadic, it is not uncommon for vendors to temporarily be put out of business during blackouts (Pangare & Pangare, 2008). In other instances, licensed vendors are often affected by tax and other public charges. This affects the profit margins of operators who in turn charge higher prices for their services. Additionally, most operations of informal (especially small scale) water vending are conducted using manual labour or manpower-based technology. Head potters and pushcart operators, especially, go through a lot of physical stress getting water to the end user. Critics who chastise vendors for high charges most often however do not consider this implicit cost as part of the cost of operation. Kjellen and McGranahan (2006) recount from an earlier work by Njiru and Albu (2004), in Khartoum (Sudan) where water vendors were harassed for non-payment of taxes (five different tax charges) (Kjellen & McGranahan, 2006). Aside not enjoying economics of scale, vendors in competitive environments need to work very hard to maintain customer trust and loyalty or risk losing market for their water. Unlike the formal utility providers, these vendors do not enjoy monopoly.

Poor access to finance, high taxes, cost of raw material and interest rates coupled with inadequate infrastructure are among the common challenges faced in Ghana‘s informal

sector. This is especially more entrenched among small and medium scale enterprises. Registering and starting a business in Ghana also takes a longer period (81 days) as compared to countries like Australia (2 days), Sierra Leon (26 days) and Benin (31) among others (Farvacque-Vitkovic et al, 2008).

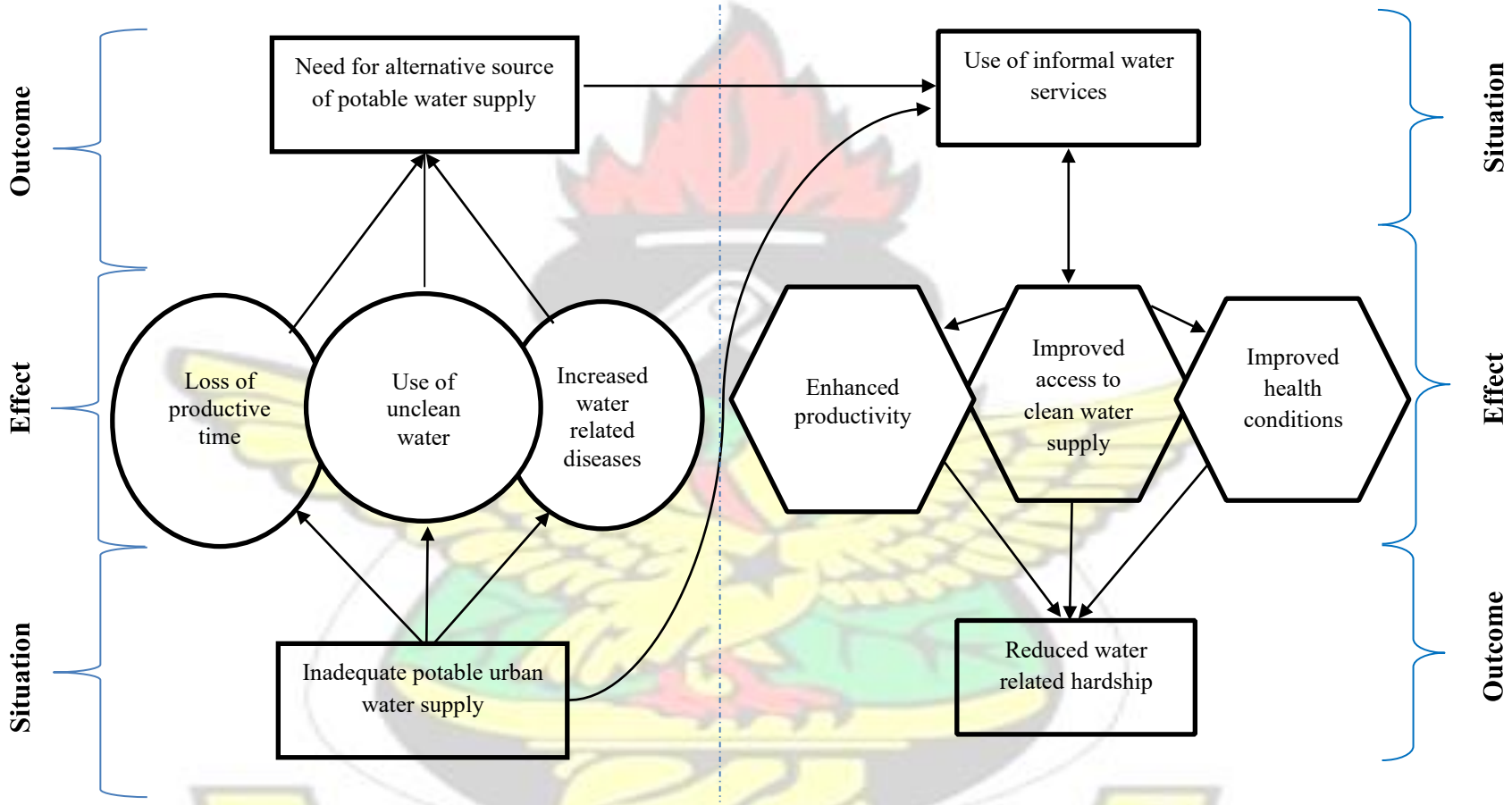
2.6 Conceptual Framework

Water supply is inadequate in urban Ghana. Urban dwellers especially the poor inhabitants in informal settlements struggle to access clean water supply to meet their daily needs. In areas with piped water connections, supply is generally sporadic and rationed thereby forcing some (abled) consumers to adopt various informal water access strategies to ensure constant supply of the resource. In some areas, rationed periods are not regular and taps often flow at odd hours, usually late at night.

In areas and among households without water utility connection, household members, mostly women and children, spend long hours searching for and collecting water for the household. It is not uncommon in these areas to see people in long queues in a struggle to get some few buckets. Sometimes competing consumers who out of frustration and the need to secure just enough to satisfy their daily water needs get agitated into quarrels. These women lose productive hours collecting water that could otherwise be spent on engaging in economic enterprises to earn income. This increases gender disparity in terms of income and employment opportunity which puts women at a disadvantage and further entrenches poverty and vulnerability among them. Also, physical stress associated with carrying water on their heads for long distances and going through stressful ordeals each day affect the health conditions of these women. Additionally, children who often have the responsibility of collecting water for their households in some cases become perpetual late comers and or absentees in school. Sometimes, schooling becomes an opportunity cost for collecting water as children are kept out of school to help secure water (often from long distances and queues) for household survival. The situation often results in poor performance and at worse loss of opportunity to gain formal education which is vital to a child‘s future.

In cases where households are without the financial capacity to buy water from alternative sources or lack access to a clear water source, poor quality water from unimproved sources including rivers, streams and sometimes gutters are collected and used. This situation exposes such households to various health risks including cholera, diarrhea, guinea worm and other infections. Subsequently, substantial amounts of financial resources are expended on getting treated water which further worsen the poor economic situations of these households most of who are the urban poor.

The combined effect of the above situation subsequently increase social and economic hardship in urban areas of most low income countries like Ghana where 7.4 percent of the urban population is unemployed. The figure for the Northern region was 6.4 percent (Ghana Statistical Service (GSS), 2013). Furthermore, the poverty situation among poor urban and peri-urban households who are most affected by poor access to water supply is entrenched and become vicious (See Figure 2.3). Consequentially, where households have some financial capacity and option to secure water from alternative water providers mostly informal vendors, they are often charged relatively high rates for the water. This notwithstanding, the services of the informal sector is vital for the survival of these households resulting in continuous engagement of the services of these alternative suppliers.



Source: Author's Construct, 2014

Figure 2.3: A Conceptual Model on the Impact of Informal Water Services

Notwithstanding the non-beneficial effects imposed on consumers of informal water vending services, the researcher tentatively posits that the informal water sector provides essential benefits to the urban populace which help reduce social hardship imposed on households as a result of poor access to water supply. Referring from the conceptual model in Figure 2.3, the informal water sector provides basic water supply to unconnected and poorly served households in urban and peri-urban areas. The services provided are flexible and demand driven such that consumers are able to choose an option which best suits their economic and social needs. Consumers decide the quantity of water they require which can be provided through doorstep services or the consumer moving to a point of sale to collect water. Unlike the public water utility which often uses a flat rate of monthly payments, consumers are privy to the amount they can afford at a time when they deal with informal water suppliers.

In effect, the informal water sector plays a crucial role in extending urban water coverage thereby helping improve water access among urban dwellers especially the poor. With improved access to water supply, various associated effects of inadequate water access including adverse health implications are positively enhanced. Missed opportunities including loss of productive hours, poor school attendance and school dropout are also improved when households have the opportunity to access water through informal water vending (and alternative water) services. This will contribute positively to women empowerment and educational achievement of children.

Consequently, there will be increased water supply coverage in urban and peri-urban areas which will help ameliorate social hardships faced by urban populaces in their struggle for water which is basic and essential for human survival. This holds significance for local, national and global level development objectives including the MDGs.

CHAPTER THREE

STUDY METHODOLOGY

3.1 Introduction

Conducting social science research is an important and complex undertaking especially when the phenomenon being studied is contemporary and involves human subjects. Its reliability and validity to a large extent depends on the methodology adopted. This includes the processes, procedures and methods used in gathering, analysing and interpreting empirical data. From the literature review, different authors used various methodologies including ethnographic studies (see: Ranganathan, 2014) and Case Studies (see Kjellen & McGranahan, 2006; Pangare & Pangare, 2008; Stoler et al, 2012; Burt & Ray, 2014; Peloso & Morinville, 2014; Kooy, 2014) to conduct similar studies on water supply.

Like many other studies, the study attempted to investigate the link, if any, between informal water supply and socioeconomic wellbeing of urban dwellers. It aimed to establish how the availability and operations of the informal water activities impacted on the living conditions of urban dwellers. Issues on economic wellbeing such as: household members especially women's ability to engage in income earning and other productive activities, income and expenditure on water and effective demand for water services were analysed. Also, the nature of interaction between households and informal water operators was assessed. This included: time spent in searching for and collecting water, effect on schooling and the reasons for patronizing informal water services. Furthermore, activities of informal water operators including: sourcing water, treating, transporting and other expenditure and income aspects of their activities were analysed. The aim was to provide indepth information on the operational activities of the informal water sector and to demonstrate the relation between formal water coverage and persistence of informal services.

This study concentrated on domestic water supply. Emphasis was therefore on water use for household (domestic) activities including cooking, bathing and other consumptive purposes. The study considered domestic water supply as household water demand for consumption (cooking and drinking), cleaning (bathing and washing) and other productive uses that were identified by Thompson et al (2001) to be of importance to urban households

in poor countries. These included construction, backyard gardening and animal feeding. In essence, this chapter explains the methodology adopted in conducting the study. The methods and procedures adopted were also informed by related empirical studies (published) conducted by authorities in the field.

3.2 Research Design

Research design in an empirical study represents the basic procedure(s) that directs the researcher's initial perception about a phenomenon to how s/he gathers empirical evidence to verify this perception. It guides the process of collecting, analysing, interpreting and reporting observations in a logical manner (Nachmias & Nachmias, 1992, cited in Yin 2003). Yin (2003) further cites Philliber, et al. (1980), explanation of a research design as a ―blueprint‖ detailing out: what research questions to study, the relevant data needed and how the results will be analysed. In other words, it is a ―*logical plan"* that ―*deals with a logical problem*‖ of formulating and answering research questions (Yin, 2003).

Different research designs are used in various fields (physical and social sciences) for different purposes. For social science research, surveys, historical studies, archival analysis, action research and case studies are popularly used to study social phenomena. Few of these designs however suit the study of contemporary phenomenon about a ―case‖ through a combination of direct observation and interaction with (no control on) subjects with the aim to analyse rigorously, diverse characteristics of the ―case‖ to infer for a large population (Blaxter *et al.,* 2010). In this regard, the case study design serves as: ―… *an empirical inquiry that investigates a contemporary phenomenon within its real-life context*‖ (Yin, 2003) is appropriate with reference to the (why and how) research questions of the study. The case study approach is a complete strategy involving the specified logic of design and techniques of collecting and analysing data.

The research adopted a mixed research approach to examine among other things, the state of water access among households and how the access situation affected these households. It further assessed how essential water supply from the informal sector was to urban and peri-urban households. Empirical data was collected through direct observation and interviews with individuals and institutions. Essentially, evidence from primary and

secondary sources were analysed and inferences and triangulation of evidence made to enhance the reliability and validity of findings.

3.3 Sampling and Sample Selection

The units of inquiry for the field survey were households, informal water operators, staff of the Ghana Water Company Limited (GWCL) and the Tamale Metropolitan Assembly (TMA). For the institutional survey which involved the Ghana Water Company, the Tamale Metropolitan Assembly and informal water operators, sampling these institutions was purposively done as these were typical cases (institutions and groups) which possessed the information pertaining to and needed for the study. Though the procedure is non-probabilistic, it was necessary due to the nature of the data required which could only be obtained from these purposively selected institutions.

As there existed no database on the number and location of informal water vendors in the metropolis, non-probability sampling techniques were used in selecting the vendors for the study. Three major water filling points where mobile water vendors obtained water were identified and visited to interview mobile vendors. One was selected from each of the three sub-metros. At the water filling point, 8 mobile vendors were accidentally selected and interviewed to collect relevant data needed for the study. A similar process was done for the direct water vendors from who customers visited to buy water (see Table 3.1). The direct vendors were mainly composed of individuals who sold water from the household pipe connection or a storage tank. Here the researcher identified and visited direct vendors to interview them.

The process of sampling for the household survey however involved a combination of sampling methods and the use of multistage sampling procedures. A multistage cluster sampling was used to map out all urban localities within the three Sub-Metros (Tamale Central, Tamale North and Tamale South) in the Tamale Metropolis as the study was supposed to be conducted in urban areas. A reconnaissance survey was conducted to identify localities without GWCL coverage. The urban localities were disaggregated into localities with GWCL water coverage and those without in order to enhance comparison of the extent and nature of informal water operations in these areas. Using the total number

of urban households (43,501) within the Tamale Metropolis, a sample size of 155 households was derived using a mathematical method (see Appendices). The sample (155) was then shared among the three sub-metros based on their population sizes (See Table 3.1).

Table 3.1: Sample Size and Distribution

Location	Urban Population (2010)	Sample Size			Total
		Households	Distribution Vendors	Direct Vendors	
Tamale Central	115,210	55	6	18	84
Tamale North	93,550	50	5	15	70
Tamale South	65,297	36	5	14	50
Total	**274,057**	**141**	**16**	**47**	**204**

Source: GSS, 2013 and Author's Construct, 2014

Two urban communities each were randomly selected from each of the three sub-metros using simple random sampling. Here, the names of all target communities were written on pieces of paper and folded into a bowl. Drawing one at a time, without replacement, six communities were randomly picked from the bowl. The process was done for communities which were within (4) the GWCL coverage area and those outside (2) the GWCL coverage area. The sampled households who resided in areas without GWCL water supply were picked from Kukuo (21 households) and Vitting (8 households) in the Tamale North and South sub-metros respectively. The remaining 112 households were sampled from Sakasaka (25) and Moshie Zongo (30) in Tamale Central sub-metro, Sagnarigu (29) in the Tamale North sub-metro and Nyohini (18) in the Tamale South sub-metro. The total number of households interviewed from each of the six communities was prorated based on the population sizes.

On the field, systematic sampling was adopted in selecting households (houses) for the questionnaire administration. A sampling interval of 10 (every 10^{th} house from a random starting point) was used. This was to ensure that the sample was representative and that all households had a known and equal chance of being part of the sample. However, the response rate for the household survey was 91 percent. Hence 141 instead of 155 households participated in the survey.

3.4 Data Sources and Gathering Techniques

The study was conducted using a combination of primary and secondary data. The primary data, collected through a field survey, served as the main data for the study. The primary data was in the form of pieces of raw first-hand data acquired through direct interfaces with individuals and groups as well as observations recorded by the researcher on the field. Techniques used included interviews, questionnaire administration, Key Informant Interviews (KIIs)) and direct observations pertaining to operations of informal water vendors and household activities. Data was collected in qualitative or quantitative formats where appropriate. Qualitative data was in the form of text expressing opinions and observations of respondents which otherwise could not be recorded numerically. Data such as age, income and expenditure, household size, cost and revenue were recorded quantitatively.

However, secondary data comprising fully and semi processed and archival data were gathered in textual and digital forms. These pieces of information including reports were obtained from the GWCL and the TMA. Information from Journal articles and other already prepared documents were used to supplement the primary data. This was necessary to ensure a balanced and evidence-based research thereby enhancing sufficient reflection of the actual situation and validity of findings.

Four data collection techniques were employed in gathering data for the study (see Table 3.2). A set of already prepared questionnaires were administered to solicit data from households. Key Informant Interviews (KII) was also conducted as part of the field survey where the researcher interacted with some staff of GWCL and private water operators, food vendors and staff of construction firms on selected issues to ascertain the opinions and observation of some stakeholders on such issues. Also, interviews were conducted with the Metropolitan water and sanitation officer and the operations manager of the GWCL. The researcher also used observation in appreciating activities conducted in relation to accessing water and the operations of informal water operators. These techniques were selected and used based on the type of data needed and their suitability for soliciting such data (Blaxter *et al.,* 2010).

Table 3.2 Research Questions, Data Sources and Collection Techniques

Research Questions	Data Needs	Sources of Data	Data Collection Techniques
What are the causes and effects of water scarcity among households in the Tamale Metropolis?	Main sources of water supply to households Level of access to potable water Challenges faced by households due to poor access	IWS operators, Households/ Consumers, GWCL TMA	Questionnaire administration Document analysis,
Why do informal water suppliers (IWS) operate in urban areas?	Reason(s) for emergence of IWS Background of operators Regulation of operations Support and opportunities for operators Mode of operations and management of activities Prospects of the IWS	IWS operators Households/ Consumers GWCL TMA	Questionnaire administration Document analysis, Interviews Direct Observation
How are the activities of informal water suppliers conducted in urban areas?	Type and quality of services Income and expenditure on operations Capacity of operators Type of equipment and technology used Forms of interaction between IWS and consumers	IWS operators Households/ Consumers GWCL TMA	Questionnaire administration Document analysis, Interviews, Direct Observation
How do the operations of informal water delivery impact on urban water access and social hardship?	Sources of water supply and access situation Effect of IWS on household conditions and wellbeing Extent of use of IWS service	Households/ Consumers IWS operators TMA GWCL	Questionnaires administration, Document analysis, Interviews
What challenges do informal water suppliers face in the Metropolis?	Pros and cons of using IWS Operational and managerial challenges of the IWS	Households/ Consumers IWS operators TMA GWCL	Questionnaires administration, Document analysis, Interviews

Source: Author's Construct, 2014

It is however vital to note that each of the adopted methods and techniques have their weaknesses and are liable to non-sampling errors including non-response, coverage error

and or measurement error. The response rate for the household survey was 91 percent. As much as possible and where necessary, the researcher rechecked and probed further to ensure that responses and other pieces of data collected were consistent and reflects the existing situation.

3.5 Data Analysis and Reporting

The study was conducted using a mixture of descriptive and explanatory research approaches. The descriptive approach, despite some criticisms regarding its weak scientific background, is useful in revealing the existence and nature of social phenomena which further inspires critical thinking and explanatory study into such phenomena. It is widely used in collecting information on social and economic indicators including household income and expenditure, poverty, employment level, religion, ethnic composition, age and sex structure (De Vaus, 2001). Poor description could however result in baseless suggestions and consequently making unqualified generalization. This approach was employed in describing the current water situation in the metropolis and water-related social hardship experienced by the populace.

In analysing the survey data, composed of qualitative and quantitative data, statistical analysis was done using Microsoft Excel and the Statistical Package for Social Sciences (SPSS version 20). These were used to collate, cleanse and generate descriptive statistics including frequency tables and charts. Proportions and percentages such as frequency distribution tables, charts and measures of central tendencies and dispersion including mean, median, mode, range and standard deviation were used where appropriate. The researcher employed descriptive and inferential statistics together with simple interrelationships among variables by way of cross-tabulation and correlation (Blaxter et al, 2010). This revealed vital trends and patterns in the various variables thereby enhancing valid inferences and analysis of the data collected. To ensure that results and findings were valid and adequately mirrored the actual situation, the primary and secondary data solicited from multiple sources (including institutional, individual and household levels) was triangulated.

CHAPTER FOUR

WATER ACCESS IN THE TAMALE METROPOLIS

4.1 Introduction

Evidence from literature indicated that the perennial water scarcity in the Tamale Metropolitan Area (TMA) has imposed various forms of hardships on the urban and periurban dwellers. This engineered various alternative water sourcing practices among the households. The study assessed the impact of informal water supply as an alternative or supplementary water sourcing strategy for the socio-economic development of the urban households. This chapter presents the findings and discussions of data from a field survey conducted in the TMA.

The study was centered in the three sub-metros of the TMA. It should however be noted that the Tamale North sub-metro, as used in the study, is now a separate district (Sagnarigu Municipality).

4.2 Socio-economic Background of Respondents

A total of 206 people were interviewed. Household respondents constituted majority (141) of the respondents based on the sample selection and objectives of the study. The remaining respondents included 63 informal water vendors and 1 respondent each from the Ghana Water Company Limited (Tamale regional office) and the Tamale Metropolitan Assembly. The informal water vendors were subdivided into stationary water supply operators (direct vendors (47)) and mobile water suppliers (distribution vendor (16)) (see Table 3.1). All these pieces of data were collated and analysed with reference to the research questions.

4.2.1 Age, Sex and Marital Status of Household Respondents

Access to water supply by households is crucial in every society. However, individual households have different experiences and adopt various strategies in getting access to water. The differences in gender, age and roles individuals play in supporting household water access engendered various perspectives concerning the household water situation and how it affected daily activities and livelihoods. Therefore, the gender, age, religion and other background information of the individuals interviewed was vital in appreciating the extent to which access to water affects the various groups of people.

Table 4.1: Age of Household Respondents by Sex

Sex	Age								Total	
	18 – 29		30 – 39		40 – 49		50 +			
	No.	%	No.	%	No.	%	No.	%	No.	%
Male	51	51	16	59.3	4	36.4	8	61.5	79	56
Female	49	49	11	40.7	7	63.6	5	38.5	62	44
Total	100	100	27	100	11	100	13	100	141	100

Source: Field Survey, May 2014

From Table 4.1, the survey respondents were mainly male dominated (56%). Though the study identified that females played a vital role in household water access, the male dominance in the survey was attributed to the fact that males were mostly household heads hence represented the household. Incidentally, the same proportion was married (56%) and single (44%) respectively. Females (51%) however dominated the married category than their male counterparts (see Table 4.2). Females were noted to marry at relatively earlier ages than males which was similar to the result of the 2010 PHC. This correlated with the age representation among the respondents where the youth (20 to 29 years) constituted 71 percent of the sampled household members. This is related to the results of the 2010 PHC where a substantial (20%) proportion of the Tamale Metropolis population were within that age range. The underlying cause of early marriage among female was attributed to the relatively low educational backgrounds, as observed in the educational characteristics of the households in Table 4.3.

The mean and median ages of respondents were 30 and 28 years respectively. Essentially, the respondents were mainly within the active labour force and the married people who constituted a substantial proportion of the metropolis population. It could therefore be concluded that the responses from the survey gave a fair representation of the major players involved in and affected by water supply.

Table 4.2: Marital Status of Household Respondents by Sex

Sex of Respondent	Marital Status		Total
	Married	Single	

	Number	%	Number	%	Number	%
Male	39	49.4	40	64.5	79	56.0
Female	40	50.6	22	35.5	62	44.0
Total	79	100	62	100	141	100

Source: Field Survey, May 2014

The ethnic and religious composition of the Tamale Metropolis was predominantly MoleDagbani (88.1%) and Muslim (87.6%) respectively. This was reflected in the survey results where over 89 percent of the household respondents were Mole-Dagbani and 83 percent were Muslims. Access to water in the metropolis was therefore not only essential for drinking and other household activities but as well played a vital role in the religious activities of the people (especially Muslims). Per capita water use in the metropolis was expected to be high with reference to the large Muslim population. Averagely one gallon (4.5 liters) of water was used for ablution daily per person. This implied that aside regular household activities, about 89 percent of the households required extra water for religious purposes.

4.2.2 Education and Economic Situation of Households

Access to water supply is crucial for the socioeconomic wellbeing of people. It affects people‘s ability to effectively conduct both economic and social activities. Likewise, a person‘s education, employment and income level could affect his/her ability to access potable water supply.

About 70 percent of the household members interviewed had attained some level of formal education. Most (44%) of them however schooled up to the senior high school level. Respondents who had attained tertiary education also constituted a significant proportion of 9.9 percent while basic school graduates formed the minority. However, the remaining 30.5 percent had never schooled (see Table 4.3). Females were found to be less empowered in terms of schooling with a significant proportion of them being housewives. This further enforced the female‘s role in household chores especially water collection for the household.

Table 4.3: Educational Background of Household Respondents by Sex

Gender	Highest Level of Schooling								Total	
	Basic		SHS/Voc./Tech.		Tertiary		Never Schooled			
	No.	%	No.	%	No.	%	No.	%	No.	%
Male	7	50	40	64.5	16	72.7	16	37.2	79	56
Female	7	50	22	35.5	6	27.3	27	62.8	62	44
Total	14	100	62	100	22	100	43	100	141	100

Source: Field Survey, May 2014

A person's willingness and ability to demand water like any good or service is influenced by his/her earning power. From Table 4.4, the employment status of household members indicated that about 53 percent were gainfully employed. A larger proportion (45%) of them were self-employed, mostly engaged in the private informal sector. Homeworkers who were mainly females constituted 6.4 percent whiles 28 percent were students. Majority (95%) of household heads were employed. Informal sector incomes have been noted to be low and mostly unable to sustainably support households. Coupled with the 13 percent of the respondents being unemployed, some households were expected to face challenges affording water services. This was confirmed by 26 percent of the respondents complaining of high cost of water hence their inability to afford water bills leading to their disconnection from GWCL water supply.

Table 4.4: Employment Status of Household Respondents by Sex

Status	Male		Female		Total	
	Number	%	Number	%	Number	%
Self-employed	39	49.4	25	40.3	64	45.4
Employee	7	8.9	3	4.8	10	7.0
Student	25	31.6	15	24.2	40	28.4
Unemployed	8	10.1	10	16.2	18	12.8
Homeworker	0	0.0	9	14.5	9	6.4
Total	79	100.0	62	100.0	141	100.0

Source: Field Survey, May 2014

An assessment of the housing and residential status of respondents indicated that over 77 percent of the households resided in their own residential accommodation. The remaining households were tenants residing as paid tenants (18%) or free tenants (14%). Tenants had little control over the decision to connect to GWCL supply or secure other water source for

the house they resided in. This implied that such households had to adapt to prevailing activities and modes of accessing water in the rented house or neighbourhood.

The main daily expenditure item among households were food and water. Average daily expenditure on food (GH¢5) recorded the highest followed by rent (GH¢4), lighting (GH¢2.5) and water (GH¢1.6). Though water accounted for the least household expenditure, it is a basic necessity that households could not survive for a day without. Averagely, a household spent GH¢48 on water every month. This figure was greater than the national figure of GH¢41 as recorded in the Ghana Living Standard Survey (GLSS 6) in 2014. The average monthly household income was GH¢400 and the modal income was GH¢350. The main source of household income was from personal income. Household members complained of high cost of living within the metropolis hence their incomes were unable to properly sustain them.

Although urbanisation is often associated with nuclear family systems, the study revealed a predominance (76%) of extended families among the surveyed households. This was in congruence with the 2010 PHC results where household sizes in all urban localities except within the Northern Region were decreasing. This had both positive and negative consequences for water conservation. Per capita water usage reduced where household chores such as washing was conducted in bulk, whereas the conduct of these chores on individual basis resulted in high water usage. On the other hand, the large household sizes and high population implied high demand for water which puts pressure on the water utility company. Coupled with low capacity and poor maintenance this situation was expected to increase informal activities and livelihoods (vendor services) within the metropolis as expressed by FIG (2010) in their study. This was demonstrated by over 90 percent of the surveyed households engaging in informal water storage and about 10 percent of the households with public water supply reselling water to neighbours. About 61 percent of the households were identified as regular users of informal water vending services. This illustrated a high penetration of the informal water market in the metropolis.

4.3 Water Supply in the Tamale Metropolitan Area

The populace of the Tamale Metropolitan Area had some basic level of access to water supply. Daily water access/use varied from a minimum of 15 liters to a maximum of 500 liters per household. Out of the 141 households interviewed, over 46 percent had access to a maximum daily supply of 100 liters for their daily household activities including drinking, cooking, bathing and washing. Most of these households lived in the Tamale Central (48%) and Tamale North (now Sagnarigu District) (45%). About 33 and 21 percent had average daily access of 51 – 100 liters and over 100 liters respectively (see Table 4.5).

In relation to the large household size (average of 6 members), the average daily water access per capita was less than 20 liters. Specifically, 47 percent of the households had daily per capita water of 17 liters. This was less than the least minimum per capita of 20 liters per day needed to support a healthy life style. This further confirmed the concerns raised by households about their water access challenges. In effect, these households did not have adequate water supply to enable them maintain a good standard of life. As expressed by Chenoweth (2008), this could have an adverse effect on the socioeconomic development of these households. The remaining households had daily per capita water access of 50 liters (30%) and 90 liters (23%).

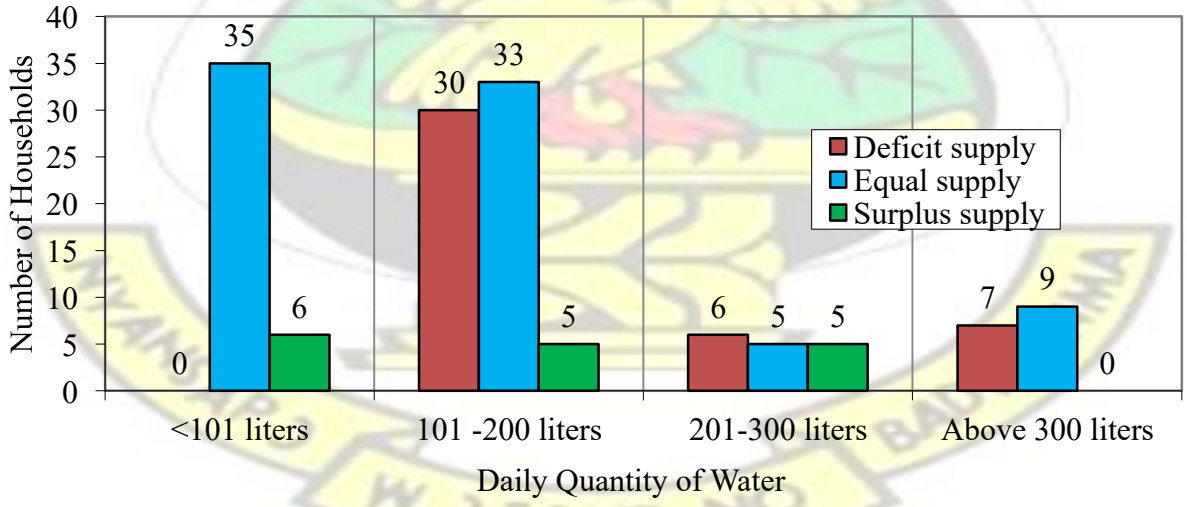
With reference to quantity of water use and efficiency of use, it was observed that connected households used more water than unconnected households. Comparatively, 76 percent of connected households used not less than 60 gallons of water per day meanwhile the figure for the unconnected households was 38 percent. The calculation factored in the average household size and subtracted non users of informal water services. This finding implied household with public water supply paid less attention to efficient water use as compared to unconnected households. Overall, households that depended mainly on informal water supply were more aware of the economic value of water than connected households. It was further confirmed by the fact the 86 percent of households with daily per capita water usage of 90 liters and more were connected to the
GWCL.

Table 4.5: Household Daily Water Demand and Access Situation in the TMA

Quantity of Water (liters)	Daily Demand		Daily Access	
	Number	%	Number	%
50 - 100	41	29.0	65	46.1
101 – 200	68	48.2	46	32.6
201- 300	16	11.4	16	11.4
Above 300	16	11.4	14	9.9
Total	**141**	**100.0**	**141**	**100.0**

Source: Field Survey, May 2014

From Figure 4.1, majority of the households who required not more than 100 liters of water to meet their daily water needs were able to obtain enough water. Statistically, 6 of the 41 households within this category were able to obtain more water than the household's minimum water demand. However, a significant proportion (average of 42%) of households with minimum daily water demand of more than 100 liters were unable to obtain enough quantity of water to meet their daily water needs. This notwithstanding, some households (10) within similar consumption categories had surplus daily supply. It was clear therefore that there was uneven distribution and access to water supply in the metropolis. Overall, 31 percent of the households did not have access to adequate water supply while 58 percent got just enough to support their basic needs. The analysis considered household sizes (average size of 6.1 persons).



Source: Field Survey, May 2014

Figure 4.1: Households Daily Water Needs and Quantity Obtained

4.3.1 Sources of Water Supply in the Metropolis

Households collected water from different sources. The three main sources of water supply to households were boreholes/well (40%), pipe borne (39%) and informal water vendors (18%). As shown on Table 4.6, boreholes and wells were important sources of drinking water for households in the metropolis. Boreholes were mainly community owned whiles wells (hand dug) were owned by individuals and households. It was also observed that some households that own wells sold water to neighbours. In the study, Pipe-borne water was further divided into in-house connection and public tap. Based on this, it was found out that pipe-borne water supply to households was mainly from public taps. Statistically, 23 out of the 41 percent of households that depended on pipe-borne water for drinking collected their water from public taps. These households fetched water from the taps at a fee. Households depending on other sources such as rainwater, sachet water and river water constituted less than two (2) percent of the sampled households.

Table 4.6: Main Source of Drinking Water for Households by Connectivity to GWCL

Main Source of Drinking Water	Connected		Not Connected		Total	
	Number	%	Number	%	Number	%
Borehole/well	7	12.1	50	60.2	57	40.4
Public tap/standpipe	24	41.4	8	9.6	32	22.7
In-House pipe	23	39.6	0	0	23	16.3
Tanker/vendor supplied	3	5.2	23	27.7	26	18.4
Rain water	0	0	1	1.2	1	0.7
Bottled/sachet water	1	1.7	0	0	1	0.7
River/stream/dugout	0	0	1	1.2	1	0.7
Total	58	100.0	83	100.0	141	100.0

Source: Field Survey, May 2014

Further analysis revealed that out of the 58 households connected to the GWCL water supply network, less than 40 percent depended mainly on in-house piped water supply as their source of water for drinking. The remaining households depended on alternative sources to supplement their water for drinking. This was as a result of sporadic pipe flow hence some households only had pipes flow few times in a month (see Table 4.6). As officials of the GWCL indicated, there was an increased daily water demand in the TMA

amidst constant supply. This implied that many more households faced challenges in accessing water especially in the dry season.

An assessment of the sources of water supply for other domestic purposes revealed similar results like the sources for drinking. From Table 4.7, over 55 percent of the urban and peri-urban dwellers collected water for cooking, washing and bathing from boreholes or wells. A substantial proportion (48%) of the connected households depended on other sources for water supply for their domestic activities. Water from these sources was either free of charge or obtained at a very low cost. This situation was more pronounced in the Tamale North where households depended largely on hand dug wells and public taps. From the water distribution map, it was clear that though there were network lines (main) in most parts of these areas, distribution lines were not easily accessible to households (see Figure 4.2). This was coupled with the fact that distribution lines were allowed a maximum length of 20 meters away from the main line, hence houses beyond 20 meters from the main line could not be connected.

Table 4.7: Main Source of Water for Other Domestic Purposes

Source of Water	Number of Households	Percentage
Pipe-borne	19	13.5
Public tap/standpipe	18	12.8
Borehole/pump/well	78	55.3
Rain water	1	0.7
Tanker/vendor provided	24	17.0
River/stream/dugout	1	0.7
Total	141	100.0

Source: Field Survey, May 2014

There were variations in the sources of water supply to households between the three Sub Metros. The Tamale central sub metro, which was the main CBD, had the most in-house GWCL supply connectivity followed by Tamale South. Over 78 percent of all households with in-house GWCL connectivity were within the CBD. The remaining households with similar connection were in Tamale South meanwhile none of the households surveyed in Tamale North had in-house pipe connection (see Table 4.8).

Despite the Tamale Central having the largest GWCL service coverage, activities and use of informal water services was dominant. The Tamale Central accounted for over 92 percent of all households that depended on the informal water sector as a main or supplementary water source. Over 55 percent of the households surveyed within the area sourced water for drinking from various informal water service providers including tanker supply (distribution vendors) and other onsite supply (direct vendors) sources (see Table 4.8). In areas where public supply was available, households without connection in their houses fetched water from connected neighbouring houses or other suppliers at a fee. Also, households experiencing sporadic supply from GWCL supplemented their water supply with the water from informal vendors.

Table 4.8: Household's Main Source of Drinking Water by Sub Metro

Main Source of Drinking Water	Sub-Metro						Total	
	Tamale Central		Tamale North		Tamale South			
	No.	%	No.	%	No.	%	No.	%
Borehole/well	1	2.3	44	88.0	12	25.0	57	40.4
Public tap/standpipe	0	0	4	8.0	28	58.3	32	22.7
In-House pipe	18	41.9	0	0	5	10.4	23	16.3
Informal vendor	23	55.8	2	4.0	1	2.1	26	18.4
Rain water	0	0	0	0	1	2.1	1	0.7
Bottled/sachet water	1	0	0	0	0	0	1	0.7
River/dugout	0	0	0	0	1	2.1	1	0.7
Total	43	100	50	100	48	100	141	100

Source: Field Survey, May 2014

However, the Tamale North and South sub-metros were mainly served by boreholes/wells (57%) and public standpipes (33%). This was partly explained by the availability of community water supply systems (boreholes and wells) as these localities were relatively less urbanized. The analysis illustrated that though the GWCL network supply was significantly available within the CBD and surrounding areas, activities of the informal water sector were mainly concentrated in the CBD. This was attributed to the high water demand within the CBD for construction, restaurants and other household activities coupled with irregular water flow from the public network. As reported by

UNSD (2012), it could be concluded that population concentration, increased economic activities vis-à-vis unmatched supply from GWCL were important factors that accounted for the high demand for informal water services in the CBD.

Noteworthy was the fact that the informal water sector played a kingpin role in providing water supply to various construction firms and individuals. Restaurants and other small food vendors also relied on the water vendors for their daily water supply. This was confirmed by the GWCL alluding to their inability to serve some consumers including the construction firms and low pressure areas. Occasions such as weddings that required substantial quantities of water often relied on the water trucks for water supply. According to some tanker truck operators, some sachet water production companies occasionally sourced water from them. Based on these, the GWCL acknowledged that even if complete and regular water supply is achieved in the metropolis, the informal water sector would not be eliminated but the demand for its services would only shift to the construction, hospitality, food processing and similar industries.

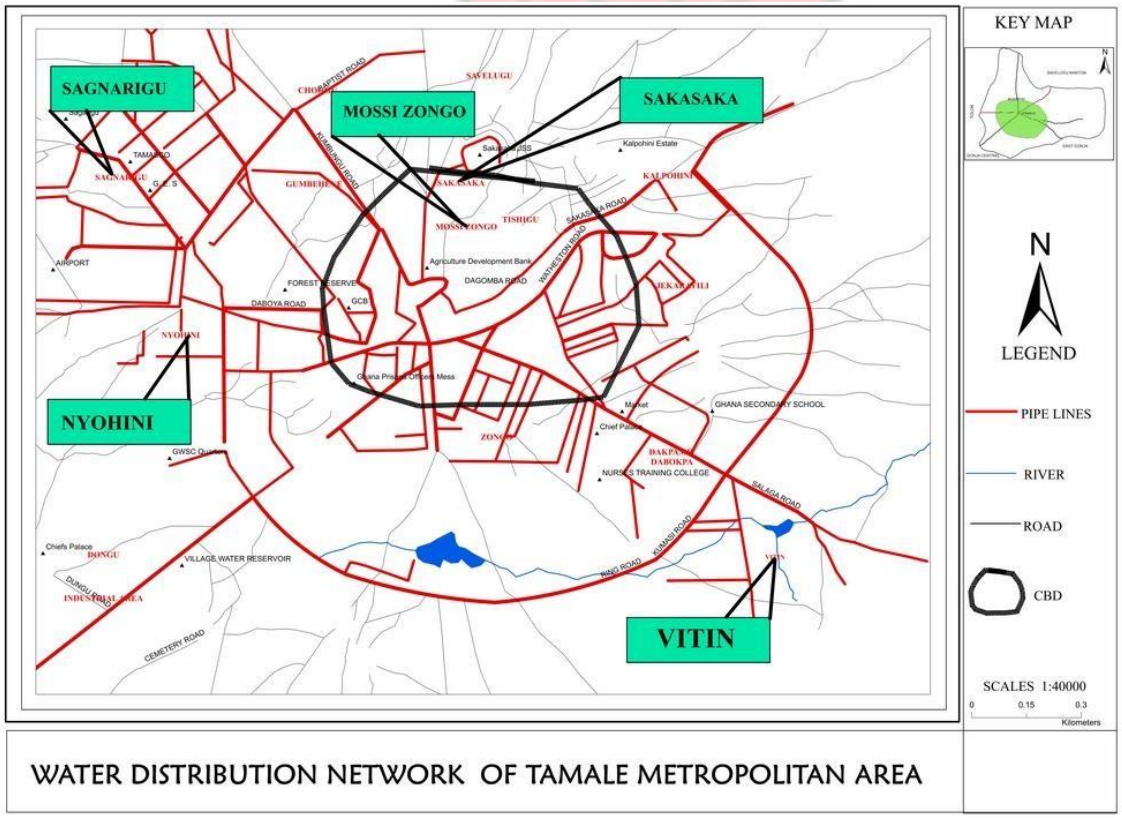
4.3.2 Public Water Access and Willingness to Pay for Improved Water Supply

Public water access in the metropolis was pegged at 55 percent by officials of the GWCL. Over the past 14 years (2002 to 2014) GWCL coverage increased by less than 15 percent (42% to 55%) in the Tamale Metropolis. However, according to the Ghana Statistical Service, TMA's urban population increased by 16 percent over the past decade (2000 to 2010). This illustrated that the rate of urban population growth (and increased water demand) exceeded the rate of water infrastructural (and supply) expansion. This implied that without urgent attention, the urban water access situation in the metropolis was progressing from bad to worse.

Public water supply was largely concentrated within the CBD where the water distribution lines were available and easily accessible (see Figure 4.2). Among the households that participated in the study, 41 percent were connected (see Table 4.10). These households enjoyed varied quality of services ranging from 24 hour supply (7%) to weekly (67%) and sporadic (26%) pipe flow. As a coping strategy, households with irregular supply engaged

alternative water sources including purchasing water from vendors. This illustrated that connectivity to the public supply network was no guarantee for regular water supply nor an indication of non-dependence on alternative water sources.

Intermittent water flow from the GWCL had affected the quality of water supplied to consumers. The presence of broken pipes and other leakages in the water supply network had the propensity to introduce pollutants into the water supplied to consumers. It was also observed that some of the GWCL distribution lines were still metal pipes most of which were old. This situation as reported from various literature sources was a potential source of contamination as metal particles and other bacteria were introduced into the piped water (see Lee & Schwab, 2005).



Source: GWCL GIS Unit (2013) and Authors Construct, 2014

Figure 4.2: GWCL Water Distribution Network of TMA

Urban households without public water supply was mainly as a result of coverage gaps in some parts of TMA. Majority (74%) of the households that were not connected to the public network attributed this to absence of distribution lines in their area (see Table 4.9).
This was confirmed by the Metropolitan Assembly which attributed the poor public water supply to the uneven distribution and inadequate coverage. However, the remaining 26 percent were not connected due to their inability to afford the cost of connection or failure to pay water bills resulting in disconnection. The services of vendors was therefore essential to these households. As reported by Peloso & Morinville (2014), it could be concluded that the activities of the informal water sector was an integral and vital component of water supply in the TMA.

Also, bureaucratic procedures in accessing public connection limited connection to the public water supply. Cost, duration and procedures (including documentation such as valid site plan and building permit) associated with connecting to the public supply network were identified as limiting factors to accessing public water supply. It took a minimum of 28 working days to get connected after submitting an application form together with some requisite documents (approved building permit and site plan) to the GWCL. To some households, the cost of connecting and the mode of payment (monthly bills) was not favourable. Consequently, some households continued to depend on public taps and other alternative sources despite the availability of distribution lines in their vicinity.

Table 4.9: Households Connected to Public Water Supply

Status	Number of Households	Percent
Connected	58	41.1
Not connected	83	58.9
Total	141	100.0

Source: Field Survey, May 2014

Further analysis revealed that over 90 percent of the connected households still used alternative water sources. Among the households connected to the GWCL, 67 percent of them depended on informal water vendors to supplement their water supply. A similar proportion (70%) of households without GWCL water supply also depended on vendors. Buying water from informal vendors was a common practice among connected and

unconnected households alike. Based on the 50 percent indicator set for the study, it was therefore conclusive to state that the informal water sector enhanced water access in the Tamale Metropolitan Area.

Table 4.10: Regularity of Public Water Supply

Regularity	Number of Households	Percent
All the time	5	8.6
Weekly	38	65.6
Sporadic	15	25.8
Total	58	100.0

Source: Field Survey, May 2014

As explained earlier, piped water supply was generally intermittent in the metropolis. This exposed majority (91%) of connected households to challenges in accessing water (see Table 4.10). Households on flat billing rates expressed dissatisfaction with the mismatch between the amount they paid as monthly water bill and the quantity of water received. The households facing intermittent supply had to pay the same amount as water bill notwithstanding the number of times they had supply from the GWCL. Monthly water bills among the surveyed households ranged from GH¢10 to GH¢120. The average amount paid as monthly water bill was GH¢58 while the modal amount paid monthly was GH¢80. It was clear from the analysis that there was the need for improvement in services provided to households by the GWCL.

In view of the above, a willingness-to-pay assessment was conducted to ascertain households' readiness to pay for improved water supply service from the GWCL. The results revealed that less than 33 percent of the connected households were ready to pay an additional amount on water bill for improved water supply service. Over 53 percent were not willing to pay extra for improvement in services whereas the remaining 14 percent were undecided on whether they were ready to pay extra for service improvement or not (see Table 4.11).

Table 4.11: Willingness-to-Pay for Improvement in Water Supply

Willingness	Number of Households	Percent
Willing to pay	19	32.8
Not willing to pay	31	53.4

Don't know	8	13.8
Total	58	100.0

Source: Field Survey, May 2014

There was some correlation between the regularity of supply experienced by consumers and their readiness to pay extra for service improvement. Consumers who received good service were more willing to pay extra for service improvements. From Table 4.12, three out of the four (75%) consumers with constant supply were willing to pay for further improvement whereas 15 (27.7%) of the 54 consumers who had irregular water supply were willing to pay for improvement. The consumers who were unwilling to pay attributed this to loss of confidence in GWCL's ability to give quality service coupled with complaints that the existing charges were already high. As many as 84 percent of those willing consumers were ready to pay additional amount of GH¢10 or less for service improvement. The rest agreed to pay above GH¢10 extra for service improvements.

Table 4.12: Regularity of Supply and Willingness-to-Pay for Service Improvement

Willingness to Pay	**Regularity of Public Water Supply**			**Total**
	All the time	Weekly Supply	Sporadic Supply	
Willing to pay	3	12	3	19
Not willing to pay	1	23	9	31
Don't know	0	4	3	8
Total	4	39	15	58

Source: Field Survey, May 2014

This further confirmed that connectivity to the public network supply in the metropolis was no guarantee of regular and improved water access to households. Majority of inhabitants had little confidence in the public water supply system which in most areas was generally sporadic and unreliable. Informal water collection activities including storage practices were largely a consequence of unavailability or poor supply from the GWCL. This therefore illustrated that informal water supply activities in the Tamale Metropolis did not cease with public water supply coverage from the public utility provider (GWCL). Informal water activities therefore did exist in areas without GWCL water supply coverage as well as among households without GWCL connectivity.

Table 4.13: Willingness-to-Pay by Employment Status

Employment Status	Willingness to Pay						Total	
	Willing		Not willing		Don‘t Know			
	Number	%	Number	%	Number	%	Number	%
Employed	17	89.5	18	58.1	4	50.0	39	67.2
Unemployed	2	10.5	13	41.9	4	50.0	19	32.8
Total	19	100	31	100	8	100	58	100

Source: Field Survey, May 2014

The status of employment and income levels of respondents correlated with their willingness to pay extra for water service improvement (see Table 4.13). Gainfully employed people were more willing to pay extra for water service improvement than the unemployed. A chi square test gave a significance of 0.040 which implies that there was a positive relationship between the employment status of a person and his/her willingness to pay for service improvement. Analysis of the correlation between a person‘s income level and their willingness to pay for service improvement demonstrated a very strong relation (coefficient of determination of 0.828) between level of income and willingness to pay. It showed that a person‘s income had 83 percent influence on their willingness to pay. This implied that the people with higher incomes were more willing to pay than those with low income.

4.3.3 Water Collection Experience among Households

In the Tamale Metropolis, households went through various experiences in accessing water. These processes and experiences were influenced by the level of availability and reliability of water supply sources. Evidence from the field suggested that households spent between 0.10 to 6 hours in collecting water daily. Averagely, a household spent about 2 hours each day collecting water (see Table 4.14). The time spent collecting water was influenced by three main factors. These were; connectivity to GWCL and regularity of pipe flow, proximity to other (mostly informal) water sources and level of pressure on source of water supply (length of queue).

Comparatively, households without GWCL water spent more time collecting water especially when their source of water was not close to their residence. A similar case was experienced by households with irregular water supply from GWCL. Households in the Tamale Central spent relatively longer time (2.30 hours) due mainly to long queues in accessing water. Tamale North (1 hour) recorded the lowest average time followed by Tamale South (2 hours). The Metropolitan Water and Sanitation Agency still operated in some localities in the North and South sub metros. Some communities were therefore provided with boreholes and small-town water systems.

Table 4.14: Time Households Spend Collecting Water Daily

Time	Number of Households	Percent
10 – 30 min.	36	25.5
31 – 59 min.	18	12.8
1 – 1.59 hrs.	51	36.2
2 – 3.59 hrs.	32	22.7
4 – 6 hrs.	4	2.8
Total	141	100

Source: Field Survey, May 2014

The study showed that 38 percent of households connected to GWCL spent an hour or less collecting water daily. The remaining 62 percent spend over 1 hour collecting water daily. About 39 percent of unconnected households spent less than 1 hour while majority (61%) spend over 1 hour collecting water daily. Considering only the households connected to GWCL, none of the households with regular water supply spent up to 30 minutes collecting water. Meanwhile over 67 percent of the households with irregular supply spent an hour or more collecting water daily. This implied that most households in the TMA, especially unconnected ones, spent at least an hour collecting water. This had adverse consequences on the time available to such household members to engage in other activities.

Table 4.15: Person(s) Responsible for Collecting Water for Household

Household Members	Number of Households	Percent
Women	86	61.0
Children	55	39.0
Total	141	100.0

Source: Field Survey, May 2014

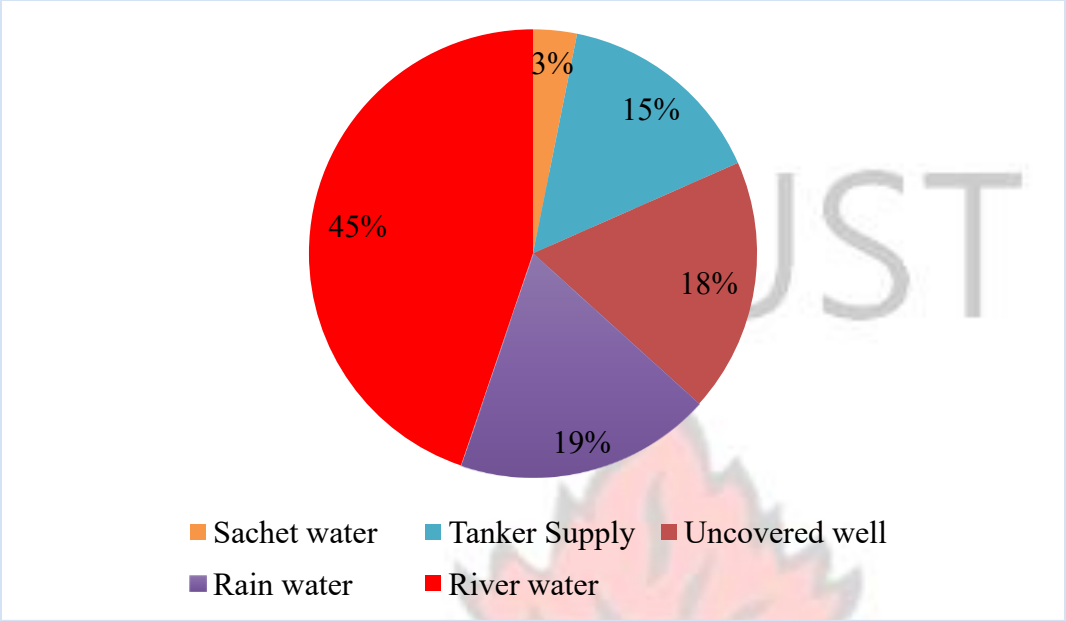
Generally, women and children were responsible for collecting water for the household. This finding gave credence to the findings in literature. As shown on Table 4.15, women were largely tasked with acquiring water in over 60 percent of the households surveyed. Children also played an important role in collecting water. This practice was attributed to the culture of the people that bestowed basic household chores on women and children. This could be said to be a common practice in most parts of Ghana with reference to similar findings in other studies conducted in other parts of the country (see Peloso & Morinville, 2014). This implied that the challenges associated with collecting water were largely borne by women and children. This included spending productive time and enduring the physical stress associated with carrying water. It also affected their work and school attendance (see Figure 4.7).

Storing water in pots, barrels and other water storage containers was a common household practice in the metropolis. This was necessary to ensure water availability for household use. Where households could afford, large overhead tanks and other mobile/concrete tanks were installed and used to store water for household use. About 84 percent of the households interviewed used various containers to store water in the house. This practice according to the households was sanctioned by irregular water supply to households in the metropolis. Most households used small containers which in most cases were unable to contain enough water to sustain the household for long periods (less than a week) (see Figure 4.3). Water therefore had to be collected almost on a daily basis.

Source: Field Survey, January 2015

Figure 4.3: Water Storage in a Household in Sakasaka, Tamale Central

People‘s knowledge on clean and unclean water sources influenced their choice of water source for drinking and other consumptive purposes. Ascertaining households‘ opinions on which water sources they deemed as clean was therefore vital. Generally, uncovered wells, rain and river water, tanker supply and sachet water were considered as unclean sources of water supply. However, some households which mentioned vendor supplied as unclean still depended on these sources. This clearly showed that dependence on vendor supply was a necessity to some households. Ironically, these respondents in their subsequent submissions commended the informal water market for their contribution to improved health conditions in their households.



Source: Field Survey, May 2014

Figure 4.4: Respondent's Perception of Unclean Water Sources

From Figure 4.4, majority (71%) of the respondents mentioned uncovered wells, rain and river water as unclean sources. About 15 percent of the respondents were of the view that water from tanker supply services was unclean and therefore unfit for consumption. Few respondents (5%) opined that sachet water was unclean. However, less than 17 percent of the households who used water from vendors treated the water before use. This implied that households paid less attention to water quality (from vendors) but just want enough water to sustain themselves. This was attributed to the water scarcity situation among households. This implied that households were at risk if the water supplied from the alternative source was contaminated.

4.4 Water Supply and Accessibility Challenges in the Metropolis

As of October 2014, the daily water production capacity from the GWCL for the Tamale Metropolis was 45,000 m^3 (10 million gallons). About 73 percent (73 million gallons) was supplied to the metropolis. There was only one production point (Dalun) from where GWCL treated and supplied water to the metropolis and surrounding areas. Though the company did not have an exact figure of the proportion of the metropolis' population

served, it was estimated that 55 percent was served by the GWCL. Estimated daily water demand of the metropolis for 2015 was 10 million gallons which was equal to the total production capacity of the Dalun water plant. Without expansion of the Dalun plant or establishment of new production points, the water scarcity situation in the metropolis was expected to worsen. This will increase water related hardships faced by urban and periurban dwellers in Tamale and the surrounding urban and peri-urban areas served by the GWCL.

Over 98 percent of the households surveyed intimated that they were facing challenges in accessing clean water supply. Water access challenges faced by households in the surveyed localities included lack of public water network lines in some parts of the metropolis, low water pressure and irregular water flow from GWCL supply. Households within the unserved, low pressure and rationed areas supplemented with supply from boreholes/wells and informal water vendors. About 26 percent of households not connected to the GWCL said they were unable to afford the cost of connection. The remaining 74 percent were however living in areas without GWCL pipelines. This gave credence to reports that Ghana like other African countries faced economic water scarcity. However, households that lived in areas without GWCL coverage lacked physical access to public water supply. This implied that such households were faced with physical scarcity as they were willing and able to afford water from GWCL but unable to access the distribution lines.

Some household members complained of physical stress imposed on them as a result of carting water from other locations into their houses. These respondents were mainly women charged with the responsibility of getting water for the household.

According to the GWCL, efforts at improving water supply were limited by illegal connections, high default rate and high non-revenue water coupled with huge arrears from unpaid water bills. This affected the company‘s ability to generate enough revenue to support its operations. Consequentially, urban dwellers were faced with poor access to potable water supply which translated into difficulty and delay in conducting household chores and economic activities. Some households also resorted to unclean water sources

such as uncovered wells and river water. It was also observed that the GWCL made little use of ground water which could be used to supplement water supply from Dalun.

4.5 Chapter Summary

The public water coverage deficiency in the Tamale Metropolis was attributed to an increased water demand from the growing urban population vis-à-vis unmatched capacity expansion in the public water supply system. There was only one water production point (Dalun) which served the Tamale Metropolis and Other surrounding urban areas. The metropolis was therefore supplied with 73 percent (73 million gallons) of water produced from the Dalun plant daily. It was realized that new entries (communities) into the urban domain further increased the number of areas to be served by the GWCL (Tamale). Consequentially, the quality of public water supply decreased. These challenges were further compounded by some operational constraints within the GWCL. Among these were high non-revenue water (illegal connections and leaking pipelines), inadequate internally generated funds due to high default rate and high non-revenue water coupled with high cost of water treatment. The poor public water supply forced some households (67%) to adopt various alternative means of accessing water.

It could be concluded therefore that connectivity to the public network supply in the metropolis was no guarantee for regular and improved water access to households. Majority of the inhabitants had little confidence in the public water supply system which in most areas was generally sporadic and unreliable. Informal water collection activities including storage practices were largely a consequence of unavailability or poor supply from the GWCL. This therefore illustrated that informal water supply activities in the Tamale Metropolis did not cease with public water supply coverage from the public utility provider (GWCL). Informal water activities therefore did not only exist in areas without GWCL water supply coverage nor only among households without GWCL connectivity.

CHAPTER FIVE

INFORMAL WATER SUPPLY IN THE TAMALE METROPOLIS

5.1 Introduction

In line with the second and third specific research objectives of the study, this chapter provides an assessment of the nature of operations of the informal water sector in the Tamale Metropolis. It also analyses the extent of demand for informal water services and how these services contributed to urban water supply and the living conditions of the urban dwellers.

5.2 Nature of Operations of the Informal Water Sector

The informal water sector has existed and supported household water access in Tamale for over 20 years. Over 75 percent of the surveyed households alluded to depending on informal water supply for over 5 years as at the time of the survey (2014). Some households (4%) had for over 10 years depended on the sector as their main source of water supply (see Table 5.1). An assessment of the duration of existence of various water vending business gave credence to the above finding. It was found out that over 15 percent of the informal water operators had been in business for over 10 years. In parts of the metropolis where GWCL coverage was unavailable, the informal water market was a vital water service provider. This finding gave credence to reports from literature (Prasad, 2007) that purported that the informal water access activities existed before networked public water supply.

Table 5.1: Duration of Dependence on Informal Water Supply

Number of Years	Number of Households	Percent
1 – 4	22	22.7
5 – 7	35	36.1
8 – 10	36	37.1
>10	4	4.1
Total	97	100.0

Source: Field Survey, May 2014

5.2.1 Background of the Informal Water Operators

The informal water market provided employment for both male and female urban dwellers. Operators in the informal water sector from the survey were predominantly males. This was especially true for the operators undertaking distribution services. Distribution vendors within the Tamale Metropolis conveyed water to consumers using motorized vehicles such as tractors and other tanker trucks. The male dominance in the distribution services was attributed to the tedious nature of their operations which was explained as less suitable for females. This was further explained by cultural beliefs and traditional practices which assigned separate roles to the male and female gender as explained in the Ghana Human Development Report (UNDP, 2007).

Out of the 63 water vendors interviewed, only 12 were females (see Table 5.2). All of the female vendors were engaged in direct vending services. The direct vendors provided onsite water sale services where consumers visited the water point to purchase water directly. The remaining 74 percent of the direct water vendors were males. These operators source their water mainly from household taps connected to the GWCL supply. This implied that the GWCL provided water for over 85 percent of urban dwellers directly though piped connection and indirectly through vendors.

Table 5.2: Sex of Vendors

Sex	Category of Vendor				Total	
	Distribution Vendors		Direct Vendors			
	Number	%	Number	%	Number	%
Male	16	100	35	74.5	51	81.0
Female	0	0	12	25.5	12	19.0
Total	16	100	47	100	63	100.0

Source: Field Survey, May 2014

The ages of the water vendors ranged from 19 to 76 years. Majority (48%) of them were within the 24 to 30 age brackets. The median age was 30 years. During the time of the survey, 49 and 51 percent of the respondents were married and single respectively. Findings from the study therefore illustrated that the informal water sector served as a vital source of income for some households in the metropolis.

Education and Employment Background of Operators

A person‘s level of education influences his/her employability and income level as well as his standard of living. From this backdrop, an assessment of the educational background of the water vendors indicated that about 10 percent of them had attained tertiary education. Majority (24%) of the vendors with formal education were secondary/vocational school leavers. A significant proportion (49%) of the vendors however did not attain any formal education (see Table 5.3). This was further reflected in the respondents‘ literacy level where over 60 percent were not literate. This finding was reflected in majority of vendors engaging in the sector due to the little skills and education required to enter the sector. Also, the inability of most vendors to keep records of their operations was to some extent as a result of their illiteracy. It stands to reason therefore that the low education level among majority of the vendors affected their ability to adopt better practices in ensuring quality water supply.

Table 5.3: Highest Level of Schooling among Vendors

Level	Number	Percent
Basic	11	17.5
SHS/Voc./Tech.	15	23.8
Tertiary	6	9.5
Never Schooled	31	49.2
Total	63	100.0

Source: Field Survey, May 2014

Majority (94%) of the water vendors reported that their main occupation was water vending. From Table 5.4, 4 out the 63 respondents had other occupations but engaged in water vending as a supplementary business. These were tertiary graduates who had their main employment in the public sector. It was noted from the survey that over 80 percent of the distribution vendors were employees who were paid on commission basis. This was attributed to the cost (of vehicle and water tank) involved in starting a distribution vending business. These employees had no direct control over the licensing and performance of tax obligation of the business. The owners of the trucks used by these vendors engaged in other occupations aside their water vending business.

Table 5.4: Main Sector of Employment

Sector	Number	Percent
Public/formal	4	6.3
Private informal	59	93.7
Total	63	100.0

Source: Field Survey, May 2014

People engaged in the informal water sector for various reasons. Over 90 percent of the vendors interviewed were in the sector owing to less skills required to engage in the informal water vending business (see Table 5.5). Others especially the direct vendors took advantage of the fact that most households within their neighbourhood faced water supply challenges. This presented an income earning opportunity for households with good water supply. These vendors sold water from the in-house tap. Some of the direct vendors had water storage tanks where water was stored to ensure continuity of their water vending business during times when GWCL supply ceased. It was also observed that some public taps owned by the GWCL were leased to private individuals to operate. In line with Kjellen & McGranahan (2006), the informal water sector activities in the TMA were sanctioned by unmet water needs which generated unsanctioned economic activites that supported the livelihoods of the urban population. The sector was therefore an essential and integral source of survival for households.

It could be concluded therefore that, despite the sector being a source of income for vendors, it essentially served as an intervention to help ease unmet water needs. The emergence and continuity of the sector was motivated by households‘ need for water on one hand and vendors‘ quest to earn income.

Table 5.5: Motivation for Engaging in the Informal Water Vending Business

Reason	Number	Percent
Less skill required	57	90.5
Low capital required	2	3.2
Only business available	3	4.8
High revenue	1	1.6
Total	63	100.0

Source: Field Survey, May 2014

Aside the above stated reasons, the water vending business provided readily available job opportunities for majority of the tanker driver operators. Over 90 percent of these operators were employees who worked for a daily commission or monthly pay. Some of these operators worked previously as commercial vehicle operators. It was therefore clear that the informal water market offered a way out of unemployment for most of the people engaged in the sector. The operatives, especially tanker drivers - most of who were employees, however complained of low returns on the business during the rainy season when there is reduced demand for their services.

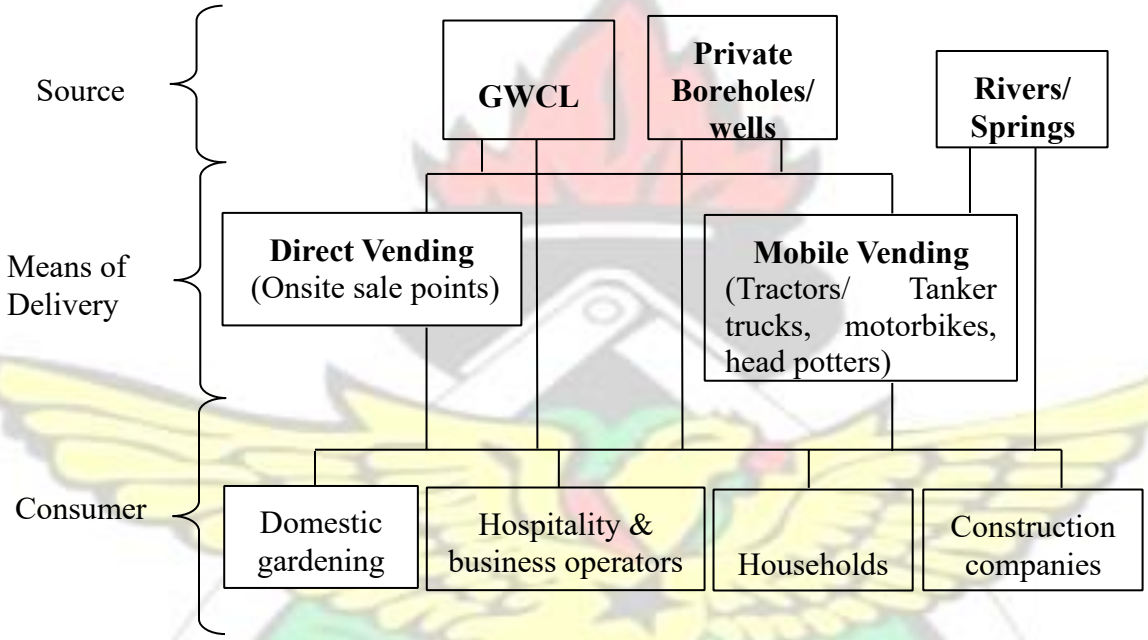
Like most informal businesses in Ghana, record keeping on activities and resources was not practiced by about 94 percent of the water vendors. These vendors had no record of their daily expenditure and revenue. To the vendors, their daily activities was a routine which they were completely abreast with. There was therefore no need to record these activities. Another factor that could be attributed to this was the rate of illiteracy (60%) among the operators. Without these records, assessing the growth trend of the various water vending businesses was difficult. As potential investors request for records for assessing the growth potential of a business as a criteria for investing, the poor record keeping was a disincentive to potential investors.

However, about 75 percent of the vendors saved some portion of their income. The remaining 25 percent did not save any portion of their income which according to them was because the income was barely enough to support the household daily expenses.
These vendors were employees who received daily commission based on the day‘s sale.

5.2.2 Source of Water and Regulation of the Informal Water Sector

The informal water market comprises of water producers, distributors (vendors) and consumers. The vendors constituted an important link in the water market. They included onsite distributors (direct vendors) and the mobile distributors (distribution vendors) comprising of water tanker truck operators. The direct vendors provided onsite water supply to consumers who visited and purchased water (see Figure 5.1). Majority (over

97%) of the direct vendors sourced water from the GWCL public network supply. Here, consumers either fetched directly from the household tap or from a storage tank where water is stored from the tap. Water from these vendors was mostly sold in small containers mostly 25 liter plastic containers commonly referred to as ―Kuffour gallon‖ and medium size buckets.



Source: Author's Construct, 2014

Figure 5.1: Urban Water Delivery in the Tamale Metropolis

Source: Field Survey, May 2014

Figure 5.2: Informal Water Supply at a Mechanized Borehole (Tamale Post Office Area)

The second category of vendors were the distribution vendors who provided door to door water supply services to consumers. These vendors traded in large quantities of water. The water tanks used by these vendors ranged from 500 to 4000 gallons.

In the Tamale Metropolis, vendors sourced water from two main sources (see Figure 2.2). These were supply from GWCL (in-house pines, water substation and public taps) and direct abstraction from hand dug wells, boreholes and open sources such as rivers and streams. Distribution vendors sourced water mainly from the substations and mechanized boreholes owned and operated by private individuals. The direct vendors sold water from in-house pipe, wells and public taps. From Table 5.6, over 85 percent of the vendors sourced water from the GWCL supply. Water sourced from mechanized boreholes (12%) was relatively less widespread in the informal water market within the metropolis. Probing further, majority of the distribution vendors interviewed alluded to periodically sourcing water from rivers/stream. This water was mainly served to consumers who required the water for non-consumptive purposes, mainly for construction works.

Table 5.6: Sources of Water to the Informal Water Market

Source of water	Number	Percent

In-house tap (GWCL)	47	74.6
GWCL substation	7	11.1
Mechanized borehole	8	12.7
Hand dug well	1	1.6
Total	63	100.0

Source: Field Survey, May 2014

Consequentially, the operations of the informal water market in the metropolis was to a large extent impacted by the GWCL supply. This implied that the inability of GWCL to supply water for prolonged periods would not only affect households that are connected and depend on the public network but will as well affect the operations of the informal water market and households and institutions that depend on the informal water market.

The operation of the informal water supply in the TMA illustrated an ongoing institutional bricolage. This was need-driven synergy of the formal water supply elements and elements of the informal sector, as explained by Sehring (2009) in his study.
Activities of the informal water market were therefore supported by both the GWCL and actors in the informal sector (vendors).

Legality and Regulation of Operations

The study revealed that over 98 percent of the water vendors surveyed operated without a permit. Only 1 out of the 63 vendors interviewed was found to have an operating license. Probing further, it was found out that the said vendor was an employee of an educational institute, GILLBT Bible training school. This gave credence to Peloso & Morinville (2014) who reported that activities of the informal water sector were mostly not registered.

The water vendors gave various reasons for operating without a permit/license. Though it was illegal to operate without a license, majority (48%) of the vendors failed to acquire an operating license because of the cost. To these vendors, obtaining a license was expensive and took a long time and process. Some (46%) of the vendors were however not aware that operating a water vending business required a permit (see Table 5.7). These vendors were direct vendors who resold water from the household taps to neighbours. The remaining 6 percent of the vendors did not know the procedure and the institution from which a permit could be acquired.

According to the GWCL, households that resold water from the household tap were required to get an operating permit from the GWCL. This meant changing from domestic to commercial consumption category – therefore paying a higher tariff. Failure to do so would attract some sanctions such as fines, disconnection and or adjustment of average charges (increase water charges). Notwithstanding the status of operations of the water vendors, the GWCL had an informal collaboration with the vendors. This according to the GWCL was due to the fact that the operations of the vendors was vital in serving areas where the GWCL was unable to serve. To this end, the operations manager of the GWCL asserted that the informal water sector played a vital role in water supply and accessibility in the metropolis.

Table 5.7: Reason for Lack of License/Permit

Reason	Number	Percent
Expensive to acquire	30	47.6
Permit not needed	29	46.0
Don't know where to get it	4	6.4
Total	63	100.0

Source: Field Survey, May 2014

At the time of the survey, no public/private institution had a database of informal water vendors operating in the metropolis. Though institutions such as the GWCL and the Metropolitan Assembly were aware of the existence of informal water vending activities in the metropolis, these institutions had little control over the operations of the vendors. Therefore, the activities of water vendors were not well regulated by any institution (see Table 5.8). With majority of water vending businesses not registered hence not paying tax to the Metropolitan Assembly, officials of the Assembly were unable to generate tax revenue from these businesses. The GWCL however confessed to an informal collaboration that exist between the vendors and the GWCL in that vendors served as unofficial distribution agents who served water to residents outside the GWCL coverage and those living within low pressure areas. This according to the production manager of the GWCL

was necessitated by the vital role played by vendors in supplying water to operational areas of the GWCL with low pressure and no supply from the public network.

Table 5.8: Regulation of the Informal Water Sector by GWCL and TMA

Aspect	GWCL	TMA
Quality of water supplied	×√	×
Price fixing of water	×	×
Registration and sanction	×√	×
Source of water	×	×
Category of consumers served	×	×
Quantity of water abstracted	×	×

Source: Field Survey, 2014

Key: √ = Regulated × = Not regulated ×√ = Partially regulated

The GWCL to some extent was able to check the quality of water supplied by vendors who sourced water from the public network. The regional office of the GWCL periodically provided chemicals for cleaning of the water tanks of the tanker truck operators who sourced water from the GWCL substations. These vendors were edged not to use their tankers to collect water from unwholesome sources such as rivers. Adhering to these instructions were however dependent on the discretion of the vendors.

5.2.3 Quality of Informal Water Services

The main consumer of informal water services in the Tamale Metropolitan Area was the household. Over 77 percent of the surveyed water vendors indicated that their main customer was the household. Comparatively, direct vendors (98%) mainly served households consumers than distribution vendors (13%). The distribution vendors mostly supplied water to businesses (food vendors) and construction companies who required large quantities of water for their operations. However, the quality of service including the availability of service, quality of water and pricing of water to a large extent affected the level of usefulness of the informal water sector to consumers.

Table 5.9: Motivation for Use of Informal Water Supply Service

Reason	Number	Percent
No public water connection	57	40.4
Availability	36	25.5

Convenience	30	21.3
Flexible mode of payment	18	12.8
Total	141	100.0

Source: Field Survey, May 2014

The use of informal water supply among households was mainly due to lack of public water supply and the availability of informal services whenever households needed water. Most of the households had limited alternative sources of water supply. From the survey, 40 percent of the households depended on the informal water supply due to lack of public supply connection. According to households with GWCL connection, depending on the informal water sector was mainly due to the availability of supply from the sector to supplement household water supply during times when taps did not flow. About 13 percent of the households depended on the informal water sector owing to the flexible payment option – buy quantity of water they needed at a given time (see Table 5.9).

Some households though within the GWCL coverage area, were not connected due to the cost and procedure involved in connecting to the public network and the mode of charges (monthly bills – mostly flat rates) which the respondents said was not favourable for low income households. With reference to the procedure and duration, it took a minimum of 28 working days to get connected after submitting a form together with an approved site plan, building permit and an application letter. This implied that houses without an approved site plan and building permit were ineligible for connection. With reference to majority of urban houses not having approved building permit and site plan (Edward et al, 2014), it could be concluded that the connection requirement from GWCL was also a limitation to some households' ability to get connected.

Table 5.10: Consumer Satisfaction with Informal Water Services

Status of Satisfaction	Water Prices	Water Quality	Quality of Service
Satisfied	61.7	73.8	31.2
Not Satisfied	30.5	22.7	66.7
Indifferent	7.8	3.5	2.1
Total	100.0	100.0	100.0

Source: Field Survey, May 2014

Generally, households were satisfied with the water quality and prices of the informal sector. Households considered the price of water from informal water vendors as moderate and fairly affordable. Statistically, 62 percent of the respondents were satisfied with the price of water from the sector (see Table 5.10). However, comparing the unit price of water from GWCL to that of the informal vendors, it was realised that the unit price of water from the vendors was about three (3) times the rates of GWCL. The GWCL sold 500 gallons to households for GH¢3.06 while the same quantity was resold by direct vendor for GH¢6 – 25. From the above, it was clear that an increase in GWCL tariffs to enhance cost recovery while enforcing efficient water use among households would be legitimate.

Based on observation and the household and institutional surveys, it was indicated that the quality of water supplied from the informal water sector was wholesome. Majority of household members were of the view that vendor provided water was potable. This was because vendors obtained their water from the GWCL and mechanized boreholes where the water was treated. As a result, over 96 percent of the surveyed households did not treat water from vendors before use. This implied that the cost of treating water by households was eliminated. Hence this money could be spent on other household needs.

Further analysis revealed that majority (14 out of 16) households which treated water from vendors before use were those connected to GWCL. It is however important to note that some tanker truck operators sometimes sourced water from dams when the water was requested for construction purposes. This posed health risk to consumers as the vendors seldom used the required chemicals to wash their water tanks.

5.2.4 Water Prices and Sustainability of the Informal Water Sector

Unlike the formal sector, the informal water market charged varied prices for similar quantities of water sold to customers. The GWCL sold 500 gallons of water to households for GH¢3.06 (domestic tariff category). A similar quantity was sold for GH¢8 to commercial consumers including the tanker truck operators. However, direct vendors who were unknowingly charged domestic tariff (GH¢3.06 per 500 gallons) from GWCL, resold 500 gallons for between GH¢6.3 to GH¢25. The distribution vendors who were on commercial tariff resold a similar quantity of water to consumers for between GH¢60 to

GH¢70 (see Table 5.11). This illustrated that price of water from direct vendors was about three (3) times the price from the GWCL while that of the distribution vendors was about 6 times. This notwithstanding, over 61 percent of households were satisfied with water prices from vendors.

Table 5.11: Water Rates from GWCL and Vendor Prices

Category of Vendor	GWCL Rates (500 gal.)	Vendor Resale Prices (500 gal.)	% Profit
Direct Vendors	GH¢ 3.06	GH¢ 6.3	104
	GH¢ 3.06	GH¢ 12.5	308
	GH¢ 3.06	GH¢ 25	716
Distribution Vendors	GH¢ 8	GH¢ 60	230
	GH¢ 8	GH¢ 70	290

Source: GWCL and Field Survey, 2014

Further analysis revealed that the 48 direct vendors surveyed charged varying rates for similar quantities of water in different neighbourhoods. The rates ranged from GH¢0.05 to GH¢0.20 for 6 or less gallons (20 - 35 liters) of water. As there was no standard instrument for measuring water for sale among the direct vendors, price for a bucket of water notwithstanding the size of the bucket was generally the same (see Table 5.12). This was partly because customers brought and used their own containers (of varying sizes) to fetch directly from the flowing pipe. Therefore vendors charge common prices for a bucket (notwithstanding the size) and a jerry can (20 – 30 liter plastic container commonly referred to as ―Koffour gallon‖).

From Table 5.12, about 42 percent of the households that depended on direct vendors purchased a bucket of water for GH¢0.05 whereas 35 percent of the households purchased a similar quantity in other places for GH¢0.20.

Table 5.12: Price of Water from Direct Vendors by Sub-Metro

Price per Bucket of Water	Proportion of Vendors by Sub-Metro			Total
	Tamale Central	Tamale North	Tamale South	
GH¢ 0.05	20.0%	60.0%	38.3%	41.7%
GH¢ 0.10	17.1%	0.0%	53.2%	23.5%
GH¢ 0.20	62.9%	40.0%	8.5%	34.8%
Total	100.0%	100.0%	100.0%	100.0%

Source: Field Survey, May 2014

From Table 5.12, direct vendors within the Tamale Central (Sakasaka) and Tamale North (Sagnarigu) localities charged relatively higher rates than those within the Tamale south (Nyohini). About 38 and 53 percent of the vendors in the Tamale South sold a bucket of water for GH¢0.05 and GH¢0.10 respectively. Meanwhile a similar quantity was sold for GH¢0.20 63 and 40 percent of the vendors in the households were charged GH¢0.20 for a similar quantity of water in Sakasaka and Sagnarigu respectively. Overall, 65 percent of the direct vendors in the metropolis charged GH¢0.10 or less for a bucket of water (4 - 6 gallons). The high water prices in the said areas were attributed to the high demand for informal water services in the Tamale Central (CBD) and North thereby resulting in high water prices. Also, it was observed that there was relatively less demand for informal water supply in the Tamale South partly due to availability of boreholes and wells. Water from these sources were free or relatively cheaper.

Source: Field Survey, May 2014

Figure 5.3: 2,000 Gallon Water Tanker Truck Supplying a Construction Firm

Generally, mobile vendors operating in the metropolis used standard sized water tanks ranging from 500 to 4000 gallons (see Figure 5.3). Rates from these vendors ranged from GH¢50 – 300 depending on the quantity of water and distance from the water filling point. Averagely, 220 gallons of water was resold for GH¢20. The price of water from distribution vendors was influenced by the unit price of water from the filling point (GWCL or

mechanized borehole) and the quantity of water requested by the customer. Distance from the filling point to the customer and in some cases the relationship between the vendor and the customer affected the price of water.

Prices of water in the informal water market was open for negotiation. Depending on the negotiation skills, a consumer could pay low or high price for the same quantity of water. This was further influenced by one's knowledge of available market prices from various vendors. Price of water was generally low when a vendor sourced the water from a free source (rivers/ponds). There was however a tradeoff between quality and price. Water from free sources was generally used for construction purposes. In an interview with one of the tanker truck operators, he stated that:

> The price of my water is determined by the quantity and distance even though the distance has little effect. I also give my regular customers discount, for instance instead of GH¢80 I can give it to them for GH¢60.

As opposed to Kjellen and McGranahan's (2006) report, mobile vendors enjoyed some discount with increased quantity of water they purchased from the GWCL. The price of water from the GWCL reduced with increased quantity purchased. This was a form of incentive to the vendors. Noteworthy was the fact that water from the GWCL substations was more expensive than from the mechanized boreholes/wells. The mechanized well at the Tamale Post Office area was one of 3 rehabilitated by the NewEnergy (Ghanaian NGO) in 2004. The 500 gallons which cost GH¢8 from the GWCL was sold to vendors for GH¢4 from the mechanized boreholes operated by private persons. The reason for this situation was that more money was expended by GWCL in treating water.

As shown in Table 5.11, mobile vendors resold water at about 8 times the cost of buying the water. Analysis of the daily expenses incurred in their operations vis-à-vis the price at which vendors resold water indicated that the average net profit made on 500 gallons of water was GH¢40. As explained by the vendors, the main daily expenses incurred were fuel (GH¢60 - 100), amount spent on buying water and feeding (GH¢5 – 20). The overall amount was determined by the number of trips made per day and the size of the water tank. For the tractor operators, GH¢60 of fuel (diesel) was used for an average of 8 trips. Other

minor expenses included toll fees and bribes to the police. Averagely, expenses ranged from GH¢80 to GH¢200 per day. It should however be noted that in the dry season where demand is usually high, expenses and revenue also increased.

In comparing the water rates between the public utility (GWCL) and the informal operators, it is however important to factor in the cost of maintenance of equipment (vehicles) and other operational cost which were borne solely by the informal operators. This was unlike the GWCL which had periodic support from government and other development partners. As observed from some literature (Kwaku & Ampaabeng, 2014), under-billing of water to consumers by the GWCL was a major reason which account for the company‘s inability to meet its operational cost. Sustainability of the informal market operators largely depended on their ability to at least recover their cost of operation.

Sustainability of Informal Water Supply

Sustainability in water provision is mainly achievable through market-based mechanisms in water pricing that ensured full cost recovery (see World Bank, 2013 and Wang et al, 2009). Based on the discussion on the water pricing in the informal water market, it was clear that ensuring cost recovery [and profit] was a vital determinant in prices vendors sold water for. Though this affected households‘ ability to afford water, it was important for the survival of informal water businesses.

The study suggested that the poor water access situation in the metropolis could not be solved by the GWCL within the short to medium term. This was as a result of the increasing population coupled with the inability of the GWCL to completely and regularly supply water to the consumers. The root cause was mainly due to lack of market-based measures to ensure an acceptable level of cost recovery in the operations of GWCL. Based on this, about 83 percent of the vendors had positive expectations on the future of their vending business. They expected an increase in patronage of their services that will lead to increased revenue. Similarly, 89 percent also believed that improvement in services provided by the

GWCL would not foldup the water vending businesses. This was corroborated by officials of the GWCL.

On the contrary, 11 percent of the vendors were pessimistic about the future of water vending in the metropolis. They explained that there had been some decline in the patronage of their services. They further opined that improvement in services provided by the GWCL will shed off the vending businesses. Officials of the TMA also shared a similar view.

Demand for informal water services, water availability and the ability of vendors to finance their operations are vital factors that affect the sustainability of the informal water sector. The study illustrated that demand for informal water services were high in the Tamale Metropolis. About 69 percent of households confirmed that they depended on water vendors as a vital source of water supply. Majority (98%) of households opined that the informal water sector was vital in ensuring water supply to households hence eliminating the sector meant worsening water access situation in the metropolis. As shown on Figure 5.2, visits to various water vending sites revealed a crowd of women and water vending trucks waiting to fetch water from mechanized boreholes/wells.

Water vending in the Tamale Metropolis was lucrative despite inadequate technical and financial support for the sector. An analysis of the revenue and expenditure of vendors revealed that direct vendors earn more than twice their operational cost. Monthly water bills ranged from GH₵15 to GH₵90 with the average amount paid by the surveyed vendors being GH₵50. It was clear from the survey that these vendors were paying domestic or flat rate to GWCL. Daily revenue from their operations revealed that 42 out of the 48 direct vendors made between GH₵8 – 15 per day from their vending businesses. The remaining 5 vendors earned over GH₵15 daily from the sale of water. This yielded an average monthly revenue of GH₵250 hence over 200 percent profit. Average net profit was even higher among the distribution vendors. The average daily income was therefore more than the national minimum wage of GH₵7. This implied that the vendors were able to cover their cost of operation. Inquiring from the vendors, over 91 percent of them were satisfied with

the revenue they got from their vending business. The vendors confirmed that the vending business constituted an important source of income for themselves and their families.

Based on the above findings, it was conclusive to state that informal water vending businesses were profitable and sustainable despite some few challenges faced by the operators. However, it was realized that though the National Water Policy (2007) commented on giving support to informal water operators, there was no evidence of support to water vendors in the metropolis.

5.2.5 Factors Affecting the Operations of the Informal Water Supply

Financial and technical support were not readily available to the informal sector businesses. Sources of finance for the informal water operators was mainly money from personal savings and from family/friends. Over 95 percent of the vendors did not have access to credit (loan) from financial institutions. This affected the ability of vendors to expand their businesses. The informal water sector was therefore dominated by small scale operators who operated on subsistence basis.

The cost of running a mobile vending business was higher than direct vending. As part of their overhead cost, vendors incurred cost on fuel and commercial water tariffs which according to the vendors affected their profit margins. Furthermore, fuel shortages coupled with bureaucratic procedures and long queues involved in accessing water also affected the operation of the mobile vendors. Where water pumping machines are used to offload water, extra expenses are made on fuel for such machines. High cost of vehicle maintenance, deplorable roads and the amount of money paid to the police (as bribes) also derailed the lucrativeness of the businesses. Other factors such as harsh weather conditions, low speed of their vehicles (mostly tractors) and the laborious work involved in offloading water to customers affected the physical wellbeing of operators. It was observed that tractors were the common vehicles used by distribution vendors. Most of these tractors were old and easily broke down (see Figure 5.2).

Analysis of the responses of the respondents and observation of the nature of the informal water market in the metropolis indicated that various factors affected the activities of the informal water sector. These included:

1. Irregular supply of water from the GWCL affected the operations of vendors who sourced water from the public network. During such periods, vendors who depended on GWCL for water supply were temporarily out of business until taps started flowing again. To the distribution vendors, this made them sometimes loose some customers as these customers used the services of other vendors who had water at the time.
2. High prices of fuel and electricity increased the operational cost of water vendors. As the business of distributing water depended on fuel and electricity (especially where water is sourced from mechanized boreholes), continued increase in prices of these utilities were reported by vendors to affect their businesses. Also, periodic fuel shortages and frequent power outages as a result of the ongoing power crisis affected the smooth running of water vending business. These issues affected the operation of tanker truck drivers and water abstraction in both the private (mechanized boreholes) and public (GWCL) sectors.
3. Payment of road toll fees and brides to the police served as extra cost of production. Though majority of the vendors did not pay tax directly, it was observed that paying bribes to the police was a routine. This was influenced by the fact that the operations of most of the vendors were illegal and the vehicles were mostly not roadworthy. In their reports, the vendors stated that _one had to pay bribes to the police if you want to continue operating.
4. Seasonal demand fluctuation caused a sales drop during the rainy season when consumers demanded less water service from vendors. The availability of water during the rainy season reduced demand for water services. Most households were able to collect some for washing and gardening. The analysis further revealed that the number of trips dropped from a daily average of 8 or more to less than 5 trips. Sales and revenue were therefore generally low among water vendors.
5. Increased competition due to increased number of private water vendors resulted in reduced daily sales especially among tanker truck operators. As reported by Burt &

Ray (2014), low capital and skills coupled with easy entry were major factors that accounted for the fast growth of informal water businesses. This was confirmed by most vendors (distribution vendors) who complained of low sales as a result of a continuous increase in the number of water vendors operating in the metropolis. In some cases, vendors had to reduce their water prices in order to attract and maintain more customers. The reduction in price was however good for consumers.

6. Mobile vendors who sourced water from the GWCL complained of bureaucratic procedures involved in buying water from the GWCL substation. Vendors were required to visit the GWCL regional office to make payment before they were served water at the substation located about 2 miles away from the GWCL regional office. Also, the substation was closed at 5:00 pm hence vendors sourcing water from the substation were unable to operate after this time.
7. Due to the poor street naming, locating and responding to calls for supply was sometimes difficult. In some instances, distribution vendors faced difficulty locating and serving new customers. This was attributed to the fact that mere description from customers was the only information vendors had to use in locating and serving customers. As most of the streets were not named coupled with poor link neighbourhood road networks, getting direction to some places was a challenge to drivers. This was time wasting and increased fuel consumption.
8. At the time of the survey, vendors had no support from neither public nor private institutions in doing their water vending business. Furthermore, over 90 percent of the vendors complained of their inability to access loans from banks to support the business as they had no collateral hence financial institution were unwilling to provide loans.
9. Some distribution vendors also complained of joining long queues to buy water thereby occasionally affecting their ability to respond quickly to calls for water services. With the increased number of mobile vendors, getting access to water meant joining a queue of operators to fetch water. According to the vendors, an average of one hour waiting time or more was experienced especially in the dry season when demand for services was high coupled with periodic water shortages at various water filling points.

5.3 Informal Supply and Household Water Access

The rapid urbanisation in the Tamale Metropolis caused high population concentration and increased economic activities. As a basic necessity for human survival and a factor of production, the demand for water by the hospitality, food processing as well as the construction industries was very high. Coupled with the low pace of expansion in the public water supply network, the GWCL was unable to meet the water needs of the urban population. In areas where network lines did not exist, informal water operators served as a means of delivering water to these areas. Informal trade especially food vending in the CBD and construction firms were mainly served by informal water vendors.

Substantial proportions (96%) of households in the metropolis used various alternative measures to enhance their access to water supply. Households adopted one or a combination of practices such as storage of water, buying of water from neighbouring houses and or buying water from mobile vendors such as the tanker operators. Some households also depend on sachet water as their source of water for drinking while they acquired water from other sources for other household activities.

5.3.1 Demand for Informal Water Services

Informal water supply served a large array of consumers. Vendors supplied water to households to satisfy their basic water needs. They also served other large consumers such as construction firms. Visits to construction sites during the survey confirmed that water supply for construction purposes of households and construction firms was largely obtained from the informal water sector. According to the respondents, ceremonies such as weddings, outdooring and funerals that required large quantities of water often depended on the informal water market especially tanker operator services.

From the household survey, 136 (96%) of the 141 households used various informal water supply strategies including water storage and buying water from vendors. However, 97 (69%) of the 141 households bought water from vendors. About 63 percent of them purchased water regularly from the informal water vendors whiles 37 percent used informal water vendors services occasionally (when taps were not flowing or for construction

purposes). The study illustrated that demand for informal water services was largely influenced by service availability in areas without GWCL coverage and to households faced with sporadic supply from the GWCL. Some respondents asserted that the informal water sector was reliable as customers got water from vendors whenever needed. To some households, services from vendors was convenient and flexible especially with respect to the mode of payment. Demand for informal water services was relatively high among households without GWCL connection than those connected to GWCL. Statistically, 7 percent more households without GWCL connection depended on water vendors than households with supply from GWCL.

Generally, demand for water in Tamale was mainly for domestic purposes. Households and firms bought and used water for drinking, washing and construction purposes. Demand for water services from the informal sector was therefore for immediate consumption or for further production. The informal water sector served as a main source of water supply for majority of households in the metropolis. The importance of the sector to these households could therefore not be downplayed.

5.3.2 Affordability of Informal Water Services to Households

Affordability can be measured using different parameters. The study adopted the household disposable income approach with a 5 percent affordability threshold as suggested by Fankhauser and Tepic (2007). This meant that a household should not spend more than 5 percent of its disposable income on water. Expenditure above 5 percent therefore implied that water was not affordable to such households. The calculations were based on the basic per capita water access of 20 liters per day. In a month, a household (of 6 members) was expected to use an average of 1000 gallons (4,500 liters) of water to meet their basic domestic water needs. This was used to estimate the proportion of household income expended on water each month. The analysis was disaggregated into the various income groups and sources of water (see Table 5.13).

Table 5.13: Affordability of Informal Water Services

Water Supplier	Water Rates (Per 500 gal.)	Expenditure on water (1000 gal./month)	% of Monthly Income Spent on Water		
			GH¢300	GH¢600	GH¢900

Direct Vendors	GH¢ 6.3	12.6	4.2%	2.1%	1.4%
	GH¢12.5	25	8.3%	4.2%	2.8%
	GH¢25	50	16.6%	8.3%	5.5%
Distribution Vendors	GH¢60	120	40%	20%	13.3%
	GH¢70	140	46.6%	23.3%%	15.5%
GWCL	GH¢3.1	6.1	2.0%	1.0%	0.06%

Source: Field Survey, May 2014

From Table 5.13, water from the public utility (GWCL) was affordable to all the three income categories identified in the study. Similarly, water was affordable to households which access water from vendors at twice the GWCL rates. However, water from vendors who charged more than twice the GWCL rates was not affordable to some income categories. Specifically, water supplied by direct vendors who sold 5 gallons of water for GH¢0.10 and GH¢0.20 was generally unaffordable to the least income category and some households within the middle and top income groups. Water from the mobile vendors was not affordable to any of the income categories. This explained the low patronage of water services from mobile vendors.

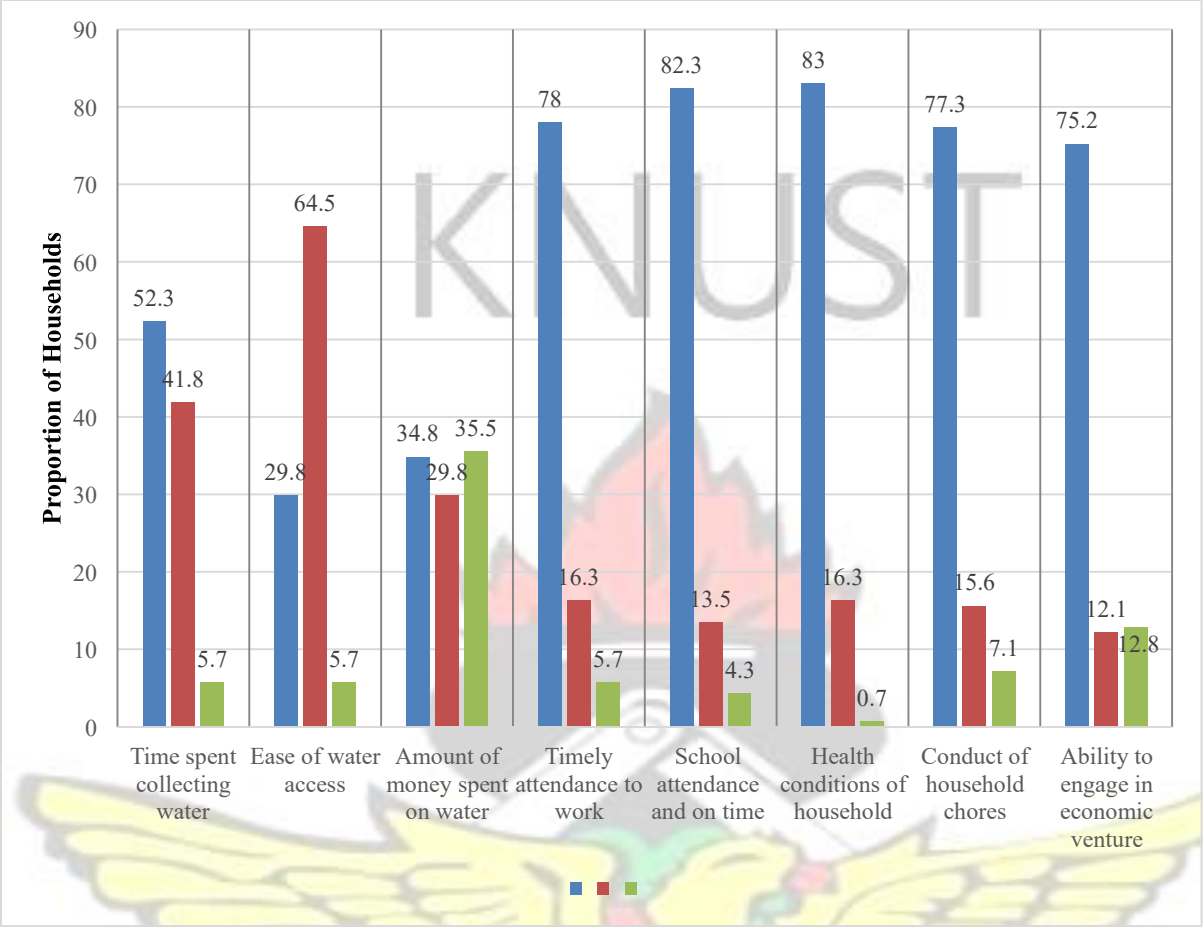
Though the statistical figures illustrated clearly that water from vendors was generally not affordable to households, consumers had a different perception about the cost of water from vendors. A perception assessment on consumers' satisfaction with the price of water from vendors indicated that about 62 percent of the households were satisfied with the price of water from vendors (see Table 5.13). On the other hand, despite the fact that water from the GWCL was more affordable (see Table 5.13), some (53%) connected households complained that water from the GWCL was expensive (see Table 4.11). This implied that households perception about the affordability of water is not only based on the amount of money they spend buying water. But factors such as the flexibility of payment and the ability of households to choose when and how much to spend on water also influenced their perception.

5.4 Effect of the Informal Sector on Household Socioeconomic Activities

The study assessed eight socioeconomic issues affected by households' accessibility to water and how the informal water sector impacted on these issues. These were directly related to the level of water availability to households and how it affected the conduct of

vital household activities such as engagement in income generating activities, schooling and daily household chores. This was generally an opinion based assessment which categorized the impact of informal water services into ‗positive', ‗no effect' and ‗negative' impacts (see Figure 5.5). A disaggregated analysis was further conducted on the various categories (regular, irregular (supplementary), and non-users) of dependence on informal water services. This illustrated the level of impact the services had on various households.

Overall, the results illustrated that the impact of the informal water sector on urban social hardship was positive. Water supply from vendors provided vital support to households especially on the health conditions and ability of household members to go to school and on time. Some households that hitherto depended on uncovered wells and other unclean water sources were now privy to potable water supply. Also, there was an improvement in the time spent searching for and collecting water daily. According to the households, vendor services also enhanced their wards ability to attend school regularly and on time (see Table 5.15). Adult household members especially women were better able to engage in income generating ventures owing to relatively less time spent collecting water.



Source: Field Survey, May 2014

Figure 5.4: Effect of Informal Water Supply Services on Households

Storing water in containers for later use was practiced by over 85 percent of the households surveyed. To some households, purchasing water from a neighbor was a daily routine. Though these conditions and activities were not easy to undertake, it was necessary for the household's survival. As shown on Figure 5.5, it was revealed that despite the reduced time spent on collecting water, the ease of access in terms of the physical stress associated with carting water was still a challenge to households. The physical stress that households went through in accessing water including carting water from long distances or waking up late at night to fetch water recorded the least positive improvement (30%) with regard to the contribution of informal water supply in improving household water access (see Table 5.14). This situation was worse among unconnected households that depended on the

informal water sector. It should however be noted that this was mainly among households which depended on the services of direct water vendors.

Table 5.14: Level of Physical Stress on Households

Level of Physical Stress	Category of Informal Water Supply Dependents						Total	
	Regular Users		Irregular Users		Non-Users			
	Number	%	Number	%	Number	%	Number	%
Improved	16	18.6	24	48.0	4	80.0	42	29.8
No change	65	75.6	24	48.0	0	0.0	91	64.5
Deteriorated	5	5.8	2	4.0	1	20.0	8	5.7
Total	86	100.0	50	100.0	5	100.0	141	100.0

Source: Field Survey, May 2014

Over 52 percent of the households that depended on the informal sector reported that the services of vendors had reduced the time they spent searching for and collecting water. The study observed that households that occasionally used informal water services to supplement the supply from the GWCL experienced the most improvement in time spent collecting water. The households attributed this to their ability to call for water services from vendors whenever the GWCL supply ceased. From Table 5.15, 20 percent of the households that received regular water supply from the GWCL reported that there were periods when they went through some difficulty in getting water when the piped water ceased flowing temporarily. However, majority of the connected households with regular water supply said there have been some improvement in the time spent collecting water due to some improvement in regularity of flow. According to them, they hardly spent time collecting and storing water in anticipation that supply from GWCL would cease.

Table 5.15: Time Spent Collecting Water by Level of IWS Dependence

Time Spent Collecting Water	Category of Informal Water Supply Dependents						Total	
	Regular Users		Irregular Users		Non-Users			
	Number	%	Number	%	Number	%	Number	%
Improved	26	30.2	45	90.0	4	80	74	52.5
No change	54	62.8	5	10.0	1	20	60	42.5
Deteriorated	6	7.0	0	0.0	0	0.0	7	5.0
Total	86	100.0	50	100.0	5	100	141	100.0

Source: Field Survey, May 2014

The disaggregated analysis revealed an overwhelming improvement (100%) in water availability among households that supplemented their water supply with informal water services. About 41 percent of the households that depended mainly on the informal water sector also reported of increased availability of water for household use. However, one (1) out of five (5) households that depended sorely on the GWCL supply reported of spending more time on collecting water. The respondent complained of occasionally spending long hours at night fetching and storing water from the pipe when water supply from the GWCL became unstable. A substantial proportion (30%) of the households that depended mainly on informal water supply attributed spending less time collecting water to the availability of water from vendors (see Table 5.15).

Table 5.16: Water Availability to Households by Level of IWS Dependence

Water Availability	Category of Informal Water Supply Dependents						Total	
	Regular Users		Irregular Users		Non-Users			
	Number	%	Number	%	Number	%	Number	%
Improved	35	40.7	50	100.0	4	80	89	63.1
No change	49	57.0	0	0.0	0	0	49	34.8
Deteriorated	2	2.3	0	0.0	1	20	3	2.1
Total	86	100.0	50	100.0	5	100	141	100.0

Source: Field Survey, May 2014

The value of informal water services to households outweighed the price households paid for water. Despite the relatively high price of water from the informal sector, people were more concerned about getting access to water and the vital contribution it made on their daily activities. The study illustrated that majority (58%) of households without GWCL connection who depended on vendors spent more money on water than those households connected. This was illustrated by over 54 percent of regular informal water sector users reporting of increased expenditure on water (see Table 5.17). This was more pronounced in the CBD where water prices of the IWS were relatively higher. This notwithstanding, many (77%) of these households were satisfied with the amount of money they paid for water from vendors (see Table 5.18). This implied that households were more concerned about getting regular water supply than the amount they paid for water.

Table 5.17: Amount of Money Spent on Purchasing Water by Dependence on IWS

Expenditure on Water	Category of Informal Water Supply Dependents						Total	
	Regular Users		Irregular Users		Non-Users			
	Number	%	Number	%	Number	%	Number	%
Improved	10	11.6	38	76.0	1	20.0	49	34.8
No change	29	33.7	10	20.0	3	60.0	42	29.8
Deteriorated	47	54.7	2	4.0	1	20.0	50	35.4
Total	86	100.0	50	100.0	5	100.0	141	100.0

Source: Field Survey, May 2014

Table 5.18: Consumers' Satisfaction with Water Prices

GWCL Connection Status	Satisfaction with Informal Water Prices			Total
	Satisfied	Not satisfied	Don't know	
Connected to GWCL	23	28	7	58
Not connected to GWCL	64	15	4	83
Total	87	43	11	141

Source: Field Survey, May 2014

Despite having concerns about the quality of water supplied by vendors, the study revealed an overwhelming majority (83%) of the households asserting that vendor services impacted positively on the health conditions of household members (see Table 5.19). The impact of water services on health conditions of household members recorded the highest positive impact. Without supply from the vendors, the respondents stated that some households resorted to other sources such as ponds/rivers and uncovered wells. The Head of the Metropolitan Water, Sanitation and Hygiene Unit reiterated and commended the services of vendors which had helped reduce water-related diseases among the populace. This finding coincides with WHO (2012) reporting of improvement in time available for livelihood activities and health conditions as a result of increased access to potable water. This also implied reduced government expenditure on water-related healthcare.

Though this finding is contestable on the basis of increased availability of improved healthcare, it is however important to take cognizance of the improvement in time and distance covered to collect water. This had a direct relation with the amount of physical stress household members endured from carrying water over long distances. The study

further revealed that vendors generally sourced water from treated (GWCL) and other improved sources (mechanized wells and boreholes).

Table 5.19: Improvement in Health Conditions by Category of IWS

Health Conditions	Category of Informal Water Supply Dependents						Total	
	Regular Users		Irregular Users		Non-Users			
	Number	%	Number	%	Number	%	Number	%
Improved	67	77.9	47	94.0	3	60.0	117	83.0
No change	18	20.9	3	6.0	2	40.0	23	16.3
Deteriorated	1	1.2	0	0.0	0	0.0	1	0.7
Total	86	100.0	50	100.0	5	100.0	141	100.0

Source: Field Survey, May 2014

As vendor supplied water was said to be potable, majority (96%) of the households did not treat water from vendors before use. However, much literature has demonstrated that proper household water treatment and good storage practices complimented efforts on access to potable water (Sobsey, 2002). This speaks to the fact that fetching, offloading and storage of water from alternative sources could introduce contaminants into the water. WaterAid (2005) recounted of high financial investment to treat high concentration of faecal coliform (21) found in the NewEnergy rehabilitated mechanized wells (currently serving as a vital source of water for the informal water sector in the Tamale Metropolis) to acceptable level (5). Therefore, where proper test and treatment are not conducted, consumers of such water are liable to adverse health effects.

The improvement in household water access situation including water availability, time spent collecting water as well as health conditions of households had according to the households enhanced household members schooling and water attendance. From Table 5.19 and 5.20, the study revealed that children were better able to attend school and on time owing to improved water access among households. Reports from the survey also showed that 70 percent of households that depended mainly on informal water supply were better able to engage in income generating activities. These households attributed this to the fact that the informal water sector helped them spend relatively less time searching for and collecting water. This freed up time for household members, especially women, who alluded to having more time to engage in economic activities.

Table 5.20: School Attendance Situation by Regularity of IWS Use

School Attendance	Category of Informal Water Supply Dependents						Total	
	Regular Users		Irregular Users		Non-Users			
	Number	%	Number	%	Number	%	Number	%
Improved	64	74.4	48	96.0	4	80.0	116	82.3
No change	18	20.9	1	2.0	0	0.0	19	13.5
Deteriorated	4	4.7	1	2.0	1	20.0	6	4.2
Total	86	100.0	50	100.0	5	100.0	141	100.0

Source: Field Survey, May 2014

Table 5.21: Work Attendance by Level of Dependence on Informal Water Service

Work Attendance	Category of Informal Water Supply Dependents						Total	
	Regular Users		Irregular Users		Non-Users			
	Number	%	Number	%	Number	%	Number	%
Improved	60	69.8	47	94.0	3	60.0	110	78.0
No change	19	22.1	3	6.0	1	20.0	23	16.3
Deteriorated	7	8.1	0	0.0	1	20.0	8	5.7
Total	86	100.0	50	100.0	5	100.0	141	100.0

Source: Field Survey, May 2014

Economically, the informal water sector enhanced income opportunities and productivity at the household and metropolitan levels. To household members, reduction in time spent collecting water and related stress, especially among females, increased their ability to engage in income generating activities. The majority of households reported of improvement in their ability to go to work and on time. This they attributed to ease of water access through informal water supply alternatives (see Table 5.21).

Table 5.22: Economic Activity Situation by Level of Dependence on IWS

Economic Activity	Category of Informal Water Supply Dependents						Total	
	Regular Users		Irregular Users		Non-Users			
	Number	%	Number	%	Number	%	Number	%
Improved	61	70.9	43	86.0	2	40.0	106	75.1
No change	10	11.6	4	8.0	3	60.0	17	12.1
Deteriorated	15	17.5	3	6.0	0	0.0	18	12.8
Total	86	100.0	50	100.0	5	100.0	141	100.0

Source: Field Survey, May 2014

As shown on Table 5.21, informal water supply improved households‘ income earning opportunities. For households that benefited from the services of the informal water sector, household members especially women had more time to engage in economic activities. This was also reflected in people‘s ability to go to work and on time. It was further revealed that majority of the households were better able to conduct household chores as water access was improved (see Table 5.22). However, a substantial proportion of households (17%) who depended regularly on direct vendors were still limited in their ability to engage in productive economic activities. This was attributed to limited improvement in the time spent collecting water into the house. Some of these respondents complained of their inability to go to work on time as they had to join long queues for water. Inferentially, the economic fortunes of this group of people were adversely affected.

Table 5.23: Improvement in Conduct of Chores by Level Dependence on IWS

Household Chores	Category of Informal Water Supply Dependents						Total	
	Regular Users		Irregular Users		Non-Users			
	Number	%	Number	%	Number	%	Number	%
Improved	63	73.3	42	84.0	4	80.0	109	77.3
No change	15	17.4	6	12.0	1	20.0	22	15.6
Deteriorated	8	9.3	2	4.0	0	0.0	10	7.1
Total	86	100.0	50	100.0	5	100.0	141	100.0

Source: Field Survey, May 2014

At the Metropolitan level, industries such as the construction, food vending and hospitality served as important sources of employment for the urban and peri-urban population. Regular and adequate supply of water to these industries enhanced their production thereby increasing their ability to employ more labour. As a direct impact, operatives in the informal water sector were mainly sustained by incomes generated from the sector. The informal water sector therefore created job opportunities for some unemployed with little skills and capital to engage in other businesses.

5.5 Chapter Summary

Informal water supply in the Tamale Metropolis was an urban phenomenon. Informal water supply activities increased with increased urbanisation. Localities which were more urbanized (high economic activity and population concentration) relied more on the

informal water sector. The Tamale Central which was the main CBD of the metropolis had more households adopting various informal strategies in accessing water than the Tamale North and South which were relatively less urbanized. Informal water supply operated in various forms in the metropolis including mobile and onsite water sale. It served different categories of consumers based on their water needs.

Overall, the study suggested that the informal water sector eased water-related socioeconomic hardship of urban and peri-urban dwellers in the Tamale Metropolis. From the perspective of households based on eight (8) indicators, it was found that majority (64%) of households were positively impacted by the services of informal water vendors. About 26 percent of the households were of the view that the sector had no impact on their water access situation. Health conditions (83%), school attendance (82%) and timely attendance to work (78%) were the top three whereas physical stress from carting water (30%), expenditure on water (35%) and time spent collecting water (52%) were the least impacted by the informal water sector.

However, 10 percent of the households that sourced water mainly from the informal water sector were worse off. This was mainly with respect to the amount of money spent on buying water and the time spent fetching water coupled with physical stress from carting water. These consequentially affected the economic fortunes of some urban households including missed income earning opportunities while expending substantial proportion of household income on water.

CHAPTER SIX

SUMMARY OF FINDINGS, RECOMMENDATIONS AND CONCLUSION

6.1 Introduction

Accessing potable water was a major challenge faced by urban households in the Tamale Metropolitan Area (TMA). Consequently, urban households adopted various alternative strategies in an attempt to improve water access and to mitigate the associated hardships. The study identified informal water delivery as a vital and integral source of water supply for households. This chapter summaries the effect of informal water delivery on water access and urban hardship. Recommendations are made for improving urban water access.

6.2 Summary of Major Findings

The main findings of the study have been grouped and elaborated under three headings.

6.2.1 Causes and Effects of Water Scarcity in the Tamale Metropolis

The study revealed that majority of households (98%) in the metropolis faced water access challenges due to insufficient coverage and intermittent water supply from the GWCL. The water scarcity situation was more pronounced among 47 percent of households who had daily per capita water access of less than 20 liters. Majority (58%) of the surveyed households did not have access to the GWCL water supply due either to lack of coverage (74%) or inability to afford (26%). Report from the GWCL indicated that the company was able to serve about 55 percent of the metropolis population. The perennial water scarcity menace was mainly caused by increased water demand which resulted from the high population concentration and increased economic activities in the metropolis vis-à-vis the low capacity of the GWCL to provide adequate and regular water supply. Also, documentary requirements (site plan and building permit) vis-à-vis unavailability of the requisite documents limited some households‘ ability to get public water connection into their houses. Some households therefore adopted alternative means of accessing water supply.

Though water rates from the GWCL were very low, majority (53%) of the connected households were not ready to pay extra for service improvement. This was attributed to the consumers‘ loss of trust in the GWCL and some consumers also reporting that the existing water prices were already high. However, it was clear from the study that the inability of the GWCL to achieve complete coverage and regular water supply was mainly due to low tariffs and high level of unaccounted for water (leakages).

Public water coverage was mainly concentrated within the CBD of the metropolis and a few surrounding localities. Owning to the uneven and intermittent nature of water supply from the GWCL, coverage and connectivity to the public water supply was no guarantee for regular and improved water access. About 91 percent of the connected households were still faced with serious water access challenges due to intermittent supply. Consequently, both connected and unconnected households adopted alternative (mostly informal water supply) strategies of ensuring continued supply of potable water to the household.

The water scarcity situation affected the socio-economic activities of the urban and periurban dwellers. Households spent productive time collecting water daily. The situation was even worse among households without GWCL connection and connected households that experienced sporadic supply. This affected the economic fortunes of some household members especially women. Also, some household members complained of physical stress imposed on them as a result of carting water into the house. These respondents were mainly women charged with the responsibility of getting water for the household. This had long-term adverse health effects on such household members. Some households resorted to less reliable water sources such as uncovered wells and river water. This exposed households to health risk and increased time spent in accessing water.

More households continued to resort to informal water supply due to the rapid increase in water demand apropos low expansion of the GWCL water supply services. The result was an increased growth and dependence on informal water activities in the metropolis. There was therefore a rapid growth in the informal water market as a source of livelihood and a means of increasing water access. As the price of water from vendors was high, households spent substantial amounts (averagely 8% of disposable income) on water. This further

affected the poverty situation of households as well as the ability of households to afford adequate quantity of water to meet their daily water needs.

6.2.2 Nature of Operations of the Informal Water Sector

The operations of the informal water sector in the Tamale Metropolis has been in existence for over two decades. The activity was triggered by a combination of demand and supply factors in reaction to the perennial water shortages among households in the metropolis. Informal water supply was therefore an integral part of the urban water supply system that provided water for urban and peri-urban households in the metropolis. It was revealed that informal water vending activities including the sale of water from privately owned hand dug wells existed before the introduction of public water supply (GWCL) in most localities in the metropolis. This situation was identified in some parts of Nyohini, Sagnarigu and Nyerizee (which had no GWCL coverage) where the informal water sector operated.

The informal water vendors sourced water mainly from the GWCL (85%) and mechanized borehole/wells (12%). Water from these sources were treated hence majority (97%) of the households that depended on informal water supply believed that water supplied by vendors was clean and needed no treatment before consumption. Some vendors however confessed that they sometimes sourced water from rivers/ponds when it was required for construction purposes. As vendors seldom treated their water tanks with the required chemicals, this implied that consumers were at health risk.

Like most informal sector businesses, majority (98%) of the informal water businesses operated without any permit from either the Metropolitan Assembly or the GWCL. Some vendors attributed this to the high cost and duration involved in obtaining a permit while others did not know that operating a water vending business required a permit or registration. As a matter of fact, the sector was generally not controlled by any institutions despite the fact that these institutions were aware of the operations of the informal water vending businesses. The GWCL and the Metropolitan Assembly attributed their reluctance to control the sector to the vital role water vendors played in extending water supply to unserved and underserved localities. They explained that an attempt to stop the operations of the water vendors would leave a substantial proportion of the urban population without

access to potable water supply. This would affect the health conditions and livelihoods of such households.

Increased population concentration and economic activities due to rapid urbanisation visà-vis unmatched supply from GWCL were important factors that accounted for the high demand for informal water supply in the metropolis. The informal water sector provided a means of livelihood to some urban dwellers. The sector provided an opportunity for the populace with low formal education and capital to earn income by selling water to households. In some cases, connected households reported that collecting money from people who came to fetch water from their in-house tap was mainly to help pay the monthly water bill. Over 96 percent of the households used various alternative means of accessing water. However, the most common alternative source of water for majority (69%) of the households was the informal water vendors.

The main factors that accounted for the high demand for informal water services were the convenient and flexibility of service and charges - to some households, having the option to buy water based on the amount of money available to the households was a major reason for use of informal water services. A significant proportion (13%) of households depended on water vendors due to the ―rigid‖ nature of charges (monthly bills) from the GWCL. In addition, the availability of water supply from vendors anytime households needed water was essential in ensuring regular water access. Among households without GWCL water supply, the availability of water supply from vendors to fill the water access gap was the main reason for the use of informal water services. During the period when pipes stopped flowing, some households that depended on informal water services continued to have stable supply of water whereas some connected households faced challenges acquiring water.

The operations of the informal water sector was not without challenges. Like most informal businesses, the informal water vendors had low financial and technical capacity to scale up their operations. The study revealed that the vendors had no financial or technical support beside the occasional supply of chemicals from the GWCL to mobile operators for washing their water tanks. High cost of vehicle maintenance, deplorable roads and the amount of

money paid to the police (as bribes) also derailed the lucrativeness of the businesses. Also, periodic fuel shortages and intermittent water supply from the GWCL impeded the operations of vendors. In addition, poor road networks, harsh weather conditions, low speed of their vehicles (mostly tractors) and the laborious work involved in offloading water to customers limited the smooth operation of vendors.

6.2.3 Effect of the Informal Water Sector on Household Water Access

The informal water sector contributed to urban water supply in various ways. To start with, the sector was an important source of water supply for about 69 percent of households in the metropolis. Most importantly, households without access to the GWCL supply depended mainly on the services of water vendors. The relevance of the sector in this regard was confirmed by officials of the GWCL who stated that the informal water sector ensured water supply to areas without public water coverage as well as areas with low water pressure. Due to this the GWCL collaborated (informally) with the informal water sector in providing water to the populace of the metropolis.

Industries and other informal sector business operators such as food processing depended mainly on the services of the water vendors. As the informal sector served as a vital source of employment for majority of the metropolis labour force, regular water supply to these businesses held much importance for the economic development of the metropolis. As a result, the GWCL acknowledged that even if complete and regular water supply is achieved in the metropolis, the informal water sector would not be eliminated but the demand for its services would only shift to the construction, hospitality, food processing and similar industries.

Overall, the study revealed that the effect of the informal water sector on urban social hardship was positive. Water supply from vendors provided vital support to households especially on the health conditions and ability of household members to go to school and on time. Some households that hitherto depended on uncovered wells and other unclean water sources were now privy to potable water supply. Also, there was an improvement in the time spent searching for and collecting water daily. According to the households, vendor

services also enhanced their wards ability to attend school regularly and on time. Adult household members especially women were better able to engage in income generating ventures owing to some improvement in the time they spent collecting water.

The increased access to potable water through the activities of the informal water supply was therefore useful to both the social and livelihood activities of households in the metropolis.

There were however some limitations in the use of informal water services. Though majority (62%) of households were satisfied with the prices of water from vendors, it was clear that water from vendors was relatively expensive. Averagely, households spent 8 percent of their disposable income on water. This affected the ability of such households to afford adequate quantity of water. Consequently, about 47 percent of the surveyed households had a daily per capita water access of less than 20 litres. According to the WHO water access benchmarks, such households could not meet the basic minimum water supply required to maintain a healthy life. This also had an adverse effect on the overall development of the metropolis as access to adequate water supply was vital to achieving sustainable development.

Also, households that depended on direct vendors continued to endure physical stress associated with carrying water. As observed in the study, household members, mostly women and children, bought and carried water using basins and ―kuffour gallons‖ into the household. This had a physical toll on household members. Despite some reported improvement in time spent collecting water, 63 percent of the households did not experience any change while 7 percent reported that they spent more time in collecting water due to long queues at the water sale point. Moreover, more households are expected to spend long hours collecting water during the dry season when the water scarcity situation becomes acute.

6.3 Recommendations

Based on the findings of the study, some recommendations have been advanced towards the improvement of urban water access in the Tamale Metropolis. There are three main recommendations with detailed strategies for achieving each recommendation clearly

explained under each recommendation. The recommendations are meant to support the three main stakeholders (informal water vendors, GWCL and households) involved in the urban water supply system.

1. Integration of the informal water supply into the formal urban water supply system

The study has identified the need for collaboration between the GWCL and informal water vendors. As a means of ensuring support and effective monitoring and control of the operations of informal vendors, the informal water operators should be integrated into the urban water supply system to serve as water distribution agents. This integration can be achieved through the following strategies:

i. Essentially, there is the need for an active association that will organise and control the activities of the informal water vendors in the Tamale Metropolis. Similar to the Private Transport Operators Association (PROTOA), an association should be established for and by the informal water vendors to ensure that the activities of water vending in the metropolis are well coordinated. The association will support the interest of the vendors including negotiating and setting water prices and as well solicit financial and technical support for vendors. This will also help the GWCL, TMA and other organisations to monitor, control and support the informal water sector. As an incentive for the successful implementation of this strategy, the TMA and the GWCL in collaboration with private water well/borehole operators (wholesale vendors) should support the formation of the association through measures such as (i) reduction of water rates for registered vendors (ii) periodic training and support for association members (iii) water from the GWCL substation and the mechanised wells should only be sold to registered vendors.

The owners of privately operated water wells and boreholes should be made to play a key role in the establishment and operation of the association. Also, the experience of the Community Water and Sanitation Agency (CWSA) in Small Town Water Systems should be tapped by involving the CWSA in the

implementation of this strategy. Ultimately, the TMA should liaise with the vendors association to institute a regulation that will prevent unregistered vendors from operating in the metropolis.

ii. Also, the Metropolitan Water and Sanitation Unit of the TMA in collaboration with the Commercial Unit of the GWCL should register and regulate the activities of all informal water operators. This should be through the proposed water vendors association. A database of water vendors should be developed. This information should be used in registering and certifying water vendors operating in the metropolis. A strict regulation that requires all informal water vending operators to be officially registered before they can operate in the metropolis should be formulated and implemented by the Metropolitan Assembly. It is however important that the process of registration be expedited based on the fact that most vendors did not register their businesses due to the long process involved. Each water vendor shall therefore be issued an operating permit from the GWCL.

iii. The GWCL in collaboration with the Metropolitan Water and Sanitation Team should conduct periodic training and education for informal water operators. This should include proper water handling, cleaning and maintenance of water vending equipment such as water tanks and pumping machines. The Business Advisory Centre under the Metropolitan Assembly should also provide business development training and assist interested water operators acquire financial support from banks. This will enhance the quality of services provided by the water vendors to consumers. It will also promote the use of acceptable water handling practices among vendors.

2. Expand and restructure the urban water supply system

The ongoing rapid urbanisation in the Tamale Metropolis coupled with progression of previously rural areas into urban localities will continuously increase the pressure on GWCL water supply. However, the limited water supply capacity of the GWCL coupled

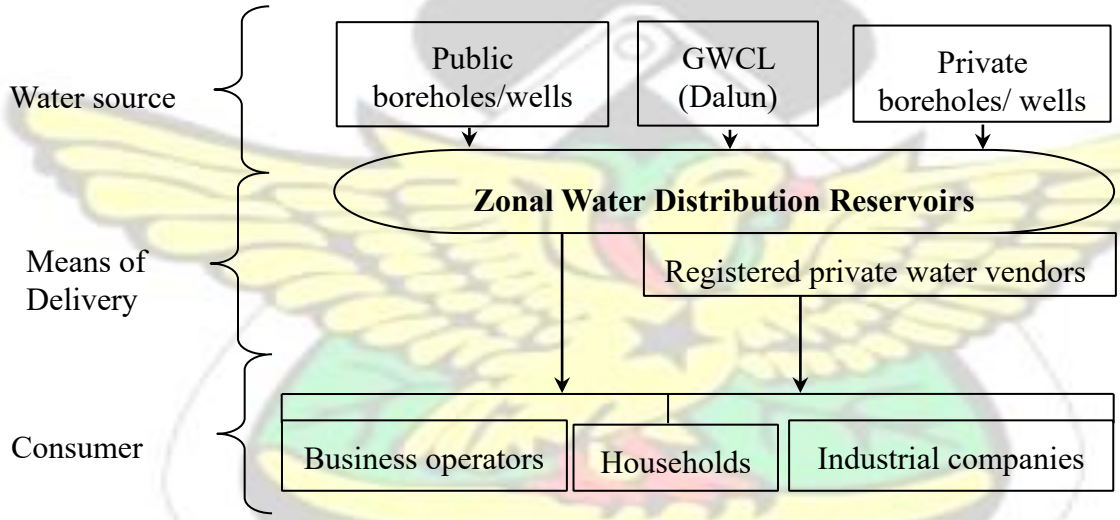
with the centralized urban water supply structure will affect the company‘s ability to expand and improve urban water supply. Consequentially, the quality of water supply service provided by the GWCL will further reduce thereby worsening the urban water scarcity situation in the metropolis. There is therefore the need to adopt alternative strategies to increase the quantity of water supplied to the metropolis and to reform the centralized management structure (decentralize) to ensure effective management of water supply in the metropolis. This could be achieved through the following strategies:

i. There is the need for further deconcentration in the operations of the GWCL beyond that from the GWCL Headquarters in Accra to GWCL Tamale. Visible sub-units (Zonal Management Units) should be created to manage the day-to-day water supply operations in the three sub-metros. To enhance effective management and tailor oriented services to meet customer needs, three zonal water distribution units should be established and operationalized in the three Sub-Metros as deconcentrated units of the GWCL Tamale. These zonal offices should be tasked with the responsibility for serving water to the respective sub-metros. The various informal water vendors should then be registered to operator under each of the zonal water distribution units. Each zonal distribution office shall then be responsible for regulating the activities of the water vendors. This should include the regulation of private wells and boreholes. The informal water operators should be integrated to serve as water distribution agents in extending water to unserved and underserved areas. This strategy will also enhance the ability of the GWCL to check and control water leakages including illegal connections and broken pipelines.

ii. Establish integrated zonal water supply system in the three sub-metros. The GWCL sourced and supplied water mainly from surface water (in Dalun) which was expensive to treat coupled with increased pressure on the plant due to the rapid urbanisation. Comparatively, water sold from the mechanized wells was 50 percent less expensive than GWCL water due to less cost in treating water. It is therefore recommended that high yielding mechanized wells should be

established by the GWCL in strategic parts of the Tamale south (Nyohini) and North (Sagnarigu) to augment the existing ones. Water from these wells will then be pumped into central zonal reservoirs from which distribution lines will be used to extend water into houses within the given zone. This concept is similar to the small town water system however the

water in the reservoirs will be supplemented by supply from Dalun and privately operated mechanized boreholes/wells. The GWCL should partner with private mechanized borehole/well operators who will supply water to the zonal water reservoir (see Figure 6.1). This will be in the form of a supply contract where the GWCL will buy water from the private mechanized boreholes/wells. The Zonal Management Units will be in charge of operating their respective zonal water supply system.



Source: Author's Construct, 2015

Figure 6.1: Integrated Urban Water Distribution Model

3. Build capacity of households' for improved water access and efficient use

As the final user and ultimate beneficiary in the urban water supply chain, the household play an important role in ensuring improve and sustainable water access. Efficient water use and conservation among households is vital in ensuring sustainable urban water supply.

This recommendation is towards enhancing the capacity of households in terms of effective water use and conservation, proper water handling to reduce contamination and improved water storage through a series of specific strategies. These include:

i. Households should be supported to maintain improved water access. This strategy is in three folds. The first part involves supporting households within GWCL coverage to connect to the urban water supply network. The GWCL should support households who are willing to connect by waiving some of the documentary requirements such as site plan to enable affected houses access water supply. Also, after the completion of the zonal water supply reservoirs, inhabitants within the zones should mobilise themselves and request water connection after pooling resources together to procure the needed equipment such as PVC pipes.

ii. Secondly, storing water in containers for future use was the commonest strategy adopted by households in enhancing water availability. Most households however lacked good water storage facilities that can contain adequate quantity of water while maintaining the quality of water stored. In the short to medium term, households living in the metropolis without GWCL coverage should be encouraged and supported by the Metropolitan Water and Sanitation Unit (MWSU) to acquire improved water storage facilities such as ―polytank‖. The MWSU should liaise with NGOs such as the NewEnergy and WaterAid and other available institutions to implement this strategy. This intervention should target low income groups within the metropolis.

iii. Finally, the GWCL in collaboration with the MWSU should embark on efficient water use campaigns to sensitize urban dwellers on the need to avoid wasteful use of water. In addition to this, the MWSU should evolve active awareness programmes to educate and encourage households on proper ways of handling water to reduce contamination. This can be done through the various media platforms. Also, the GWCL should expand their metered water billing to all

connected households in the metropolis. This strategy is premised on the fact that per capita water use among the connected households was high.

6.4 Conclusion

The study has confirmed that a substantial proportion of urban dwellers faced challenges in accessing water in the Tamale Metropolitan Area. The situation had adverse repercussions on the socioeconomic conditions of the households. As a coping strategy to improve water access and ease the associated hardships, some of the households resorted to the informal water sector as an alternative source of water supply. Demand for informal water supply was therefore high especially in the Tamale Central which had a relatively higher concentration of population and economic activities.

Contrary to being a temporary activity which only existed in areas without public water coverage, the study demonstrated that informal water supply activities persisted in both areas with and those without GWCL water supply coverage. The difference in the use of informal water services among households with (67%) GWCL connection and those without (70%) was small. Furthermore, informal water activities were more pronounced in the CBD of the metropolis despite the high availability of distribution lines and household connectivity. Though households mainly depended on informal water supply due to the unavailability or irregular public water supply, it was noted that full coverage and regular public water supply will only shift the demand for informal water services to other sectors such as the construction, food processing and other amenity uses in the metropolis.

Informal water supply was therefore an integral part of the urban water supply apparatus which played a vital role in the socio-economic development of the metropolis. Achieving improved and sustainable urban water supply therefore required strengthening the collaboration between the GWCL and operators of the informal water sector. This will also require some operational reforms in the activities of the GWCL and effective control and monitoring of informal water supply activities.

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APPENDICES

Sample Size Calculation:

Using data from the 2010 PHC:

Total population of Northern Region = 2,479,461

Total population of Tamale Metropolis (TMA) = 371,351

Urban population of TMA (73.8%) = 274,057

Average household size of TMA = 6.3

Total Number of Households in Urban TMA = 43,501

Therefore:

$$n = \frac{N}{1 + N(a^2)}$$

Where; *n = sampling size*, *N = sampling frame*, 1 = *constant*, a = *margin of error*

Sample size for Household survey:

N = 43,501 a = 0.08

$$\frac{43501}{1+43501\ (0.08^2)} = 155 \text{ Households}$$

RESEARCH INSTRUMENTS

QUESTIONNAIRE FOR INFORMAL WATER OPERATORS

Name of Community/Area: _____ Name of Sub-Metro: _____

Location of business: _____ Phone Number of Respondent: _____

Date of Interview: DD ____MM___YY___ Time of Interview: *Start*____ *End* ____

Enumerator's Name//Number: _____

Section A: Bio-Data

A01. Sex of respondent: a. Male b. Female

A02. Age of Respondent _____

A03. What is your religious affiliation? a. Muslim b. Christian c. Traditionalist d. Other:___

A04. What is your ethnic affiliation? _____

A05. What is your marital Status? a. Married b. Single c. Divorced/ Separated d. Widowed

A06. Position in Household: a. Household head b. Other household member

A07. Size of Household: _____

A08. What is your highest level of schooling? a. Basic b. SHS/Voc./Tech. c. Tertiary

d. Never schooled

A09. What is your main sector of employment? a. Public/govt. b. Private formal c. Private informal d. Not applicable

Section B: Background of Activity

B01. Type of vendor service: a. Wholesale vendor b. Distribution vendor c. Direct vendor

B02. How long have you been engaged in this job? _____

B03. How old were you when you started your business? _____

B04. What is your main reason(s) for your choice of business? a. Less skill required b. Low capital required

c. The only business available d. High capital returns e. others, specify _____

B05. How many hours do you spend on your job daily? _____

B06. Where do you collect the water you sell? a. GWCL b. hand dug well/borehole c. mechanized borehole d. River/stream/pond e. household tap (GWCL)

f. illegal connection from GWCL g. Other, specify: _____

B07. Do you have an operating license/permit for your operations? a. Yes b. No c. Don‘t know

B07a. If no, why: _____

B07b. If yes, from which institution did you obtain the license/permit? _____

B08. Do you treat the water before selling it? a. Yes b. No c. Don‘t know

B09. How many people have you employed in your business? _____

B10. Who are your main customers? a. Households b. Business operators (e.g. food vendors) c. Construction companies d. Others, specify _____

B11. Do informal water operators have a functional Association/Union? a. Yes b. No c. Don‘t know

Section C: Cost and Returns on Operations

C01. How much do you sell a unit (bucket/jerry can/gallon/tanker) of water? GH¢_____

C02. Averagely, what quantity of water are you able to sell per day? _____

C03. How much do you spend daily/monthly in operating your business? GH¢ _____

C04. How much do you earn daily/monthly from the sale of water? GH¢ _____

C05. What inputs/equipment do you use in your operations?

Input/Equipment	Quantity	Unity Cost (GH¢)

C06. Which factors influence the price at which you sell water? a. Quantity of water b. Distance to consumer c. relationship with customer d. Season of the year e. Cost of production f. other: _____

C07. How satisfied are you with the market prices for your water? a. very satisfied b. satisfied c. Dissatisfied d. Very dissatisfied e. Indifferent

C08. Do you pay taxes on your business? a. Yes [amount GH¢ ____] b. No c. Don‘t know

C09. Do you have access to credit facilities? a. Yes b. No c. Don‘t know

C10. Currently, how do you finance your business? a. Personal savings b. Family and friends c. Financial institution d. Others: _____

C11. Do you save? a. Yes b. No

C12. Do you keep records of your operations (e.g. financial records)? a. Yes b. No c. Don‘t know

Section D: Prospects and Challenges of Operation

D01. Do you receive any assistance from any institution in undertaking your operations? a. Yes b. No c. Don‘t know

D01a. If yes, what form of the support do you receive? a. Financial b. Technical/Training c. Ready market d. Others (specify) _____ **D02**. Do you think improvement in the services and coverage of GWCL will put you out of business? a. Yes b. No c. Don‘t know

D03. How do you foresee the future of your business? a. Improvement b. No change c. Decline d. Don‘t know

D04. What are the major challenges you face in doing your business? _____

D05. What do you think can be done to solve these problems? _____ **D06**. Do you think the current challenges in water access in the Tamale Metropolis can be solved? a. Yes b. No c. Don‘t know

Please explain: _____

ANSWER KEY FOR B01

Types of water vendors:

Wholesale vendors – abstract and sell water to distributing vendors (resellers)
Distribution vendors – obtain water from wholesales/public supplier and sell it to consumers (door-to-door);
Direct vendors – on-site water points from where consumers visit to purchase water. Direct vendors included household reselling (unofficially) water from the public network, water kiosks and standpipe operators.

QUESTIONNAIRE FOR HOUSEHOLDS

Questionnaire No.:_____ Enumerator's Name//Number: _____

Name of Community/Area: _____ Name of Sub-Metro: _____

House Number of Respondent: _____ Phone Number of Respondent: _____

Date of Interview: DD ___MM___ YY___ Time of Interview: *Start*_____ *End* _____

Section A: Bio-Data

A01. Sex of respondent: a. Male b. Female

A02. Age of Respondent _____

A03. What is your religious affiliation? a. Christian b. Muslim c. Traditionalist d. Other:_

A04. What is your ethnic affiliation? _____

A05. What is your marital Status? a. Married b. Single c. Divorced/ Separated d. Widowed

A06. Position in Household: a. Household head b. Other household member

A07. Size of Household: _____

A08. Residential status: a. Owner-occupier b. Tenant c. Rent-free Tenant d. Other: ____

A09. Region/country of origin of respondent: a. Northern region b. Other region c. Other country

A10. What is your highest level of schooling? a. Basic b. SHS/Voc./Tech. c. Tertiary d. Never schooled

A11. What is your current employment status? a. Self-employed b. Employee c. Student d. Unemployed e. Homeworker

A12. What is your main sector of employment? a. Public/govt. b. Private formal c. Private informal d. Not applicable

A13. What is your household's daily expenditure (GH¢) on each of the following items?

a. Food _____ b. Lighting (e.g. electricity) _____ c. Water_____ d. Rent _____

A14. Averagely, how much is your household's monthly income? GH¢ _____

Section B: Household Source of Water Supply

B01. Is the house connected to the public water network (GWCL)? a. Yes b. No

c. Don‘t know

If Yes, *continue from question* ***B*****02. -** ***If*** **No,** *continue from* **B07**

B02. How regularly does your tap flow? a. All the time b. Weekly c. Monthly c. Sometimes d. No flow

B03. How much do you paid as monthly water bill? GH¢ _____ **B04**. Would you be willing to pay a little more on your monthly water bill to have improved and regular water supply from GWCL? a. Yes b. No c. Don‘t know **B05**. What additional amount would you be willing and able to pay? GH¢ _____ **B06**. Does your household collect water from other sources apart from GWCL supply? a. Yes b. No c. Don‘t know

B07. What is the main source of drinking water for your household? a. Pipe-borne b. Public tap/Standpipe c. Borehole/Pump/well d. Rain water e. Bottled/Sachet water f. Tanker/Vendor provided g. River/Stream/Dugout h. Other (Specify) _____

B08. What is the household‘s main source of water for other domestic purposes (cooking, washing)? a. Pipe-borne b. Public tap/Standpipe c. Borehole/Pump/well d. Rain water e. Bottled/Sachet water f. Tanker/Vendor provided g. River/Stream/Dugout h. Other: ___

B09. Averagely, how many hours per day, does your household spend collecting water? _

B10. Who is the main person(s) responsible for collecting water for the household? a. Women b. Children c. Men d. Other [specify] _____

B11. Does your household store water (in tanks/containers) for use? a. Yes b. No c. Don‘t know

B12. Why have you not connected to the public water network (GWCL)? _____

B13. Which of the following do you consider as **unclean** source(s) of water? [*Multiple options allowed*] a. Pipe-borne b. Public tap/Standpipe c. Borehole/Pump d. Covered well v. Uncovered well d. Rain water e. Bottled water f. Sachet water g. Tanker/Vendor provided h. River/Dugout

<u>Section C: Effects of Poor Water Supply on Household</u>

C01. Does your household face any challenge(s) in accessing potable water? a. Yes b. No c. Don‘t know

C02. How has the water access situation affected your household over the past 3 years? [*Please grade appropriately*]

No.	Indicator	Current Situation		
		Improved	No Change	Deteriorated
a.	Availability of clean water for household use			
b.	Time spent in collecting water			
c.	Ease in accessing water			
d.	Amount of money spent on buying water			
e.	Ability to go to work and on time			
f.	Children's ability to attend school and on time			
g.	Health conditions of household members			
h.	Household's ability to do domestic chores			
i.	Ability to engage in economic activities			

C03. Please describe, if any, the challenges faced by your household due to poor water access? _____

Section D: Informal Water Supply Services

D01. How often do you buy water from water vendors/neighbours?

a. All the time b. When taps do not flow c. Other: _____ **D02**. How long has the household been buying water from tanker supply/vendor provided services? _____

D03. How many buckets of water does your household require per day? _____

D04. How many buckets is your household able to buy per day? _____

D05. How much do you pay for a gallons/bucket (size 35) of water from informal vendors? GH¢ _____

D06. Are you satisfied with the cost of water from the informal vendors?

a. Yes b. No c. Don't know

D07. Are you satisfied with the quality of water from informal vendors?

a. Yes b. No c. Don't know

D08. Are you able to get water from vendors anytime you need water?

a. Yes b. No c. Don‘t know

D09. Do you treat water from vendors before use? a. Yes b. No c. Don‘t know **D10**. Why do you patronize water from informal supply services? [*Select all that apply*] a. Inability to connect to GWCL supply b. Availability c. Affordability d. Reliability e. Flexible mode of payment v. Other [specify] _____

D11. Do you think government should stop informal water suppliers from operating?

a. Yes b. No c. Don‘t know

Please, explain? _____

Section E: Contribution of the Informal Water Sector

E01.Would you say informal water supply is beneficial to your household?

a. Yes b. No c. Don‘t know

E02. Have informal water supply had any negative impact(s) on your household?

If so, please explain: _____

E04. Do you think the current challenges in water access in the Tamale Metropolis can be solved? a. Yes b. No c. Don‘t know

Please explain: _____

QUESTIONNAIRE FOR GWCL

Name and Contact of Respondent: _____ Position in GWCL: _____
Name of Interviewer: _____ Contact Information: _____
Date of Interview: DD ____MM___ YY____ Time of Interview: *Start*___ *End* ___

Section A: Background of GWCL

Vision: _____

Mission: _____

Year GWCL became operational in Tamale: _____

Section B: Capacity and Operations of GWCL

1. What are the water production point(s) of GWCL for the Tamale Metropolis? _____
2. What is the daily water supply capacity of GWCL in Tamale? _____
3. What quantity is supplied daily to the Metropolis? _____

4. What is the daily water demand of the Metropolis? _____

5. Proportion (%) of Tamale Metropolis is currently served by GWCL? _____

6. How do the follow issues affect the operations of GWCL in the Metropolis? [*Please rate appropriately*]

Issue	Highly Positive	Positive	Neutral	Negative	Highly Negative
Logistical capacity of GWCL					
Human resource capacity of GWCL					
Quality of equipment and technology used					
Illegal connections and other leakages					
Availability of water resources in the Metropolis					
Wasteful usage practices among consumers					
Administrative and managerial factors					
Financial capacity of GWCL					
Revenue collection & payment of bills					
Power (electrical) supply stability					
Support from central government, TMA & NGOs					

Operations of informal water operators					

7. What is the unit price of water from the GWCL to consumers? [*Please quote quantity and unit price*] _____

8. How would you describe the unit price of water sold to retailors (water vendors)?

a. Higher than normal rate b. Same as normal rate (to households) c. Lower than normal rate

Section C: Operations of Informal Water Supply Services

9. Do GWCL -Tamale have a comprehensive record of available informal water supply operators in the Tamale Metropolis? a. Yes b. No

10. What prompted the emergence of informal water supply operations in the Metropolis? 11. Do GWCL collaborate with informal water operators (e.g. private tanker operators) in providing water supply services to consumers in the Metropolis? a. Yes b. No

12. Is GWCL able to monitor and control the operations of informal water operators in the Metropolis? a. Yes b. No

12a. If yes, which of the following aspects do GWCL check?

Issue	**Highly Positive**	**Positive**	**Neutral**	**Negative**	**Highly Negative**
Water quality					
Unit price					
Legality of operations					
Sources of water					
Category of consumers served					

13. Which of the following areas do GWCL provide support to informal water operators?

a. Capacity building b. Operation standards c. Pricing and service charges d. No support

14. Do GWCL collaborate with informal water supply operators in water service provision in the Metropolis? a. Yes b. No c. Don‘t know

15. What is GWCL's view on the effect of the existence and operations of informal water supply operators? a. Strongly negative b. Negative c. Neutral d. Positive e. Strongly negative

16. Do you think informal water operators have any benefit for populace of the Metropolis?

a. Yes b. No c. Don't know

Please explain: _____

17. Do you think informal water supply will cease with full supply coverage provided by GWCL? a. Yes b. No c. Don't know

Please explain: _____

18. What, in your opinion, are the negative effects of informal water operations to consumers?

a. High prices b. Poor water quality c. Others: _____

19. Is it legal for individuals with GWCL network connection (piped supply) to sell the piped water to others? a. With permission (Yes) b. Without permission (Yes) c. No d. Don't know

19a. If no, what are the sanctions for such practices? _____

Section D: Challenges in Water Supply

20. What are the major challenges confronting the operations of GWCL in the Metropolis? ____

21. With respect to continuous population increases and increasing urban localities, do you think GWCL will be able to achieve universal supply coverage in the Metropolis? a. **Yes** in the next _____ years b. **No** c. Don't know

22. How do the operations of informal water operators affect the operations of the GWCL?

Positive Impact: _____

Negative Impact: _____

QUESTIONNAIRE FOR TAMALE METROPOLITAN ASSEMBLY

Name and Contact of Respondent: _____ Position in Assembly: _____

Name of Interviewer: _____ Contact Information: _____

Date of Interview: DD _____MM____ YY_____ Time of Interview: *Start*___ *End* __

Section A: Water Supply and Access in the Metropolis

1. Year Assembly became operational: _____

2. What role(s) does the Assembly play in water provision in the Tamale Metropolis? ___

3. How would you describe Ghana Water Company Limited (GWCL) operations in the Metropolis? [*Please use the table to rate accordingly*]

No.	Issue	Excellent	Very Good	Good	Poor	Very Poor
a.	Quantity of water supplied (adequacy)					
b.	Regularity of supply (reliability of services)					
c.	Quality of water supplied					
d.	Unit price of water (affordability to consumers)					
e.	Consumer participation and customer service					
f.	Network coverage within metropolis					
g.	Willingness of people to connect to GWCL					
h.	Unaccounted for water (leakages & illegal connections)					
i.	Maintenance culture					
j.	State of equipment/facilities used					
k.	Financial capacity					

Section B: Operations of the Informal Water Sector

4. Does the TMA approve of the activities of informal water operators (e.g. private tanker operators) in providing water supply services to consumers in the Metropolis?

a. Yes b. No c. Don‘t know

5. Does the Assembly have a comprehensive database/record of available informal water supply operators in the Tamale Metropolis? a. Yes b. No c. Don‘t Know

6. What prompted the emergence of informal water supply services in the Metropolis? __ 7. Does the Assembly have any control/check mechanisms over the activities of informal water operators in the Metropolis? a. Yes b. No c. Don‘t know If yes, which of the following aspects do the Assembly check?

Issue	Highly Effective	Effective	Neutral	Ineffective	Highly Ineffective

Quality of water supplied					
Unit price of water					
Legality of operations					
Source of water					
Category of consumers served					
License of operation					
Quantity of water abstracted					

8. Generally, what is the impact of the informal water sector on reducing social hardship in the Metropolis? a. Strongly negative b. Negative c. Neutral d. Positive e. Strongly negative
9. How do the operations of the informal water sector impact the following issues? [*Please rate appropriately*]

No.	Issue	Highly Positive	Positive	Neutral	Negative	Highly Negative
a.	Improved access to potable water supply					

b.	Reduced stress on households' search for water					
c.	Improved health status of households					
d.	Unit price of water (affordability to consumers)					
e.	Quantity of water resources in the metropolis					
f.	Wasteful usage practices among consumers					
g.	Reduction in water-related diseases					
h.	Unemployment situation					
i.	Revenue generation of the Assembly					
j.	Willingness of people to connect to GWCL					
k.	Illegal connection and leakages in GWCL supply					
l.	Rate of groundwater abstraction					

10. Which of the following areas does the Assembly provide support to informal water operators? [*Multiple options*] a. Capacity building b. Credit and finance c. Pricing and service charges d. No support e. Others, specify _____

11. Do you think informal water supply operations will cease with full networked water supply coverage provided by GWCL? a. Yes b. No c. Don't know Please explain _____

12. Would you say that the informal water sector pose negative impact to consumers? Please explain: _____

Section C: Water Access Challenges

13. What are the major challenges in accessing potable water supply in the metropolis?

14. With respect to continuous population increases and increasing urban localities, do

you think GWCL can achieve full coverage and regular water supply in the Metropolis?

a. **Yes** in the next _____years b. **No** c. Don‘t know

15. What strategies can help improved and sustain water access coverage and regularity of supply? _____