

UNIVERSITY OF GHANA

DEPARTMENT OF GEOGRAPHY AND RESOURCE DEVELOPMENT

**WATER USE AND ASSOCIATED HEALTH RISKS ALONG THE VOLTA
RIVER - THE CASE OF SOUTH TONGU DISTRICT**

BY

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**THIS THESIS IS SUBMITTED TO THE UNIVERSITY OF GHANA,
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DECLARATION

I hereby declare that this research work represents my own and has not been presented to any other institution for award of degree. The information derived from the literature has been duly acknowledged in the text and list of references provided.

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DEDICATION

This work is dedicated to the loving memory of my late Brother Foster R.K. Alorbu.

I also dedicate this to my mother Madam Vicentia Agbenyexo, father Mr. M.K.Y. Alorbu, siblings Antoinette, Peace and Winfred Alorbu. Finally, to my wife Patience Agbezudor, children Sedudzi, Selikem and Seladem.



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LIST OF ABBREVIATION

CDC	Center for Disease Control
CRC	Cooperative Research Centre
CWSA	Community Water and Sanitation Agency
DRA	Demand Responsive Approach
FAO	Food and Agriculture Organization
GSS	Ghana Statistical Service
GWSC	Ghana Water and Sewerage Corporation
HWT	Household Water Treatment
HWTMs	Household Water Treatment Methods
IOWH	Institute of One World Health
ORS	Oral Rehydration Solution
STDA	South Tongu District Assembly
UNDP	United Nations Development Programme
UNEP	United Nations Environment Programme
UNESCO	United Nations Educational, Scientific and Cultural Organization
UNICEF	United Nations International Children Emergency
US EPA	United State Environmental Protection Agency
USAID	United States Agency for International Development
USGS	United State Geological Survey
WASH	Water, Sanitation and Hygiene
WBCSD	World Business Council for Sustainable Development
WCC	World Chlorine Council
WHO	World Health Organization
WRI	Water Resource Institute
WWAP	World Water Assessment Programme

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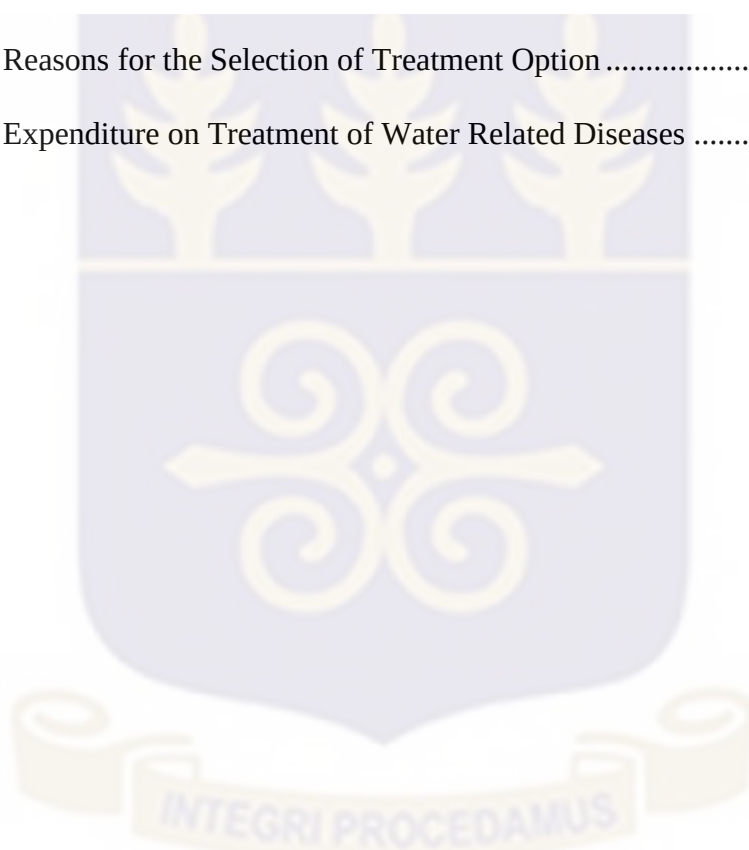
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ABSTRACT

One major challenge for both rural and urban Africans is the ability to access clean water supply. Water is integral to all aspects of human welfare, including security, energy, food, and health. Even though stakeholders in Ghana have been creating public awareness and education against the direct use of unimproved water sources, wide variation continues to exist in access to pipe borne water, making households more susceptible to water use related health risks through unsafe water consumption. The main objective of this study is to ascertain the level of public awareness and knowledge about water quality improvement in curbing water related diseases among rural communities along the Volta River in South Tongu District.

The research used mixed method to collect field data quantitatively and qualitatively. A total of 160 questionnaires were administered to 3 selected communities, 9 interviews with stakeholders and 3 sets of focus group discussions were conducted. The study found a significant relationship between the main sources of water and location of residents. Additionally, it was found that communities living along the Volta River without access to potable water always depend on the Volta River. There was low level of public awareness and educational programmes within the communities without potable water, couple with little knowledge on the use of most effective simple HWTMs to improve water quality for drinking and other uses. The most prevalent water-use related diseases were diarrhoea, skin itching, bilharzia, typhoid and others.

It is recommended that the South Tongu District Assembly together with other stakeholders including NGOs should canvass for resources in order to supply the communities along Volta River with potable water. There should be short and long-term intensive public awareness and educational campaign on the effects of using unsafe water and unhygienic practices along the river bank.

CHAPTER ONE

GENERAL INTRODUCTION

1.0 Introduction

Water is essential to all aspects of human wellbeing, such as food, energy security, and health. Hunter et al (2010) noted that good health is dependent on safe, reliable, affordable, and easily accessible water supply. Water is perhaps the most precious asset on earth and for that matter there is competing demands for its usage for drinking, domestic use, waste disposal, industrial processes, irrigation, hydroelectricity, transport and recreation, as well as ecosystem functions and services. Water demand has tremendously increased as a result of population and income growth, and the expansion of industry and irrigated agriculture. This phenomenon has culminated into demand exceeding supply in many developed and developing countries. Unfortunately, the available freshwater supplies are not evenly distributed in time and space (Gleick, 1993; Hunter et al, 2010).

According to UNICEF (2008), safe water is a precondition for good health and development and a basic human right. It is water that allows the human body to carry out all its major functions, since the body is made up of 70 to 90 percent of water. Hence, the quality of water is extremely important for the health and wellbeing of all living creatures (UNESCO, 2009). It is further noted that good quality drinking water comes from taps in homes. Therefore, drinking or washing with unsafe water can pose serious risks to health of the people. On this premise, access to safe water by all is very essential. According to WHO/UNICEF (2010), about 783 million people do not have access to clean and safe water worldwide. Most of these people without access to safe and clean water are mainly found in developing countries. Unfortunately, Africa is reported to be

the most affected with an estimated 319 million people, found in Sub-Saharan Africa, who are without access to improved reliable drinking water sources (WHO, 2015).

Lack of access to quality water has contributed to many water-related diseases in Africa. There are four main classes of water related disease according to White et al, (1972) and these comprise of waterborne (faecal-oral), water-washed, water-based and water-related insect vector. Most of these water-related diseases include diarrhoea, bilharzia, skin infection, typhoid, hepatitis and so on. These water-related diseases affect more than 1.5 billion people every year worldwide (WHO/UNICEF, 2015). It is further pointed out that diarrhoea is the third leading cause of child death, a majority of which are water related. These water related diseases are mostly found in developing countries but very pronounced in Sub-Saharan Africa.

Waterborne diseases are among the main killers of children under five years. Annually, death from the usage of unsafe water exceeds death recorded through violence, including war (WHO 2002). Every year, about 1.8 million people die from diarrhoeal diseases, 88 percent of which are accounted for by unsafe water supply or inadequate sanitation and hygiene (WHO 2004b). WHO (2000) noted diarrhoea is responsible for as much as 7.7 percent of all deaths in Africa. There are also non-diarrhoeal waterborne diseases including typhoid fever, which causes 600,000 deaths per year. In related development, 55 percent of malnutrition in children is associated with diarrhoea or intestinal nematode infections from unsafe water (Pruss-Ustun et al, 2008), and schistosomiasis, accounting for 200,000 deaths in Sub-Saharan Africa alone (Zhang et al, 2007).

Ghana is also affected by lack of access to improved water sources. Currently, close to 3 million people in Ghana depend on surface water to meet their daily water needs, leaving them susceptible to water related health risks (<http://ghana-water/crises.water.org>). It

further noted that as a result, about 70 percent of all diseases in Ghana are caused by unsafe water and poor sanitation, with diarrhoea leading the causes of death among children under five. More specifically, the South Tongu District in Ghana, which depends on the Volta River for daily uses, has historically had high prevalence rate of water related diseases and still requires significant assistance with water improvement (GSS, 2014). Beyond the health risks that are associated with the use of poor quality water, economic and social activities are greatly impeded, and immediate and lasting attention is needed to resolve these issues (<http://ghana-watercrises.water.org>).

In order to deal with water related diseases, public awareness and understanding of the challenges are imperative and while some Non-Governmental Organisations (NGOs) have made significant efforts in this direction, more sustainable action is required. This study sought to investigate water sources and uses in the South Tongu District and how communities have been impacted by public education and awareness campaigns in eliminating or minimising the effects of water-related health risks.

1.1 Problem Statement

There is an alarming rate of water related health risks issues in South Tongu District due to lack of public awareness and educational campaign concerning the uses of unimproved water. Ghana has a very long history with water problems. In 1965, under an Acts of Parliament (Act 310), Ghana Water and Sewerage Corporation (GWSC) was established as an authorized public service provider among other responsibilities to provide water and sanitation to rural and urban areas. However, a report from World Bank (1998) stated that the water supply systems in Ghana deteriorated rapidly during the economic crises of the 1970s and 1980s when Governments ability to adequately

operate and maintain essential services was severely constrained (cited in Ministry of Water Resources, Works and Housing, 2009).

Consequently, the water sector was decentralized from Ghana Water and Sewerage Corporation to the District Assemblies in 1993. With the passage of Act 546 of the 1998, Community Water and Sanitation Agency (CWSA) was instituted to provide for the management of rural water supply systems, hygiene education and provision of sanitary facilities. These confirmed the development of the nationwide agenda report by CWSA (2013) provision of; new boreholes fitted with hand pumps-436, boreholes rehabilitated and fitted with hand pumps-67; small towns' piped systems practically completed- 11 and others. The agency has also been able to bring on stream new projects such as Sanitation and Water Innovation Project (SAWIP).

While these reforms improved access to safe water, the problems of adequate safe and portable water distribution to rural and urban areas in Ghana still faces some challenges. This is confirmed by Ghana Multiple Indicator Cluster Survey (2011), which states that rural dwellers are less likely to have access to safe drinking water than the urban dwellers at 69% and 91% respectively. Consequently, unsafe water sources are highly dependent on by rural dwellers in Ghana (<http://ghana-watercriseswater.org>). Meanwhile, the turbidities of most local surface waters in rural areas are greater than 200 NTUs (Nephelometric Turbidity Units) and contain high microbial and faecal contamination, exposing children and the rest of the population at high risk to water related diseases (Mintz et al, 2001).

In Ghana, the use of unimproved water for cooking, drinking, washing and cleaning to a large extent account for waterborne health risks such as diarrhoea, hepatitis A, typhoid, and so on in the rural communities (CWSA, 2013). A diarrhoeal disease is identified to

be among the top ten causes of deaths in Ghana (WHO, 2015). Not only these water related diseases affect health of the people, it also affects their economic livelihood and social lives as well as education of children. Many of these diseases find more expressions in rural areas and most commonly in communities along the Volta River in South Tongu District.

Pretty much, the 2013 -2017 corporate plan towards rural water and sanitation focus on the strategic direction of the agency in line with the changes in the rural water, sanitation and hygiene (WASH) subsector. The corporate plan was a continuation of a process which began in 2002 aiming at improving rural water and sanitation clearly, indicated in the literature that, there has been important change in policy and legislation in rural water and sanitation subsector (CWSA, 2013). Importantly, among these policy and legislation included the facilitation of providing sustainable safe water and related sanitation and hygiene promotion to small towns and rural communities.

In South Tongu District, on the contrary, these strategic plans highlighted towards improving water, sanitation and hygiene promotion seem not to have yielded much result, thus, aggravate health issues in the communities. This is buttressed with the confirmation by South Tongu District Health Directorate (2012) which reflected in the disease burden of the District with diarrhoea among the top ten diseases which constitute 5.3 percent and 6.2 percent in 2010 and 2011 respectively, for the cause of death in the District with bilharzias and typhoid also highly prevalent.

It is therefore, clearer that if the corporate plan which was continuation of a process which started since 2002 aiming at improving rural water and sanitation really at its peak, South Tongu District would not have been in the mess with water related health risks. Meanwhile, few studies conducted outside Ghana by Cairncross et al. (2006) and O'Reilly et al. (2007) revealed that home visits, awareness campaign programmes, and

health education classes were effective mechanisms on water quality and treatment methods available. As to whether there was any awareness and education about water quality improvement in mitigating water related health issues, is something that urgently needs to be investigated.

Although, a plethora of studies have been conducted into water related issues, for instance, a study by Gbedemah, (2010) looked at the management, uses and values of demand-oriented domestic water facilities in Akatsi District of Ghana. Mensah and Antwi, (2013) researched into bridging the water and infrastructure gap. Another study by Owusu-Sekyere et al, 2013 looked at coping with water scarcity, household water supply vulnerability in low income communities. These studies focused much on issues of quantity of water, infrastructure, and management of water facilities. Besides, the most recent study conducted in the District by Kumi-Ayeh et al (2016) explored the relationships between malaria, schistosomiasis, soil transmitted helminths and malnutrition. Yet, these studies have completely failed to assess the level of awareness and knowledge about water quality improvement in the South Tongu District, a gap which this study set up to fill.

Thus, the water treatment measures that people adopt to make water safer for use significantly depend on the level of awareness and knowledge about water quality improvement which have not been assessed as indicated in the literature. This research therefore seeks to help fill this gap through an assessment of the level of awareness and education about water quality improvement. Besides, comprehensive assessment of the level of awareness and education about water quality improvement will make a significant contribution to the literature towards awareness level about water quality improvement within communities living along the Volta River in the South Tongu District of Ghana.

1.2 Research Questions

1. What is the relationship between location of residents and sources of water?
2. What is the level of awareness and knowledge about measures to improve water quality?
3. What are the prevalent water related diseases in the communities?
4. How do the people manage water related diseases in their communities?

1.3 Aim and Objectives of the Study

The main objective of this study is to assess the level of awareness campaign and education about water quality improvement towards reduction of water related health risks among rural communities along Volta River in South Tongu District.

1.4 Specific Objectives are:

1. To examine the relationship between location of residents and sources of water
2. To assess the level of awareness and knowledge of people about water quality improvement
3. To identify prevalent water related diseases in the communities
4. To examine how people manage water related diseases

1.5 Significance of the Study

Water is the most basic necessity of life and fundamental human right of every individual. Therefore, every community deserves the basic right to water for their daily domestic and economic activities. However, several communities tend to consume any available sources of water particularly surface water without resort to any form of less expensive treatment options that may exist to lessen impact of disease causing organisms hence exposing them to severe health risks such as diarrhoea, schistosomiasis, intestinal

worms and guinea worm amongst other threats. It is against this backdrop, that this study assesses the level of awareness and knowledge of the people about water quality improvement. The outcomes of this research would provide very useful guidelines for stakeholders in taking very pragmatic decisions to resolve water problem which would mitigate health risks on the people. Besides, local knowledge that would be gained from management practices likely to be adopted in resolving water related diseases in this area could be exported to other areas experiencing similar situation. More so, the study is expected to add to the body of knowledge by pointing out the real issues pertaining to water related situations and to kindle future research into the problem and other related matters.

1.6 Organisation of the Study

The study was organised in six chapters. The first chapter dealt with general introduction to the study, the problem statement, objectives, and research questions of the study. The chapter ended with the significance of the study.

The second chapter reviewed related literature on specific themes including water sources, uses and problems, community and households water management approaches, importance of awareness and education, understanding concept of health risks in association with unimproved water, types and management of water related diseases. The chapter concluded with a review on the disease ecology model adopted from Meade and Emch (2010) for this study.

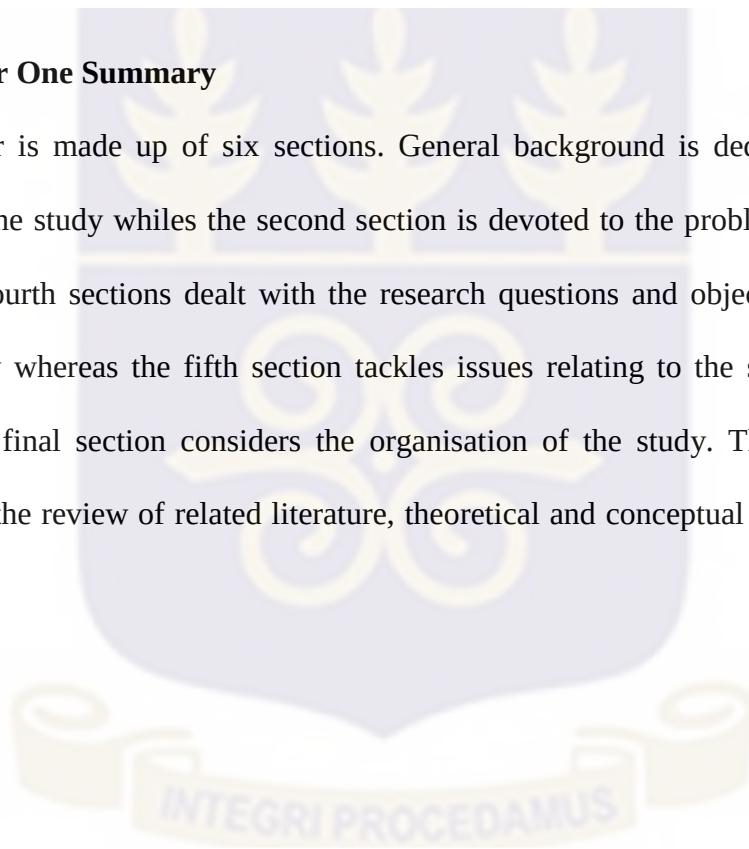
In addition, the third chapter was devoted to the Study Area and Methodology of the study. The chapter particularly dwelt on the data collection methods, sampling technique, sampling size, data sources and the study area.

The fourth and fifth chapters dealt with the analysis and discussions of data. The chapter analysed and discussed the respondents' characteristics, available water sources and assessment of awareness and knowledge about water quality improvement. The fifth chapter discusses the prevalence of water related diseases and management of these diseases.

The final chapter concluded with summary of key findings, conclusion and recommendation.

1.7 Chapter One Summary

The chapter is made up of six sections. General background is dedicated to the first section of the study while the second section is devoted to the problem statement. The third and fourth sections dealt with the research questions and objectives of the study respectively whereas the fifth section tackles issues relating to the significance of the study. The final section considers the organisation of the study. The next chapter is devoted to the review of related literature, theoretical and conceptual frameworks of the study.



CHAPTER TWO

LITERATURE REVIEW

2.0 Introduction

Water has a very significant impact on the health of humans. Fundamentally, a minimum quantity of water is needed for daily consumption to survive. Thus, right to use water is very critical for life. More so, health and well-being of the people is much influenced by amount and quality of the water accessible to individuals and the whole communities. The chapter delves into the various sources of water, different uses, water treatment options, the concept of health risks, common prevalent water related diseases and management practices adopted in minimizing or eradicating these diseases.

2.1 Sources and Uses of Water

According to Water Resource Institute (2006), the Earth's surface is covered by more than 70% of water. Although water is seemingly abundant, the real issue is the amount of fresh water available. WRI (2006) indicated that 97.5 percent of all water on Earth is saline water, with the remaining 2.5 percent as fresh water. UNESCO (2003) admitted that frozen water in the icecaps of Antarctica and Greenland constituted 70 percent of fresh water; most of the remainder is present as soil moisture, or lies in deep underground aquifers as groundwater which is not directly accessible for human use. Only 1 percent of the world's fresh waters including lakes, reservoirs and river systems are accessible for direct human uses (UNESCO, 2003; WRI, 2006). Therefore, the available amount of water is sustainably renewed by rain and snowfall. According to UNESCO (2003) fresh water is water that people can drink or use for their animals and their crops. Although several sources of water exist, people basically derive their fresh water from surface water, groundwater and rainwater.

2.1.1 Surface Water

The surface water sources comprise of rivers, lakes, ponds and streams which are opened to the environment. They have a wide variation in flow and this affects water quality which occurs particularly in wet periods where water carry a very high silt load and washes feces into the river resulting in high risk of contamination (<http://www.who.org>). In addition, due to warmer climate resulting in high water temperatures, and subsequent discharges of waste, heats are expected to cause many kinds of pollution. The accompanying pollution has potential to cause possible negative impacts on human health, ecosystem, and water system reliability through the activities of sediments, nutrients, dissolved organic carbons, pathogens, pesticides and salts (Bate et al, 2008). WHO (2001) noted that lack of equal access to safe and portable water compel women to spend hours every day in search of water, causing low productivity, loss of energy and health related risks in the developing countries particularly in the rural areas. As a result, people are forced to utilize water from unsafe sources exposing them to diseases such as schistosomiasis, typhoid, diarrhea or dysentery, and cholera. WHO further maintained that water being taken directly from river or stream without treatment presents a major health risks to the users (<http://.who.org>).

2.1.2 Groundwater

This source of water is obtained from springs, shallow wells and shallow or deep boreholes. Groundwater provides one of the safest sources of water for domestic and other forms of uses. According to UNDP (2003) rural areas are the main beneficiaries of groundwater as their domestic and agricultural water use is satisfied. In United States of America, the rural population constituting over 95 percent depends on groundwater source, and hundred millions of people in Africa depend on groundwater for household

supply, often from individual boreholes due to low per capita water availabilities (UNEP, 2003).

In effect, the only feasible source of quality and reliable water where perennial surface water sources lack is the use of groundwater. Nonetheless, EPA (2005) contended that groundwater becomes easily susceptible to contaminants through natural and anthropogenic causes (cited in Ojo et al, 2012). Ojo et al (2012) noted that ground water is polluted through contaminants such as chemicals (calcium, sodium, iron, manganese etc.), pathogens and physical or sensory changes (high temperature and discoloration) can have negative effects on aquatic lives. He further stated that the anthropogenic causes resulting from petroleum product leakages through underground tanks, nitrates from overuse of chemical fertilizers or manure on farmland, over-use of chemical pesticides, accidental spills, etc. contaminating groundwater have serious health implications for users.

2.1.3 Rainwater

In the absence of surface water and groundwater when accessibility is difficult or too salty or acidic, the use of rainwater becomes very important (WaterAid, 2013). Rainwater is collected from most forms of roof including tiled roofs, or roofs sheeted with corrugated mild steel and thatched or palm leafed surfaces are preferably used in the rural settings. Whilst US EPA (2008) conceded that collecting and using rainwater can be a better way to conserve resources, WaterAid (2013) conversely opined that rainwater provide some of the cleanest naturally occurring water that is available everywhere. Rainwater is used by many for drinking, irrigating plants, cleaning, bathing, etc. However, Ahmed et al (2011) and Lye (2002) bemoaned that rainwater can contain disease causing organisms that could infect people and lead to outbreak of diseases.

One's location, frequency of rains, season, collection and storage of rain water determine the risk of being from the use of rainwater. Vialle et al (2011) were of the view that rainwater before landing on rooftops can be dissolved with dust, soot and smoke in the air. CDC (2013) admitted that harmful chemicals such as asbestos lead, copper into the water through roofing materials, piping and storage materials. Similarly, rainwater collected several days after dry weather may wash dirt and germ into the collected rainwater (Sands and Chapman, 2013; Ahmed et al, 2011; Lye, 2002). Furthermore, contamination may be due to bird/animal droppings in catchment surfaces and poorly constructed containers which suffer from algae growth as well as attack from insects, lizards and rodents aiding as a fertile ground for disease vectors (WaterAid, 2013).

2.1.4 Uses of water

Globally, there are basically three competing water uses which include domestic use at 8 percent, industrial use at 22 percent and agricultural use being the largest proportion of 70 percent (UNESCO, 2003). It is however revealed in the literature that the earnings of a country increases with industrial uses of water ranging from 10% and 59% for developing and developed countries respectively. It is projected that irrigation accounted for 70 percent of global water use with 15-35% of irrigation withdrawals being unsustainable. About 2000 to 3000 litres of water is required to provide sufficient food to meet the daily dietary requirement of a person (UN-Water, 2007). UNESCO (2012) observed that groundwater is depended on by hundreds of millions farmers for their livelihoods and support of food production. The use of water for irrigation accounts for 43 percent used of groundwater (WWAP, 2015). Contrary to drastic surges in large-scale irrigation structure over the past half century the greater part of the global agricultural production mostly still comes from rain fed lands (Molden et al, 2007). Rain fed

agriculture contributes to about 55% of total value production of crop. However, there are large regional differences in the percentage of rain fed cultivated land, from almost 95% in Sub-Saharan Africa and almost 90% in Latin America, to less than 70% in the Near East and North Africa and less than 60% in South Asia. Rain fed areas support both permanent crops like rubber, tea, and coffee and annual crops such as maize, wheat, and rice (Molden et al, 2007). Besides, an estimated 1 billion of the poorest in the world are engaged in livestock production as full time or part time which form part of an important component of agricultural production (FAO, 2006a cited in FAO, 2013). According to FAO (2013), livestock constitutes to 17 percent and 33 percent of average human energy intake and protein intake respectively. Pimentel et al (2004) concluded that the production of plant protein requires less water than the production of animal protein. This is possible through the use of water which is significant for animals in terms of drinking, cooling, and feeding. In addition, surface water is very important in agricultural production, for instance in USA about 80 percent of freshwater withdrawals comes from surface water (USBC, 2003).

Furthermore, the second highest user of water is the industrial sector. WBCSD (2009) estimated that 22 percent worldwide water is used in industry. There are four main industrial sectors including mining and quarry, manufacturing, production of electricity and construction among others (Forster, 2014). However, the amount of water used varies from one industry to another. WBCSD (2009) conceded that the largest component user of water within the industrial sector is for cooling in thermal power generation mostly from surface water. This is confirmed by study conducted by USGS (2005), that 83 percent of industrial water use was from surface water source of the entire industrial withdrawals, while 17 percent of withdrawals was accounted for by

groundwater. Besides, many industries that use water as an ingredient in their finished products include pharmaceutical, food, and beverage sectors.

It is estimated that household water use accounts for 8 percent of global water usage (WBCSD, 2009). The household water uses include drinking, cooking, bathing, washing, cleaning, toilet flushing, laundry and so on. Peter Gleick (2003) estimated that a household water requirement per person per day is 50 litres, not including water for garden. However, there is the need for high quality drinking water standard to consume or use without any immediate or long-term health risks. According to UNESCO (2012), groundwater provides substantial water supply for human well-being as 2.5 billion populations globally depend mainly on groundwater to meet the daily water needs, with at least 50 percent of the world populations use it for drinking. UNEP (2003) agreed that groundwater is accessible, cheap, and convenient to a large number of users and less capital intensive to develop especially in rural areas for their domestic water supply. Besides, (<http://who.org>) maintained that rainwater equally provides for multitude of uses including drinking, garden watering, laundry, toilet flushing, and car washing and so on. Surface water similarly supplies significant domestic water, however, water taken directly from river or stream without treatment presents a major health risk to the users.

2.2 Challenges with the Uses of Unimproved Sources of Water

In developing countries, an estimated 75% and almost 95% of all industrial waste and sewage respectively are released into surface waters without any treatment (Carty 1991 cited in WHO, 2013). This undoubtedly would pose serious health implications for people in this part of the world who lack access to safe and reliable pipe borne water but depend much on this source for their daily water needs. Unimproved water supply at household level, significantly affect health of the people through contraction of

waterborne diseases. Hinrichsen et al. (1997) observed that water-borne diseases are "dirty-water" diseases, that is, those caused by contamination of water by man, animal, or chemical wastes. Lack of clean water for drinking, cooking, washing as well as improper disposal of sanitary waste are blamed for more than 12 million deaths a year. Bhavnani et al. (2014) noted that unimproved water sources such as rivers, ponds, lakes, and unprotected springs together with unimproved sanitation pose as major risk factors of diarrhoea where the prevalence of water-borne diseases fluctuate with seasons, particularly during the rainy and summer periods. It was found that infectious diseases like diarrhoea and skin disease were the largest contributors to the disease burden from using unprotected and contaminated surface water in the study area (Haque et al, 2000). The literature further revealed that, diarrhoea and skin diseases were most prevalent and frequently found water borne diseases. Haque et al (2000) elaborated that the collection and carry of water a distance away from the source, the water become contaminated and most people were not aware of this possible contamination.

Furthermore, a study conducted by Boone et al (2011) revealed that rural areas depended on surface water sources more than the urban areas which reflect in the statistics as 44 per cent of rural households fetch water from a stream, pond, river or lake with the urban areas recording 8 percent. Similarly, in Ghana many rural communities used water from unimproved sources and due to high level of pollution, water borne and water-related diseases are widespread in rural communities (Gyau-Boakye and Dapaah-Siakwan, 1999).

Sobsey (2002) noted that diarrhoeal and other water borne diseases can be reduced by 6 to 50%, with access to safe water without better sanitation and hygiene measures. Ozkan et al. (2007) had reported on the study conducted in rural areas of Turkey that inadequate safe water supply was responsible for all kinds of sicknesses such as diarrhoea and other

waterborne diseases. In a meta-analysis by Fewtrell et al. (2005), stated that access to water supply, quality of water, and sanitation minimised the risk of diarrhoea-related ill-health by 25%, 31%, and 32%, respectively. These challenges confronted by many people and communities using unimproved water sources became development issue which led to several community and households water management approaches in containing the problem.

2.3 Community Water Management Approaches

The debate on development paradigms began in the mid to late 1970s (Moriarty et al, 2013), as to whether people's participation is critical in raising their level of development (Lammerink and Bolt, 2002). Chambers (1983) and Oakley (1991) noted that the argument received significant support from the reports of emerging failures of "top-down approach". It became very clear that development cannot be achieved if the people concerned do not participate. So in the mid-eighties, the centralized operation and maintenance system for water and sanitation could no longer be funded by government and donor (UNICEF, 1999). Consequently, there emerged community involvement and management in rural water supply.

However, the perceptions as to what these terms means vary greatly. Accordingly, Harvey and Reed (2006:367) defined community participation to be "a consultative empowerment process designed to establish communities as effective decision-making entities". This generally means that the community to benefit from an improved water supply participated in and initiation of action, information sharing, consultation, and decision-making, (Guijit and Shah, 1998 cited in Harvey and Reed, 2006). Harvey and Reed (2006) argued that in the provision of water to rural areas, a community is likely to be defined by the area to which a given water system can realistically serve, contrary to pre-existing community defined by village, ethnic, or family groups. Therefore

community participation is regarded as a precondition for sustaining efficient, effective, fairness, and replicable for water supply.

On the other hand community management is a “bottom-up development approach whereby community members have a say in their own development and the community assumes control of managerial, operation, and maintenance responsibility for the water system” (Doe and Khan, 2004 cited in Harvey and Reed 2006:368). This implies that community members who are beneficiaries should have an absolute control over management of the water projects (McCommon, Warner, and Yohalem, 1990 cited in Harvey and Reed, 2006).

However, Harvey and Reed (2006) observed that there are several limitations to community management approaches which affect the sustainability of rural supply water in several communities. They attributed the failures of breakdown in the management systems to six common causes as identified in a survey conducted in several hundred of communities in the study countries as follows:

Firstly, the approach often depends on voluntary involvement from community members, characterized by no long term reward and free will to continue or opt out at any given time by community members. Secondly, there is absence of mechanism to replace key personalities on the water committee in the event of death or departure from the community. Thirdly, lack of transparency and accountability, and lack of regulation by a supporting institution (e.g. local government) defeats the trust the community members repose in those in charge of managing water supply. In addition, inability on the part of community members to pay their maintenance fees causes disenchantment to committee members who abandon their responsibilities. This may be primarily due to lack of community unity, and absence of legal status and authority. Furthermore, demotivation due to lack of contact with the appropriate implementing agencies make

them feel abandon or rejected. Finally, the high level of poverty in the community makes it difficult in replacing major capital items when broken down (Harvey and Reed, 2006). Additional vital “limitation to community management is the widespread perception that ‘ownership’ is a prerequisite for community management and is the key to sustainability” (Knudsen and Tidemand, 1989; Cotton and Taylor, 1994; Niedrum, 1994; Bossuyt and Laporte, 1995 cited in Harvey and Reed, 2006:370). There is evidence to the contrary by Harvey and Reed (2006) that there is no relationship between ownership and community management of water supply systems. However, in an extensive work by Harvey and Reed (2006), they acknowledged three potential solutions to limitations associated with the management of rural water supply. These according to them include household and small user-group water supplies, implementation of private sector service delivery models, and provision of institutional support.

Following the failure of community management approaches in the late 1990s, the demand responsive approach (DRA) was introduced to serve as a complement, supported by World Bank (Moriarty et al, 2013). The DRA was aimed at strengthening community management in ensuring appropriateness of water supply type or level and demand through involvement of the community in terms of choice of technology, investment cost and responsibility for future operation and management costs (World Bank, 1998 cited in Moriarty et al, 2013). They noted that by early 2000s, DRA became the widely used strategy for water supplies in rural communities in developing countries. The main achievement of the default approach has provided many rural populace accesses to portable water, sometimes through community supplies or self-supplies providing a broad picture of success (Moriarty et al, 2013). Notwithstanding the achievement of this approach, it has its fair share of failures as non-functionality of the technology employed results in poor services delivery.

Over the last decade or so, having realized and recognized both the possibilities and potential limitations of community management, Moriarty et al (2013:335) have noted that “three sets of responses have emerged in rural water supply as professionalization of community management, support to community-based service providers and self-supply. Indeed, these three evolutions in rural water point to the need for a flexible and pragmatic approach that must meet the rights, demands, desires and needs of diverse groups of rural citizens, in a broad range of rural contexts and livelihoods with much focus on self-supply”.

2.4 Household Water Treatment Methods Use in Water Quality Improvement

Due to numerous challenges confronted by community water supply systems through the various management approaches adopted. It would be very appropriate if an alternative approach would be embraced to alleviate sufferings of people without improved source of water or safe water in order to minimize health risk exposures. Pruss-Ustun (2008) estimated that improvement in water quality, sanitation and hygiene could prevent at least 9.1 percent and 6.3 percent of all global burden of disease and of all deaths respectively (cited in WHO, 2013). Provision of safe, reliable, piped-in water to every household is an indispensable goal, yielding optimum health gains while contributing to the targets for the United Nations MDGs (WHO, 2013). Yet, lack of access to improved water sources due to cost poses the greatest challenge in safe water delivering (WHO/UNICEF, 2012 cited in WHO, 2013). Accordingly, Mintz et al. (2001) and WHO/UNICEF (2007) pointed out that public health officials have called for alternatives that will provide some health benefits of safe water while progress is being made in improving water facilities (cited in WHO, 2013)

2.5. Purpose and Benefits of Household Water Treatment

Household Water Treatment (HWT) is the application of means (physical or chemical methods) to render water safe for drinking or other domestic uses at point of use, particularly in households. Study by Artiola et al (2009) revealed that about half of the homes in the U.S have some kind of water treatment device aimed at controlling minerals, contaminants and disinfecting their water. This the authors attributed to uncertainty over water quality standards, mistrust of public water utilities, and concerns about general health issues. On the basis of that, WHO (2013) argued that HWT allows people to use different water sources such as rivers, ponds, streams and canals which may be more suitable and easily accessible, even though they are of poor quality. It is therefore agreed that, treating water in the home allows people to adapt to the temporal and seasonal variations in their water supply. Clasen et al (2007) did an annual comparative cost-effectiveness analysis of leading HWT option per person covered and that with conventional improvements in water supplies concluded that the HWT produce the best result for public health intervention (cited in WHO, 2013). The use of unsafe water is a major source of water borne infection, illness and death which is due to exposure to pathogens, as a result HWT has been recognized as a breakthrough in the reduction in the risks of diarrhoeal and other water borne diseases (WHO, 2002). Safe water has the potential of reducing infectious burden of the developing countries population, as it is evidenced that access to safe water alone can minimize diarrhoeal and other enteric diseases by 6 to 50% even if there is inadequate sanitation and other hygiene measures (WHO, 2002). It is agreed that, 5% reduction in household diarrhoea is a remarkable achievement and being set as a minimum target should be regarded laudable to promote and implement by health officials.

However, much emphasis is placed on effective treatment at the household level because once it is done well; it can eradicate, destroy or inactivate most microbial pathogens (Quick et al. 1996; Luby et al. 2001; Rangel et al. 2003; Souter et al. 2003 cited in WHO, 2013). Wright et al. (2004) admitted that by focusing at the point of use rather than the delivery point minimizes the risk of recontamination even better than enhanced water supplies can provide (cited in WHO, 2013).

2.6 Types of Household Water Treatment in Water Quality Improvement

In considering household water treatment options, certain basic criteria need to be considered. These include treatment effectiveness, appropriateness, acceptability, affordability, accessibility, use and sustainability, all of which are met by household water treatment. As opined by Sobsey et al. (2008), there exist a number of simple household treatment technologies and approaches that have been tested and effectively implemented in different settings among different populations. An application of diverse household water treatment technologies removes different categories of contaminants to different levels. It is identified that the main focus of household water treatment technologies is in removing biological pathogens as they are recognized to present the most significant health risk. Consequently, some household water treatment options that help to remove chemicals and improve physical qualities of drinking-water are highlighted as follow.

2.6.1 Boiling

The widely used, easily and effective methods of removing pathogens is boiling method. Clasen (2009) and Rosa and Clasen (2010) cited in WHO (2013) identified boiling to be predominate method of HWT with 21 percent of low- and middle-income households with an estimated 1.6 billion people report that they usually drink boiled water since it

enhanced the microbiological value of drinking water. Studies further revealed that boiling is almost universal in Indonesia (90.6%), Vietnam (91%) and Mongolia (95.1%). More importantly, boiling is recognized as the only method that is fully effective against all waterborne pathogens in all types water conditions (WHO, 2013). The authors were however quick to add that in some countries, the success of boiling as an effective method is as a result of governments efforts in championing it as part of their overall health hygiene campaigns. Again, it has been admitted that health and community workers are trained by many governments to promote the practice in villages and communities (Clasen 2009; Rosa & Clasen 2010 cited in WHO, 2013). Notwithstanding, the effective use of boiling as a method is limited by fuel cost and time involved in the process (WHO, 2013). Further, due to high fuel costs, it is increasingly getting out of reach for most people who are contributing to disappearance of forests (Potgieter, 2007; UNICEF, 2008b). In addition to earlier claims, it is evidenced in Bangladesh that, boiling as a water treatment method would account for 7 percent of the average family budget in order to treat water for the whole village (Gilman & Skillicorn, 1985). Therefore, due to high energy costs and environmental issues it should be considered suitable only in case of emergency situations (Haider, 2006).

2.6.2 Sedimentation

One physical process in the treatment of water where turbidity of water is reduced by allowing the water to settle down for few minutes in basin, containers or bucket is sedimentation/plain sedimentation. The quality of water can be achieved by storing the water without mixing it for some time to allow for large microbes and particles to settle by gravity. Decanting and ladling processes can be adopted to carefully remove and recover the settled water. Sedimentation is noted to be very effective in reducing water

turbidity. Pathogenic microbes such as bacteria and viruses inability to settle down are considered as some of the demerits (Sobsey, 2002).

Addition of native plants (coagulants) or special chemicals is another form of sedimentation. Coagulants aid the shingle, sediment and mud join together to form bigger particles called floc, to easily settle at the bottommost of the storage device. The widely used chemical coagulants include poly-aluminium chloride (also called as liquid alum or PAC), alum potash, aluminium sulphate (alum), and iron salts (ferric sulphate or ferric chloride). Prickly pear cactus and moringa seeds are traditional native plants locally available for sedimentation process.

2.6.3 Coagulation and Flocculation

The most efficient removal of fine suspended materials where viruses and bacteria get hold and attracted to their surface is through coagulation and flocculation. CRC (2008) maintained that these methods can remove up to 99.9 percent and 99 percent of bacteria and viruses from water supplies that flows across land surface respectively but cautions that particular taste and unpleasant smell may be problems.

2.6.4 Filtration

Filtration is a physical process that involves passing water through filter media. According to Potgieter (2007), filtration is a widely used method for removing some microorganisms and particles from water. Households make use of filters and filtration processes of diverse types. However, local factors influence the microbes' removal, filtration media availability and the cost, and approaches in developing countries (Sobsey, 2002). Filtration through porous layers of sand, gravel and charcoal is most widely used physical water treatment method within households and at community level (Lantagne et al., 2006). This granulated kind of media filtration has the potential of

reducing by 90 percent the turbidity and enteric bacteria, removing larger parasites, enteric viruses and pathogens at a percentage rate of 99%, 50% and 90% respectively (Sobsey, 2002; Potgieter, 2007). Slow sand filters, fibre, cloth and skin filters, permeable earthenware filters and diatomaceous earth filters are recognised different filters that have been tested and patronized in homes for treating water in less developed countries (Potgieter, 2007). Some of the established filters in less developed countries are;

2.6.4.1 The BioSand Filter (BSF)

The most extensively BSF used in homes is slow-sand filter. It is a container made of concrete with a height of about 0.9 metre and 0.3 metre rectangular, filled with shingle. The level of water is maintained within a range of 50 to 60 mm above the shingle stratum by fixing the height of the tube outlet. The shallow water on top of the shingle enhances the growth of bioactive stratum, which reduces bacteria and protozoa for causing diseases. In order to forestall any destruction to the bioactive stratum when water is poured into the system, a plate punch with holes is placed above the shingle. Finished water is collected through the tube outlet into the bucket by simply pouring water into the BSF. Through the slow sand filters, water drips at the rates of 0.1 to 0.2 m/h, showing that slow sand filters are very effective and efficient than rapid filters at eliminating microscopic contaminants and particles and is also easier to use. Unlike rapid sand filters, slow-sand filters do not require backwashing. Thus, BSF technology is characterized by minimal cost of acquisition and maintenance, but requires enough land space (Lantagne et al., 2006; UNICEF, 2008b). Consistently, experiment conducted in laboratory and field on water produce from the BSF minimizes protozoa and bacteria averagely by 99.98-100 percent and 81-100 percent respectively. Nevertheless, its

efficacy to fight viruses is little and recontamination may occur due to its deficiency in residual protection (Lantagne et al., 2006).

2.6.4.2 Ceramic Filter

Ceramic filtration is the application of permeable earthenware (fired clay) to sieve drinking water of microorganisms or other pollutants. Traditionally, earthenware filters have been used for treatment of water worldwide. Most contemporary earthenware filters are in the form of pots or hollow cylinder-shaped "candles". Commercially produced earthenware filters are infused with silver to serve as a bacteriostatic agent and averts formation of biofilm on the sieve surface and extreme levels of bacterial in the product water (Sobsey, 2002). The filter by mechanical processes eliminates protozoa by 99.99 percent (UNICEF, 2008b).

A study conducted in Cambodia by Brown (2007) reported that, earthenware water filter reduced *E. coli* up to 99.99%, in drinking water and contributed to reduction in diarrhoeal illness by almost 40% in users. However, Lantagne et al., (2006) noted that the efficacy of the filter in disabling or eliminating viruses is unknown. More so, lack of chlorine residual in the stored water can result in recontamination (UNICEF, 2008b).

2.6.5 Solar Disinfection (SODIS)

The use of Solar Disinfection (SODIS) was considered as an inexpensive disinfectant water treatment technique that was developed in 1980's to disinfect water for the use of oral rehydration solutions for diarrhoeal cases (CDC, 2008). It is noted that, for SODIS to be used, 0.3-2.0 litre synthetic bottles should be filled with very clear water, shake very well to oxygenate and the bottles leave on the roof top or stand for 6 hours when sunny or 2 days when cloudy. The disease-causing organisms such as virus, bacteria, pathogens are killed through the effects of joint thermal inactivation, photo-oxidative,

and UV-induced DNA alteration, leaving the water secure to drink (CDC, 2008; Lantagne et al., 2006). In a confirmation, a study by CDC (2008) revealed that in four randomized, controlled trials, SODIS has proved to be effective in the reduction of diarrhoeal disease prevalence ranging from 9 to 86 percent. CDC (2008) noted that SODIS has benefited users in many ways such as proven reduction in disease causing organisms in water; reduce the incidence of diarrhoeal disease, acceptability and no cost to the users with minimal change in taste of the water. Nonetheless, few challenges were identified as pretreatment of waters of higher turbidity to be effective (Lantagne et al., 2006; UNICEF, 2008b), small quantity of water that can be treated at once. Application of SODIS is not conducive in rainy season and within certain climates.

2.6.6 Household chlorination

The most extensive and inexpensive disinfectant for disinfecting water for drinking is chlorine (Sobsey, 2002; Lantagne et al., 2006). The sodium hypochlorite being a source of chlorine is packaged in bottle in the form of sodium hypochlorite solution with instructions directing consumers to mix a full bottle cover of the solution to less turbid water (or two caps to unclear water) in a standardized storing device of 20 litres; stir up; and drink after 30 minutes wait (Lantagne et al., 2006). With the appropriate use of chlorine concentrations in homes through HWT programs together with clear water, chlorine works effectively to deactivate bacteria and some viruses (American Water Works Association, 1999 cited in CDC, 2008) and thereby averts water-related diseases such as typhoid, dysentery and cholera (WCC, 2008). Chlorine disinfection has a residual effect, unlike other technologies, which protect the water against re-contamination for over a period (Montgomery and Elimelech, 2007; UNICEF, 2008b).

Studies have pointed to the fact that the use of sodium hypochlorite has enhanced drinking water quality and minimised the threat of diarrhoeal disease (Sobsey et al., 2003; Luby et al., 2004; Potgieter, 2007). In recent times, a study conducted in rural communities of South Africa revealed that sodium hypochlorite solutions successfully minimized the numbers of indicator of microbes to untraceable counts in drinking water (Potgieter et al., 2008). An intervention to reduce the contamination of water in rural South India was conducted, which indicates a substantial reduction of thermo tolerant coliform in water samples. However, it is not efficient at deactivating some protozoa, such as *Cryptosporidium* and *Giardia* (Sobsey, 2002; WCC, 2008; Firth et al., 2010).

Additional demerits are that, high turbidity levels can protect microbes from the impacts of disinfection, hence giving aid to bacteria growth and a substantial demand for chlorine. Disinfection needs less than 5 NTU in water to be very effective (UNICEF, 2008b).

In conclusion, Uwimpuhwe (2012) observed that home based treatment far outweigh that of communal system in terms of offering sustainable solution and these, people are motivated to operate and maintain their system than that of the community. It is very important to acknowledge that, home based treatment of water alone may not meaningfully and sustainably lessen the incidence of water-related diseases unless water is stored and used safely and every household member adopt good hygiene practice (UNICEF, 2008b). Above all, health and sanitation education where community members are educated on water handling and hygiene are the most essence interventions (Sobsey et al., 2003; Quick et al., 2004; Potgieter, 2007).

2.7 Importance of Education and Awareness Campaign

Education and awareness creation towards the treatment of water for drinking and other domestic uses are important which requires changes in behaviour through a long-term training approach and repeated contact with the community (UNICEF, 2008b).

Important factors aimed at achieving reductions in diarrhoea related ill-health and mortality cases depend on accessibility to quality water, excreta disposal, and promotion of hygiene education (WHO, 1999). The causes and transmission of water borne diseases should be promoted mostly in rural communities through education on hygienic practices (Banda et al., 2006). Home visits, awareness campaign programmes, and health education classes have been identified as effective mechanisms through which information on water quality and available methods are achieved (Cairncross et al., 2006; O'Reilly et al., 2007).

Thus, effective education, awareness campaign and promotion of activities are achieved through different communication channels. Rogers (1995) noted that different communication strategies applied in promotional strategies are into mass media, interpersonal communication and centralised communication (cited in Tamas et al., 2009). More importantly, the communication strategy used should induce a change in behaviour. Alcalay, (1983) and Griffin & Dunwoody, (2000) cited in Tamas et al, (2009) however noted that, many studies have been conducted on effectiveness of classical mass media such as radio or television, often do not change the actual behaviour of the majority of the people. Tamas et al (2009) further observed that mass media communication may have the potential to inform but not to change their behaviour.

On a different account, Roger (1995) pointed out that interpersonal communication channels have great potential to change behaviour because they allow effective

persuasive communication (cited in Tamas et. al., 2009). Tamas et al (2009) further stated that two interpersonal promotional strategies, promoters and opinion leaders have been recognised to be very effective. This is because promoters have stronger short-term effects while opinion leaders have stronger long-term effects, hence, the combination of the two would have much greater impact on change in behaviour. Levy-Storms and Wallace (2003) noted that these promoters have the advantage of being experts in the topic they are promoting, they can be easily trained to work continuously with their clients, and NGOs usually report high success rates with them whereas the disadvantage is the great effort needed to reach people (cited in Tamas et. al, 2009). Also Passanisi et al (2001) pointed out that advantages of working with opinion leaders include, besides more effective communication, better aptness in dispersed areas where employed promoters are impractical due to long distances and lack of supervision with limitations attributed to their 'working' hours and the availability of targeted people (cited in Tamas et. al, 2009). Therefore with the clear understanding, the promoters will be engaged to educate and train the people at early stage and with time, they will then exit gradually with the opinion leaders taking over the process to effect the change anticipated.

2.8 Understanding the Concept of Health Risk

Risk has a multitude of definitions and understandings, varying both across and within disciplines. Highlighting the importance of risk without a common understanding about risk does not serve its purpose. Consequently, risk exist because, several distinct groups have different views on risk from different disciplines including disaster management agencies, development corporations, climatic change organization, business organizations, natural resources management, health agencies and so on. The work of Frank Knight on uncertainty and risk in the field of economics has been a ground-

breaking to, and influential in shaping how agencies and practitioners understand risk (WWAP, 2015). In this conception, risk refers to a “situation in which the probability of future outcomes is measurable” (Knight, 1921 cited in WWAP 2015: 9). In contrast to uncertainty which occurs when it is not possible to measure the likelihood of outcomes. Implying, risk does not apply only in cases of possible negative outcomes. On the other hand, this does not reflect the general assertion held by the public as used by engineers in the field of water resources in relation to risk as explained by probability of structural or performance failure (Mays, 1996 cited in WWAP, 2015).

Furthermore, UN International Strategy for Disaster Reduction defined risk as “the combination of the probability of an event and its negative consequences” (UNISDR, 2009, cited in WWAP 2015: 9). Importantly, they also highlight that risks are perceived and defined differently, specifically “in popular usage the emphasis is usually placed on the concept of chance or possibility, such as in ‘the risk of an accident’; whereas in technical settings the emphasis is usually placed on the consequences, in terms of ‘potential losses’ for some particular cause, place and period” (UNISDR, 2009 cited in WWAP 2015:9). In a comprehensive report on understanding risk, US Environmental Protection Agency considered risk to be the probability of harmful effects to human health or to ecological systems resulting from exposure to an environmental stressor (<http://epa.gov>). A stressor is any physical, chemical, or biological entity that can induce an adverse response. Grey and Sadoff (2007:545) further held that there is link of “an acceptable level of water-related risks’ with the availability of an acceptable quantity and quality of water for health, livelihoods, ecosystems and production”. The focus is upon potentially harmful outcomes associated with the aquatic environment. Hall et al (2013) observed that, in a given water resources system, water related issues with reference to

quantity and quality are determined at different spatial and temporal scales with direct bearing on human health and wellbeing within human and physical environment.

2.8.1 Health Risk

According to Collins dictionary, 'health risk' is something that could cause harm to people'. WHO (2009) similarly defined "health risk" as a factor that raises the probability of adverse health outcomes. According to these definitions with the main focus on water (WHO, 2008; Hunter et al 2010) identified some factors as quality, quantity, access, reliability, affordability and ease of management as a means of determining whether supply of water can maintain good health effectively or as a way of reducing an adverse health consequences particularly on consumption of poor quality water.

2.9. Health Risks Associated with Unimproved Water

2.9.1 Definition of Water-Related Diseases and their Link with Man

Stanwell-Smith (undated:2) defined water-related disease as "any significant or widespread adverse effects on human health, such as death, disability, illness or disorders, caused directly or indirectly by the condition, or changes in the quantity or quality, of any waters". Water-related diseases are mostly caused by micro-organisms, parasites, toxins and chemical contamination of water.

Man has identified the need for water since creation for the sustenance of life. Historically, man has recognized that, the type of water used determine the quality of his health and life. King Hezekiah for instance in about 750 B.C identified the need to improve public water supply to Jerusalem by channeling mountain streams into the city through a conduit. In addition, the sixth century B.C witnessed a Persian by name Cyrus

who was general and emperor embarked on a military journey with flagons of boil water (Taylor, et al; 1967 cited in Nanbakhsh, 1993).

Not until ninetieth century, mankind knew nothing about the relationship between water supply and disease. Nanbakhsh (1993) stated that Snow was the first to ever establish relationship between water and disease in his known studies of the London cholera epidemic which was caused by drinking contaminated water from the Broad Street pump. Subsequently, other scientists and physicians identified that not only drinking from contaminated water supplies cause cholera but also typhoid fever, dysentery and other enteric diseases (Taylor et al, 1967 cited in Nanbakhsh, 1993).

Currently, water related diseases continue to affect human health predominantly among rural folks in developing countries. The incidence of water related diseases prevalence depends on several factors. Saunders and Wardford (1976) identified such factors as local climate, culture, geography, sanitary habits and facilities, and very importantly on the quantity and quality` of the local water supply, and waste disposal system (cited in Nanbakhsh, 1993).

2.9.2 Classification of Water-Related Diseases

In order to enhance understanding of water-related diseases, White et al (1972) categorized the disease type into four classes: waterborne, water-washed, water-based, and water-related insect vectors. Many water-related diseases are the result of poor quality water that is used for drinking, washing, and other uses. Gleick, (2002) pointed out that the first three are most clearly associated with lack of improved domestic water supply.

Table 2.1: Classification of Water-Related Diseases

Category	Description	Examples of diseases
Waterborne diseases	Enteric infections spread through human and animal faecal contamination of drinking water	Typhoid, Campylobacter, diarrhoea giardiasis, Cryptosporidium, cholera, enterohemorrhagic and enterotoxigenic E. coli, norovirus, etc.
Water-washed diseases	Infections that spread in communities that have insufficient water for personal hygiene	Trachoma, scabies, Shigella
Water-based diseases	Diseases where the causative organism requires part of its lifecycle to be spent in water	Schistosomiasis, dracunculiasis
Water- vector related diseases	Vector-borne diseases where the insect vector requires access to water	Malaria, onchocerciasis, trypanosomiasis

Source: White et al (1972)

2.9.2.1 Waterborne Diseases

Waterborne diseases are mainly caused by ingestion of contaminated water from pathogens contained in human or animal excreta. Lack of safe and clean water supply and disposal make people suffered from water borne infections. Out of the many water borne diseases, diarrhoea is recognized to be the most common water borne disease. According to Armon et al (2001), diarrhoea is defined as a change in bowel habit for the individual resulting in substantially more frequent and/or looser stools. Palaniappan et al. (2010) stated that most of the enteric and diarrhoeal diseases are caused by bacteria, parasites and viruses, such as cholera, *Giardia*, typhoid, and rotaviruses. WHO/UNICEF (2010) has noted that less than a quarter of the population in 18 countries in Sub Saharan Africa utilizes an improved sanitation facility. Diarrhoea caused by these pathogens is the second leading contributor to global burden of disease ahead of heart disease and HIV/AIDS (Pruss and Havelaar, 2001; Fewtrell et al., 2005). Over the years, water borne disease remains disease burden through which millions of people continue to die over

easily preventable illnesses. Numerous epidemiological studies and outbreak investigations have found a strong connection between poor water quality and infectious diarrhoea (Pruss-Ustun et al., 2008). Ferley et al (1986) conducted a study in France revealed that water that did not meet microbiological standards was associated with an increased risk of gastroenteritis and similar report in the Philippines about an outbreak of diarrhoea was attributable to consumption of contaminated water (Moe et al., 1991). According to the WHO and UNICEF, an estimated 88% of diarrhoeal deaths worldwide are caused by unsafe water, poor hygiene, and inadequate sanitation, indicating that WSS intervention can play an significant role in fighting the incidence of this disease among children. A survey conducted in Pakistan by Qureshi et al (2011) revealed that the most common illness people had suffered from was diarrhoea and vomiting as represented by 62.67 percent whereas the second highest illness discovered was skin problem, having a incidence rate of 21 percent. An earlier findings by Esrey et al (1991) who researched on 6 of the major water-borne diseases in 142 studies had estimated that in developing countries (excluding China), there were 875 and million cases of diarrhoea and 4.6 million deaths annually in the mid-1980s. It is believed that diarrhoea have a significant impact on growth due to reduction in appetite, altered feeding practices and decreased absorption of nutrients (IOWH, 2000). These interventions include improving water quality at the source, improving access to safe water, treating household water and storing it safely, improving access to adequate sanitation facilities, and encouraging good hygienic practices, particularly hand washing (WHO/UNICEF, 2004). A comprehensive review conducted by Waddington et al (2009) on the impact of water, hygiene, and sanitation interventions on diarrhoea morbidity indicated that water quality is more significant than water supply in reducing diarrhoea. Additionally, it was found that sanitation facilities were as effective as hygiene in reducing diarrhoea morbidity. A study

conducted in Egypt by El-Zanfaly (2015) found that diarrhoea was very high among children whose family disposed of refuse near the house or in surface water. Children in poor households are 8.7 times more likely to drink from unsafe water sources that are unprotected or located a half an hour's round trip from their home than children who reside in urban households, and 6% of women and girls spend time collecting water up to five or six hours daily in some cases (UNICEF/WHO, 2011). It was recognized that severe and repeated cases of diarrhoea contribute extensively to childhood malnutrition causing permanent effects in brain development since malnourished and anaemic children grow up to be less intelligent and do less well in school (Pollitt, 1995 cited in UNICEF, 2008). "Malnutrition, often caused by diarrhoea that is in turn the result of unsafe water, causes 35 percent of all deaths worldwide of children 5 or younger. Fifty percent of this malnutrition is associated with diarrhoea or intestinal nematode infections from unsafe water" (Pruss-Ustun et al. 2008:7). The spread of water related diseases significantly impact on the children's health and nutrition as a result of lack of access to safe water and poor sanitation, and in addition to low level of appropriate hygiene practices (El-Zanfaly, 2015).

Inadequate access to safe drinking water is also associated with several non-diarrhoea diseases (Hunter, 1997). Non-diarrhoeal waterborne diseases including typhoid fever is caused by ingestion of *Salmonella typhibacteria* in food or water, and affects about 17 million people each year and causes 600,000 deaths (Palaniappan et al. 2010; UNICEF, 2008). Infection resulting from this disease causes a sudden high fever, nausea, severe headache, and loss of appetite. Palaniappan et al (2010) further identified two forms of Hepatitis, Hepatitis A and E, to be waterborne diseases caused by ingestion of faecally contaminated water. UNICEF (2008) echoed that unlike Hepatitis E, 1.5 million people are infected with Hepatitis A annually which occurs through monsoon rains, heaving

flooding, contamination of well water, or massive uptake of untreated sewage into city water treatment plants. Hunter (1997) predicted that exposure to many organic and inorganic chemical agents result in chronic adverse health effect ranging from acute nausea and vomiting or skin rashes, to cancer and foetal abnormalities.

2.9.2.2 Water-Washed Diseases

Water-washed diseases occur when there is inadequate clean water for washing, personal hygiene, and contact with contaminated water. These diseases include trachoma, typhus, and diarrhoeal diseases that can be passed from person to person. Helminths are intestinal worms that are transmitted primarily through contact with contaminated soil. UNICEF (2008) noted that the most prevalent helminths are ascaris, hookworm and whipworm all together affecting about one-quarter to one-third of the world's population. Over 130 million children are affected by high intense helminths infections, resulting to about 12,000 deaths each year (WHO, 2002a). UNICEF (2008) further noted that the global leading cause of preventable blindness is trachoma which cause blindness in 6 million of the population and those being at risk at 10 percent of the world population

2.9.2.3 Water-Based Diseases

Parasitic pathogens mainly found in aquatic host organisms are responsible for water based diseases which is transmitted to human by drinking or washing with contaminated water. The most widespread examples in this category are schistosomiasis, guinea worm and other helminths. Research revealed that the disease is associated with poverty, with resultant poor housing, absence of clean water, insufficient hygienic environments, few if any sanitary facilities and several activities bringing people into contact with water into which eggs are delivered and in which are found intermediate host snail hosts

(Steinmann et al., 2006). Gleick (2002) noted that schistosomes which live inside snails currently infects 200 million people in 70 countries and about 10% of these suffer severe consequences from the disease, including tens of thousands of deaths every year (UNICEF, 2008). It is further observed that people become infected with schistosomiasis by coming into contact with contaminated water containing schistosome parasites while engaging in such activities as drinking bathing, swimming, or performing everyday household tasks, including laundry, herding animals, fetching water as well as fishing and agricultural activities (Alika, 2013). This outcome confirmed the earlier study conducted by WHO (2000) state that the people come into contact with the river water whilst using it for agricultural purpose or when they come for fishing. To this extent, patterns of hygiene, water delivery, and human water usage are critical factors in identifying the risk of infection (USAID, 2014).

Besides, guinea worm is identified to be a disease responsible for roundworm *dracunculus medinensis* that survive in surface water ingested by *cyclops* water flea through which people become infested by means of drinking contaminated water with cyclops (UNICEF, 2008).

2.9.2.4 Water- Related Vector Diseases

Dengue, filariasis, malaria, onchocerciasis, trypanosomiasis and yellow fever are responsible by insect vectors, such as mosquitoes; black flies that breed in and around water bodies. However, lack of access to good drinking water or sanitation is not directly linked with these diseases (Gleick, 2002).

2.10 Management of Water Related Diseases

Management of diseases related to water is very important aspect of dealing with the rate at which millions of lives are lost through preventable illnesses. It is recognized that diarrhoea is one of the leading disease burdens and its management is very crucial. Casburn-Jones and Farthing (2004) recognized the main reason of using any anti-diarrheal treatment is to replace or lessen fluid and electrolyte loss, stool frequency reduction and any other symptoms like abdominal pain, reduce faecal losses and eventually reducing the duration and severity of illness. They further admitted that the administration of oral rehydration solutions (ORS) provides effective treatment for the replacement of fluid and electrolyte loss in patients. Different formulations of these solutions exist but the basic ingredients are water, electrolytes and glucose with new formulations including rice starch and other concentrated carbohydrates (Atia and Buchman, 2009). Besides, ORS with zinc has also been reported to alleviate diarrhoeal symptoms and expedite recovery of many patients in different parts of the world (Santosham et al, 2010). This treatment is being invigorated because it has the potential to avoid needless application of antibiotics, especially in children (Njume and Goduka, 2012). Furthermore, a 10–14 day therapy of zinc during and after diarrhoea has been noticed to reduce the recurrence of the disease in the next 2–3 months (Ellis et al, 2007; Santosham et al, 2010). Notwithstanding the effectiveness of ORS, its application is hindered by difficulty in administration of the therapy during purging and vomiting as well as lack of parental knowledge especially in rural and semi urban areas of the developing world (Casburn-Jones and Farthing, 2004). Besides, lack of professional staffs makes it difficult in African rural communities to do intravenous fluid replacement (Njume and Goduka, 2012). Anti-diarrhoeal drugs act by increasing intestinal transit time and enhancing the potential for re-absorption of fluids and electrolytes (Casburn-

Jones and Farthing, 2004). For instance, bismuth salicylate contains anti-secretory properties which have been identified to be effective in reducing the number of unformed stools by approximately 50% in patients with travellers' diarrhoea (Casburn-Jones and Farthing, 2004; Dupont, 2005). Besides, the treatment of diarrhoea is very effective due to the antibacterial and anti-inflammatory properties. Conversely, the potential nervous system side effects make anti-diarrhoeal drugs impermissible to be administered to children and young infants (Njume and Goduka, 2012; WHO, 2005). Again, as a result of delayed onset of action, high pill burden and the presence of unpleasant side-effects make the drugs with anti-secretory properties unpopular choice (Dupont, 2005; Manyi-Loh et al, 2010).

Antimicrobial therapy is very effective at reducing longevity of illness, avoids complications and minimizes the severity of signs of abdominal pain and fever (Daniz-Santos et al, 2006; WHO, 2005). It also reduces secondary cases by halting person-to-person spread of diarrhoea pathogens. In most cases, antibiotic treatment is only administered upon recommendation for acute blood treatment in children (Cooke, 2010; Daniz-Santos et al, 2006). The most readily accessible and affordable therapies to regulate diarrhoea in many rural communities in the developing countries are prepared from indigenous or native plants (Green et al, 2010). The various parts of plants such as roots, rhizomes, aerial parts, tubers, stem barks and leaves are used in the preparation of concoctions and extracts for curing diarrhoea and other illness (Njume et al., 2009). The anti-diarrhoeal activity of many of the plants have been found to be effective to the presence of tannins, alkaloids, saponins, flavonoids, steroids and/or terpenoids (Teke et al, 2010; Ojewole et al, 2008). The potential problems of drug resistance, cost of treatment and side effects has led to a cautious use of antibiotics in treatment of diarrhoea (Njume et al, 2011). Because of the effect on gut microflora, there is the fear

for the use of antibiotic therapy which is believed to worsen the clinical conditions of the patients. Njume and Goduka (2012) complained that only few of anti-diarrhoeal compounds after many years of research and clinical assessment have eventually found themselves on pharmaceutical shelves

Guinea worm disease has no known medicinal remedies or vaccine for which patients are unable to develop immunity from previous infections with the exception of traditional removal of the worm by winding it around a small stick or gauze with slow pain process that often takes few weeks (Awofeso, 2013; Cairncross et al, 2002). The current mainstay of treatment is submersion of the affected lesion to facilitate the release of eggs by the female worm and the provision of subjective pain relief (Awofeso, 2013). The skin lesions invariably develop secondary bacterial infections, which exacerbate the suffering and prolong the period of disability.

Fenwick et al., (2003) and Olveda et al., (2013) observed that an effective, safe and simple drug was discovered in the 1970s as a cure to devastating bilharzia (schistosomiasis). Praziquantel is recognized as the drug that is active against all schistosome species (Da Silva et al, 2005) which is now the most widely used (Gryseels et al, 2006). It is mostly marketed as 600 mg tablets, with a recommended standard regimen of 40 mg/kg bodyweight in a single dose (WHO, 2002). Gryseels et al (2006) considered the drug very effective because within one hour of ingestion, it acts by paralysing the worms and damaging the tegument with mild side effects which include nausea, vomiting, malaise, and abdominal pain. WHO (2002) further stressed that it is judged safe for treatment of young children and pregnant women. Stelma et al. (1995) however, observed that in heavy infections, acute colic with bloody diarrhoea can occur immediately after treatment, perhaps triggered by massive worm shifts and antigen release. On a different note, Praziquantel has been recognized to have little or no effect

on eggs and immature worms because the tissue-dwelling eggs can excrete after several weeks of treatment and during the same period or newly acquired infections can become productive (Gryseels, 2006).

2.11 Theoretical and Conceptual Framework

It is very relevant to understand how people get infected with diseases associated with the use of water in their communities. In order to explain the use of water and its related diseases, disease ecology is adopted for the study. Disease ecology is explained as the interaction among the behaviour and ecology of hosts with the biological pathogens, as it related to the impact of diseases on populations. According to Meade and Emch (2010) disease prevalence is usually affected by interaction of the three variables, namely habitat, population and behaviour as indicated in Figure 2.1.

In Figure 2.1, habitat as explained by Meade and Emch (2010) is the aspect of the environment within which people live and work, thus are directly affected by the environment. The components of the environment include houses and workplace, physically and naturally occurring biotic and abiotic component phenomena, health care services, transportation system as well as government. This observation made about habitat in disease ecology framework is linked to the study area of South Tongu where respondents live and work. The environment consists of both man-made and natural resources which they depend on for their survival. The utilization of these resources either exposes them to or protects them from any diseases that may emerge through the use of such resources.

One of such resource in this particular instance in the study area is water bodies/resource. The use of water plays very significant role in life of every living organism including

respondents in the study area. Therefore, health of the people, basically depend on the use of water. Apparently certain activities that are undertaken within the environment such as farming, construction and industrialisation change the state of the environment which equally affects water resources. This tends to create the atmosphere for breeding of diseases which mostly impact on the health of people. The people suffer much from water related health risks which are gotten through drinking contaminated water, contact with infected water. The containment of these diseases depends greatly on health services to the people in the district. However, few limitations to health services to the people are determined mainly by availability and accessibility.

Meade and Emch (2010) stated that the population part as shown in Figure 2.1 focuses on the human organism as the potential host of the disease. The ability of the population to cope with the various aspects of maladjustment is a function of genetic susceptibility or resistance, its nutritional status, and its immediate physiological status. In other words, the population component of the disease ecology model represents the people in South Tongu district who live along the Volta River. They are the potential host of any disease prevalent in the area. However, exposure of the people to any disease depends on genetics of such individuals which either makes them susceptible or resistance to water related diseases in this case. Besides, susceptibility or resistance to diseases by the people is greatly influenced by the age of individuals. This is because as the person is very young or grows older the body's natural defenses tend to break down, increasing susceptibility to water related diseases being investigated.

In Figure 2.1, behaviour as the third and last component of disease ecology model is considered to be the observable characteristic of culture (Meade & Emch 2010). It stems from cultural precepts, economic constraints, social norms and the individual. Others

include mobility, roles, education, cultural practices and technological innovations. Behaviour is the most enigmatic of the three corners of the triangle. This reflects the character, attitudes, understandings and perceptions of people in South Tongu about water, hygiene and sanitation situations around them. Behaviours such as open defecation, poor household waste disposal, unhygienic water collection, transport and storage of water, consumption of untreated water and using same for household activities, negatively impacts communities' well-being. On the other hand, positive behaviours such as awareness campaign, public education, and adoption of technological innovations like household water treatment, would protect the population from health risks concomitant with the use of contaminated water.

As a consequence of behaviour, habitat consequence conditions are created by the population or people which either expose them to or protect them from habitat conditions as a result move elements of the habitat from place to place. Thus, the relationship between habitat, population and cultural behaviour encloses the state of human health. Therefore, human disease of ecology model is precisely the interplay between humans and their environment which leads either to the production of or prevention of disease.

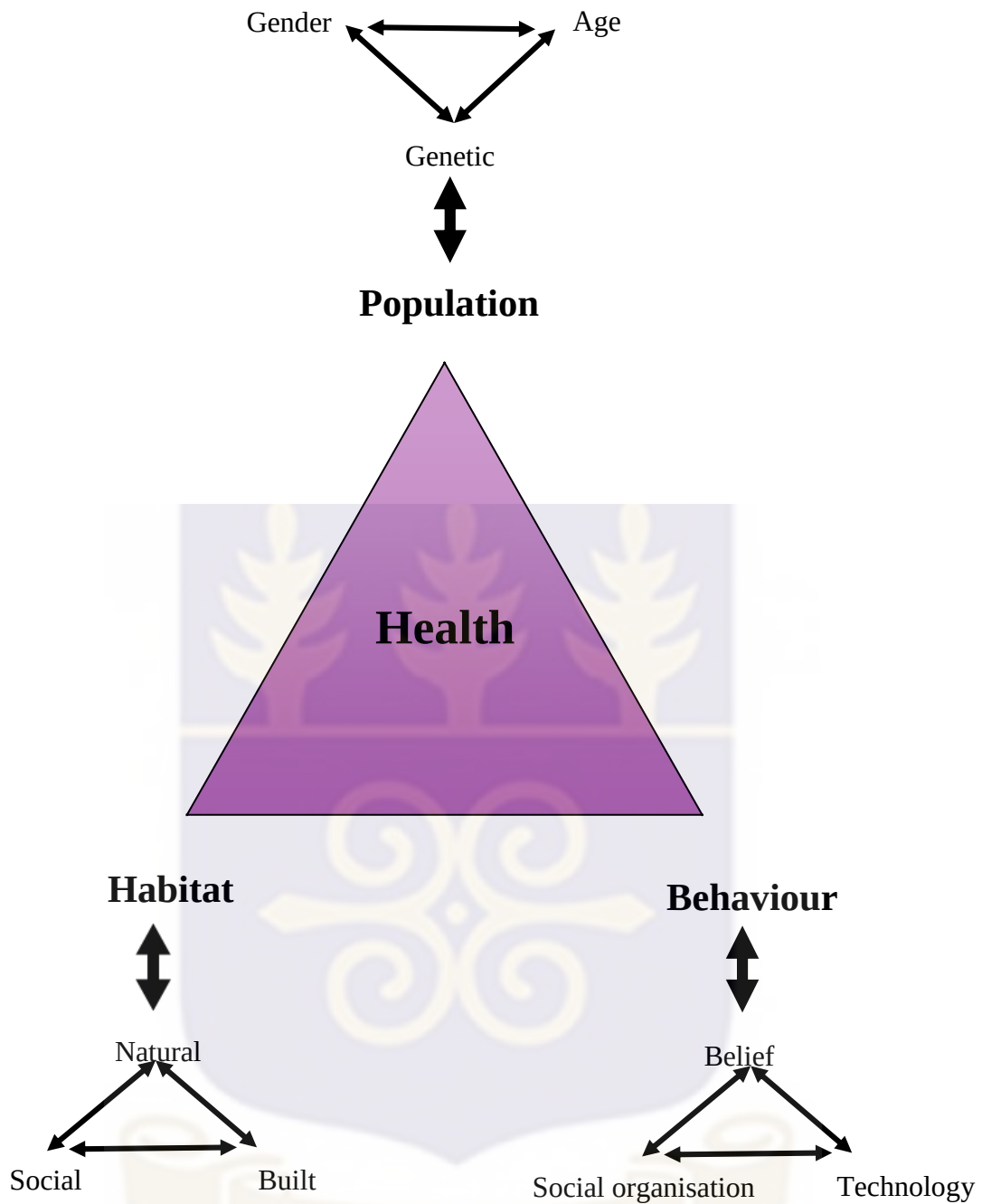


Figure 2.1: Disease Ecology Model Adopted from Meade and Emch (2010)

2.12. Chapter Two Summary

The chapter was dedicated to review of the related literature and the theoretical and conceptual framework adopted for the study. The main themes discussed under the related literature including sources and uses of water, challenges with the uses of

unimproved water sources, community and households water management approaches and importance of education and awareness campaign. Also issues on concept of health risks and associated health risks with unimproved water and management of these water related diseases.

The second section dwelt on the conceptual framework adopted for the study. The study reviewed disease ecology model by Meade and Emch (2010). The framework basically described characteristics of each component and relevance of the model in dispersion of diseases through the interactions among the population, habitat and behaviour of the people in the study area.



CHAPTER THREE

STUDY AREA AND METHODOLOGY

3.0 Introduction

This chapter discusses detailed literature on study area and the methodology adopted for the study. The study area emphasized issues on physical location, climatic conditions, and health and water issues among others. The chapter further provided detail information on methodology that guided the study involving research design, population, sampling technique, data collection and analysis of data.

3.1 Study Area

3.1.1 Location

The area chosen for this study is situated in south of the Lower Volta Basin. The South Tongu District lies between latitudes 6°10' and 5°45' North and longitudes 0°30' and 0°45' East. The District is bordered to the north by the North Tongu and Central Districts, the Akatsi South District to the east, the Ada East District to the west and to the south by the Keta Municipality. The South Tongu District occupies a total land size of 643.57 square kilometres (STDA, 2006).

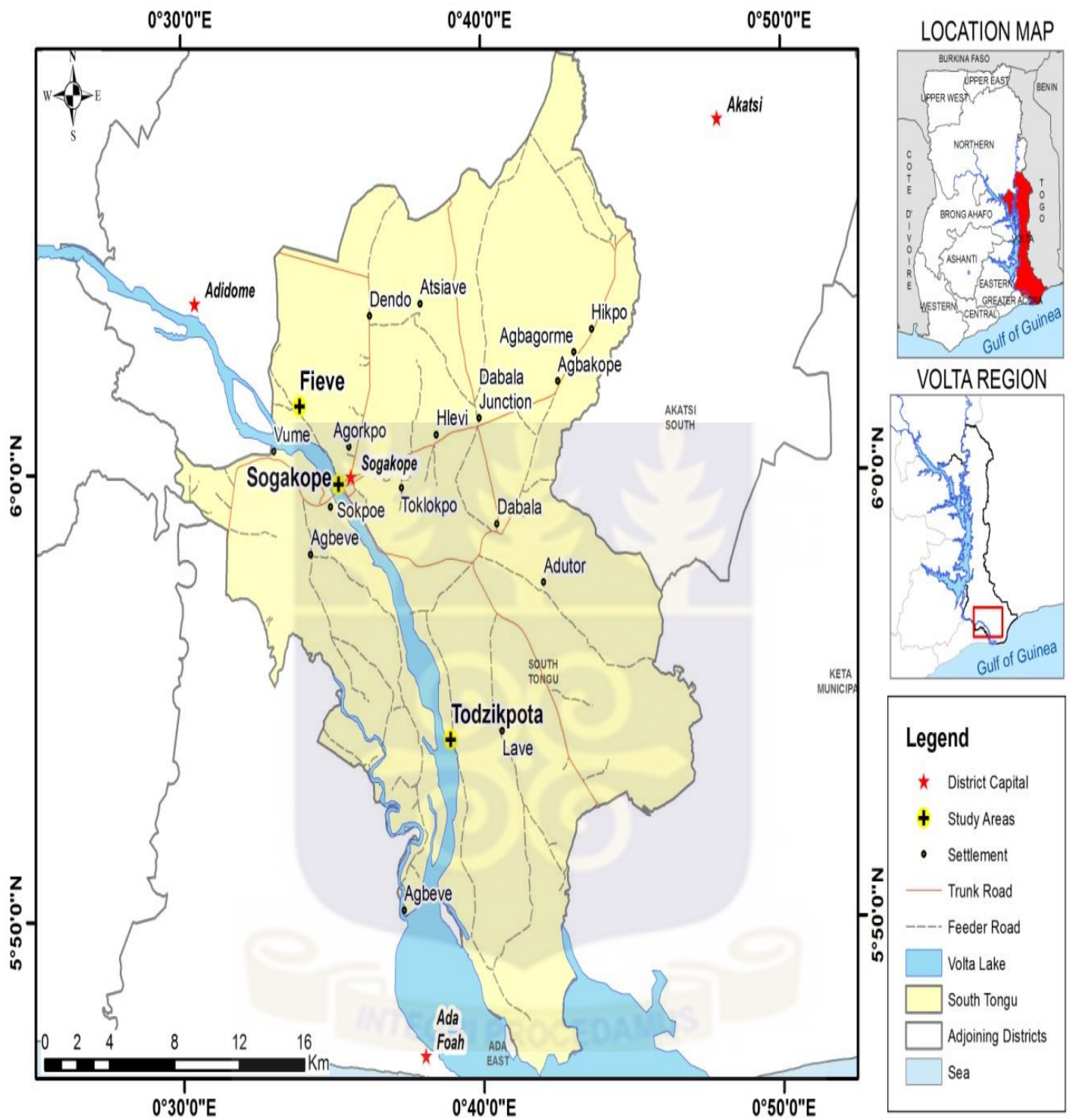


Figure 3.1: Map of the Study Area

Source: CERGIS, (2017)

3.1.2 Topography and Drainage

Generally, the District is located within the coastal plain which is low lying, but steadily increases to a height of 75 metres above sea level. The main rocks found in the District are metamorphic consisting of gneiss and schist. The Volta River is the main river draining the District and the biggest in the country, which runs alongside the western border to Dangme East District. Many other important streams also flow within the District, which include the Chinwi and Tordzi as well as a number of lagoons in the southern part. Avu lagoon is one of the notable lagoons which are located in the eastern part of Dabala (GSS, 2010). In addition, the availability of the River Volta provides an excellent opportunity for the expansion of water infrastructural facilities.

3.1.3 Climate

GSS (2010) stated that the District is located in the climatic zones of the wet semi-equatorial and dry equatorial with the northern section of the District located in the wet semi-equatorial zone whereas the southern section located in the dry equatorial climatic zone. Another observation is that, southwest monsoon winds influence the climate of the district resulting in double maxima rainfall regime. The main rainy season begins from late March or early April and continues until July with the maximum rainfall in May-June and the minor rainy season occurs from late September and ends in November. Temperatures range between 22.6°C and 29.3°C daily, hence giving relatively small diurnal temperature range. Humidity is between 60% and 65% day-to-day and evaporation rates ranging daily from 5.4mm to 6.8mm. In recent times, there are indications of annual drop in the rainfall figures in the District, where rain fed agriculture is the backbone of farmers and this trend has food security implications.

3.1.4 Demographic Characteristics

According to the recent Population and Housing Census (2010), the South Tongu District population is 87,950, representing 4.2 percent of the Volta Region's population. Males constitute 45.5 percent relative to 54.5 percent for females. The population density of the District is 136.7 persons per square kilometre. The population is highly dense in towns close to the main roads and in other few towns where good road networks exist. However, the sparse population is mostly found within the north-eastern and south-eastern parts of the District. The District is largely rural with majority of its population (87.1%) living in the rural localities. The District capital is Sogakofe located at the western part of the District along the Accra-Aflao road. The Volta River also runs through the District capital where the construction of the Lower Volta Bridge provides link between west and east by the Accra Aflao Road. Other major settlements in the District include Dabala, Sokpoe, Tefle (<http://ghanadistrict.com>).

3.1.5 Economy

The District has a lot of prospects for huge rice production and sugarcane as noted by GSS (2014) with about 52 percent of the energetic inhabitants betrothed with agriculture in the District. Rice is cultivated commercially on about 3,500 hectares. Different food crops grown in the District are maize, cassava, tomatoes and okro. Pepper or chilli farming predominates as the major cash crop undertaken by farmers. The South Tongu District Assembly and the District Directorate of the Ministry of Food and Agriculture through the support of donors trained and supported about two hundred pepper/chilli farmers in 2011/2012 farming season to cultivate 126 hectares solely for export. The rearing of livestock and fishing are also done on large scale basis.

Again, GSS (2014) pointed out that cattle rearing dominate livestock activities in the District where herds of cattle in the District ranks second highest to the Nkwanta North District in the Volta Region. The absence of tsetse fly, short grasses and low rainfall pattern provide a favourable environment for animal husbandry.

GSS (2014) stated that the Volta River which flows through the District is extremely rich in fishes such as tilapia and fresh water clam (Adodi). Besides fishing, it is used as means of transport and currently, a passenger boat plies Akuse-Ada-Foah enroute to Sogakofe, Tefle, Agordomi, Sokpoe, Vume and Agave. There are numerous creeks and lagoons running parallel to the Volta River, which serves as good breeding grounds for tilapia, shrimps and mud fish. These are harvested and sold to travellers along the Trans ECOWAS Highway, and other towns such as Accra, Keta and Aflao.

3.1.6 Education

The development of every human resources required for accelerated socio-economic growth of every nation is based on relevant education. It involves acquisition of knowledge, skills, attitudes and values to totally develop capacities of individuals for societal well- being. In the 2010 census, literacy was defined by Ghana Statistical Service, (2010) as the ability to read and write a simple sentence with understanding. The literacy rate of the population aged 11 years and older represented by a total population of 61,042. GSS (2010) stated that the District recorded 68.7 percent for the population who are literate in both English and Ghanaian Language, those who are literate in a Ghanaian language only is higher than English language only. This is due to presence of numerous educational institutions in the District which are public and privately owned. From these, there are 114 Kindergartens, 111 Primary, 63 Junior High Schools, three Senior High Schools, one Technical/Vocation Institute and one World

Class Soccer Academy in the District. It is striking to note that in the category of those who are literate in both English and Ghanaian Language, persons aged 20-24 years form the highest percentage (74.0%) and 11-14 years form the lowest at 60.3%. In terms of sex, majority of the non-literate population is females accounting for 76.1 percent while males form 23.9 percent.

3.1.7 Health sector

The health service delivery is organized under a 3-tier structure. Community-Based Health Planning and Services (CHPS) zone is first in line, follows by Health Centre services which are complemented by Hospital services as third in line. The District has good number of health facilities, but without qualified staff and equipment which prevent these facilities from functioning effectively.

There are 13 facilities with two owned by mission providers and one also by a private midwife. The Dorkplorme and Gamenu CHPS facilities that are for Ghana Health Service are without nurses. Hospital services are provided by a mission-owned institution which is one of the two institutions in the District. Private chemical sellers are operating without any official links with the government health service, and some traditional birth attendants had received training from the health service (<http://ghanadistrict.com>).

According to STDA (2012) comparing the top ten diseases which cause death in the District, diarrhoea diseases represent 5.8 percent and 3.1 percent of cause of death in 2010 and the first half of the year 2011 respectively. Bilharzia, typhoid is other water related disease cases reported in the District. However, a leading disease in the District for some years now has been malaria.

3.1.8 Water Sector

Assessing the health of population depends on two main components which are accessibility to safe water and sanitation services. Accessibility to portable water in the District covers 40% of the total population. Currently, main sources of drinking water available in the District include rivers, pipe borne, ponds, dugout, borehole, hand dug wells, rain harvesting, stream and so on. In the District, public tap/standpipe is the common source of drinking water in the District which accounts for 46.4 percent. Notwithstanding, unimproved water sources including rivers or streams, dugout, dam, lake and pipe borne water outside dwelling account for 27.3 percent and 13.4 percent as drinking sources respectively with others accounting for insignificant percentages. However, pipe borne water inside dwelling as drinking source account for only 6.9 percent, out of which 25.7 percent are in urban areas with 3.7 percent in rural settings. The inhabitants of the District derive the source of their pipe water from the Volta River which is pumped from two head works station at Agordome and Kesseve head works (<http://ghanadistrict.com>).

Agordome head works serves 46 communities with the pipe borne water while 14 communities are supplied by Kesseve head works. Besides, boreholes and wells are different sources of safe water. These public facilities are run by various Water and Sanitation Committees (WATSAN) in the respective communities. In all 10 boreholes are effectively working out of 20 boreholes as well as only 3 communal wells. With regard to the study communities, only Sogakope has pipe borne water as well as a well water and the remaining other two communities have none except the Volta River.

The low population densities of the District is the main hindrance to water provision, as many communities are far from existing main pipe line, coupled with high salinity of the water table (<http://ghanadistrict.com>).

3.1.9 Sanitation

Relatively, big towns in the District such as Sogakope, Sokpoe, Tefle, Kpotame, Dabala Junction, Adutor, Vume, Dabala, Agbakofe, and Agbagorme are confronted with severe risk to solid waste disposal. There are no public refuse dumps designated for these communities therefore, they resort to dumping of refuse haphazardly. Households and commercial refuse are deposited into excavated holes by some people. The majority of offices within departments and business premises are unable to provide for refuse bins. A place at outskirts of the most rural communities is designated as refuse dump unlike the big towns. Communal labour is mostly used by community constituents to maintain these dumps (<http://ghanadistrict.com>). It is further noted that the District assembly lack a place to dispose sludge from septic tanks.

3.2 Research Design

This research adopted survey design in gathering data for this study. A survey design involves data collection to provide answers to research questions pertaining to the present state of issues or phenomena (Winchester, 2005). Although there are other designs available including case study design which can also be applied to this study, survey design is considered the most appropriate due to the following reasons. The design seeks to find answers to questions through analysis of relationships between or among variables (Castro et al, 2010). It also provides a systematic account, accurate and precise description of issues, events, and phenomena. Survey design helps to determine prevalence of disease or other related characteristics important in public health (Hennekens & Buring, 1987). Data gathered through survey represents accurate field conditions and it answers questions analytically and interpreting situations, phenomena and events as they are presented (Bryman, 2001).

In spite of these arguments advanced, survey design has its own limitations. Plano Clark et al (2008) pointed out that survey design limits experience in two forms. Firstly, research is being directed by what is perceived by the senses. Secondly, quantifiable data is employed using standardized tools. He further noted that the survey design cannot capture the real meaning of social behaviour. Quantification as noted often results in “meaning” that are closer to the beliefs of the researcher than those of the respondents. The author further explained that though survey covers a wide scope and spectrum of responses, the data generated may lack much in terms of detail or depth of the problem investigated. Despite these limitations of the survey design, it was adopted for this present study because the survey is the best method of collecting quantifiable data to determine prevalence of health risks as well as in planning and allocating health resources.

3.3 Research Strategy

This research employed mixed method strategy. The mixed method strategy as identified in Creswell (2009) is a term that focuses on mixing different methods in a single research. According to Tashakkori & Teddlie (2010) dichotomous qualitative and quantitative approaches have little to offer in comprehending research problem than triangulation method which presents broader perspective and more credibility to research. The philosophical perspective that underpins mixed method strategy is pragmatism where the results are combined concurrently during the interpretation stage of the research study (Creswell, 2009). Creswell (2009) observed that, mixed method approach is far more than just a collection of data using the quantitative and qualitative strategies nonetheless must ensure that the two approaches provide a robust result of the research than any of the methods would have produced.

Teye (2012) explained quantitative strategy as basically involving the use of statistical techniques in analysing data, allows for generalization, predictions and comparison. He further noted that findings from the quantitative data are devoid of the researcher's influence. Nevertheless, this strategy is not very useful for in-depth explanation of behaviours and experiences (Tashakkori & Teddlie, 2010). Conversely, the qualitative strategy requires the use of words and narratives which is often believed to be very effective for detailed explanations on perceptions, experiences, emotions, beliefs and behaviours (Bryman, 2001; Winchester, 2005; Teye, 2012), yet this strategy is not really effective in establishing patterns and relationships among variables (Bryman, 2001). Thus, as a consequence of the above strengths and weaknesses of the dichotomous approaches, the researcher resolved to use triangulation method.

The quantitative analysis component helped to analyse the prevalence of water related diseases in various communities. Also, a questionnaire survey was used to collect quantifiable statistics from people living within the study communities. Conversely, in-depth interviews and focus group discussions were used to generate data for qualitative analysis.

The blend of quantitative and qualitative methods enabled the researcher to expand the scope of the study as well as augment validity of findings (Bryman, 2001). The quantitative methods also offset the limitations of the qualitative methods. In fact, while the quantitative methods were useful for generalizations and the establishment of relationships between different variables (for instance, relationship between location of residents and water sources) (Castro *et al.* 2010), they were not effective for explaining experiences and behaviour of research participants. Conversely, while qualitative method was inappropriate for generalizations (Plano Clark *et al.*, 2008), it was more flexible and

effective for getting a deeper understanding of specific issues (for example, variations in prevalence rate of water related diseases among men and women) (Winchester, 2005; Castro et al, 2010). In this way, methodological triangulation helped the researcher to enhance validity of findings.

3.4 Target Population

Kothari (2004) explained population as all the objects under consideration in any field of inquiry. In order to achieve the objectives of the study, the people of South Tongu District living along the River Volta were chosen as the population for the study. The literature indicated that the communities living along the River Volta depend on this water source for drinking and other domestic uses thus making the inhabitant exposed to water related diseases (GSS, 2014).

Therefore, it would be representative in nature if these communities were used as the population for those communities, elsewhere in Volta, depending on this water source. The target population in order to achieve the objectives of this study is the members of these communities who are 15 years and above and resident in the community for at least one year. This was deemed to be necessary because from anecdotal evidence, the age group make use of the water sources a lot.

3.5 Research Instrument

3.5.1 Quantitative Data

Quantitative data was gathered from the field using questionnaires. The questions included both open-ended and close-ended questions. The questionnaires were divided into five sections, structured to reflect the order of objectives of the study. This was to assist in the organisation of responses to themes for analysis. The first section gathered

the bio-data of respondents including age, sex, and educational level, length of stay in community, income level and the name of community of residence.

The second section dwelt on respondent's water sources, followed by awareness level of people about measures taken to improve water quality at the households, prevalence of water related diseases and lastly practices adopted in management of water related diseases. This was to give an idea on available sources of water to the respondents and its associated diseases based on the usage and management practices on the respondent and the possible measures that are deployed by the households in reducing or curbing these diseases among rural communities along the Volta River in South Tongu District.

3.5.2 Sample Size for Quantitative Data

The study took population statistics from the department of planning of the South Tongu District Assembly. However, a major difficulty with the population data was the absence of the community breakdown population statistics of the 2010 Population and Housing Census. Notwithstanding, estimates were created with assistance from the District Assembly Planning officer. The estimated figures were then used to calculate for the sample sizes in each community. Using sample size formula, $S = \frac{x^2 NP(1-P)}{d^2(N-1) + x^2 P(1-P)}$ as indicated by Krejcie and Morgan (1970) where S= sample size, N= Population Size, X= Z value, P= Population proportioned= Degree of accuracy, for all the three communities. The final output resulted in 38 questionnaires for Tordzikpota, 49 questionnaires and 73 questionnaires for Fievie and Sogakofe respectively, adding up to 160 questionnaires distributed to the targeted respondents. This sample size was large for the purposes of quantification and representativeness needed for quantitative studies (Bazeley, 2004, cited in Teye, 2012). This was to ensure that populations were fairly epitomized in the study to permit a more thorough analysis and interpretations (Teye, 2012).

3.5.3 Sampling Technique

The three communities were purposively selected for the study along the Volta River included Fievie, Sogakofe and Tordzikipota. The justifications for the selection of these communities were based on their location and very high tendency of some communities using water from the Volta River due to lack of portable water. Also, this was deemed necessary as heterogeneous purposive sampling provided diverse range of cases relevant to particular phenomena or event. The purpose of this kind of sample design provided much insight possible into the event or phenomena under study, to construct robust view of issue from public perspective. This notwithstanding, the sampling method adopted was the most cost effective and time effective unlike homogenous purposive sampling having a shared characteristic (Crossman, 2017).

In order to ensure representativeness of all populations, multi-stage sampling technique was used. This technique was adopted due to the diverse nature of the entire population and within each community. The step by step division of the population at different phases for representativeness was done through multistage sampling technique. The first phase involved the clustering of each community into well-defined blocks using main roads and footpaths as separable landmarks. The dispersed settlement pattern observed in all the three communities had necessitated for this approach. Every community was divided into three clusters, western, central and eastern blocks. At the second stage, houses were selected by using simple random sampling technique for questionnaire administration within each block of cluster in each of the 3 communities. An estimation of houses with assistance from an assembly member aided the use of the simple random sampling technique to reach out to houses. At the third and final phase, household heads were selected. In situations where household heads were unavailable, any available person who had stayed in the community for at least one year and 15 years old or more

with knowledge on water use and associated health risks in the area were considered for the interview. However, the researcher made conscious effort to give fair representation to both male and females as well as to some youth and elderly.

3.6. Qualitative Data

3.6.1 Sample Size for Qualitative Data

The respondents for both the interview and focus group discussions were purposively selected for this activity. A total of 9 stakeholders were selected for interview during the field work (table 3.1). The stakeholders included assembly members, unit committee members, District Health Service and traditional authorities. Interviews as noted by Teye (2012) do not require large sample sizes as emphasis is placed on process and meaning. Though, few challenges were encountered during the exercise such as the refusal or hesitance of contacted heads of institutions and some stakeholders who matters in the issue under consideration. However, the researcher was able to persist to gather information needed to complete this work.

Table 3.1: Stakeholders and Interviewed Conducted

Stakeholder	No. Interviewed
Health Directorate official	1
Public Health Nurse	1
Assembly Man	3
Traditional Authorities	2
Unit Committee Member	2
Total	9

Source: **Field Data, (2016)**

3.6.2. Interviews

Qualitative data was collected through in-depth interviews with key informants. Broshenka and Castro (1983) described a key informant as someone who is regarded to have some deep facts pertaining to the research problem and who is ready to talk (cited in Teye, 2008). The interviews used semi-structured interview guide (see appendix II). The categories of respondents were selected from District Health Directorate, assembly members within the communities and Traditional authorities. Digital photographs were also taken during the data collection. These were to assist in giving pictorial view to areas and situations observed on the field so as to provide a vivid explanation to the problem under study.

3.6.3. Focus Group Discussion

Bedford and Burgess (2001: 121) explained focus group as "a one-off meeting of between a few individuals who are brought together to discuss a particular topic chosen by the researcher(s) who moderate or structure the discussion" (cited in Teye, 2008). Focus group discussion is very important as the researcher is provided with better opportunity to qualitatively identify with issues that may be statistically difficult to explain. Besides, it proffers the potential of natural debate to ascertain the series of view on a topic and issue. The approach was used to explore the opinion, knowledge and experience of the participants who were households' heads from the communities about water use and its related health risks as they have stayed in these areas for years.

Three focus group discussions were held in each of the three communities, which constitute both men and women. One of the focus groups was made up of six participants, while the other two were made up of five participants each. The participants for the focus group discussion were recruited based on age grouping ranging from 15-30,

31-45, 46-60 and 60 and above. In order to get the required number of the participants, the researcher solicited the help of Assembly men to select twenty participants from each community involving all age groups. In order not to be biased, participants were randomly selected from age groups constituting the sample size for focus group discussions. Gender wise, female participants dominated the discussion, this was based on the fact that though male participants were few, they were not forthcoming and those selected some opted out due to personal reasons.

In order to make the discussions more convenient for participants, the discussions were held at the participant's compound agreed upon by the participants. The researcher assisted the moderator to discuss critical issues relating to the study. The researcher was more careful to create conducive environment for the participants to contribute willingly towards the discussion even though there was somehow, counter assertions from the participants; these were taken care of for the discussions to flow. The discussions mostly lasted for approximately 20 minutes and it was mostly done in the evenings between 15:00 and 16:00 GMT. The period for the discussion was deemed to be convenient for the participants due to their farming and other occupational activities that happen within the early hours of the day. Discussions were recorded in addition to few notes which were occasionally taken.

3.7 Data Sources

The data for the research was gathered from both primary and secondary sources. Primary data is the collection of data through specific research from the field using quantitative and qualitative approaches. The primary data consisted of data gathered from quantitative data through questionnaires while qualitative data was derived through semi-structured interview guide for interview and focus group discussion, recorder and

digital photographs. Primary data was also gathered from reconnaissance survey and direct field observations by the researcher. Likewise, secondary data is a data that has already been gathered for a specific reason and is used again during other circumstances for specific reasons. This type of data is primarily used when the researchers do not have enough time and data is needed quickly. The secondary sources of data included articles, books, reports, publications and newspaper reviews that dwell on issues related to water use and associated health risks were used essentially.

3.8 Validity of Instruments

Validity of instrument is frequently defined as the degree to which an instrument measures what it purposed to measure (Kimberlin & Winterstein, 2008). An initial questionnaire was sent to Ten (10) respondents on the subject, thus pilot questionnaire, to check the depth of the items under constructed. The response from these respondents was used to enhance the content and eliminate ambiguity and duplication of test.

3.9 Reliability

Reliability refers to whether you get the same answer by using an instrument to measure more than once (Zhang, 2000). Reliability is a statistical tool to measure how reproducible the surveying instrument data is (Zhang, 2000). Four methods are used in measuring reliability namely; the split-halves, test-retested, alternative form and internal consistency methods (Zhang, 2000; Hair et al. 2007). For the purpose of this research internal consistency method was used because it is the most widely used reliable estimate in empirical research (Zhang, 2000; Conca et al., 2004).

It is more reliable because it requires simple administration (Suresh- Chander et al., 2001). The internal consistency of each factor will be determined by examining each

item inter-correlation and computing the Cronbach's Alpha. The minimum advisable level is 0.7 (Nunnally, 1978; Cronbach, 1951) although it may be reduced to 0.6 in exploratory research (Hair et al., 2007; Conca et al., 2004) and anything less than 0.6 is usually eliminated (Malhotra & Grover, 1998). The proposed success factor whose calculated Cronbach's α greater than the critical point of 0.70, is said to be highly reliable and internally consistent. Therefore, based on this study the computed Cronbach's Alpha was (.916) indicating that the instrument used was highly reliable and internally consistent (See Appendix III).

3.10 Data Analysis

Data collected for the study was analyzed base on the research questions using Descriptive statistics including frequencies, percentages, as well as some inferential statistics (Factor Analysis) were employed in the analysis of the data to make meanings to the responded questions from the respondents. Chi square, cross tabulation together with Logistic regression analysis was also used to investigate the relationship between the dependent variable (Awareness and knowledge) and independent variables, (Background variables). The data was presented in tables and others were discussed and actual responses were italicized. Statistical package for social scientist (SPSS.20) was used as a tool for the analysis of the data retrieved from the survey as for the quantitative whereas interview and focus group discussion data were transcribed and the result used to support the findings since mixed method was adopted.

Measurement for reliability was done to determine the measurement scale that had been developed. This would produce consistent results if measurement was done on a repeated basis. This study utilized internal consistency method in determining the instrument reliability with the Cronbach coefficient, Alpha, as the relevant coefficient to evaluate.

Construct validity was determined by conducting exploratory factor analysis (through principal component analysis) using SPSS.20.

3.10.1 Exploratory factor Analysis (Principal Component Analysis)

Before conducting principal component analysis, two tests were carried out to screen the presence of multi-collinearity or correlation among the items and then appropriateness of factor analysis. The two tests were Kaiser-Meyer-Olkin (KMO) and Bartlett's tests. KMO quantifies the degree of inter-correlation among the variables and the appropriateness of factor analysis (Field, 2005). Bartlett test of sphericity checks for the presence of correlation among the variables and provides the probability that correlation matrix has significant correlation among at least, some of the variables (Hair et al 2007 and Field, 2005). Kim and Mueller (1978) suggested that KMOs in the range of 0.5-0.6 are considered poor, those in the range of 0.6-0.7 are average, those in the range of 0.7-0.8 are considered good, 0.8-0.9 are great and values greater than 0.9 are superb. In regards this study, the KMO's values for background variables (Independent variables) based on FA conducted, the KMO's values realized was **0.728** and this considered good.

3.11 Chapter Three Summary

This chapter was devoted to the study area and methodology. It was divided into two main sections. The first section dwelt on study area that described the physical location, health issues, water and sanitation related matters and education among others in the district.

The second section dealt with data collection methods adopted for the study. The methods were discussed under the themes including research design, research strategy, quantitative and qualitative methods of data collection, data sources and sampling techniques and sample sizes and finally data analysis.

CHAPTER FOUR

DEMOGRAPHIC CHARACTERISTICS, AVAILABLE WATER SOURCES AND AWARENESS ABOUT HOUSEHOLD WATER QUALITY IMPROVEMENT BY RESPONDENTS

4.1 Introduction

When talking about water use and its associated health risks, characteristics of the respondents (demographic) need to be clearly assessed. In other words, anecdotal evidence proves that one becomes sick based on what one eats, drinks and the environment that one lives, which could also be related to age or sex. However, in order to fully understand the background of the respondents, in order to authenticate the source of data for the study, the characteristics of the respondents were assessed since their compositions and responses would influence the result. According to Murdock and Ellis (1991) demographic data are any data that provide an understanding of population size, distribution, and composition. Hence the demographic data of this study that have specific application to water use and associated health risks were presented as follows.

4.2 The Background Characteristics of Respondents

Table 4.1 shows that majority of the respondents (46.3 percent) were 31-45 years old, followed closely by respondents in the 15-30 years age group with 31.9 percent. This shows that respondents are highly youthful in nature between the ages of 15 to 45 years. The group falls into the active working group that usually engaged in most of the activities including house chores such as cooking, search for water and so on. The group was able to provide valuable information concerning current water situation within their communities

Table 4.1: Background Characteristics of Respondents

Variables	Freq	%	Variables	Freq	%
AGE			SEX		
15-30	51	31.9	Male	59	36.9
31-45	74	46.3	Female	101	63.1
46-60	15	9.4	Total	160	100.0
61 and above	20	12.5			
Total	160	100.0			
LENGTH OF STAY			LEVEL OF EDUCATION		
Born Here	74	46.3	No Education	39	24.4
1-10 years	44	27.5	Primary	37	23.1
11-20 years	20	12.5	JHS/JSS	45	28.1
21-30 years	14	8.8	SHS/SSS	29	18.1
31-years and above	8	5.0	Tertiary	10	6.3
Total	160	100.0	Total	160	100.0

Source: Field Data (2016)

The age structure corresponds with the youthful distribution of the District's population (GSS, 2010). On the other hand the relatively older respondents from the ages of 46 to 60 and above provided detailed insights into the prevailing general water situation pertaining in the study area.

The sex distribution favoured the female respondents as confirmed in table 4.1. The female population represented 63.1 percent of total respondents and men accounted for only 36.9 percent. Certainly a fair representation to both sexes presented a more neutral response as observed by each sex group. However, the higher number of females (63.1%) is as a result of number of factors noticed across all communities under study. Firstly, certain household tasks are considered primarily in these communities as duties of women and children to perform, consequently issues concerning water has been recognized as one of such. Apparently, in some households where household heads who are mostly men whom these questionnaires were meant for to answer had directed their wives instead to answer the questions since they did little or nothing at all on the issues

of water in the home. This explains why more women end up being respondents in most homes visited.

Besides, this year 2016 having been an electioneering year and men who are more politically conscious attributed this research activity to one of the political engagements to woo them vote. This also made it difficult accessing men for the questionnaire surveys. Although, these factors were found mainly in the Fievie and Tordzikpota (farming communities), similar factors accounted for the Sogakofe community where the population were more heterogeneous in terms of ethnicity. Also, the capital has more job opportunities and saw people employed in diverse sectors rather than a dominant farming community. Notwithstanding, meeting men at home again was more difficult as they spent longer times in their offices. In spite of the factors listed above, the sex distribution has fair representation of the population.

Respondents' general levels of education were also investigated in this study. The result in the Table 4.1 reveals that primary and JHS education accounted for 23.1 percent and 28.1 percent respectively followed by secondary and Tertiary education accounting for 18.1percent and 6.3 percent respectively. Significantly, 24.4 percent had no education at all. The researcher's interest to assess each community's educational level, led to a crosstab computation which was conducted with respondent's level of education and their community of residence. Sogakofe (capital) emerged as a community that has more educated respondents than the other two communities, Fievie and Tordzikpota.

From Table 4.2 JHS, SHS, and Tertiary level of education in Sogakofe, accounted for 31.5 percent, 24.7 percent, and 12.3 percent respondents respectively endorsing common perception that Sogakofe have more educated respondents. Based on the educational background of the respondents, Sogakofe as the capital had highest number of people

with education due to their access to better education facilities. In the reports from the STDA (2012) the capital Sogakofe has access to better and more schools with improved infrastructure. Fievie has only one large public school from the basic to the JHS level and Tordzikpota has just a basic school up to upper primary. Students from Tordzikpota would therefore have to attend schools in Agorta a nearby town mostly on foot. Perhaps these factors may have accounted for the low educational levels in these two communities.

Table 4.2: Respondents Levels of Education by Community

No Formal Community	Education	Primary Education	JSS/JHS	SSS/SHS	Tertiary	Total
Fievie	13(26.5%)	13(26.5%)	14(28.7%)	8(16.3%)	1(2.0%)	49
Sogakofe	9(12.3%)	14(19.2%)	23(31.5%)	18(24.7%)	9(12.3%)	73
Tordzikpota	17(44.7%)	10(26.3%)	8(21.1%)	3(7.9%)	0(0.0%)	38
Total	39	37	45	29	10	160

Source: Field Data (2016)

The study also gathered information on length of stay of the respondents in the communities. As indicated in Table 4.1, a greater number of the total respondents representing 46.3 percent were born in their respective communities. This was then followed by those who stayed in the community between 1-10 years, 11-20 years 21-30 year and 30 years above representing 27.5 percent, 12.5 percent, 8.8 percent and 5 percent accordingly. The result clearly indicated that the majority who responded to the questionnaire had stayed long in the community constituting above 70 percent and hence indicating the knowledge and familiarity with the environment therefore under pine the authenticity of the data collected.

Table 4.3 reveals the specific length of respondents' stay in each community. Fievie had 59.2 percent of respondents being "Born here" while 18.4 percent of the respondents stayed between 1-10 years in the community with the rest of the members stayed in the community ranging from 11–30 years and above. Closely comparing this with Sogakofe and Tordzikpota, indicated that 34.2 percent of respondents were "Born here" in Sogakofe and 52.6 percent of respondents from Tordzikpota were "Born here". The remaining community members stayed between 1-30 years and above. However, Sogakofe recorded the highest percentage of 39.7 percent of respondents that actually stayed in the community from 1–10 years. This is an indication that Sogakofe (capital) was widely spread showing a more heterogeneous population than the two communities (Fievie and Tordzikpota) which can be described to be more homogeneous.

Table 4.3: Respondents Length of Stay by Community

Community	Years					Total
	Born here	1-10	11-20	21-30	31 +	
Fievie	29(59.2%)	9(18.4%)	7(14.3%)	1(2.0%)	3(6.1%)	49
Sogakofe	25(34.2%)	29(39.7%)	8(11.0%)	6(8.2%)	5(6.9%)	73
Tordzikpota	20(52.6%)	6(15.8%)	5(13.2%)	7(18.4%)	0(0.0%)	38
Total	74	44	20	14	8	160

Source: Field Data (2016)

The study also sought to find out the main occupation of the people in the area. Table 4.4 showed different characteristic feature of distribution of occupation among the communities. The predominant occupation of respondents of Fievie and Tordzikipota was farming and fishing. About 57.2 percent of respondents in Fievie engaged either in farming or fishing while 71 percent of respondents in Tordzikipota also engaged either in farming or fishing. However the situation in Sogakofe presented different picture with about 52 percent of respondents embarked on trading or commercial activities. Significant respondents of 13.7 percent were in the civil service while the other sectors such as farming, fishing, and construction and so on sharing the rest of the percentages.

The main reason for the dominance of these primary activities in Fievie and Tordzikipota communities is the fact that these communities are like other typical rural areas in Ghana that lack manufacturing industries. On the other hand, in Sogakofe the district capital, the probable reason for the relative even distribution of occupation among respondents is a characteristic feature of most district capital that more often than not have access to many of the social amenities that bring into being the conducive environment hence get attracted to by many companies and organizations which provide several employment possibilities in these areas.

Table 4.4: Occupation of the Respondents

Community	Farming	Trading	Fishing	Civil Servant	Others	Total
Fievie	18 (36.8%)	6 (12.2%)	10 (20.4%)	3 (6.1%)	12 (24.5%)	49
Sogakofe	2 (2.7%)	38 (52.1%)	6 (8.2%)	10 (13.7%)	17(23.3%)	73
Tordzikipota	16 (42.1%)	5(13.2%)	11(28.9%)	1(2.6%)	5 (13.2%)	38
Total	36	59	27	14	34	160

Source: Field Data (2016)

The study further revealed vital information on income of respondents in their various communities. From the table 4.5, a large number of the total population generally, thus the three communities, Fievie, Sogakofe and Tordzikpota earned less than Gh 100.00 accounting for 55 percent. This was closely followed by 100-300 Gh cedis and 301-500 Gh cedis representing 33.1 percent and 8.8 percent respectively. The specific result points out that 61.2 percent of respondents from Fievie, have an income level hinged on less than 100 Gh cedis, whereas, 43.8 percent of respondents in Sogakofe being the capital, declared their level of income also on less than 100 Gh cedis. Tordzikpota recorded the highest percentage of respondents of 68.4 percent who earned least income level, 100 Gh cedis. Critical observation of income level ranging from 100-300 Gh cedis, revealed that Sogakofe had 34.2 percent of respondents who earned income between 100-300 Gh cedis and was followed by 36.8 percent of respondents from Fievie community. Aside these, Tordzikpota, hit the least level with 26.3 percent of respondents having the income ranging from 100-300 Gh cedis. The result further indicated that 15.1 percent of respondents from Sogakofe, 2.0 percent and 5.3 percent of respondents from Fievie and Tordzikpota respectively have their income levels ranging from 301 - 500 Gh cedis whereas only 6.9 percent of respondents from Sogakofe declared their income level to be more than 500 Gh cedis.

Having critically assessed the income levels of the people, Sogakofe as the capital tends to have people with higher income levels perhaps due to availability of better educational facilities that equipped the people with employable skills. Again due to the heterogeneous nature of the capital, with its associated activities tend to create many opportunities for people who are then employed into these various job avenues, earning them regular salary. Besides, some people engaged in more than one job hence their sources of earning incomes improved tremendously.

Table 4.5: Respondents income in Ghana Cedis

Community Total	<GHC100	GHC 100-300	GHC 301-500	>GHC 500
Fievie 49	30 (61.2%)	18 (36.8%)	1 (2.0%)	0 (0.0%)
Sogakofe 73	32 (43.8%)	25 (34.2%)	11 (15.1%)	5 (6.9%)
Tordzikpota 38	26 (68.4%)	10 (26..3%)	2 (5.3%)	0 (0.0%)
Total 160	88(55.0%)	53(33.1%)	14 (8.8%)	5 (3.1%)

Source: Field Study (2016)

4.3 Main Sources of Water

4.3.1 The relationship between location of residents and sources of water

Understanding the relationship between location of residents and sources of water plays very significant role in assessing the health of people. Apparently, a water source available to households is a major determinant of health conditions that may exist in particular community as indicated in the literature. With this understanding, the policy makers and development partners will be greatly influenced to formulate and implement strategies to improve upon available water sources in order to eliminate associated water related diseases among communities. This section tries to comprehend the general water situation and how people of South Tongu living along the Volta River are affected. Based on this, the researcher employed crosstab and chi square to establish if there exist a relation and the significance of water situation and its effect on people of South Tongu. Table, 4.6 illustrates the results on main source of water as well as the relationship between location of residents and sources of water with the Chi-square test.

Table 4.6 shows that 93.9 percent of respondents use river as their main source of water at the household level at Fievie, Sogakofe accounted for 5.5 percent and Tordzikpota accounted for 100 percent. Talking about well water, Fievie had 0.0 percent, Sogakofe recorded 2.7 percent and Tordzikpota accounted for 0.0 percent whereas the stand pipes use in the three communities accounted for 6.1 percent, 91.8 percent and 0.0 percent at Fievie, Sogakofe and Tordzikpota respectively.

Table 4.6: Community Main Source of Water for the Households

Community		River	Well	Stand Pipe
Total				
Fievie 49	Count	46	0	3
	% within	93.9%	0.0%	6.1%
	100.0%			
COMMUNITY				
Sogakofe 73	Count	4	2	67
	% within	5.5%	2.7%	91.8%
	100.0%			
COMMUNITY				
Tordzikpota 38	Count	38	0	0
	% within	100.0%	0.0%	0.0%
	100.0%			
COMMUNITY				
Total 160	Count	88	2	70
	% within	55.0%	1.2%	43.8%
	100.0%			
COMMUNITY				

$$X^2 = 133.364^a, df = 4, p < 0.000$$

Source: Field Data (2016)

To determine whether there is any significant association described by the respondents based on the responses which were computed by the crosstab, a Pearson chi-square test was conducted. The chi-square test conducted shows a significant relationship between location of residents and available sources of water with a chi-square value of 133.364 at a degree of freedom of 4 which is significant at $p < 0.000$

The implication is that respondents would depend on water sources found within their locality. Therefore, communities with more than one source would have the options of selecting cleaner and safer water source amongst the available sources for use while those with only one source would be forced to use it as such irrespective of the quality, thereby predisposes the people to health risks associated with these unsafe water sources.

This outcome provides a very strong clue that geographical location of resources actually influence establishment of communities around these resources. As the resources play very vital role in sustaining survival of the people. Thus people always find it more convenient to locate near or close to resources such as water source. The result also established that there was strong relationship between where residents are located and their water sources at a significant level of 0.001. Many residents of South Tongu therefore are influenced to live close to or along River Volta for many immense benefits this resource tends to offer. Access to and use of safe water for drinking, cooking, bathing, washing, irrigation and so on contribute immensely to health, productivity and social development. The water source provide the basic livelihood for the people through farming activities particularly rice cultivation, fishing, animal rearing which formed the main backbone of the economic activities within the district and an indication of the relation of why the residents of the locality choose to be closed to the water source. As a result many people are self-employed making them economically viable which enhance their living standard thereby reduces the high level of poverty among the people. As

pointed out in the literature, domestic use of water basically help in the improvement of the health status of the people in order to avoid dehydration, improve personal hygiene and other health related problems associated with lack of clean or sufficient water.

Notwithstanding these immense benefits, thus economical and health, the respondents gained from the main available surface water source, they also certainly suffered great deal of health related risks through the use of this water source since it is generally the available source of water accessible to the rural folks while the appropriate measures to enhance quality of this water source are unlikely or to be taken. This opinion unifies with a study by Naiman et al. (1995), where it was revealed that most surface water in North America would be unpotable without some form of treatment to remove pathogens and contaminants. Several diseases were identified to be prevalent among people depending on this water source for their daily uses and activities based on this study. These diseases affected the health of most of the people thereby rendering them incapacitated. Consequently people become less productive as their economic activities could not be attended to. This discussion further corroborated the finding of WHO (2001) that lack of equal access to safe and portable water compel women to spend hours every day in search of water, causing low productivity, loss of energy and health related risks in the developing countries particularly in the rural areas. As a result, people are forced to utilize water from unsafe sources exposing them to diseases. Also, beyond those who were directly affected with these diseases, the care givers to these debilitated patients had been equally unable to engage in any economic activity causing low productivity. The people are mainly farmers, fisher folks and traders whose incomes were directly derived from these economic activities related to the use of this water body without any other additional source of income.

Furthermore, in assessing main sources of water available in the study area, the result reveals that different communities have access to different sources of water. Generally, it is worth noting that urban areas are the largest beneficiaries of infrastructural development and it is not surprising that water infrastructural facilities are extended to these areas. On the other hand, rural areas tend to lack most of these infrastructural facilities including water infrastructure which fundamentally formed the basis of sustainable livelihood and survival of the rural folks. Out of the three communities where the study was conducted, it was identified that Sogakofe which is also serving as the district capital had pipe borne water as their main source of water. However, Fievie and Tordzikpota communities which are typical rural areas depended solely on the river as their main water source for all their household activities including drinking, cooking bathing and so on.

4.3.2 Reasons for Choice of Water Sources

As displayed in Table 4.7, it can be seen that varied reasons are outlined by respondents from these communities for which specific water source is preferred or chosen for use. In Fievie community, 93.9 percent of respondents admitted that the justification for the choice of water source they used which is primarily the water from the Volta River is because it is the "only source" of water available in the community. Similarly, 100 percent of respondents from Tordzikpota declared that the use of the Volta River as their main source of water is justified on the basis that it is the "only source" Unlike Sogakofe the district capital, respondents relatively expressed diverse justifications for the choice of water source in their community. As many as 42.5 percent respondents justified their selection on the grounds of "proximity". A significant respondents of 39.7 percent and 17.8 percent defended their preference for water source use on the basis of "taste of

water" and "affordability" respectively. This outcome is expounded further during focus group discussion session with some members the communities.

This assertion is confirmed by a participant during one of FGDs:

"We people in this community have no choice than to use water from the river, because this is the only available source of water here and that is what we use for everything-drinking, cooking, bathing, and washing"(FGDs Tordzikpota).

The same view is expressed in an interview with one of the community leaders:

"In this community, the chief, opinion leaders, and every one of us work hard for pipe lines to be extended to this community with the help of the government. However, after two years of extension of the pipe lines, we are yet to see a drop of water flowing through the pipe lines. So we do not have any option than to use water from the river which is the only source of water in this community"(Assembly man, Fievie).

Table 4.7: Reasons for Choice of Water Sources

Community	Reasons								Total
	Proximity		Affordability		Only source		Taste of water		
	Freq	%	Freq	%	Freq	%	Freq	%	
Fievie	1	2.0%	0	0.0%	46	93.9%	2	4.1%	49
Sogakofe	31	42.5%	13	17.8%	0	0.0%	29	39.7%	73
Tordzikpota	0	0.0%	0	0.0%	38	100%	0	0.0%	38
Total	32	20%	13	8.1%	84	52.5%	31	19.4%	160

$X^2=148.935$, $df=6$, $p<0.000$

Source: Field Data, (2016)

The chi-Square test shows a Chi-Square value of 148.935 with a significant figure of 0.000 at 5% significant level. Since the probability value of 0.000 is less than the significant level of 0.05, it is concluded that, there is a statistically significant relationship between reasons for choice and available water sources. The implication of this result is that availability of more than one water source in every community is very important when it comes to choice. The findings therefore suggest that people are more likely to use the only available source of water in the community when there is no alternative water source.

Hence, people of Sogakofe have options to choose from, as they have more than a source of water, for which they tend to depend less on unimproved water sources. However, the people of Fievie and Tordzikpota are forced to use unimproved water sources such as Volta River more than Sogakofe people creating large difference between urban and rural folks dependence on unimproved water sources. The literature also acknowledged that a little below 80 percent of the populations in South Tongu District are mainly rural settlements which implies that most of these areas are without potable water creating, large discrepancies in supply of portable water to rural areas that lack infrastructure than urban areas.

The study therefore finds that rural areas without pipe borne water depend on unimproved sources of water mainly from the Volta River than urban areas in the district. This study confirmed the findings of Boone et al (2011) that rural areas depended on surface water sources more than the urban areas which reflect in the statistics as 44 per cent of rural households fetch water from a stream, pond, river or lake with the urban areas recording 8 percent. Additionally, the study is consistent with Gyau-Boakye and Dapaah-Siakwan (1999) assertion that in Ghana many rural communities

used water from unimproved sources and due to high level of pollution, water borne and water-related diseases are widespread in rural communities.

4.3.3 Perception about Main Source of Water

In order to assess the quality of water used in these communities, the researcher elicited from the respondents their perception about the water quality used by the respondents in the study area which is presented in Table 4.8. Observing from the Table 4.8, the result indicated generally that 77.6 percent, 90.4 percent and 94.7 percent of respondents in the three communities, Fievie, Sogakofe and Tordzikpota respectively considered their water source as clean. However 9.6 percent of the respondents from Sogakofe described one of the water sources as salty whereas the other two communities Fievie and Tordzikpota with 22.4 percent and 5.3 percent of respondents respectively affirmed their water sources as coloured which is attributed to run off water into the water body particularly in the rainy season.

Table 4.8: Perception about Main Source of Water in the Communities

Community	Quality Description			Total
	Clean	Salty	Coloured	
Fievie	38 (77.6%)	0 (0.0%)	11 (22.4%)	49
Sogakofe	66 (90.4%)	7 (9.6%)	0 (0.0%)	73
Tordzikpota	36 (94.7%)	0 (0.0%)	2 (5.3%)	38
Total	140	7	13	160

Source: Field Data (2016)

This is confirmed by discussant during the FGDs:

“In our community Sogakofe here, water is never a problem since we have pipe borne water, well water and the water from the Volta River. But pipe borne water is considered cleaner than the water from the river whereas the well water is usually salty, so we always use pipe water for all household chores including cooking, washing as well as drinking” (woman from Sogakofe).

Another participant expressed diverse view during the FGDs:

“The source of water available is the Volta River which is always clean throughout the dry season but it becomes very dirty and mostly brownish in colour as a result of run-off water into the river making it unsuitable for use” (man from Tordzikpota).

Similar view was expressed during different FGDs:

“The Volta River we depend on is clean but our problem is that, sometimes herdsmen send their cattle to feed along the river, mostly during the dry season when grasses are not available, where animals defecate and urinate into the water leading to contamination” (Woman from Fievie).

Undoubtedly, in all the three communities there was an overwhelming response to the effect that the main source of water available within their respective communities was clean. The result is an indication that many of the people's perception about quality of water is determined on the basis of appearance of the water which really goes beyond mere look meaning that most people lack better understanding of quality of water they use which has an implication for their health. So, any source of water that comes clear in terms of its appearance or colour irrespective of the source is considered safe for use

without any form of improving water quality is expected to expose many of these people to severe health risk unknowingly.

The further insinuation is that communities perceived the quality of water sources as clean exclusively on the basis of physical appearance. As result people from these communities are prone to health risks associated with the use of surface water directly except Sogakofe people who mostly depend on pipe borne water that undergoes some form of treatment. This account falls in line with UNICEF/WHO (2015) report that those who use surface water face the greatest risks to their health and well-being. The same account also resonates with Gyau-Boakye and Dapaah-Siakwan (1999) that many rural communities used water from unimproved sources and due to high level of pollution, water borne and water-related diseases are widespread in rural communities. It must however be emphasised here that the judgement of the people about the perception of water quality on the basis of appearance could be much more ascribed to low level of literacy among the people in the study area.

4.4 Awareness of Water Quality Improvement

The result in Figure 4.1 revealed as to whether the respondents have any awareness about water quality improvement within households. The majority of the respondents accounting for 61.9 percent acknowledged not to have had any awareness about water quality improvement whiles 38.1 percent of respondents disclosed that they have some level of awareness about water quality improvement.

This result is also confirmed during one of the interview sessions with a Health Official from the health directorate which stated:

"In fact, we owe the people much responsibility in terms of public awareness and education towards their health particularly in the areas of

water and sanitation which we unable to perform, but is really not our fault. The logistics such as vehicles and adequate staff are not available. The directorate is much constrained in discharge of our duties effectively".

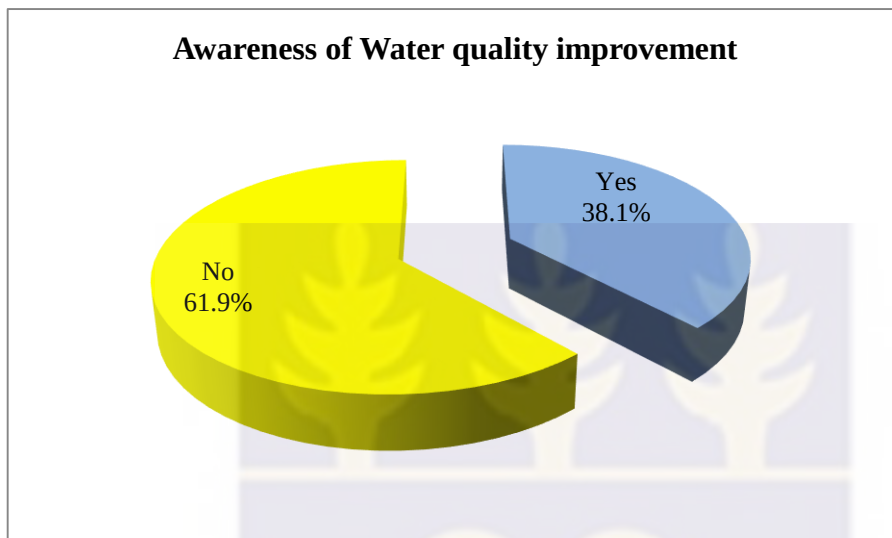


Figure 4.1: Awareness of Water Quality Improvement
Source: Field Data (2016)

4.4.1 Measurement of Respondents Awareness of Water Quality Improvement against Background Information

In order to measure awareness of people about water quality improvement, factor analysis was employed to simplify the variables in obtaining the major background factors. The major aim of Factor Analysis (FA) is the orderly simplification of a large number of inter-correlated measures to few representative constructs or factors. In applying, FA, three major steps needs to be followed and are: computation of the correlation matrix for all variables; extraction of initial factors and; rotation of the extracted factors to a terminal solution. Since factor analysis is based on correlation between measured variables, a correlation matrix containing the inter-correlations

coefficient for all the eight (8) background variables. An observation of the correlation matrix indicates a fairly high correlation for background variables.

However, the Bartlett's test of Sphericity as shown in Table 4.9 was used to test for the adequacy of the correlation matrix. (That is to find out whether the correlation matrix has significant correlations among at least some of the variables). The Bartlett's test of Sphericity, test the hypothesis that the correlation matrix is an identity matrix, or the variables are independent. From Table 4.9, the Bartlett test of Sphericity yielded a value of 86.427 and an associated *p-value* of 0.000. Hence by rule, since the *p-value* (0.000) is less than the default level of significance (0.05), we reject the null hypothesis and conclude that, all the variables are dependent or the variables are fairly dependent or inter-correlated among themselves, hence fulfills the major assumption of FA, therefore we can proceed with the application of FA (See appendix IV) for correlation matrix Table.

Table 4.9: KMO and Bartlett's Test

Kaiser-Meyer-Olkin Measure of Sampling Adequacy		.728
Bartlett's Test of Sphericity	Approx. Chi-Square	86.427
	df	28
	sig	.000

The communality section as shown in Table 4.10 presents the proportion of variance in each variable accounted for by each common factors or the communality for a variable is 1 for all variables as shown in Table 4.10. From Table 4.11, at least, approximately 48% or 0.48 of the variance accounted for by each variable in general was accounted for by each common factor.

Table 4.10 presents the communalities before and after extraction of the factors. Communality (the column labeled **Extraction** in Table 4.10) is the proportion of variance in each variable which all the factors can explain. It is therefore the squared multiple correlation (R^2) between the variable (i.e. the statement in the questionnaire) and the factors emerging from the factor analysis. The higher the communality value of a variable, the more the particular set of factors explain the variance in that variable. So for instance, the factors extracted together explained 46 % of the variance in statement 1 (*Gender*). The variable that the factors together least explained is statement 7 (*Respondent's income in Gh cedis*) which the factors explained 23 % of the variance. The 1s in the column labeled **Initial** reflect the assumption behind the use of Principal component method of extraction, which is that all variance is common and therefore before extraction the communalities are all 1s. In other words, the Principal component method ensures that all variance, including error variance is included in the factors; it does separate error variance from unique or specific variance. The variance in a variable should have two components: **Common** variance (i.e. some of the variance in the variable will be shared with other variables. This is the communality) and **Unique** variance (i.e. variance that is attributed to that variable only). However, there could also be what is called an Error variance (i.e. a proportion of the variance in a variable that is there due to error in measuring the variable).

Table 4.10: **Communalities**

	Initial	Extraction
Gender	1.00	.457
Respondents age	1.00	.736
Length of stay in community	1.00	.624
Marital status	1.00	.652
Level of education	1.00	.632
Occupation of the respondents	1.00	.306
Respondents' income in Gh cedis	1.00	.236
House type respondents live in	1.00	.545

Extraction Method: Principal Component Analysis.

Table 4.11 presents the number of common factors computed, the eigenvalues associated with these factors, the percentage of total variance accounted for by each factor and the cumulative percentage of total variance accounted for by factors. In deciding on the number of factors to extract to represent the data, the associated eigenvalues with the factors were used. Using the criterion, factors with eigenvalues of 1 or greater were retained to be the extracted factors. From Table 4.11, the first three (3) factors were retained for rotation, being the extracted factors to explain the variables. Also the three (3) extracted factors accounts for 52% of the total variance in the data. However, the remaining five factors accounts for approximately the remaining 48%. Meaning larger proportion of the variable contribution is being accounted by the three extracted factors hence representative. Therefore a model with three factors will be adequate to represent the data.

Table 4.11: **Total Variance Explained**

Component	Initial Eigenvalues			Extraction Sums of Squared Loadings			Rotation Sums of Squared Loadings		
	Total	% of Variance	Cummulative %	Total	% of Variance	Cummulative %	Total	% of Variance	Cummulative %
1	1.606	20.071	20.071	1.606	20.071	20.071	1.542	19.278	19.278
2	1.490	18.628	38.698	1.490	18.628	38.698	1.530	19.126	38.405
3	1.092	13.653	52.351	1.092	13.653	52.351	1.116	13.946	52.351
4	.977	12.214	64.565						
5	.949	11.863	76.428						
6	.774	9.679	86.107						
7	.612	7.648	93.755						
8	.500	6.245	100.000						

Extraction Method: Principal Component Analysis

Table 4.12 shows the component matrix which represent the unrotated component analysis factor matrix and therefore presents the correlations that relate the variables to the three extracted factors. The coefficients as shown in Table 4.12, also called the *factor loadings* indicate how closely the variables are related to each factor. Unrotated factors results in significant *cross-loadings* (i.e. a variable loading highly with two or more factors at the same time). From the component matrix Table 4.12, three (3) of the variables were found to be cross-loaded, hence making the interpretation of the factors difficult and theoretically less meaningful.

Table 4.12: **Component Matrix^a**

	Component		
	1	2	3
Level of education	-.720		
Respondents age	.635	.557	
Occupation of the respondents	-.425		
Marital status	.478	.646	
House type respondents live in	.490	-.550	
Length of stay in community			.739
Gender			.544
Respondents' income in Gh cedis			-.415

Extraction Method: Principal Component Analysis

a. 3 components extracted

The component matrix in Table 4.12 was therefore subjected to VARIMAX rotation method to maximize the relationship between the factors and the variables, thereby reducing any possible cross-loadings. From Table 4.13a, it is clear that none of the variables were cross loaded as observed.



Table 4.13a: **Rotated Component Matrix^a**

	Component		
	1	2	3
Level of education	.754		
House type respondents live in	-.705		
Occupation of the respondents	.551		
Respondents age		.848	
Marital status		.785	
Length of stay in community			.654
Gender			.623
Respondents' income in Gh cedis			-.460

Extraction Method: Principal Component Analysis

Rotated Method: Varimax with Kaiser Normalization

Hence from Table 4.13b, the eight variables were reduced to three (3) variables as being explained by (3) extracted factors, Table 4.13b, factor 1 and factor 3 explain three (3) variables whereas factor 2 explains two (2) variables respectively. Factor 1 explains “Level of education”, “House type of respondent that they live in” and “Occupation of the respondent”, therefore reflects state of respondents in the community and hence can be labeled as *social status*. Factor 2 explains “Respondents age”, and “Marital status”, and therefore reflects state of family background of respondents in the community and hence can be labeled as *family status*. Factor three explains “Length of stay in community”, “Gender”, and “Respondent's income in Gh cedis” and therefore reflects period of stay of respondents in the community and hence can be labeled as *period stay in community*.

In summary, the three main factors being the independent variables (demographic factors) to predict dependent variable (awareness of people about water quality improvement) in reduction of water related disease are:

- *Social status* = Socialstatus
- *Period stay in community* = PeriodSICom
- *Family status* = Familystatus

Table 4. 13b: **Rotated Component Matrix^a**

	Component		
	1	2	3
Level of education	.754		
House type respondents live in	-.705		
Occupation of the respondents	.551		
Respondents age		.848	
Marital status		.785	
Length of stay in community			.654
Gender			.623
Respondents' income in Gh cedis			-.460

Extraction Method: Principal Component Analysis

Rotated Method: Varimax with Kaiser Normalization

4.4.2 Logistic Regression Analysis of Awareness about Water Quality Improvement as a Function of Social Status, Period Stay in Community and Family Status

In order to measure the levels of awareness of people about water quality improvement. Logistic regression analysis has been conducted. The major aim of performing Logistic

Regression Analysis is to predict one membership of a group base on certain factors or information (thus awareness of people about water quality improvement).

On this note a test of full model with three predictors against a constant only model was statistically not reliable ($x^2 = .957$, degree of freedom = 3, $p > 0.05$). Indicating that, the predictors as a set do not reliably distinguish between respondents who said "Yes" and those who said "No". The variance in the awareness accounted for is low (Nagelkerke $R^2 = .008$), indicating 8% of shared variance between awareness and the set predictors, thus the gain in prediction is very low.

Table 4.14 shows the result of direct Logistic Regression Analysis predicting awareness from Socialstatus, Period stay in community and Family status of respondents. According to the Wald Test *Socialstatus* ($X^2 = .000$, $df = 1$, $p = .998$), *Periodstay in community* ($X^2 = .925$, $df = 1$, $p = .336$) and *Familystatus* ($X^2 = .008$, $df = 1$, $p = .929$) do not predict awareness suggesting that they were not significant predictors when their effects are controlled for.

Hosmer and Lemeshow Goodness of fit test which compared the observed with predicted number of cases for the two categories of awareness using all the predictors in the model just about show a bad fit with ($X^2 = 2.341$, $df = 8$, $p = .97$). Additionally, the odds ratio value in Table 14, indicated that the odds not in favour of the respondents who said "Yes" to the awareness reduces by multiplicative factor of .883 for one unit change in the respondents ability to respond to awareness.

The ability of the model to correctively classify the respondents in terms of their awareness was found to be low (61.9%). The model sensitivity was also very low (0%) of the respondents who said "Yes" were correctly classified whereas sensitivity of the respondents who said "No" were very high and were correctly classified.

Table 4.14: Logistic Regression Analysis of Awareness about Water Quality Improvement as a Function of Social Status, Period Stay In Community and Family Status

Variables	B	Wald	Sig	Odds Ratio Exp(b)	95% CI for exp(b)	
					Lower	Upper
Socialstatus	.000	.000	.998	1.00	0.88	1.16
PeriodSICom	-.124	.925	.336	0.88	0.69	1.14
Familystatus	-.009	.008	.929	0.99	0.89	1.22
Constant	.000	.000	1.00	1.00		

4.5 Knowledge of Water Quality Improvement

4.5.1 Water Treatment to Improve Quality for Use

The study as part of its objective sought to determine number of households who endeavoured to improve water quality to avoid health risks associated with the use of unimproved source of water for drinking and other uses. A careful look at Figure 4.2 shows that overall as many as 65.0 percent respondents of the total respondents admitted not to have ever treated water to improve quality for use. Quite a significant number of 30.6 percent respondents claimed to have ever treated water to improve quality for use whereas 4.4 percent respondents did not know nor was not sure whether they ever treated to improve quality of water for use.

This finding shows how respondents within the District have less knowledge about how to improve water quality for use. The implication for the populace is that most of them are highly exposed to water related health risks associated with the use of unimproved water sources especially communities without portable water due to lack of awareness and education. This outcome tends to have direct link with earlier finding that points to low level or non-existent of awareness among the people in relation to how to improve

water quality to avoid health risks associated with the use of unimproved sources of water. This falls in line with UNICEF (2008b) report that in creating awareness and education towards the treatment of water for drinking and other domestic uses is very important which impart knowledge, thereby induce changes in behaviour through a long-term training approach and repeated contact with the community.

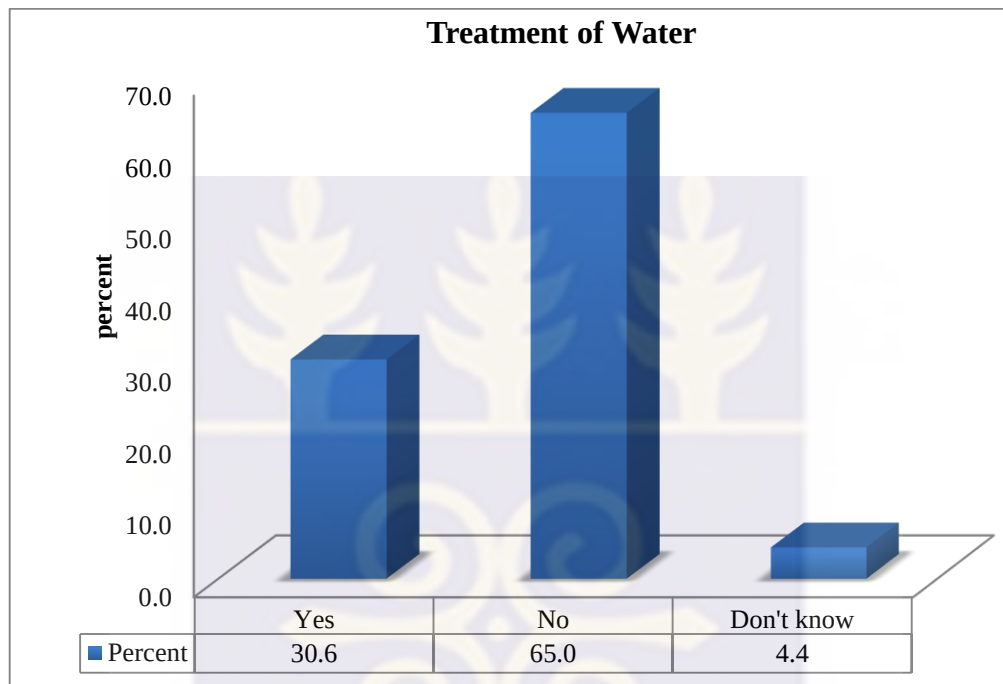


Figure 4.2: Water Treatment to Improve Quality for Use
Source: Field Data (2016)

Furthermore, Table 4.15 displays the result of respondents who treated water to improve quality for use within each community. At Fievie about 44.9 percent of respondents reported not to have treated water to improve quality for use. Most of them attributed their inability to treat water to improve quality due to many chores that need to be attended to and sometimes is out of forgetfulness. From anecdotal evidence others stated that they believed in the old tradition passed down to them where their grandparents whom they stayed with used water from the Volta River for several years without any kind of improvement on quality of water, hence no need to treat water before use. Again

50 percent of respondents from Tordzikpota admitted that they did not treat water before use simply because the water looks very clean and treating the water would be waste of time and besides the Volta River is the source of water used by their parents for many years without problems. On the other hand, at Sogakofe 82.2 percent of respondents claimed to have done nothing to improve water quality for use with the simple reason that they had access to an improved source of water that is the pipe borne water which is considered safe for consumption.

It is clear evidence that the vary reasons outlined by respondents in each community was an allusion to the fact that much had not been done with regards to awareness creation and educational campaigns on importance of water quality improvement through household water treatment. This could be a major contributing factor to prevalent of these water related diseases as people use water directly from this unimproved water source without treatment.

Table 4.15: Water Treatment to Improve Quality for Use within each Community

Community Total	Response		
	Yes	No	Don't know
Fievie 49	22 (44.9%)	25 (51.0%)	2 (4.1%)
Sogakofe 73	8 (11.0%)	60 (82.2%)	5 (6.8%)
Tordzikpota 38	19 (50.0%)	19 (50.0%)	0 (0.0%)

$$X^2 = 25.938^a, df=4, p<0.000$$

Source: Field Data (2016)

The chi-Square test shows a Chi-Square value of 25.938 with a significant figure of 0.000 at 5% significant level. Since the probability value of 0.000 is less than the significant level of 0.05, it is therefore concluded that, there is a statistically significant relationship between community and respondents who treated water to improve quality. The implication of this is that most people from these communities do not treat water to improve quality. The results suggest that many people are likely to suffer from associated health risks with unimproved water sources in communities where people lack access to safe and potable water.

4.5.2 Knowledge on Household Water Treatment to Improve Water Quality

It was clear from the preceding paragraph that, an attitude of treating water before use among the respondents in communities without an improved source of water had significantly been on the low side. Notwithstanding the minimal level of interest exhibited in the treatment of water before use, the study attempted to ascertain from the few respondents who treated water, their knowledge on household water treatment method usually adopted as means of reducing or eliminating contaminants from the source of surface water in order to make the water safer for human consumption. Referring to Figure 4.3 we can see that various Household Water Treatment methods in improving water quality were identified by respondents through which the water from the Volta River source is made safer to use. As many as 17 percent respondents of total respondents used boiling as method of treating water. Boiling had been identified as the largest means by which respondents treated water within households particularly for drinking and other uses. A total of 15.9 percent respondents pointed out that they adopted the use of strain through the cloth method as an approach of treating water for households' consumption which aided in elimination or reduction of contaminants in the surface water. Also, 4.4 percent of respondents said that they were using the let it stand

and settle method as a technique of getting rid of impurities from the water obtained from Volta River before consumption as measure of avoiding contraction of water use related diseases. Additionally, as low as 1.6 percent respondents only settled on the use of adding chlorine to water as method of treating water in order to make it safer for consumption. Conversely, significant 61 percent of respondents stated that they did not use any household water treatment method as a measure of making the water safer for use.

Boiling method of treating water has been identified as the most common means people improve water quality before use. Also in all the FGDs and interview, it was stated that boiling was the common means of improving quality of water:

“When we fetch the water from the river, we mostly boil the water after which it is allowed to cool and is put through a sieve before use. However, boiling consumes a lot of firewood which makes it difficult to boil the water sometimes”(Woman from Fievie,)

In an interview with one of the health personnel:

"When people report with diarrhoea cases, I and my colleagues always advise them to boil the water before use especially for drinking to kill contaminants. Also during antenatal care, we admonish mothers all the time to boil water mostly from river source before giving it to their children to drink so as avoid diarrhoea diseases” (Nurse from Health Facility).

The finding of this study agreed with the previous study by Clasen (2009) and Rosa and Clasen (2010) cited in WHO (2013), identified boiling to be predominate method of HWT with 21 percent of low- and middle-income households with an estimated 1.6 billion people report that they usually drink boiled water since it enhanced the

microbiological value of drinking water. Studies further revealed that boiling is almost common in Indonesia (90.6%), Vietnam (91%) and Mongolia (95.1%). More importantly, boiling is recognized as the only method that is fully effective against all waterborne pathogens in all types water conditions (WHO, 2013). Notwithstanding its universal use, the success of boiling is attributed to governments recommending it as part of their overall health or hygiene campaigns. Again, it has been admitted that many governments have trained health and community workers to promote the practice in villages and communities (Clasen 2009; Rosa & Clasen 2010 cited in WHO, 2013).

The second highest water quality improvement approach adopted by the respondents is filtration primarily through cloth. It is important to note that different filters are identified be used in filtering process. According, to Potgieter (2007), slow sand filters, fibre, cloth and skin filters, permeable earthenware filters and diatomaceous earth filters are recognised different filters that have been tested and patronized in homes for treating water in less developed countries. However, it should be noted that, each of these filters possess different properties and construct that absolutely determine effectiveness at reduction of turbidity, bacteria, pathogens and viruses. Therefore, depending on a particular filter medium used determine how a person becomes safe or unsafe from using the treated water. Indeed, the use of fabric or cloth by the people in the study area becomes effective against turbidity and parasites but not effective for reducing pathogens, bacteria and viruses. So, it has dire health consequences for people as they are not completely safe from certain water related diseases in spite of their efforts in treating water to avoid these water related diseases. The finding of this study confirms the report that, granulated kind of media filtration has the potential of reducing by 90 percent the turbidity and enteric bacteria, removing larger parasites, enteric viruses and pathogens at a percentage rate of 99%, 50% and 90% respectively (Sobsey, 2002; Potgieter, 2007).

On the other hand, the least number of respondents who improve water quality prior to drinking used method of chlorine addition to water which is represented by 1.6 percent only. Though the use of chlorine is widely acknowledged as one of the common household water treatment methods in water quality improvement, the respondents within these communities used less of this method in making their water safer to drink. The result of this study however contradicts the far and wide opinion held by many and supported by Sobsey (2002) and Lantagne et al (2006) that the most extensive and inexpensive disinfectant for disinfecting water for drinking is chlorine. American Water Works Association (1999) noted that with clear water, chlorine works effectively to deactivate bacteria and some viruses (cited in CDC, 2008) and thereby averts water-related diseases such as typhoid, dysentery and cholera (WCC, 2008). On other hand, chlorine disinfection has a residual effect, unlike other technologies, which protect the water against re-contamination for over a period (Montgomery and Elimelech, 2007; UNICEF, 2008b). Different studies have pointed to the fact that the use of sodium hypochlorite has enhanced drinking water quality and minimised the threat of diarrhoeal disease (Sobsey et al., 2003; Luby et al., 2004; Potgieter, 2007). In recent times, a study conducted in rural communities of South Africa revealed that sodium hypochlorite solutions successfully minimized the numbers of indicator of microbes to untraceable counts in drinking water (Potgieter et al., 2008). An intervention to reduce the contamination of water in rural South India was conducted, which indicates a substantial reduction of thermo tolerant coliform in water samples.

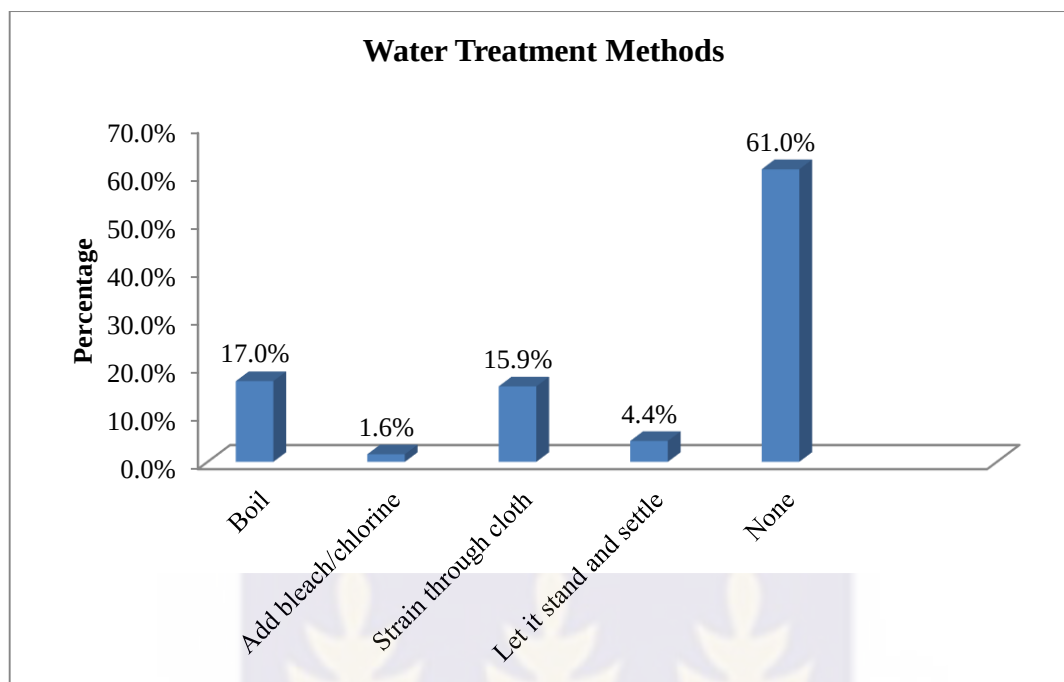


Figure 4.3: Knowledge on Household Water Treatment to Improve Water Quality
Source: Field Data (2016)

4.6 Summary

The chapter was made up of four sections. The first section dwelt on the characteristics of the respondents where residents' age, gender, level of education, income and length of stay of respondents in the community were considered. The second section dealt with the main sources of water and respondents' perceptions about water sources in the communities studied. The third section addressed issues relating to awareness level of respondents about water quality improvement which was measured against background variables. Final section touched on respondents' knowledge about water quality improvement through the adoption of simple household water treatment methods.

CHAPTER FIVE

KNOWLEDGE ON PREVALENCE DISEASES AND MANAGEMENT OF WATER USE ASSOCIATED HEALTH RISKS

5.1 Background Variables and Prevalence of Water Related Diseases in the Communities

One of the main objectives of this study is to identify the water use related diseases prevalent, with its associated health risks within the communities and its management.

Cross tabulation of multiple response data was run for the prevalence of diseases which were related to the background variables as presented in Table 5.1. From the Table 5.1, Diarrhoea was revealed as the most prevalent water use related diseases accounting for 34.1 percent, closely followed by Skin rashes, Bilharzia and Typhoid representing 29.3 percent, 25.2 percent and 20.3 percent respondents respectively. Table 5.1 further presents detail distribution of prevalence of water related diseases in relation to background variables including gender, age and level of education.

It is well known that water is life and there is link between lack of safe water in any community in the world and various forms of health risks including water use related diseases (Omole et al., 2015; Moe and Rheingans, 2006). This study was no exception as some water use related diseases were discovered as diseases suffered from by community members of South Tongu district. These were diarrhoea, skin rashes, bilharzias, typhoid, hepatitis A, whereas no case of guinea worm was recorded. The arrangement of these diseases was done in order of pervasiveness of the diseases among the respondents of the communities.

The study shows that, diarrhoea was the most prevalent water related disease suffered by the members of these communities depending on the Volta River. This confirmed a similar survey conducted in Pakistan by Qureshi et al (2011) which revealed that the

most common illness people had suffered from was diarrhoea and vomiting as a result of using untreated surface water and followed closely by skin diseases. Similar study conducted in Bangladesh by Haque (2010) found that diarrhoea and skin diseases were the most prevalent and frequently water borne diseases at 55.5 percent and 20 percent respectively followed by 17.3 percent for typhoid. Furthermore, findings of this study is also in conformity with the report of Esrey et al. (1990 1991) cited in Qureshi et al (2011) who carried out 142 studies on 6 of the major water-borne diseases and estimated that in developing countries (excluding China), there were 875 million cases of diarrhoea and 4.6 million deaths annually in the mid-1980s.



Table 5.1: Background Variables and Prevalence of Water Related Diseases in the Communities (Multiple Response)

Variables	Diseases				
	DIA	HEP	TYP	BIL	SKIN
Community					
Fievie	21(44.6%)	1(100.0%)	9(42.9%)	19(67.9%)	24(58.5%)
Sogakofe	13(27.7%)	0(0.0%)	8(38.1%)	3(10.7%)	5(12.2%)
Tordzikpota	13(27.7%)	0(0.0%)	4(19.0%)	6(21.4%)	12(29.3%)
Total	47(34.1%)	1(0.7%)	21(15.2%)	28(20.3%)	41(29.7%)
Gender					
Male	23(48.9%)	0(0.0%)	12(57.1%)	19(67.9%)	18(43.9%)
Female	24(51.1%)	1(100.0%)	9(42.9%)	9(32.1%)	23(56.1%)
Age					
15-30	14(30.4%)	1(100.0%)	4(20.0%)	13(38.2%)	16(40.0%)
31-45	24(52.2%)	0(0.0%)	14(70.0%)	10(29.4%)	17(42.5%)
46-60	3(6.5%)	0(0.0%)	0(0.0%)	5(14.8%)	4(10.0%)
60 above	5(10.9%)	0(0.0%)	2(10.0%)	6(17.6%)	3(7.5%)
Education					
No Education	12(26.7%)	0(0.0%)	4(20.0%)	16(48.5%)	12(30.0%)
Primary Edu.	10(22.2%)	1(100.0%)	6(30.0%)	6(18.2%)	4(10.0%)
JSS/JHS	15(33.3%)	0(0.0%)	8(40.0%)	6(18.2%)	17(42.5%)
SSS/SHS	6(13.3%)	0(0.0%)	0(0.0%)	5(15.1%)	6(15.0%)
Tertiary	2(4.5%)	0(0.0%)	2(10.0%)	0(0.0%)	1(2.5%)

NB: DIA= Diarrhoea, HEP = Hepatitis, TYP= Typhoid, BIL= Bilharzia, SKI= Skin Rashes.

Source: Field Data (2016)

Furthermore, in order to ascertain which category of people that are mostly affected by these diseases prevalent in the communities, the respondents were asked to indicate category of people affected in terms of male and female. From Table 5.1, water related diseases identified, affect both male and female relatively differently. Prevalence of diarrhoea did not show any considerable difference between male and female respondents representing 48.9 percent and 51.1 percent respectively who were affected by diarrhoea. Conversely, there was copious difference in prevalence of bilharzia between male and female respondents where 67.9 percent and 32.1 percent respectively were affected. During the FGDs, question was raised as to which people are mainly affected by these water related diseases. Here is an excerpt from one of the discussant:

"Bilharzia worries men more than women and children; because men always go into the river and so they suffer from bilharzia than any other person."(Man from Tordzikpota).

Another discussant submitted:

"In fact men are mostly victims of bilharzia or diarrhoea than any other person. Because men stay in the river for long time sometimes for five hours and once in the river, these diseases causing organisms infect or enter our body leading to contraction of these diseases. Besides, on our fishing expedition we cannot carry water from the house and therefore we drink water directly from the river which causes them to suffer from diarrhoea."(Man from Fievie)

Another woman participant of FGDs contested:

"To be frank both men and women are equally affected, because we women always fetch water from the river for household activities which make us have many contact with the water and it is not always water is

treated for use especially for drinking so equally suffer from diarrhoea, bilharzia and skin rashes."(Woman from Tordzikpota)

Also an interview with a nurse stated:

"I think is equal I can't really tell whether..... but I am talking from my personal experience".

On the basis of the arguments advanced and information gathered from respondents as to which group of people suffered from water related diseases identified. It is therefore very clear that prevalence of water related diseases among men and women were relatively on same level with the exception of bilharzia where men were the most victims.

5.2 Knowledge on the Infection of Water Use Related Diseases

The analysis based on the respondents' knowledge on the transmission of water use related diseases in Table 5.2 shows that 34.4 percent of respondents believed that drinking unsafe water infected them with diseases, followed closely by swimming/bathing with 15.6 percent of responses among other factors that were considered as the means by which they had been infected with these diseases.

From this information, it can be deduced that respondents were to some extent knowledgeable enough on how these diseases were contracted. However, over reliant on water bodies as a means of sustaining their livelihoods through farming activities such as rice cultivation along the river bank and fishing which included harvesting of shrimps, oysters as a consequence of extreme poverty due to absence of better alternative jobs exposed them to some of these diseases through constant and direct contact with the water bodies. More so, the direct use of water from the Volta River as source of drinking and for other uses by majority of people due to lack of safe water in most of these

communities along the river had made situation more complicated. This observation was found to be consistent with the report of USAID (2014) which stated that people get infected with diseases such as schistosomiasis (bilharzia) by coming into contact with contaminated water containing schistosome parasites while engaging in such activities as bathing, swimming, or performing everyday household tasks, including laundry, herding animals and fetching water. Similarly the outcome of this study corroborates with the study by Aliko (2013) who found that human activities which include cooking, drinking, bathing, washing, farming, fishing, masonry, swimming, wading and religious washing of the body-ablution and baptism. Different studies conducted by UNICEF (2008) and WHO (2000) fall in line with this study which stated that people come into contact with river water whilst using it for agricultural purpose or when they come for fishing. A study by Steinmann *et al* (2006) also confirmed this findings that some diseases including bilharzia is associated with poverty, with resultant poor housing, absence of clean water, insufficient hygienic environments, if any sanitary facilities and several activities bringing people into contact with water into which eggs are delivered and in which are found intermediate host snail hosts.



Table 5.2: **Knowledge on infection of Water Use Related Diseases**

Community	How People Get Infected with Water Related Diseases					Total
	Drinking Unsafe Water	Inadequate Personal Hygiene	Swimming/ Bathing	Poor Personal Domestic Hygiene	Don't know	
Fievie	23	0	15	0	11	49
Sogakofe	10	0	5	13	45	73
Tordzikpota	22	1	5	0	10	38
Total	55(34.7%)	1(0.6%)	25(15.6%)	13(8.1%)	66(41.3%)	160

$X^2 = 60.552^a$, $df = 8$, $p < 0.000$

Source: Field Data (2016)

The Pearson chi-Square test shows a Chi-Square value of 60.552 with a significant figure of 0.000 at 5% significant level. Since the probability value of 0.000 is less than the significant level of 0.05, there is a statistically significant relationship between community and mode of infection to water related diseases. The implication is that most people from these communities understood the means by which they were infected with water related diseases. The outcomes suggested that respondents having close contact with contaminated water by means of drinking, bathing/swimming indicated higher risks of infections mostly by diarrhoea and other water related diseases.

5.3 Knowledge on Seasonality of Diseases

As prevalence of water related diseases fluctuates with seasons, information was obtained from respondents as to when these diseases are most prevalent among the communities. The information obtained revealed very clear picture as shown in Figure 5.1, where prevalent of water use related diseases in rainy seasons accounted for 45

percent of respondents and 13.8 percent affected in the dry season while significant 41.2 percent respondents did not know the actual season water use related diseases were prevalent.

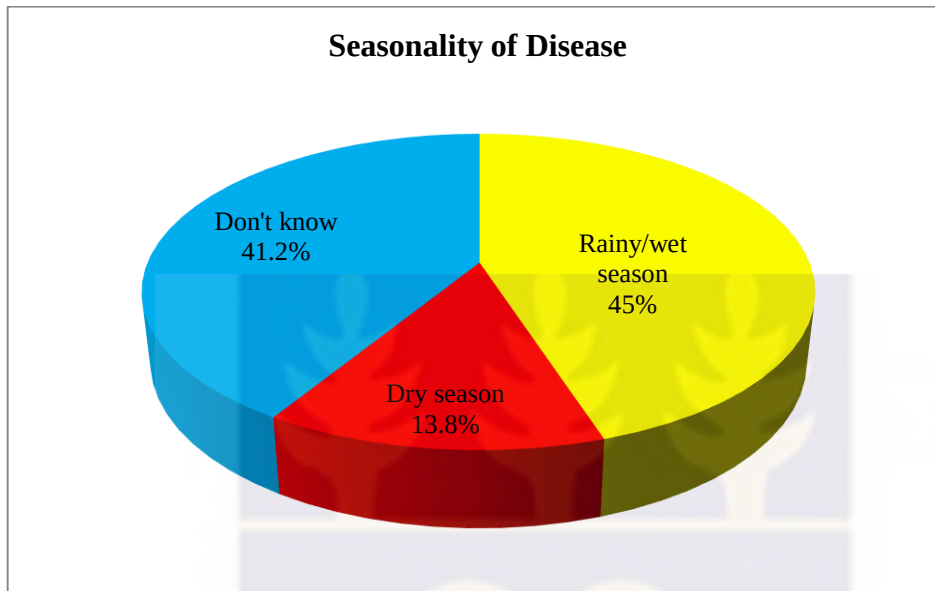


Figure 5.1: Knowledge on Seasonality of Disease
Source: Field Data (2016)

The reason for the high prevalence rate of diseases during rainy seasons was obvious. Rainy seasons were usually associated with run-off water through many places such as farmlands, homes and gutters draining into water bodies. Consequently, the run-off water carries several contaminants such as chemical residues from farms, pathogens and germs generated through waste materials in the homes, open defecation and dumping of rubbish into or near water bodies. One of the respondents in the FGDs stated:

"Sometimes when it is raining people throw away their rubbish and other waste into the running water which are carried into the river."(Woman from Sogakofe).

Thus, the level of impurities in the water bodies during this period become very high than during the dry season. This observation is confirmed where it is noted that there is a

wide variation in flow and this affects water quality which occurs particularly in wet periods where water carry a very high silt load and washes feces into the river resulting in high risk of contamination (<http://who.org>) Also, the water looks muddy at this time which may create conducive environment for disease causing organisms to thrive thereby resulting in high prevalence rate of water use related diseases among the people. The results of this study confirmed the findings of Quereshi et al (2011) which found that water borne diseases were mostly prevalent during the rainy season than any other season. The finding of the study further falls in line with Ogutonke et al (2009) that there is variation in the prevalence of diseases during different seasons

5.4 Coping Strategies and Management of Water Use Related Health Risks

5.4.1 Treatment of Diarrhoea Disease

Figure 5.2 shows what respondents did when they were infected with diarrhoea. The outcome suggests that majority of 50.6 percent of respondents visited hospital or clinic when they become infected with diarrhoea, 18.8 percent of respondents used herbal medicine, 17.5 percent bought drug from chemical or drug shop and 13.1 percent used ORS therapy. The used of ORS is recognized as the most effective treatment against diarrhoea and surprisingly diarrhoea was identified as the most prevalent among respondents in the study area which was expected to be treated effectively with ORS, but the situation was completely different as the respondents adopted a variety of treatment options other than the used of ORS. Nevertheless, 13.1 percent of respondents who administered ORS for treatment of diarrhoea admitted its effectiveness and fast rate of recovery from the disease. The report therefore is in agreement with Casburn-Jones and Farthing (2004) statement that the administration of oral rehydration solutions (ORS) to replace fluid and electrolyte loss in patients provides effective treatment and expedite

recovery of many patients in different parts of the world (Santosham et al, 2010). The relatively very low percentage of respondents that mentioned they use ORS therapy against diarrhoea would be attributed to the rural areas lack of health professionals who usually aid in education and awareness creation for effective use of ORS therapy in treating diarrhoea as water use related diseases. This confirmed the findings that, notwithstanding the effectiveness of ORS, its application are hindered by difficulty in administration of the therapy during purging and vomiting as well as lack of parental knowledge especially in rural and semi urban areas of the developing world (Casburn-Jones and Farthing, 2004). Besides, lack of professional staffs makes it difficult in African rural communities to do intravenous fluid replacement (Njume and Goduka, 2012).

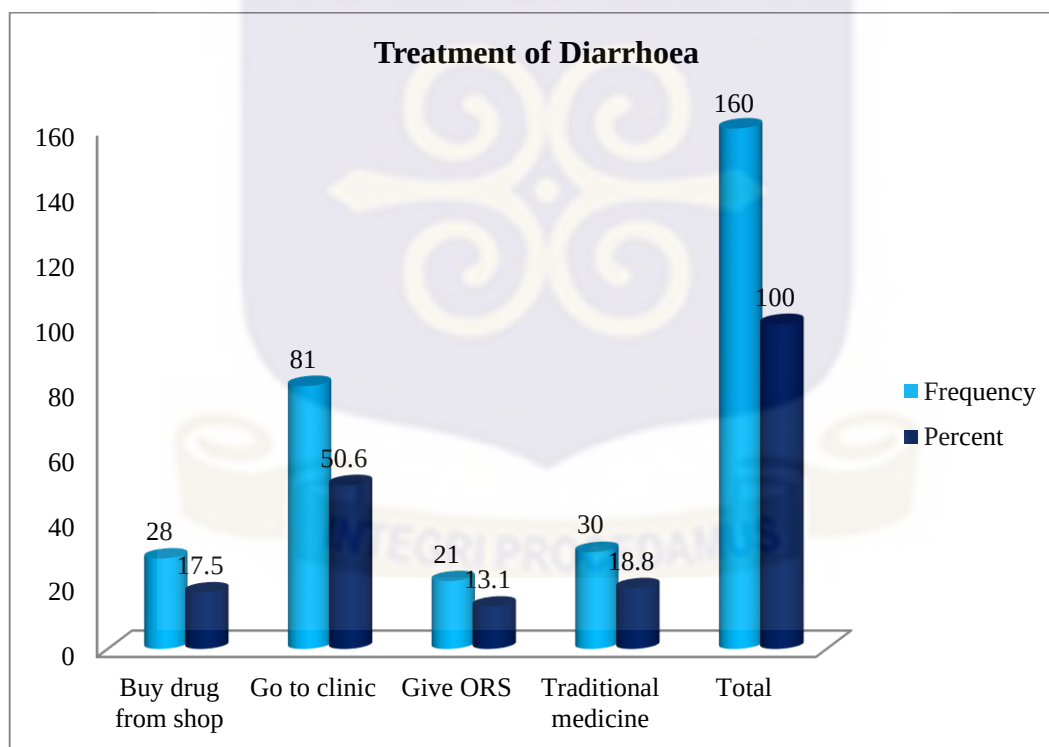


Figure 5.2: Treatment of Diarrhoea Disease
Source: Field Data (2016)

Similarly, traditional or herbal medicine has been recognized as the second most treatment option for diarrhoea in the study area where a significant number of respondents identify the efficacy and importance of local herbal preparation for curing diarrhoea and other water related illnesses. The use of herbal medicines is common among respondents due to its ease of access and inexpensiveness to buy. This is therefore consistent with results of Green et al, (2010) who recount that The most readily accessible and affordable therapies to regulate diarrhoea in many rural communities in the developing countries are prepared from indigenous or native plants. The various parts of plants such as roots, rhizomes, aerial parts, tubers, stem barks and leaves are used in the preparation of concoctions and extracts for curing diarrhoea and other illness (Njume, 2009).

5.4.2 Treatment of other Water Use Related Diseases

The research also elicited from the respondents how they have treated water related diseases suffered from. As we can see in Table 5.3 different modes of treatment of water use related diseases were identified by respondents. With typhoid, majority of respondents representing 66.7 percent resort to the use of herbal medicine whiles 23.8 percent of respondents visited hospital for treatment. The treatment of bilharzia by respondents was mostly sent to hospital represented by 57.1 percent. This observation confirmed the report of Fenwick et al., (2003) and Olveda et al., (2013) that an effective, safe and simple drugs as a cure to devastating bilharzia, that is Praziquantel drug that is active against all schistosome species (Da Silva et al, 2005) which is now the most widely used (Gryseels et al, 2006). Also 46.3 percent of respondents treated skin rashes within hospital whereas the remaining percentages of respondents resort to the use of herbal medicine and self-medication. In general, majority of 45.1 percent of respondents

usually visit hospitals for treatment of diseases suffered. This was followed by 34.1 percent and 20.8 percent of respondents who resorted to the use of herbal medicine and self-medication respectively.

This is a clear indication that respondents acknowledged and understood where to seek the best form of treatment particularly from hospitals or health care facilities for their illnesses. This is because the respondents recognized that health professionals in health facilities are the right caliber of people to diagnose any disease, identify the underlying causes of such sicknesses and appropriate prescription for treatment.

Table 5.3: Treatment of Other Water Related Diseases by Respondents

Disease	Frequency	Mode of Treatment		
		Hospital	Herbal Medicine	Self-Medication
Hepatitis	1	1 (100.0%)	0 (0.0%)	0 (0.0%)
Typhoid	21	5 (23.8%)	14 (66.7%)	2 (9.5%)
Bilharzia	28	16 (57.1%)	9 (32.1%)	3 (10.8%)
Skin rashes	41	19 (46.3%)	8 (19.6%)	14 (34.1%)
Total	91	41 (45.1%)	31 (34.1%)	19 (20.8%)

Source: Field Data, (2016)

5.4.3 Reasons for the Selection of Treatment Option

There were varied reasons for which patient had preferred a particular place in seeking treatment for their health problems. Subsequently, the researcher sought from the respondents to outline the underlying reasons why they preferred a particular treatment option to another as presented in Figure 5.3. A greater proportion of respondents representing 68.1 percent selected their treatment option because they considered it to be

safer and effective. Affordability was the second highest reason respondents gave for the selection of treatment option which accounted for 25 percent of respondents whereas easy accessibility came as the least reason for the preference for respondents' treatment option.

The clear indication is that respondents were much more concerned about their safety and effectiveness of the medicines that need to be administered to them which they fully believed could only be provided in hospitals and other health facilities. For instance, blood in urine is effectively cured with special drug administered in the hospital or health facility. This account is confirmed by Da Silva et al, (2005) where Praziquantel is recognized as the drug that is active against all schistosome species, which is now the most widely used and very effective because within one hour of ingestion, it acts by paralyzing the worms and damaging the tegument (Gryseels et al, 2006).

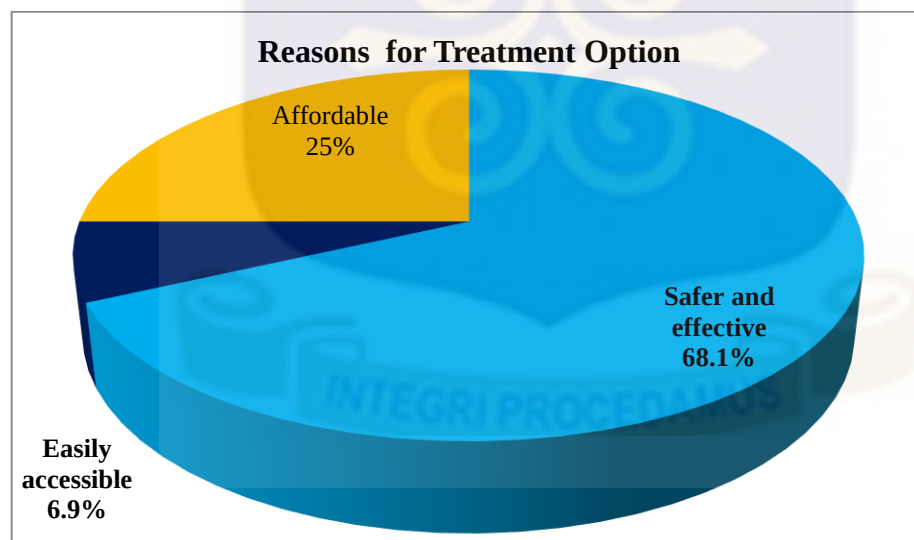


Figure 5.3: Reasons for the Selection of Treatment Option
Source: Field Data (2016)

5.5 Impact of Water Related Diseases on Individuals in the Communities

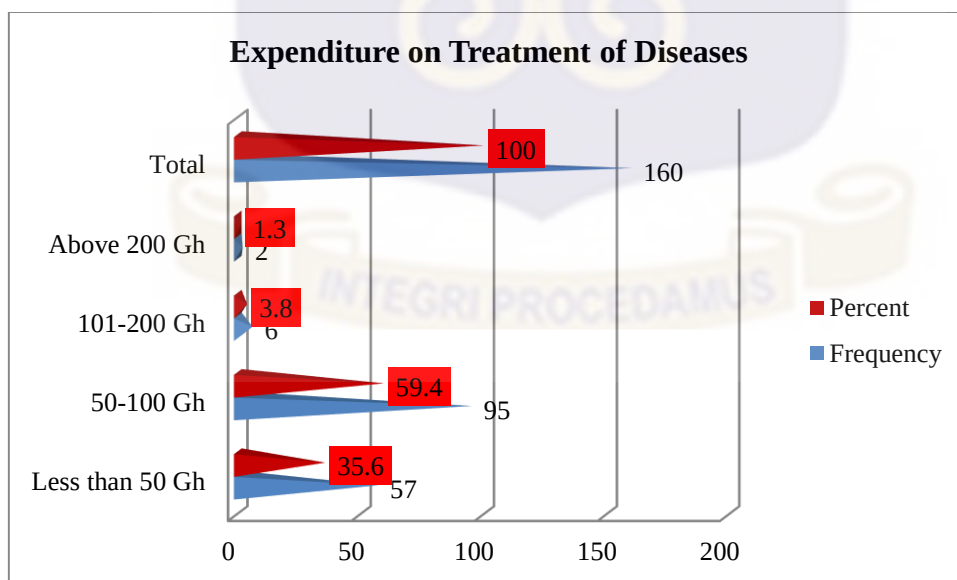
It is indicated in the literature, that waterborne/related illnesses often constitute a substantial economic liability to rural households that affects the productive capability of adults, as well as the health and education of children (WHO, 2010).

In relation to health, it is clear evidence that many rural communities that lack portable water are forced to drink or usually have close contact with contaminated water that results from pollution by human or animal waste as well as insects which breed in water leading to water use related diseases such as diarrhoea, bilharzia and so on among the respondents. In children particularly under five year, most illnesses of very severe nature contracted through the ingestion of water of poor quality such as diarrhoea, have been indicated as the major cause of infant mortality. This is probably due to weak immune system of children which make them susceptible to infections very easy. Besides, women and children suffer different degrees of injuries by carrying water on head over long distance which cause damage to their neck, knee, shoulders and sometimes long term injury to their spine leading to body deformation as water sources are mainly several metres away from their residence.

Some individuals affected by water related disease as bilharzia with either passing of blood in urine frequently or stain of blood in stool, tend to experience anaemic condition through excessive loss of blood. As a result people infected with this disease tend to experience loss of body weight and associated deterioration health conditions of the affected people. Also, due to infection of water related diseases their skin become disfigure through the itching of skin which is experienced as a consequence of drinking contaminated water or contact with contaminated water through their daily work engagements such as fishing and harvesting of oyster to earn a livelihood.

With regards to the economy, water related diseases affect rural, agriculture and fishing population and this is an attribute which affected communities along the river in the study area. These diseases have debilitating effects on the health of the victims which render them weak and incapable to engage in any vigorous and effective economic activities for survival and sustainability which ultimately affect productivity level and income status of both the individual and the family.

In order to determine how this water related diseases affect the victims economically, respondents were asked how much they spent on treatment of water related diseases. As depicted in Figure 5.4, 59.4 percent representing greater proportion of respondents spent between 50-100 Ghana cedis on treatment of water related diseases for every visit within any health facility or consultation with health practitioner or doctor. Next to it was 35.6 percent of respondents spent less than 50 Ghana cedis whiles few respondents used between 101-200 Ghana cedis representing 3.8 percent and only 1.3 percent spent above 200 Ghana cedis on treatment of these diseases.



**Figure 5.4: Expenditure on Treatment of Water Related Diseases
Field Data (2016)**

This outcome of expenditure on treatment of water related diseases had very serious financial implications for the victims. This is because considering this expenditure on treatment of diseases most especially in instances where a patient may visit health facility twice or more in a year juxtapose with income earn by the victims, it would be difficult for these victims to live any meaningful life if the little resources they have would be spent on treatment of diseases. Against this back drop that, this was happening in a developing country like Ghana where respondents who were mainly rural folks had access to very limited resources and unsustainable economic activities become more exposed to severe financial burden. Thus, their livelihood conditions tend to be extremely vulnerable in the face of devastating nature of these diseases on patients who are weak and incapacitated.

This is confirmed in one of the interviews by community leader:

“Most of the diseases suffered from in this community are mainly from the water we use. These diseases affect us in many ways. For instance, most of us are farmers, fishermen and traders, so when we are sick we are unable to go to our work places which affect our productive activities. As a result, we lose much income we suppose to get and the little we have is spent on medical bills which make life very too difficult to survive” (Unit committee member from Fievie).

Finally, considering the impact of water use related diseases on education of the people. It is observed that people infected with these diseases tend to experience deterioration in their health conditions which make them very weak and unable to even attend certain social functions such as school. Thus school children or students afflicted with these diseases have their schooling or education affected in various ways. First and foremost, children's academic activities are severely affected as they become very weak, dull and

inactive as they often sleep in class. These observations were confirmed by the study conducted by McGarvey (2000) who indicated that the disease affects the general liveliness and academic performance of children infected is affected in school.

Another confirmation from a discussant during FGDs stated that:

“My child does not perform well at school again after he recovered from suffering from that bilharzia. I don’t know the problem, he is never active like before and always isolates himself from other friends whenever they are having fun or playing. This affects his academic performance to the extent that, he repeated class” (Man from Tordzikpota).

The school attendance rates are affected once children become infected with water related diseases. The repercussion for affected children is inability to attend school regularly due to lack of physical fitness to walk to school and be able to undertake other activities or demands in school. Apparently, several students are unable to attend school which denies them of quality education meant to develop their potentials for economic growth and development. This explanation falls in line with UNDP (2006) report which stated that 443 million school days are lost each year due water related diseases.

Furthermore, academic performance of school children is consistently affected through loss of momentum and concentration as they deal with pains and affliction ensuing from these diseases. These diseases may apparently result in mental retardation in school children as their immune systems become very weak which do not allow them to develop and function well due to constant attack from these health’s related risks. Subsequently, this tends to prevent them from school most of the time in order to look for treatment to improve upon their health conditions. School children infected with these diseases perform extremely poorer than their contemporaries without these diseases. These

observations are also confirmed by the 2014 USAID report which shows that poor growth and decreased mental development are principally suffered by children as the most side effects of the disease.

Finally, this situation undermines efforts being made by government and various stakeholders of education to increase children enrolment in school aim at achieving Free Compulsory Universal Basic Education (FCUBE) policy. This is because unhealthy children consider schooling herculean tasks as much attention is given to their health conditions through treatment of diseases instead of their education.

5.6 Chapter Five Summary

The chapter consists of three sections which dwelt on issues of prevalence of water related diseases, coping strategies and management of water use related health risks and associated impact on respondents. The first section tackled on the issue of prevalence, knowledge on infection and respondents' knowledge on seasonality of water related health risks in the study area. Third section was dedicated to the management of various water related diseases identified by the respondents and reasons for the adoption of such treatment option. The final section dealt with the impact of these health risks on the individuals and the communities as a whole.

CHAPTER SIX

SUMMARY OF FINDINGS, CONCLUSION AND RECOMMENDATIONS

6.0 Introduction

This chapter presents the summary of major findings of the study. It also presents the conclusions drawn from the study as well as recommendation derived from the conclusions of the study. The first section of the chapter summarizes the entire study and also presents the key findings. This is followed by the conclusions and recommendations drawn from the findings. Suggestions for further studies are added in the end.

6.1 Summary

The study set out to assess water use and associated health risks along the Volta River. The study adopted mixed method strategy where quantitative data was gathered using questionnaire to collect data. Qualitative approach was used to gather information from key informants through in depth interview and focus group discussion. The data was analyzed in line with the study's objectives. Descriptive statistics including frequencies, percentages, and some measures of central tendencies (mean), inferential statistics (Chi-Square) and logistic regression as well as information gathered through interview and focus group discussion were employed in the analysis of the data to make meanings to the responded questions from the respondents.

The study identified the demographic characteristics of the sampled respondents (Sogakofe, Fievie and Tordzikpota) who participated in the survey in order to provide basis for authenticating the sources of responses and differentiating between responses, since aggregated responses may exclude some pertinent isolated concerns.

6.2 Key Findings

Access to safe, clean water remains and would continue to pose a major challenge to individuals, communities and governments around the world. Access to safe and clean water has direct bearing on the health of the people. Thus health of any group of people may either be affected positively or negatively depending on the kind of water available to them. However, availability of fresh and safe water in many parts of the world is very scarce. Fortunately for Ghana, there are many of these water sources that need to be tap for use but inadequate water infrastructural facilities made it difficult and more importantly, lack of public awareness and education about water quality improvement impaired many people access to potable water. These forced people to depend on all kinds of water sources for use, exposing them to health risks. For these reasons, the current study has been conducted to unravel the relationship between main sources of water and the respondents' location in order to assess awareness and knowledge of respondents about water quality improvement, prevalent water related diseases and management of these diseases by the respondents.

Based on the analysis and discussion, the respondents indicated, based on the percentages that;

On the first objective of examining the relationship between location of residents and water sources, the study revealed that there is significant relationship between the main sources of water and location of residents. The study further revealed that most of the communities living along the Volta River without access to pipe borne water has no alternative sources of water to depend on except the Volta River. The non-availability of other sources of water was attributed to high salinity of underground water table in addition to dispersed nature of most of the settlements with low population which made

connection of these communities to existing water pipe line difficult and capital intensive.

On the second objective of assessing level of awareness and knowledge of people about water quality improvement, the study revealed that there was lack of awareness and knowledge on the part of many people about improving water quality in the absence of access to improved water sources. Thus, this led to only few people having little knowledge about water quality improvement through boiling, filtration through cloth, let it stand and settling and finally an addition of chlorine.

On the third objective of identifying prevalent water related diseases in the study area, the study revealed that the most prevalent among them was diarrhoea, closely followed by; skin rashes/ itching, bilharzia, typhoid and so on.

Finally, on the fourth objective of examining different management practices people adopt in curing themselves of water use related diseases, the study revealed that diarrhoea, bilharzia, skin rashes/itching cases were mostly sent to hospitals for treatment with few people using drugs bought from drug stores as well as others using herbal preparations as remedies.

6.3 Conclusion

The study has succeeded in revealing that, communities living along the Volta River in the South Tongu District continue to be exposed to preventable water related health risks. The main cause of these diseases is attributed to consumption of unsafe water. However, this fundamental cause of the problem is linked to the dispersed nature of the communities with low population densities which pose very difficult challenge for the communities to be connected to the existing pipe lines. Therefore, these communities are

denied of access to safe potable water hence, forces the people to depend on water from the polluted Volta River.

It has also been identified that, there is non-existence of any effective public awareness and educational campaign strategy among the people about the need to improve water quality as means of avoiding health risks associated with the use of polluted water from the Volta River. As a result, lack of public awareness has imparted less on the knowledge base of the people in terms of usage of simple household water quality improvement methods. It again reflected the behaviour of the people towards the environment including disposal of domestic and industrial waste materials, open defecation and so on which increase pollutants in the water bodies that need to be treated before use to avoid any health consequences.

Besides, lack of decent jobs in these areas mostly pushed people into activities closely related to water bodies such as fishing and farming in earning livelihood thereby get infected with some of these diseases. Subsequently, the impact of these diseases on the people become very devastating in their health status, economic condition and long term educational implication.

Finally, these findings give vivid credence to disease ecology model of Meade and Emch (2010), which was used for the study (see chapter 2). Certainly, prevalence of water related diseases in the study area is fundamentally determined and influenced by the interaction and relationship between the habitat and the behaviour of the people.

6.4 Recommendations

First and foremost, the South Tongu District Assembly together with other stakeholders including NGOs should canvass for resources in order to supply these communities

along Volta River with potable water to eliminate the dependence of people on the polluted water.

There should be an intensive public awareness and educational campaign, for short and long term on the effects of using unsafe water and disposal of waste in the community. This is also stressed in one of the interviews with a nurse in the District Hospital which stated:

"I think it will bore down to the education, how the water is being used, if they want to use the river water, first of all they must boil it to kill living organisms to make water a bit hygienic to use for their domestic purposesfishermen and others should be educated, I think education is the best thing for them" Nurse from Health Facility).

Again, there should be collaboration with stakeholders, Non-Governmental Organisations (NGOs) in South Tongu to roll out an extensive awareness creation and educational campaign on the use of less expensive but very effective and efficient household water treatment methods to improve water quality for use. This should be done through sustainable educational programme involving trainer of trainees which would lead to local capacity building and then training of every households. The wide range of treatment methods such as **SODIS, BioSand Filtration, Slow Ceramic Filtration** and others that are very effective and efficient in eliminating disease causing organisms should be introduced.

Furthermore, public education and awareness campaigns should be done through interpersonal communication process which allows people to interact with the promoters of the new water treatment methods face to face.

There should be a policy or by-law binding on everyone to treat water. Some volunteers from each community must be trained to supervise the residents of these communities and always encourage them to regularly treat water. It is expected that with time it would result in change in behaviour and once this change occurred, the benefits become enormous for individuals, the district and the nation as whole in terms of cost, time and economic freedom.

The government should also establish some factories in the area to provide job opportunities for the people in order to reduce over reliance of people on water bodies which serve as contact point for contraction of some diseases. Besides, in every community, platforms should be mounted at points of fetching water to prevent people from entering or having direct contact with the river body.

Finally, more health facilities must be provided closer to people especially CHIPS compound to enhance easy accessibility and utilization of primary health care services. This will further lessen the financial burden of paying for medical bill which is invested in livelihood ventures to improve standard of living and save time and energy from travelling to access health care service.

6.4.1 Suggestions for further Research

The study can be conducted to ascertain the causes of low level of public awareness and educational campaigns on water quality improvement in the study area.

Further study can also be conducted into the reasons why most of the communities living along rivers are mostly not connected to existing pipe lines.

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APPENDICES

APPENDIX I

UNIVERSITY OF GHANA

DEPARTMENT OF GEOGRAPHY AND RESOURCE DEVELOPMENT

This survey is conducted by a student of the above Institution as a requirement to the award of an MPhil in Geography and Resource Development. The current study seeks to **Assess Water Use and Associated Health Risk along the Volta River in South Tongu District**. The study among many other things will seek to assess available sources of water, and its associated diseases on the people through water usage and management practices adopted in dealing with water related diseases. This survey is designed to cover selected communities along Volta River. Respondents are assured that all responses are strictly for academic purposes and will be treated confidential.

DEMOGRAPHIC AND SOCIO-ECONOMIC CHARACTERISTICS

1. Community Name:.....
2. Sex: 1. Male ☐ 2. Female ☐
3. Age (in years).....
4. Length of stay in this community.....
5. Marital Status.....
6. What is your highest educational attainment?
 1. No Education. ☐ 2. Primary ☐ 3. JSS/JHS ☐ 4. SSS/SHS ☐ 5. Tertiary ☐ 6. Others ☐
7. What is your main occupation?
 1. Farming ☐ 2. Trading ☐ 3. Fishing ☐ 4. Civil Servant ☐ 5. Others (specify).... ☐
8. How much do you earn monthly GH ¢.....
9. Kindly tell me the house type that you live in?
 1. Cement house ☐ 2. Mud house with thatched roof ☐ 3. Brick house ☐
 4. Brick with Iron roofed ☐ 5. Others..... ☐

WATER SOURCES

10. What is the general water situation in your community?
 1. Very easy to come by ☐ 2. Easy to come by ☐
 3. Difficult to come by ☐ 4. Very difficult to come by ☐
11. What is your main source of water for the household?
 1. River ☐ 2. Well ☐ 3. Borehole ☐ 4. Rain ☐ 5. Stand Pipe ☐ 6. others ☐ specify

12. How would you describe the water sources in your community?

[Check all that apply]

1. Clean ☐ 2. Salty ☐ 3. Smelly ☐ 4. coloured ☐ 5. others (specify).....

13. What is the reason(s) for the choice of water source by your household?

1. Proximity ☐ 2. Affordability ☐ 3. Only source ☐ 4. Taste of water ☐ 5. colour of water ☐

14. What distance does it take to go to the main source, get water and come back?.....

15. Are there seasonal (dry/wet seasonal) differences in water availability to your community?

1. Yes ☐ 2. No ☐ 3. Not sure ☐

16. Please tick (✓) the appropriate one

Water sources used at the households	River	Well	Borehole	Rain	Stand Pipe	Others
Major source of water during dry season						
Major source of water during wet season						
Main source of drinking water						
Main source of drinking water during dry season						
Main source of drinking water during wet season						

17. How satisfy are you with your drinking water quality during the dry season?

1. Very satisfied ☐ 2. Satisfied ☐ 3. Unsatisfied ☐ 4. Very unsatisfied ☐

18. How satisfy are you with your drinking water quality during the wet season?

1. Very satisfied ☐ 2. Satisfied ☐ 3. Unsatisfied ☐ 4. Very unsatisfied ☐

19. Do you spend any money on your source of drinking water?

1. Yes ☐ 2. No ☐ 3. Not sure ☐

20. How much do you spend on drinking water monthly?.....

KNOWLEDGE ON WATER TREATMENT OPTIONS

21. Do you consider the source of water in your community safe?

1. Yes ☐ 2. No ☐ 3. Don't know ☐

22. Has your household ever treated the water to make the water safer to drink?

1. Yes ☐ 2. No ☐ 3. Don't know ☐

23. How do you treat your water?

[Read all options, check all that apply]

1. Boil ☐ 4. Use a ceramic water filter ☐ 7. Let it stand and settle ☐
 2. Add bleach/chlorine ☐ 5. Use a sand filter ☐ 8. Don't know ☐
 3. Strain it through a cloth ☐ 6. Solar disinfection ☐ 9. Other ☐ specify.....

24. Why do you treat your water before drinking it?

[DO NOT read options. Check all that apply]

1. Contaminated with dirt ☐ 6. Looks bad ☐
 2. Contaminated with germs, bacteria, viruses ☐ 7. Good for health/appearance ☐
 3. Animals use the water ☐ 8. Smells bad ☐
 4. Contaminated with faeces/human/animal waste ☐ 9. Insects in it ☐
 5. So I don't get sick ☐ 10. Don't know ☐
 11. Other ☐ specify.....

25. Why did you select this water treatment method?

1. Affordable cost ☐ 3. Ease of use ☐ 3. It is effective ☐ 4. Other ☐ specify

26. How important to you is treating your water for drinking?

1. Very important ☐ 2. Quite important ☐ 3. Not so important ☐ 4. Not important at all
 5. Don't know ☐

27. How often do you treat your water before drinking?

1. Always ☐ 2. Sometimes ☐ 3. Never ☐ 4. Don't know ☐

28. When was the last time your household treated water using this method?

1. Today ☐ 2. Yesterday ☐ 3. Less than one week ago ☐
 4. Less than one month ago ☐ 5. More than one month ago ☐ 6. Don't know ☐

29. How much does your household approximately spend on the water treatment per month?

ExpendituresGh per month 1. Nothing ☐ 2. Don't know ☐

30. Have you ever received any awareness on how to treat water?

1. Yes ☐ 2. No ☐

31. What was the main source of your information?

1. Radio/Television ☐ 2. Health centre/Hospital ☐ 3. Information van ☐
 4. Community health agent ☐ 5. Community meeting/committees ☐ 6. Other ☐
 7. Don't know

32. Have you received any training on water treatment methods? 1. Yes 2. No

PREVALENCE OF WATER RELATED DISEASES

33. Do you think water can transmit diseases?

1. Yes ☐ 2. No ☐ 3. Don't know ☐

34. Does the water you use in this community gives you any diseases?

1. Yes ☐ 2. No ☐ 3. Don't know

35. Has anyone in this household ever suffered from a water related disease?

1. Yes ☐ 2. No ☐ 3. Don't know

36. What are the water used related diseases suffered by your household?

[Check all that apply]

1. Diarrhoea ☐ 2. Hepatitis A ☐ 3. Typhoid fever ☐

4. Bilharzia ☐ 5. Guinea worm ☐ 6. Skin rashes ☐

7. Other ☐ specify.....

37. Do you know of any water used related diseases in your community?

a. Yes ☐ b. No ☐ 3. Don't know

38. What water used related diseases are prevalent in your community?

[Check all that apply]

1. Diarrhoea ☐ 2. Hepatitis A ☐ 3. Typhoid fever ☐

4. Bilharzia ☐ 5. Guinea worm ☐ 6. Skin rashes ☐

7. Other ☐ specify.....

39. Which group of people are mainly affected by these diseases?

1. Children ☐ 2. Teenagers ☐ 3. Adult ☐ 4. Elderly

40. How many times has household member been affected by those diseases in the past year?.....

41. What do you think is responsible for the cause of these diseases in the community?

1. Use of unsafe water ☐ 2. Unsafe water storage ☐ 3. Poor sanitation ☐ 4. Poor hygiene practices ☐

42. How do you get infected by these diseases?

1. Drinking unsafe water ☐ 2. Contact with contaminated water ☐

3. Swimming/bathing ☐ 4. Other ☐ Specify.....

43. Has anyone in your household less than 5 years had any water related disease in the past four weeks?

1. Yes ☐ 2. No ☐ 3. Don't know ☐

44. What illness is experienced in your household by a child less than 5 year of age?

1..... 2.....

45. Why do you think these diseases are prevalent among the people in this community?

1. Lack of awareness to treat water ☐ 2. No education on effect of unsafe water consumption ☐

3. Use of unimproved sources of water ☐ 4. Lack of sanitation facilities ☐

46. In which season does the water related diseases become more prevalent?

1. Rainy/wet season ☐ 2. Dry season ☐

MANAGEMENT PRACTISES OF WATER RELATED DISEASES

47. What do you do when someone from your household has a diarrhea?

1. Buy drug from shop ☐ 2. Go to clinic ☐ 3. Give ORS ☐ 4. Traditional medicine ☐

48. How far do you travel to seek medical treatment for water related diseases?.....

49. Where do you go to seek medical treatment?

1. Herbalist ☐ 2. Hospital ☐ 3. Spiritual leader ☐ 4. Spiritualist ☐ 5. Any other ☐ specify

50. How have you treated water related disease suffered from?

.....

51. Why do you choose the treatment option you selected?

Briefly explain.....

52. How much do you spend on treatment of water related disease?.....

53. What would you do when you are unable to raise money requested for treatment?

Briefly explain.....

54. Do you face some challenges in the cause of treatment of water related diseases?

1. Yes ☐ 2. No ☐

55. What are these challenges?

1..... 2..... 3.....

56. What other strategies do you adopt in managing water used related diseases?

.....

.....

57. Give your recommendations in minimizing or eliminating water used related diseases prevalence in the community.

.....

.....

.....

.....

.....

APPENDIX II

SEMI-STRUCTURED INTERVIEW GUIDE FOR STAKEHOLDERS

COMMUNITY LEADERS/TRADITIONAL AUTHORITIES / HOUSEHOLD HEADS

Sources of water

1. What is the main source of water in the community
2. Tell me what you think about the water source in your community

Prevalence of Water Related Diseases in the Communities

3. Do you know some water related diseases associated with the use of your water
4. What are the common water related diseases prevalent in your community

People Most Affected by Water Related Diseases

5. Which people are mostly affected by these water related diseases
6. Describe how water related diseases affect people in the community

Management of Water Related Diseases

7. What are some of the ways people manage water related diseases in your family or community?

Awareness and Knowledge on Water Quality Improvement

8. Do you have any awareness or education about how to improve on quality of water? Yes [] or No []. If yes, explain how and where?
9. What have you been doing to improve quality of water?
10. What are your recommendations in eliminating or minimizing water related diseases in the community?

FOR HEALTH PERSONNEL/ ENVIRONMENTAL HEALTH OFFICERS

Bio Data

1. Name
2. Gender: 1. Male [] 2. Female []
3. What is your occupation.....
4. How long have you been working in this institution?

Prevalence of Water Related Diseases Reported in the Health Facility

5. What are the common cases of water related diseases reported within your facility?

People Most Affected by Water Related Diseases

6. Which category of people are mostly affected by these water related diseases

Effect of Water Related Diseases on the People

7. Describe effects of water related diseases on people reporting to the facility

Management of Water Related Diseases

8. What are some of the ways you manage water related diseases in your facility?

Awareness and Knowledge on Water Quality Improvement

9. Do you have any programme aim at creating awareness and public education towards water quality improvement? Yes [] No [] If yes, could you please explain how it is done
10. In your view, what should be done to improve quality of water for the people

Recommendations

11. What are your recommendations in eliminating or minimizing water related diseases reported in the facility?

APPENDIX III

Reliability Statistics

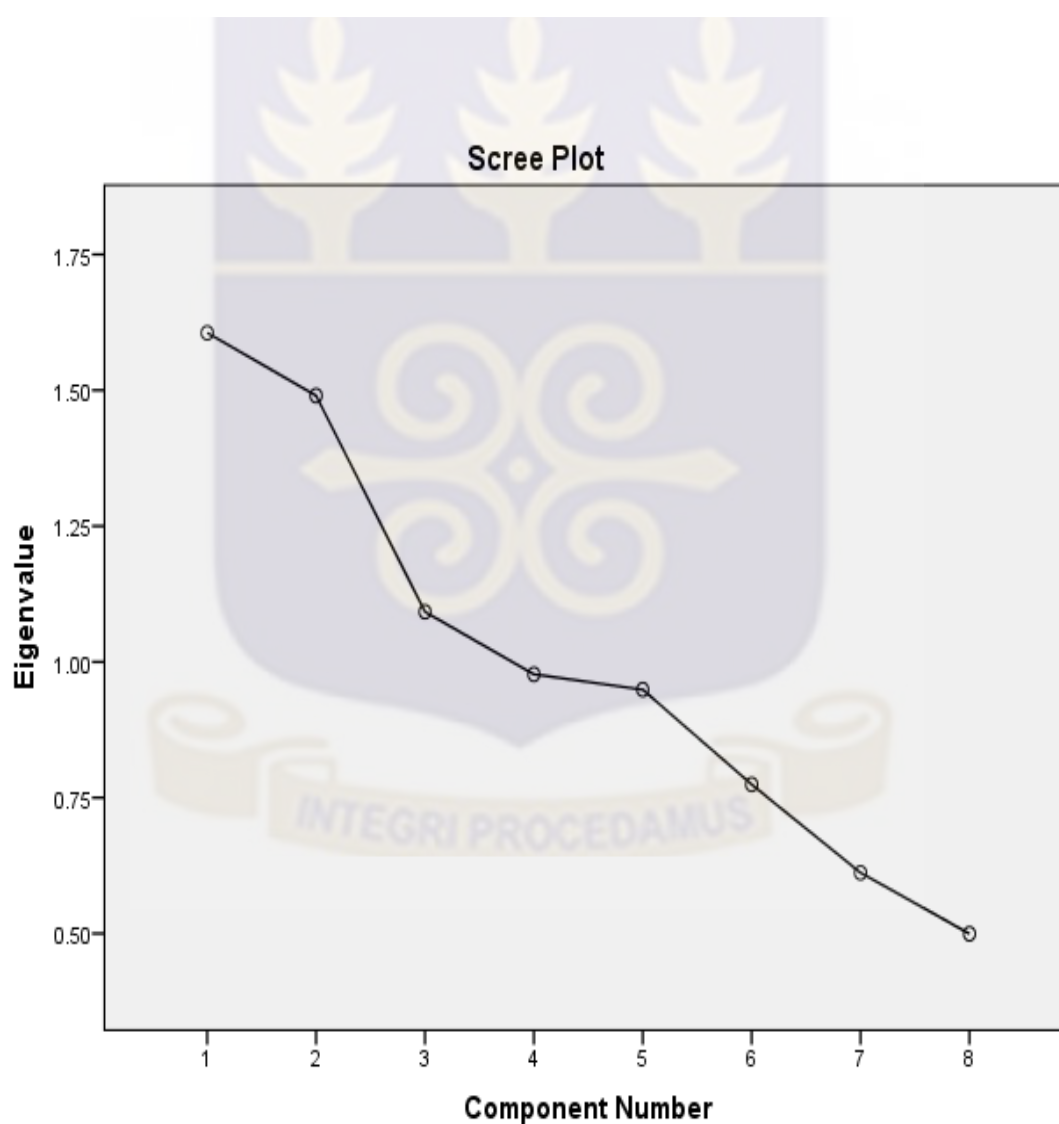
Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	Number of Items
.916	.941	80



APPENDIX IV

Correlation Matrix for Demographics (Independent Variables) to Predict Awareness about Water Quality Improvement (Dependent Variable)

	1	2	3	4	5	6	7	8
Gender	1							
Respondent age	-.021	1						
Length of stay	.047	.161	1					
Marital status	-.056	.449	-.002	1				
Level of education	-.073	-.188	.083	-.100	1			
Occupation	-.023	-.032	.012	.046	.239	1		
Respondent income	-.060	.047	-.005	.052	-.031	.053	1	
Respondent house type	.179	.026	-.071	-.081	-.315	-.147	-.058	1



APPENDIX V



Photo: A Focus Group Discussion with one of the Communities.



Photo: An interview session with an Assemblyman