UNIVERSITY FOR DEVELOPMENT STUDIES, TAMALE

WATER, SANITATION AND HYGIENE (WASH) PRACTICES AND THE INCIDENCE OF WASH RELATED DISEASES WITHIN THE TAMALE METROPOLITAN AREA

MUSAH ABDUL – KADIRI NAIDOO

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BY:

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AUGUST, 2020

DECLARATION

Student

I hereby declare that this thesis is the result of my original work and that no part of it has been presented for another degree in this University or elsewhere, with the exception of references which have been dully acknowledged.

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Supervisor

I hereby declare that the preparation and presentation of this thesis was supervised in accordance with the guidelines on supervision of thesis laid down by the University for Development Studies.

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ABSTRACT

Improved water, sanitation and hygiene (WASH) practices have been the most effective means of reducing the incidence of WASH-related diseases. This thesis assessed the association between WASH practices and the incidence of WASH-related diseases in the Tamale Metropolitan area of Ghana. The mixed method approach was employed with an explanatory study design. Multi-stage sampling technique was used to sample household heads and purposive sampling to select key informants for the quantitative and qualitative phases, respectively. A household survey, direct observations and key informant interviews were used to collect data. Using SPSS and MS excel, both descriptive and bivariate (Chi – squares[X^2]) statistical analysis were done for the quantitative data and thematic analysis for the qualitative data. The quantitative results revealed that out of the 398 households covered, 64.1% of them draw water from improved sources. 81.41% use unimproved toilet facilities with 79.9% not owning household toilets. 97.2% practice handwashing before eating, 81.8% practice handwashing after going to toilet but 80.2% of households had soap for handwashing. 23.87% of the households reported an incidence of a WASH – related disease within the past two weeks. The incidence of WASH – related diseases was statistically significantly associated with improved water sources (X^2 =6.565, p=0.010), water treatment (X^2=16.622, p=0.000), alternative place of convenience (X^2=15.170, p=0.010), type of household solid waste disposal system (X^2=37.542, p=0.000) and presence of soap for handwashing (X^2=5.599, p=0.018). The qualitative data revealed Islamic religion, Dagbon tradition and the predominant role of women in WASH as the socio-economic factors influencing WASH practices. Providing access to affordable improved WASH facilities and the enforcement of WASH-related byelaws are required to reduce the incidence of WASH-related diseases especially in urban areas like the Tamale Metropolis.

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DEDICATION

I dedicate this write up to my late father (Alhaji Musah Justice), late mother (Hajia Fatiha Ussif) and late brother (Musah Ibrahim Anyass). May Allah be pleased with your souls and grant you Jannatul firdaws.

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ACRONYMS

AMCOW	African Ministers' Council on Water
BVIP	Blair Ventilated Improved Pit
CDC	Center for Disease Control
CONIWAS	Collation of NGOs in Water and Sanitation
CAWST	Centre for Affordable Water and Sanitation Technology
CLTS	Community Led Total Sanitation
CREPA	African Regional Centre for Water and Sanitation
CRS	Catholic Relief Service
DFAT	Department of Foreign Affairs and Trade
DHS	Demographic and Health Survey
DALY	Disability – Adjusted Life Year
DDT	Dichlorodiphenyltrichloroethane
DVBD	Division of Vector Borne Diseases
DFWED	Division of Food Borne, Waterborne and Environmental Disease
DOMI	Diseases of the Most Impoverish
ENPHO	Environmental and Public Health Organisation
EAWAG	Eidgenössische Anstalt Für Wasserversorgung, Abwasserreinigung Und Gewässerschutz
ECDPC	European Centre for Disease Prevention and Control

FRC	Free Residual Chlorine
GPEI	Global Polio Eradication Initiative
GHS	Ghana Health Service
GDHS	Ghana Demographic and Health Survey
GDWQ	Guideline for Drinking Water Quality
GDP	Gross Domestic Product
GWCL	Ghana Water Company Limited
GWD	Guinea Worm Disease
GAR	Greater Accra Region
GDB	Global Disease Burden
GNA	Ghana News Agency
HLPW	High – Level Panel on Water
HWWS	Hand Washing with Soap
HWTS	Household Water Treatment and Safe Storage
HAT	African Human Trypanosomiasis
ITN	Insecticide – Treated Net
IRS	Indoor Residual Spraying
IPV	Inactive Polio Vaccine
IBM	Integrated Behavioural Model
IDE	International Development Enterprise
JMP	Joint Monitoring Programme

KVIP	Kumasi Ventilated Improved Pit
MLDC	Middle and Less Develop Countries
MMDAs	Metropolitan, Municipal and District Assemblies
MICS	Multiple Indicator Cluster Survey
MDG	Millennium Development Goals
NGOs	Non – Governmental Organizations
NAS	National Academy of Science
NCDs	Non Communicable Diseases
NTDs	Neglected Tropical Diseases
NCEZID	National Centre for Emerging and Zoonotic Infectious Diseases
NHD	Nanoro Health District
OPV	Oral Polio Vaccine
ORS	Oral Dehydration Salt
ORS	Outdoor Residual Spraying
ODF	Open Defecation Free
OPD	Out – Patient Department
PHAST	Participatory Hygiene and Transformation
PSI	Population Service International
RCT	Randomized Controlled Trial
STH	Soil Transmitted Helminth

SAFE	Surgery, Antibiotics, Facial Cleanliness and Environmental Improvement
SMSU	Sanitation Market Scale Up
SMoH	Saudi Ministry of Health
SANDEC	Sanitation, Water and Solid Waste for Development
SDG	Sustainable Development Goals
TaMA	Tamale Metropolitan Assemble
UNICEF	United Nations Children's Fund
URI	Upper Respiratory Infection
USAID	United States Agency for International Development
UDS	University for Development Studies
VIP	Ventilated Improved Pit
WASH	Water, Sanitation and Hygiene
WHO	World Health Organization
WSS	Water Supply and Sanitation
WCARO	West and Central Africa Regional Office
WSP	Water and Sanitation Program
WSUP	Water & Sanitation for Urban Poor

CHAPTER ONE

INTRODUCTION

1.1. Background to the study

One of the most operative means of decreasing the incidence and prevalence of water, sanitation and hygiene (WASH) related diseases in households, communities, districts, regions and countries is by guaranteeing an improvement in appropriate WASH practices within the said areas (Akter & Ali, 2011). Common WASH related diseases include Diarrhea, Malaria, Cholera, Typhoid, Intestinal Worms, Schistosomiasis (Bilharzia), Trachoma, Respiratory Infections among others (WHO & UNICEF, 2006). These are instigated by micro – organisms including viruses, bacteria, protozoans, parasites, vectors which are highly related to poor WASH practices (WHO & UNICEF, 2006).

For good health and survival, clean water, sanitation and hygiene are inseparable. By disrupting their infection cycle, access to clean water and sanitation services, and proper hygiene habits will prevent many diseases (CDC, 2010). By maintaining their access to clean water and sanitation services and encouraging them to uphold better medical, domestic and environmental hygiene, the principles of poor people's lives can be strengthened (UNICEF, 2015). In a specific context, people's knowledge and comprehension of clean water, sanitation, hygiene and related health problems are considered important factors in orienting practice (Akter & Ali, 2011).

Improved water habits include drinking water from an improved household water source, available if necessary and free of faecal and previous chemical contamination, so that the collection point for a round trip, including queuing, is not longer than 30 minutes (WHO & UNICEF, 2017b). Enhanced supplies are provided by pipe water, boreholes or tube wells, secured hand- dig out wells, secured spring and package or transported water. Water safety is

a vital factor in human poverty, schooling, and economic prospects, provided that contaminated water is a significant cause of illness and death. Sadly, the quality of water is globally declining, impacting the health of ecosystems and humans (UN-Water, 2006). Numerous causes, including population increase, rapid urbanization, land use, industrial removal of chemicals, and climate change impacts, effect this depletion (CDC, 2010). 1 in 10 people, around 663 million people, lack access to clean water worldwide. (Australian Water Association, 2010). Basic sanitation is defined as having access to facilities for the safe disposal of human waste (faeces and urine) and creating the capacity of service providers to maintain hygiene practices, such as waste disposal, industrial / disposal of hazardous waste, and waste disposal (CDC, 2015). In addition, proper sanitation is the use of better services (toilets and latrines) that are not shared with other household members and where excrement is properly disposed of in situ or transported and handled off-site. The basic principles of proper sanitation are not known to be hanging latrines or container latrines, the use of tube wells without a floor or base. Piped sewage system flush / pour wash, septic tanks or pit latrines, ventilated improved pit latrines, composting toilets, and concrete pit latrines are improved systems (WHO & UNICEF, 2006). Around 40 percent of the global population carries out open defecation or lacks adequate sanitation, or 2.5 billion people, more people in the world have a cell phone than they have a shower (Australian Water Association, 2010).

Basically, hygiene is the availability of hand hygiene facilities on soap and water premises, handwashing equipment that can be static or mobile, like a sink with tap water, pump pots, tippy taps, and jugs or basins allocated for hand washing, it has been predicted that handwashing alone has the capacity to minimize the incidence of dangers reported with diarrhea disease almost in half.

Despite a big increase in access to improved water component of WASH, WASH still remains a key challenge in worldwide development where countries tussle to cope with the principal problems of poor WASH practices (Smits, Schouten, & Fonseca, 2015). According to the United Nations, one of the world's most exigent issues is nonexistence of safe water, poor sanitation and hygiene, making WASH related developments vital to meeting the worlds development goals, decreasing child mortality, and improving health sustainably (United Nations, 2015).

The implementation of Sustainable Development Goal Six (SDG 6), ensuring accessibility and sustainable water, sanitation and hygiene protection for everyone, reflects the intensified focus of the global development and governance agenda on WASH issues. The 2030 Plan recognizes growing inequality, the loss of natural resources, environmental destruction and climate change as some of the major threats of our period. It acknowledges that the sustainable management of freshwater resources and habitats is based on social growth and economic growth and highlights the cumulative existence of SDGs (United Nations, 2018). Firstly, the SDG 6 goals call for universal and equitable access to water and sanitation for everyone, indicating a reduction in service level differences. Second, sanitation, which was not discussed in the Millennium Development Goals (MDGs), is included. Thirdly, they state that drinking water should be safe and available and that there should be sufficient sanitation. Finally, categorical references to the cessation of open defecation and the needs of women and children and those in disadvantaged circumstances are included (WHO & UNICEF, 2017a).

Low drinking water quality, sanitation and hygiene results in public health, poor nutritive outcomes in children, low productivity of the population, and gender disparity due to water collection and processing, the shame and vulnerability of open defecation, and barriers to

education and jobs where there are no clean, private toilets in schools and workplaces (UNICEF, 2016b). The shortage of clean drinking water, sanitation and hygiene impairs human decency, and stakeholders are thus satisfied that the SDGs pertaining to health, gender equity, education and hunger cannot be addressed without WASH reforms. Progress in achieving the WASH goals under SDG 6 also depends on achieving those relating to water resources, water safety, water reliability and habitats, as they are all connected to the total water cycle (UN-HLPW, 2016).

The significance of the efforts of the universal WASH community is highly acknowledged by the United Nations (UN) and encourages all prevailing stakeholders to share their knowledge and capability in order to successfully implement the SDG targets (UN-HLPW, 2016). In the light of the above, WASH practices and management becomes important and obligatory on individuals, households, communities, regions, nations and the world at large to aid in preventing diseases that may arise from none – practices and improper management of WASH in societies.

1.2. Problem Statement

The relation between poor WASH and health has long been known (UNICEF-UFC, 2012). WASH – related diseases are suffered by an enormous number of people worldwide, particularly in developing countries (Hutton, 2010). Acute respiratory infections (ARI), especially acute respiratory infections (LRTI) as a WASH-related illness, are estimated to be the leading cause of death in children under the age of five and are expected to be responsible between about 1.9 and 2.2 million childhood deaths worldwide, of which 42% of these ARI-related deaths occur in Africa (Williams, 2002). Diarrheal diseases continue as one of the main causes of deaths among under-fives, accounting for more than 600,000 child deaths globally, notwithstanding all the advancement in its management and the incontestable achievement of

the oral rehydration therapy (ORT) (WHO, 2014b). According to WHO (2008), contaminated water, poor sanitation and bad hygiene was related to 88% of diarrhea cases globally (WHO, 2008). Malaria cases are estimated at 216 million globally in 2016 with 90% of these cases taking place in the African Region, with 4% (7,776,000) of the cases happening in Ghana within that said period (WHO, 2017d). Out of these cases, 445,000 deaths occurred due to malaria of which 91% (407,000) were in Africa, with 3% of the recorded deaths that is 12,210 of the reported deaths happened in Ghana within 2016 to 2017 (WHO, 2017d).

The problem of WASH – related diseases are growing day – in – day – out and put forth pressure on scarce government resources (World Bank & WSP, 2012). The effects of unsafe water, inadequate sanitation and poor hygiene practices on the global economy with regards to health spending and labour division cannot be underscored (UNICEF, 2004). If the world is willing to provide countries in need of basic, low-cost water, sanitation and hygiene services, the world will save approximately US$ 263 billion a year (UNICEF, 2004). An operational means of preventing the spread of these WASH - related diseases in society is through the appropriate practices and running of WASH activities within households (Campbell et al., 2018). Within the Tamale Metropolitan Area, WASH – related diseases accounts for 43.28% of the total estimated cases at the various health facilities within the Metropolis between 2015 to 2017 (Ghana Health Service, 2017). Moreover, malaria and diarrhea are said to have contributed greatly to most deaths, particularly among infants. Malaria alone accounted for over 60 per cent of all deaths in the metropolis within the period of 2008 to 2011 (Tamale Metropolitan Health Directorate, 2011). According to literature, safe drinking water supply is said to have increase within the Metropolis over sometime however, reports has it that recent population increase which leads to a very high demand for portable water within the metropolis has resulted in acute water crisis in the area (Awepuga, 2015). As reported by Ziem & Gyebi (2017) GWCL will start a water rationing plan due to her

incapacity to supply 10 to 20 million gallons of water a day to the metropolis to meet the water demand of the population leading to dependence on unsafe water sources and improper water storage by residents within the metropolis (Ziem & Gyebi, 2017).

Over the past periods a lot has been studied within Ghana, Northern Region (NR), Tamale metropolis and the world at large in relation to WASH related diseases and WASH practices. Nkansah (2014) reported that under – 5 child death can be considerably reduced with improved sanitation and hygiene practices within households in Ghana (Nkansah, 2014). Moreover, a systematic review by Prathiba and Marshall (2012) indicated clearly that environmental factors contribute largely to the breeding sites for malaria vectors in urban Ghana (De Silva & Marshall, 2012). Kabilaa (2014), also reported that households with high and numerous WASH – related disease problems are those whose main source of water were traditional (rivers, streams and lakes), households with unhygienic or dirty fetching pans, unsafe transportation process, poor storage facilities within households as well as use of unsanitary toilet facilities and dipping of dirty hands into water during the fetching process (Kabilaa, 2014). Furthermore, studies such as UNICEF WASH Program (2011) which continues to focus WASH studies more on understanding and addressing inequities so that all children and women, particularly those who suffer the worst deficiencies, realize their full potential for existence, growth and development in trying to improve WASH focused on equity issues at all program levels in Ghana (UNICEF, 2011). World Vision Ghana WASH Programme (WVI) (2016) also focuses much on access to safe water, improve sanitation and hygiene services to poverty reduction and socio – economic development as well as access to basic education for children (World Vision Ghana, 2016). Multiple Indicator Cluster Survey (MICS) (2017), have also focus their studies primarily on the percentages of population with access to safe drinking water, improved sanitary facilities specifically toilets and hygiene services.

The existing researches and programmes in Ghana, Northern Region and Tamale Metropolis, have therefore concentrated on assessing the impact of WASH programmes in societies as well as access to WASH activities without investigating the influence of WASH practices on the incidence of communicable WASH - related diseases within the Tamale Metropolis. In addition, WASH collaborators have also concentrated primarily on structural capacities and services needed to handle the complexities of environmental sanitation, with limited insight into the behaviours of urban people in the Metropolis about communicable diseases. Imperatively, this study sought to consider the association between WASH practices and the incidences of WASH-related diseases within Tamale Metropolitan area in the Northern Region as well as the influence of various socio – cultural factors that may directly or indirectly affect the practices of WASH and the incidence of WASH – related diseases on households within the Metropolis. This kind of assessment is conspicuously missing in various studies, thereby creating a gap that forms the locus of this study.

1.3. Research Questions

1.3.1. Main Research question

What is the association between WASH practices and the incidence of WASH – related diseases and what sociocultural factors influence WASH practices within households in Tamale Metropolitan area?

1.3.2. Specific Research questions

1. What are the water, sanitation and hygiene practices within the Tamale Metropolis?
2. What is the incidence of WASH – related diseases within the Tamale Metropolis?
3. What is the association between water, sanitation and hygiene practices and the incidence of WASH – related diseases within the Tamale Metropolis?
4. What socio-cultural factors influence WASH practices in the Tamale Metropolis?

1.4. Objectives of the Study

1.4.1. General objective

To assess the association between Water, Sanitation and Hygiene (WASH) practices and the incidence of WASH Related Diseases and explore the socio-cultural factors that influence WASH practices within households in Tamale Metropolis.

1.4.2. Specific objectives

1. To determine the Water, Sanitation and Hygiene (WASH) practices within the Tamale Metropolis.
2. To determine the incidence of WASH-related diseases within households in the Tamale Metropolis.
3. To determine the association between WASH practices and Incidence of WASH related diseases within the Tamale Metropolis.
4. To explore the socio-cultural factors that influence WASH practices within the Tamale Metropolis.

1.5. Hypothesis of the study

Null hypothesis (H_o):

There is no association between Water, Sanitation and Hygiene (WASH) Practices and the Incidence of WASH – related diseases with the Tamale Metropolis.

Alternative hypothesis (H_a):

There is an association between Water, Sanitation and Hygiene (WASH) Practices and the Incidence of WASH – related diseases within the Tamale Metropolis.

1.6. Significance of the Study

The study adds knowledge to WASH and its related diseases with emphasis on the Tamale Metropolis. It serves as a guide to Health Directorates, Metropolitan, Municipal and District Assemblies as well as other interested stakeholders in the development arena in designing appropriate disease preventive programmes and to ensure effective management of WASH-related activities. The findings from the study will enable policy makers to package programmes that will ensure reduced exposure to WASH-related disease-causing pathogens, vectors, bacteria as well as improve health conditions of individuals and households within the Tamale Metropolis. In addition, the study lays bare other issues that will generate further research into the issue of Water, Sanitation and Hygiene Practices (WASH) and WASH-related diseases.

1.7. Organization of study

Six chapters are grouped into the research work. Chapter one is the overview that covers the context, issue statement, analysis concerns, aims, study importance, and task structure. Section two provides a study of recent research on water, sanitation and hygiene (WASH) and WASH-related disease practices. Chapter three comprises the procedures used: field of study, architecture of study, population of study, sampling (sampling scale and strategies of sampling), data collection tools and techniques (Structured questionnaire, observation guide key informant interviews, among others) as well as statistical data analysis (with graphs and diagrams) and ethical consideration. Chapter four presents the results as well as analysis and findings of the study. Chapter five basically discusses the major findings of the study. Finally, chapter six includes summary of findings, conclusion and recommendations of the study.

CHAPTER TWO

LITERATURE REVIEW

2.1. Introduction

The chapter reviews relevant conceptual, theoretical and empirical literature related to the study. The conceptual component of the review covered; the concept of WASH, forms of WASH practices, the concept of WASH-related diseases, Types/forms of WASH related – diseases, and burden of WASH-related – diseases. This was followed by a review of theories and/ frameworks on the relationship between WASH practices and WASH related – diseases. Finally, the empirical review covered evidence of WASH practices, incidence/prevalence of WASH related – diseases, the association between WASH practices and incidence of WASH-related diseases and socio-cultural factors influencing WASH practices.

2.2. Concepts of Water, Sanitation and Hygiene (WASH) practice

2.2.1 Introduction

The definition of water, sanitation, and hygiene (WASH) seek to improve access to essential needs, including safe water, decent sanitation and hygiene facilities in order to split the faecal – oral path of spread of disease (Weaver et al., 2016). Good WASH practice target the provision of quality drinking water supply, good sanitation facilities to guarantee safe stool discarding and good hygiene services including handwashing facilities, and the required behaviour change techniques that promote effective use of WASH-related facilities (Weaver et al., 2016).

2.2.2. Safe drinking water supply

A healthy supply of water applies to the production of water as a resource that does not adversely impact human health (Hamner et al., 2006). A household piped water link; a public

stand pipe; a borehole; a protected drilled well; a shielded spring and a rain harvesting system are safe water supplies (Cairncross & Valdmanis, 2006). If these sources are capable of providing 20 liters per capita per day at a distance not greater than 1 kilometer from the dwelling of the consumer, then enhanced (safe) substances are considered (Hamner et al., 2006). The 2001 World Water Supply and Sanitation Evaluation Study reveals that some nations have used stricter concepts than others for an enhanced flow of water (WHO/UNICEF, 2001).

Unimproved water supplies are referred to as: unprotected wells and rivers, tanker trucks and vendors (WHO/UNICEF, 2001). Furthermore, Cairncross and Valdmanis (2006) noted that what one group of consumers may perceive to be a completely sufficient water supply system might be unacceptable for another group, as this could be determined by socio-cultural differences between groups. They also argue that there is no particular, well-defined presence in drinking water ... But at various levels of operation, modifiable advantages and different costs can be given (Cairncross & Valdmanis, 2006). If used for consumption, household use, food security or leisure purposes, increased water quality and better water quality management, safe and easily available water is vital to public health, can promote countries ' economic development and can make a significant contribution to alleviating poverty (WHO, 2018a). Four essential characteristics will determine the status of healthy drinking water supply: consistency, quantity, reliability, and cost (National Academy of Sciences, 2007a).

2.2.3. Sanitation

The word sanitation is part of the wider definition of sanitation facilities, which refers to systems that resolve storm-water and effluent drainage problems, flood prevention, storage and disposal of waste, and the removal of human excreta (Pandve, 2008). Furthermore, Pandve (2008) agreed that natural environment requires not just the services offered by

government officials, but also the mind-set of the society. This is due to the fact that if community members strive for the same end, a healthier atmosphere will result.

Within the context of WHO, sanitation refers to both the delivery of social services for the safe management of human excreta from the toilet to containment and storage facilities onsite or conveyance, treatment and safety stock end use or disposal. More broadly, sanitation also includes the safe solid waste management and animal waste (WHO, 2017a). All sanitary techniques are emerging adequate as long as they are private or shared but not public and provided that the hygienic separation of human excreta from human contact exists (Cairncross & Valdmanis, 2006). UNICEF specifies that the use of pit latrines, hanging latrines or bucket latrines, without a slab or foundation, is not considered to be a core concept of better sanitation. Improved services, however, include piped sewage system drain / pour drain, septic tanks or pit latrines, ventilated enhanced pit latrines, composting toilets, and concrete pit latrines (WHO & UNICEF, 2006).

2.2.4. Hygiene

An activity that is either personal or domestic can apply to hygiene (Esery et. al., 1991). Personal hygiene refers to the use of water for the washing of areas of the body, and water used to disinfect household products such as food, utensils and floors (Esrey, Potash, Roberts, & Shiff, 1991). Hygiene practice has generally been considered part of water and sanitation research in many articles reviewed, and this is because all three modules (water, sanitation and hygiene) have a common impact on human health (Pruss-Ustun, Robert, Fiona, & Jamie, 2008). Hygiene documentation was therefore considered by WHO and UNICEF as an essential piece of their work on hygiene and sewerage issues (WHO & UNICEF, 2006). Fewtrell and Colford (2005) observed that sanitation steps consisting of hand-washing and sanitation education typically lead substantially to a decline in WASH-related diseases

(Fewtrell & Colford, 2005). Effective hygiene is a major barrier to several infectious diseases, such as faecal-oral diseases, as Howard et al. (2002) concluded, and facilitates better health and well-being, so hygiene reforms should be made in addition to enhancements in quality of water and drainage and combined with other steps to obtain the highest health benefits (Howard et al., 2002). Howard et al (2002) also indicated that it is not possible to identify pathogens on hands and that water alone is not inherently enough to eliminate them, indicating that soap, wood ash and sand are washing and disinfecting agents when reacted with air which can be used to destroy bacteria on hand and cookware (Howard et al., 2002). In addition, the most critical occasions when hands can be washed with water and soap are; after defecating; after cleaning a child who has defecated and before eating or handling food.

2.3. Types/Forms of WASH practices

2.3.1. Types/forms of improve drinking water supply sources

A freely available water source that provides ample clean water to satisfy neighbourhood needs should be accessible to facilitate community health, and household water uses can be measured by asking community members regarding their everyday use of water (Howard et al., 2002). In addition, Howard et al (2002) clarified that either the water supply source should be covered, or the water should be handled before use, to ensure that the water is potable. Unprotected reservoirs of water, such as streams, common wells and wetlands, may also be strengthened and the creation of brand new supplies may be beneficial. Unprotected outlets, however, are vulnerable to pollution and pose a potential health danger, so the use of regulated sources of drinking water should be promoted by environmental sanitation schemes (Howard et al., 2002). In several cases, water sources for drinking and other domestic uses may be provided to societies. Popular water management procedures are presented in the following sections.

The provision of water from pipes is one source of water. Plumbing networks are sometimes classified as conduit or suspension mains, delivery mains, utility lines, and drainage properties from the smallest to the largest, for the transfer of water from the source (such as a treatment plant) to the recipient. Usually, transmission or trunk mains carry vast volumes of water over long distances, such as from a treatment plant to a delivery grid holding tank. Usually, delivery mains are narrower in diameter than the transmission mains which normally fit the streets of the city. Service lines bring water to the house from the delivery channel. Service lines can be of any size based on how much water is needed to support a given customer and are sized such that the construction pressure of the utility is preserved with the desired flows at the customer's premises. Premise plumbing refers to the pipe that distributes water to the level of use within a building or house (Yezzi, Haught, Tafuri, Meckes, & Clark, 2010). Public officials should carefully determine where to position the taps when designing a public piped scheme, so that everybody has comparatively opportune access, in addition, drain leaks need to be easily fixed to reduce water contamination, and to prevent surface water from accessing the pipes and contaminating the flow (Howard et al., 2002). The most enhanced and secure main source of water for drinking and other domestic uses is the pipe water supply source, as per the WHO, as strong progress has been made in the use of piped water supply on premises, which embodies the highest rung of the ladder of water supply where health benefits are greatly increased (UNICEF/WHO, 2017). Since 1990, the consumption of piped drinking water has increased by six percentage points, hitting 78 per cent worldwide in 2006, based on WHO reports. Although this can seem small, it reflects an expansion of one billion individuals. This breakthrough is exceptional. Piped drinking water, however, appears to be primarily an economic privilege: 2.5 billion urban residents compared to only 1.1 billion people in rural areas, a piped drinking water connection is used on site

(UNICEF/WHO, 2017). In addition, WHO (2017) said that this has helped to reduce water-related diseases in most urban cities around the world, especially in the developing world.

Hand pump / borehole water supply is another source of water. Boreholes are narrow holes drilled into the surface that tap into groundwater, moreover, boreholes can be drilled using motorized rigs controlled by qualified people, but this is costly. Boreholes may also be bored under pressure ('jetting') by hand using an augur, or by pressing water into the earth (Howard et al., 2002). Generally, a very well-constructed borehole with a hand pump yields water of decent quality (Watson, 2011). In addition, Watson (2011) clarified that a perfectly built borehole should be placed at a reasonable distance from sanitary establishments and that a proper plasterboard seal should be mounted to prevent the intrusion of contaminated surface water or underground water into the borehole (Watson, 2011). The borehole housing must be intact or polluted water can enter and a waterproof apron slopes down away from of the pump must stretch around the borehole for at least 1 meter and the apron must also drainage into a drainage channel that leads to spilled water at least 4 meters from the tube-well until it is disposed of in a garden or soaked away. Watson (2011) further asserted that the borehole, pump, pipework and related structure should be regularly disinfected using chlorine solution to remove pathogens and guarantee the water is safe to drink (Kebbede, 2018).

Household water treatment is another form of water operation within households. It is well known that tap water at the household level can contribute to essential improvements in drinking water quality (Majuru, 2008). Household water treatment has been shown to be one of the most efficient and cost-effective approaches in manufacturing and emergency settings to inhibit bacterial infections (UNICEF, 2008). According to Conroy et al (2001), in most developing countries, the occurrence of infectious diseases and other crises caused by floods and drought inflicts a major health strain and diverts scarce health and economic resources

away from existing national and regional development policies and, because of its potential for rapid and customized delivery, domestic water agreements (Conroy et al., 2001). Conroy et al (2001) also reported that in incidences or emergencies, heating, point-of-use chlorination, water purification and sachets incorporating flocculation / disinfection have been shown to be effective in minimizing the spread of cholera and certain diarrheal diseases (Conroy et al., 2001). The boiling or heat composition of fuel waste water is effective against both the full spectrum of microbial pathogens and can be used independent of the salinity or dissolved water components (UNICEF, 2008). According to Sobsey (2002), boiling or boiling of fuel water has been in use since ancient times to clean household water and is useful in destroying all forms of bacterial species (viruses , bacteria and pathogenic bacteria, fungi and microbes and helminth ova) and also can be applied successfully to all liquids, including those rich in turbidity or soluble materials. In addition, Sobsey argued that, while some officials endorse bringing water to a gentle simmer, as an acknowledgement of a rising water boil and temperature has been achieved (Sobsey, 2002).

The method of applying chlorine to drinking water to clean it and remove germs is chlorination (CDC, 2015). Chlorine has been used as a significant water disinfectant for over a century and is essentially responsible for the removal in developing countries of water-borne diseases such as typhoid and dysentery (Water Professionals, 2014). Apart from boiling, it is also the process most commonly used in households and the most commonly used way of preparing water at the neighbourhood level (UNICEF, 2008). Sodium hypochlorite (such as white vinegar or electronically produced from a mixture of salt and water), chlorinated lime, or high-test hypochlorite (chlorine tablets) may be the source of chlorine, according to UNICEF (2008), and they are typically accessible and inexpensive. The sodium hypochlorite solution is wrapped in a bottle with instructions to advise consumers in a standard-sized storage jar to apply one full bottle cap of the solution to clear

water (or two turbid water caps); stir; and wait 30 minutes before drinking (UNICEF, 2008). If the chlorine dosage is low, the solution will fail to kill all the dangerous micro-organisms and, if in excess, health will be adversely affected. The proper quantity of chlorine solution must be used. Both dangerous micro-organisms can be killed with just an acceptable quantity of chlorine which can have a healthy volume of residual chlorine. "Free Residual Chlorine" (FRC) is named chlorine that does not mix with other elements and stays in the environment. The FRC contamination of drinking water should be approximately 0.2 and 0.5 mg / L, according to WHO recommendations (ENPHO, 2005).

Filtration is also another ancient and commonly used technique for household or point-of-use treatment of water that extracts pollutants and at minimum some bacteria from drinking water and a number of filter devices and filtration methods are available (Sobsey, 2002). The convenience, ease of use, availability, usability and affordability of these filtration media and methods differ widely and also rely on local factors, according to Sobsey (2002), and the efficacy of these filtration methods in microbe reduction varies widely, depending on the type of microbe and the type and efficiency of the medium or device of filtration (Sobsey, 2002). Through moving it via porous material, the filtration process involves the isolation of dissolved solids and impurities from water and the removal of a filter is achieved by a variety of processes (Sagara, 2000). According to Sagara (2000), the most popular filtration pathways are other source of water and process of reducing the number are physical straining, subsidence and granular bed filtration. Throughout mechanical straining, particulates in the water that are greater than the pore size of the filter media particles are stuck on the exterior of or within the mainstream press, removing the particles. Inside the pores, ions contained within the pores of the filter media settle and are separated by a sedimentation process from water (Sagara, 2000). Based on the type of filter media used while water is moving through

the granular material, granulated bed filters can remove impurities in the shape of impurities or chemical pollutants, and the contaminants are either squeezed or adsorbed (Sagara, 2000).

2.3.2. Types/forms of improved sanitation facilities

As per the Center for Disease Control (CDC), basic sanitation is characterized as supplying access to schools for the safe disposal of human waste (faeces and urine), and also some maintaining the capacity to maintain hygienic conditions through services such as garbage pickup, industrial / disposal of hazardous waste, and solid waste disposal and treatment (CDC, 2010). The aim of clean water is to safeguard public health through the conservation of water sources and to prevent the environmental degradation of faeces and break the disease cycle (CAWST, 2011).

The flushing toilet, which has a flushing system to wash the feces, faeces and toilet paper away with water and needs a continuous and adequate (adequate) water source, has evolved into its modern form over the years. A quick, safe and hygienic sewage disposal system is given by the flushing toilet (Griffiths et al., 2010). In addition, Griffiths et al (2010) observed that the water force from the flushing process called the cistern washes the faeces and toilet paper into the septic tank or drainage system. The pour flush toilet stops people from viewing or hearing previous people' excreta and is normally well tolerated as long as the water seal fits well and there should be absolutely no odour and the toilet should be clear and easy to use (Tilley, Ulrich, Lüthi, Reymond, & Zurbrügg, 2014).

In any sanitation facility where the faeces and urine go directly into a hole in the ground (Griffiths et al., 2010), a pit sanitation is also called latrines, drop-hole toilets, even shaft-hole toilets. They consist of a hole in the earth that can be representative of the overall or covered with a supportive sheet to contain human excrement (e.g. bricks, concrete rings), most often combined with a kneeling slab or door handle and a frame that offers protection (Orner,

Naughton, & Stenstrom, 2019). Although the suggested minimum pit depth differs from one study to another, it should not ultimately be sunk lower than at least 2 m above the fluid velocity of freshwater, allowing for the maximum monthly depth of water table (Reed, Torr, & Scott, 2016). According to Brouckaert, Foxon and Wood (2013), a pit is deemed complete until the accumulated excreta reaches from about 0.5 to 1.0 m below the ground surface and pit toilets may be used for 10 to 30 years based on their nature and regularity of usage, though many are used less than 5 years before they are complete and must be drained or sealed (Brouckaert, Foxon, & Wood, 2013). The materials (i.e., faecal sludge) can either be removed before the "filled" level of the pit is reached, or debris can occupy the free 0.5-1.0 m upper area. In this above case, the pit is no more used and the upper components (slab and privacy shelter) can be dismantled and transferred to a new pit. Pit toilets come in and in different forms and sizes. They will have a p, for example.

The ventilated improved pit (VIP) latrine is an improved version of the pit toilet. This is a specially built dry drop-hole toilet so that any flies that enter the hole and scuttle over the water will not escape and bring disease-causing germs to individuals and food. Odours (smells) are minimized and by finding the correct location for the toilet, those that do exist are guided away from the environment (Griffiths et al., 2010). Furthermore, the liquid for excreta and anal cleaning sinks into the pit where the raw material decomposes and residual fluids enter the surrounding soil. Normal ventilation across the upper layer and traveling through the surface of the vent pipe eliminates odours from the pit to the atmosphere and absorbs gases. This latrine technology is ideally suited to agricultural, Peri-urban and some parts of urban areas where, after pits are filled, land is available for future resettlement (UNICEF, 2016a). An upgrade to the standard VIP is the Kumasi Ventilated Improved Pit (KVIP), according to UNICEF (2016), which is equipped with double pits with exactly the same pit configuration as the Single Pit VIP with an additional advantage of a second pit that

allows it to be used at all times and allows better and faster emptying. One pit can be used for utilizing two pits, while the content of the second pit sits, sinks, falls in depth, and degrades, and it is protected until the second pit is nearly complete (the excreta is 50 cm from the surface of the pit), and the content of the first pit is withdrawn (UNICEF, 2016a).

As per Crennan Leonie (2007), composting toilet (CT) or latrine is a drainage procedure capable of turning faeces and organic material into a leafy or soil-like material with a healthy earthy odour that can be safely disposed of in the atmosphere after ample time has elapsed for organic waste (Crennan, 2007). Excreta fall into a watertight tank or chamber in this latrine to which ash or vegetable matter is applied. The mixture can decompose to form a strong organic fertilizer in about four months if the water absorption and chemicals balances are managed. Pathogens in the dry alkaline manure are destroyed, and can be extracted as a fertilizer for application to the soil (UNICEF, 2016a)..

2.3.3. Types/forms of hygiene practices

However, according ESCON (2017), good hygiene helps to prevent infections, infections and gut-turning body smells. Hygiene is a much wider term than many say to be "cleanliness." Hygiene is an option to make private habit choices such as daily washing, clean clothes, hand washing (especially before and after meals), keeping sanitized urinals / bathing area for a clean and virus-free environment, and even sharply dressing a shallow scratch (ESCON ARENA, 2017). A much wider concept is sanitation.

One of the most significant respects we have to protect ourselves and others from disease is proper physical health and this means brushing your teeth, mostly, and also the skin. It also involves being vigilant not to cough or sneeze on someone, washing items that you handle while you are unwell, throwing stuff in a bucket, such as tissues (that may contain germs),

and having precautions (such as gloves or condoms) when you could be at risk of getting an infection (Hiscock, 2008).

Therefore, personal hygiene is a step taken at the individual level to encourage personal cleanliness so that disease spread from the source to susceptible hosts is avoided (Legesse & Argaw, 2014).

Basically, hygiene is the accessibility of hand washing facilities on soap and water premises, hand washing facilities that can be immovable or movable, including a sink with tap water, tap containers, tippy taps, and jugs or basins reserved for hand washing. It has been estimated that hand washing alone has the potential to minimize almost half the incidence of diarrhea disease-related deaths (Australian Water Association, 2010).

Another research by Luby et al (2004) showed that children under 15 years of age using hand washing with soap had half the incidence of diarrhoea relative to children living in nearby populations without hand washing (Luby et al., 2004). Make sure the customer satisfaction is maintained when repairing a hand washing facility (e.g. adding drainage; creating regular cleaning and repairs, etc.). The more pleasant the services are, the more likely they are to continue to be used by customers and the more they support and are prepared to bring work into upkeep (Molly, 2019).

According to Molly (2019), hand washing facilities will take various forms inside households and populations, including basic hand washing containers, a tub with a hole in it; finding a jar (e.g. a will or plastic bottle) and cutting a hole in the bottom is one of the easiest ways to create a hand sink. Hands should be cleaned after being filled with water, as the water drips down steadily. This low-cost alternative is quickly and very effectively executed. In comparison, taking a container (i.e. a wide pan, bottle or pot) and drilling a hole at the top is a Tippy Tap type hang sink, which can be created by many techniques and the most common

technique. On the top of the bottle, a string and a pedal are added to allow the water to flow out. Another hand washing facility Molly, (2019) mentioned of is Tippy-Top Hand Sink, very quick, but needs constructed fitting, a bucket with a valve at the bottom can also serve as a hand sink (Molly, 2019).

A research by Howard et al (2002) confirmed that tainted food epitomizes one of the population's biggest health threats and is a significant source of disease outbreaks and spread. Food that is processed for too long can go bad and produce poisonous chemicals or bacteria, and dirty hands, unclean water or flies can contaminate foods that are consumed raw, such as fruits or vegetables (Howard et al., 2002). In comparison to the research quoted above, Howard et al (2002) observed that it is crucial that families learn the values of basic hygiene and know how to cook food safely, since most food is likely to be prepared at home. Hands should be washed with soap or ash prior to food preparation. Raw fruit and vegetables should not be eaten until they are first peeled or washed with clean water. Cooking food properly, especially beef, is also essential (Howard et al., 2002). In order to ensure food safety and to protect consumers at any given stage, all the requirements and procedures required to ensure the quality of food from cultivation to consumption must be adequately exercised. During slaughtering or harvesting, collection, packaging, delivery and transport, food may become polluted at any point (WHO, 2018c).

Only the community as a whole should pursue certain health measures; these include conservation of the water supply, proper treatment of solid waste and excreta, recycling of waste water, animal rearing control and public hygiene. In community hygiene, individual community members play an important role and have a responsibility to their neighbours and to the community to encourage good health and a safe atmosphere (Howard et al., 2002). Successful hygiene education can facilitate immediate and permanent changes to current

hygiene standards and foster positive attitudes towards hygiene in the society. Practicing good hygiene is also a lifestyle shift that can be achieved for any and every one, whether wealthy or poor, young or elderly, educated or not, and good community hygiene can also be a low-priced way of making a significant impact on a village 's health as hygiene is one of the least costly, most cost-effective improvements that can be implemented with immediate quality of life benefits (LifeWater, 2014). For instance, everyone in the neighbourhood must keep their homes and compounds clean, since many conscientious neighbours will be infected by one filthy house and lead to the spread of disease (WHO, 2014a).

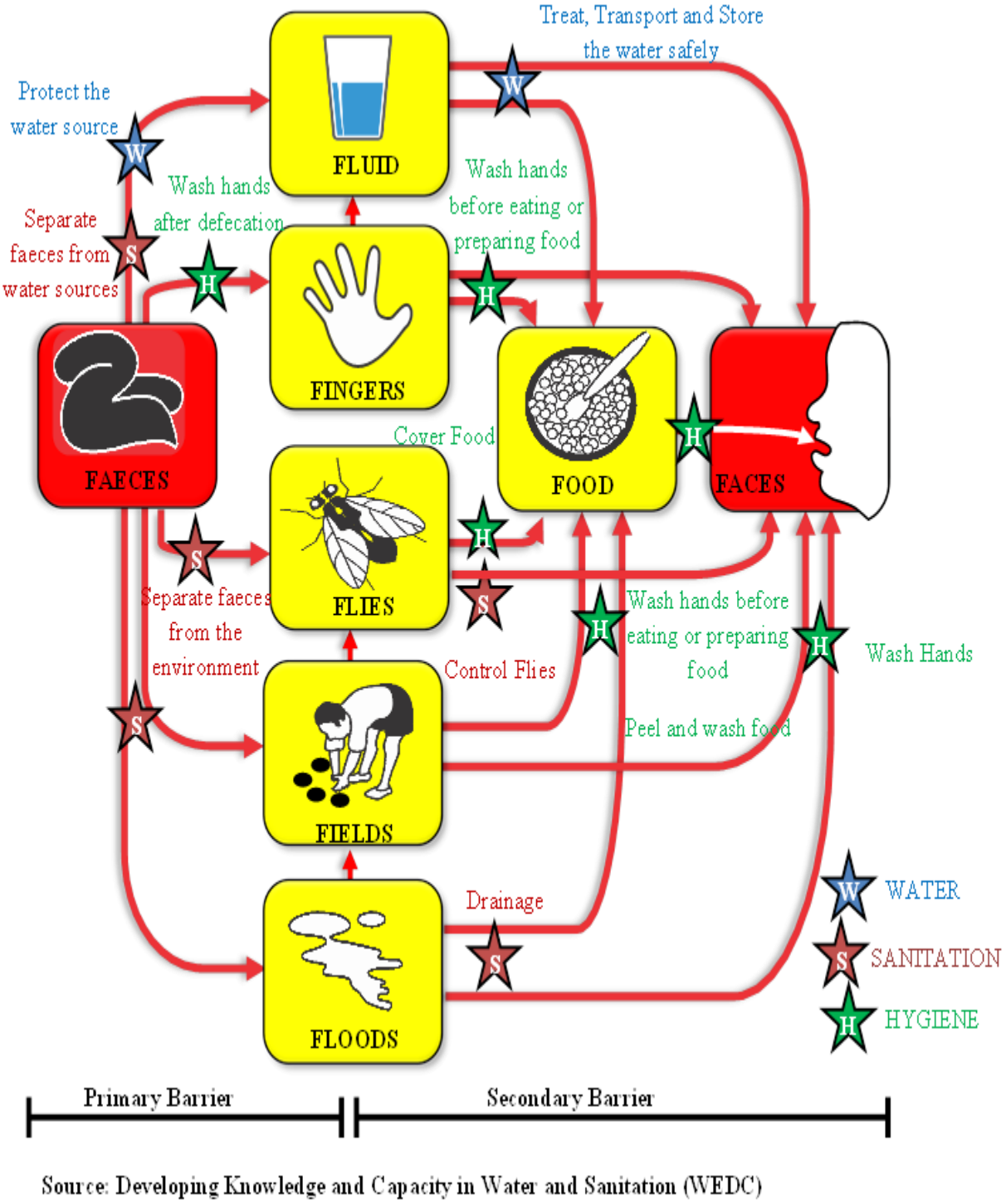
Markets often pose a health risk because foodstuffs may not be sufficiently stored and because the markets also lack basic services, such as water treatment, hygiene, solid waste disposal and drainage. Markets should have several taps in an exceptional way and allow ready access to clean drinking and laundry water for traders and customers. Many fruit and vegetable sellers also cover their products with water, and it is important that they have access to clean water for this (Howard et al., 2002). WHO (2014) proposed that basic sanitation within the market grounds should be adequate for the number of people who would enter with separate spaces for men and women (WHO, 2014a). Markets typically produce a lot of solid waste and it is vital that it is disposed of properly and regularly, to prevent feeding and breeding of vermin such as rats and insects, and this can be made more efficient by strategically placed waste bins (often concrete bunkers), in order to stop pollution and pest spawning, commercial areas can also be well drained (Howard et al., 2002).

2.4. The concept of WASH related diseases

In the theories and activities of various authors involved in the field, the definition of WASH associated diseases is used and described differently (Szálkai, 2019). Jamul (2007) refers to WASH-related illness as a disease that happens during the intake or use of drinking (potable)

water, or the use of recreational water. Pools, spas, amusement park amusement, and fresh and coastal shore water provide aquatic water (Jamul, 2007). WASH-related diseases have been identified by the US National Institute of Environmental Health Sciences as follows: WASH-related diseases are caused by a broad range of pathogenic microorganisms, biotoxins, and harmful pollutants contained in the water we drink, clean, play in, and are exposed to by other less clear mechanisms, such as cooling systems (EHP-NIEHS, 2010). WASH-related diseases were recognized by Shankar, Mishra, and Singh (2014) as any disease caused by the ingestion of water polluted by human or animal faeces containing pathogenic microorganisms. These may include viruses, bacteria, or protozoans (Shankar, Mishra, & Singh, 2014).

There are several routes, some direct and some not direct, for the passage of bacteria from the faeces of an infected person to where they are eaten by someone else (World Health Organization, 2001). WASH-related bacteria passes through a number of paths from one host to the next, either as a result of overt transfer by infected hands or indirect transfer of drinking water, soil, utensils, food and flies by means of exposure (Brown, Cairncross, & Ensink, 2013). Any route that enables faecal matter to enter the mouth will transmit Excreta-related WASH-related diseases; the faecal-oral route (Reed, 2017). Knowing how diseases (disease-causing organisms) are spread helps public health professionals to act in effective ways to interrupt the chain of infection, save lives and reduce needless suffering. In 1958, Wagner and Lanoix defined the key transmitting methods and created what is now known as the 'f' diagram. (Reed, Skinner, & Shaw, 2012).



Source: Developing Knowledge and Capacity in Water and Sanitation (WEDC)

Figure 2. 1 "F – DIAGRAM"

The F-Diagram is one of the several methods in the technique of Participatory Hygiene and Transformation (PHAST) that aims to describe in depth the faecal oral transmission path defined by photographs of faecal-oral processes to break / reduce infection (David, Mumuni, & Awuku, 2009). Lack of proper sanitation (leading to open defecation) and inadequate

hygiene habits are the major causes of the spread of faecal – oral disease. If soil or bodies of water are contaminated with faecal waste, waterborne diseases or soil-transmitted diseases may affect humans. Another type of faecal-oral transmission is faecal contamination of food. Washing hands correctly will prevent illnesses from spreading after changing a baby's diaper or returning from the toilet. Fingers, flies, fields, liquid, and food are the prevalent faecal-oral routes (Modric, 2016).

2.5. Types/forms of WASH – related diseases

2.5.1 Introduction to water-related disease classification

Thomas (2018) claimed that the picture of WASH-related diseases is complicated for certain reasons and over a period of decades, with the advent of new WASH-related infectious diseases and the re-emergence of those we already know about (Weiss, 2018), the picture of WASH-related human health problems has also become more and more wide (Weiss, 2018). WASH-related diseases are classified into four (Johnson & Paull, 2011), as shown in Figure 2.2: water-borne-vector-related diseases are those diseases transmitted by insects that depend on water for survival and procreation (Malaria, Yellow Fever etc.); water-washed (or water scarce) diseases are mostly communicable diseases mainly caused by water shortage (Trachoma); water-related diseases (Johnson & Paull, 2011).

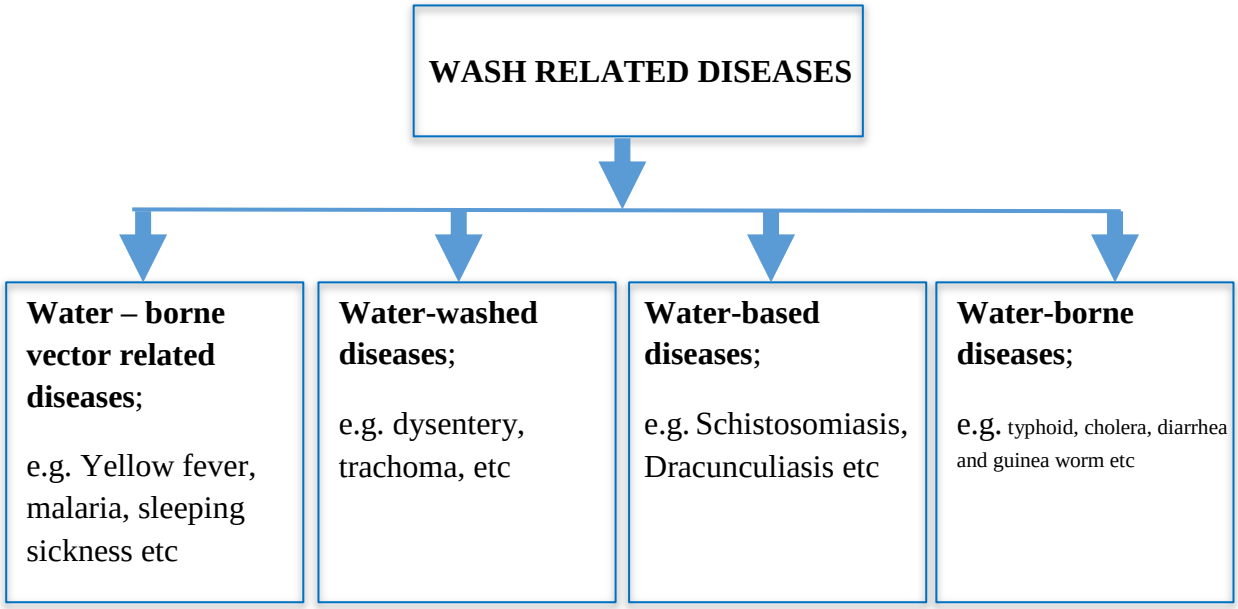


Figure 2. 2 Forms of WASH related diseases

Source: (Omole, Emenike, Tenebe, Akinde, & Badejo, 2015)

2.5.2. Water – borne vector related diseases

Today, vector-borne infections are a worldwide problem and a significant source of human morbidity and mortality once again (Lemon et al., 2008). WHO (2018), alleged that human diseases caused by fungi, viruses and bacteria that are spread by mosquitoes, sand flies, tritons bugs, blackflies, ticks, tsetse flies, mites, snails and lice are vector-borne diseases (WHO, 2017b). A change in temperature have impact in their development, reproduction, behaviour and survival rates as these organisms and their infection agents are cold – blooded (Rudge & Kovats, 2013). In addition, urban slum development, lack of quality piped water or sufficient solid waste management will make large populations in cities and towns at risk of mosquito-spreading viral diseases. Such factors together affect the scope of vector communities and the modes of dissemination of disease-causing pathogens (WHO, 2017b). Owing to poor sanitation and poor hygiene, the carrier insects breed in or

around polluted water and thus the diseases they propagate are as linked to water as those conveyed more directly by liquids. Malaria, filariasis, yellow fever, and river blindness are water-related vector illnesses (National Academy of Sciences, 2007b). Among water-associated vector diseases, malaria is the most notorious, caused by minute parasites, transmitted through mosquitoes (National Academy of Sciences, 2007b). Malaria is caused by one of four Plasmodium parasite species spread by female Anopheles spp mosquitoes (El Adlouni, Beaulieu, Ouarda, Gosselin, & Saint-Hilaire, 2007). The insects reproduce in fresh or brackish water and suck in the malaria parasites along with the blood of the infected individual when they bite an infected human. The disease will then be spread by the insects to the next person they bite (National Academy of Sciences, 2007b). In the tropical and subtropical regions of the world, especially in the young age groups, malaria is responsible for high morbidity and mortality rates (WHO, 1988). This malaria parasite creeps into the human body's red blood cells and kills them. , recurring bouts of high body temperature and shiver, sweating, headache, nausea and vomiting and diarrhea are some of the symptoms that one may experience when infested with malaria (SMoH, 2016). There are several ways to keep malaria at bay (Ashley & White, 2014) However, vector control is the main way to prevent and decrease the transmission of malaria, according to the WHO. In addition, if the handling of vector control measures within a given area is too high, a community-wide protection measure will be granted because, in a wide range of situations, there are two forms of vector control, insecticide-treated mosquito nets because indoor residual spraying (WHO, 2019b). Sleeping under an insecticide-treated net (ITN) is the most widely adopted preventive measure against malaria. This highly effective technique of vector control prevents individuals from malaria-carrying mosquitoes in at least three forms: by acting as a physical barrier between mosquitoes and people who sleep under the net; the chemical in ITNs repels mosquitoes, or kills them when they land on the net and through the ‘community

effect' as many people sleeps under an ITN, subsequent in an overall decrease of the mosquito population and its lifecycle, thereby decreasing the transmission of malaria (Malaria Consortium, 2016). Indoor Residual Spraying (IRS) consist of the use of insecticide products in areas where people are considered at risk of malaria (or other vector-borne diseases that also consist of Chagas disease and leishmaniasis), to the internal surfaces (walls and ceilings) of homes, public houses, or animal dwellings (Choi, McIntyre, & Furnival-Adams, 2019). Choi et al., (2019) went on to note that it is most successful against endophilic (indoor-resting), endophagic (indoor-biting) mosquitoes of the Anopheles genus resting on these surfaces and that the World Health Organization (WHO) Prequalification Team's vector control committee suggests various insecticidal chemicals for use in the IRS, such as organophosphates and other insecticides products (Choi et al., 2019). Malaria is a preventable health disease and the main purpose of treatment is to ensure full recovery, i.e. the quick and total clearance from the patient's blood of the Plasmodium parasite, to prevent progression of uncomplicated malaria to serious disease or death, and to avoid chronic infection leading to anaemia associated with malaria (WHO, 2019e). Furthermore, the purpose of malaria care from a public health perspective is to decrease the dissemination of the virus to others by reducing the infectious reservoir and avoiding the appearance and spread of resistance to antimalarial medicines (WHO, 2019e).

The acute viral haemorrhagic disease spread by infected mosquitoes is yellow fever. The "yellow" in the name refers to the jaundice that affects certain patients (WHO, 2019g). The jaundice affects certain patients. In tropical and subtropical regions of Africa and South America, the yellow fever virus is present. Yellow fever signs include fever, headaches, jaundice, pain in the body, nausea, vomiting, and tiredness (WHO, 2019g). The most effective way to eliminate Yellow Fever virus transmission, according to the CDC, is to stop mosquito bites (vector control) by using insect repellent, wearing long-sleeved shirts and

trousers, cleaning clothes and supplies, and having vaccinated before flying, if vaccination is required (CDC, NCEZID, & DVBD, 2019). Water containers that are in daily use requires frequent emptying and scouring to remove eggs; they should be kept covered or screened to prevent access by mosquitos, therefore, the provision of wells or pipe water where possible would reduce the need for water storage (Stephenson, 2002). Furthermore, Stephenson (2002) stated that, containers, mainly tyres, tins and jars should be destroyed or buried to aid in mosquito control.

One of the most effective means of combating yellow fever is vaccination. For the prevention of epidemics, timely identification and management of outbreaks utilizing mass immunization is important in high-risk areas where vaccine coverage is poor. In an area with a yellow fever epidemic, it is necessary to vaccinate most (80 percent or more) of the population at risk to avoid infection (WHO, 2015b).

There is currently no accurate anti-viral medicine for the management of yellow fever, according to the WHO, but specialized medication to combat vomiting, liver and renal damage, and fever increases results and antibiotics should be handled for associated bacterial infections (WHO, 2015b). Therefore, preventive or vector management is important and there is no yellow fever vaccine or cure (William, 2017).

Sleeping sickness is a vector-borne parasitic disease, also known as Human African trypanosomiasis, which is caused by contact of protozoan parasites belonging to the genus Trypanosoma. Tsetse fly (Glossina genus) bites are transmitted to humans who have obtained their infection from humans or from animals who harbor human pathogenic parasites (WHO, 2019c). Symptoms can include extreme headaches, change in mood, loss of weight, irritability, loss of focus, gradual depression, episodes of slurred speech, trouble walking and communicating, resting for long stretches of the day, and night insomnia (Johns Hopkins

University, 2018). There is no vaccine or medication for prophylaxis against African trypanosomiasis, according to Global Health, but prevention steps aim to limit interaction with tsetse flies (Vector Control) (Global Health, 2012). In addition, African trypanosomiasis management depends on two strategies: the elimination of the source of the disease and the regulation of the tsetse fly vector. And the important disease source for T is humans. b. Active case-finding by population sampling, accompanied by treatment of the affected individuals that are detected, is the key management method for this subspecies. As an adjunct, Tsetse fly traps are also used. The depletion of infection reservoirs is more difficult for *T. b. rhodesiense*, as there are a lot of animal hosts. The main technique in use is vector control and this is typically achieved with traps or screens, in tandem with insecticides and fly-attracting odours (Global Health, 2012). The type of medication needed for sleeping sickness depends primarily on the level of the illness, according to the WHO, and the medicines used for therapy in the first level are simpler to prescribe than those used in the second stage. Often, the faster the illness is diagnosed, the stronger the likelihood of a cure (WHO, 2019d). In addition, Global Health said the precise course of medications and care would depend on the type of infection (T. b. gambiense or T. b. rhodesiense) and the extent of the disease (i.e. whether the parasite has reached the central nervous system). Pentamidine is the prescribed medication for first stage of *T. b. gambiense* infection (Global Health, 2012). For the second stage, melarsoprol, eflornithine, nifurtimox and a new comprehensive oral treatment drug fexinidazole are recommended for first line of treatment (WHO, 2019c).

2.5.3. Water – borne vector diseases

Water-borne diseases are caused by the spread of pathogenic bacteria by polluted water and the propagation of these pathogens happens when, among other things, dirtied water is used for drinking, food storage and laundry washing (Patel & Angela, 2019). There are no sufficient water treatment plants in many developed countries, and the supply of water is so

limited that people do not have the time or resources to afford water purifiers or water treatment processes (Patel & Angela, 2019). Many kinds of diarrheal diseases, like cholera, and other major diseases such as Guinea worm disease, typhoid, and dysentery, may be caused by polluted water due to inadequate sanitation and hygiene (Vestergaard, 2014). Contaminated water is likely to disperse where private and public drinking sources, such as surface water-creeks, ponds, streams, and rain, receive their water. Owing to inadequate hygiene practices, which have caused a variety of drastic outbreaks of faecal-oral diseases such as typhoid or cholera, these water supplies can be polluted by sick animals or humans, as well as drainage from landfills, drainage pipes, septic fields, commercial or residential projects. There are a variety of additional ways in which faecal content can enter the mouth of a human, such as in infected food or the hands of the individual (Weiss, 2018).

Cholera is an acute diarrheal infection caused by ingestion of food or drink infected with the Vibrio cholerae bacterium, according to literature, which remains a global public health problem and an indication of inequity and lack of socioeconomic progress (Azman, Rudolph, Cummings, & Lessler, 2013). Cholera typically happens in humans with painless, watery diarrhea and some infected patients have abundant levels of diarrhea and develop dehydration so that it can lead to death (Charles & Melissa, 2018). Outbreaks may occur where water supply, sanitation, food safety and hygiene are insufficient and contaminated food (especially seafood) is a more prevalent cause of cholera in developed countries as transmitted by the faecal-oral pathway, whereas contaminated water is more prevalent in developing countries (Bardhan, 2013). Cholera preventive initiatives consist mainly of supplying drinking water and adequate sanitation to communities who do not yet have access to essential facilities (WHO, 2011). According to the CDC, access to clean water, proper sanitation, and basic hygiene standards are critical preventive mechanisms for breaking the cholera cycle of faecal oral transmission (CDC, NCEZID, & DFWED, 2018). According to Mayo (2017), cholera

can also be prevented at the personal level by washing hands regularly with soap and water, especially after using the toilet and before touching food or using an alcohol-based hand sanitizer. In addition, drink only clean water, whether distilled or disinfected water or bottled water (Mayo, 2017).

Cholera needs urgent care since the disease will cause death and rehydration within hours, as the primary treatment is to replace missing fluids and electrolytes with oral rehydration salts (ORS) using a simple rehydration solution. The ORS solution is available as a powder that can be reconstituted in boiling or distilled water and about half the persons of cholera die without rehydration.

Typhoid fever is a life-threatening infection caused by the SalmonellaTyphi bacterium that is usually transmitted by infected food or drink, according to the WHO (WHO, 2018b). They replicate and disperse into the bloodstream until SalmonellaTyphi bacteria are swallowed or intoxicated. In addition, urbanization and climate change have the ability to raise the global burden of typhoid and also to improve resistance to antibiotic care, making it possible for typhoid to propagate across overcrowded city populations and poor and/or polluted water and sanitation services (WHO, 2018b). Within a few days after beginning antibiotic therapy, most individuals with typhoid fever feel better, but a limited percentage of them may die from complications. A high fever, headache, stomach pain, and either constipation or diarrhea are usually signs and symptoms and are likely to progress progressively, often occurring one to three weeks after exposure to the disease (Anwar et al., 2014). Usually, nations with fewer access to clean water and WASH facilities have a larger number of cases of typhoid (Newman, 2017). To avoid typhoid fever, access to clean water and proper sanitation, hygiene among food handlers and typhoid vaccination are all effective (WHO, 2018b). The WHO suggested that two vaccinations have been used to safeguard people against typhoid

fever for several years: an injectable vaccine based on pure antigen for people over 2 years of age and a live oral attenuated vaccine for people over 5 years of age in capsule formulation (WHO, 2018b). Antibiotics are the most appropriate treatment for typhoid fever, though ciprofloxacin (for non-pregnant adults) though ceftriaxone are the most widely used (Newman, 2017). It is vital for people treating typhoid fever to take prescription of antibiotics as long as the doctor has administered them, wash their hands after using the bathroom with soap and water, and do not cook or serve food to other people, thereby minimizing the risk of passing the infection to someone else and getting their doctor's examination to ensure that no Salmonella Typhi bacteria remain (WHO, 2018b). Other than antibiotics, it is necessary to rehydrate by consuming sufficient water and surgery could be needed in more serious situations where the intestine has been perforated (Newman, 2017).

Dracunculiasis, also referred to as Guinea worm disease (GWD), is an illness that is spread through drinking water containing an immature species of worm carrying Guinea worm larvae caused by the bacterium Dracunculus medinensis (John, 2017). Kara Rogers (2011) siding with John (2017) hypothesis that by drinking water infected with water fleas (Cyclops), which are crustaceans harboring worm larvae, individuals are afflicted with guinea worm disease. Gastric liquids kill the water fleas in the human host's intestinal tract, releasing the larvae from the intestinal tract, where they grow and where male and female larvae breed, to migrate and penetrate into the abdominal tissues. Whereas males die after mating, fertilized females migrate to other tissues (possibly through bone or tissue tunnelling), usually transfer to the legs and the adolescent worm, which can reach a length of 1 meter (3.3 feet), around one years following bores subcutaneous tissues which aimed towards to the skin's surface and emerges from a blister (Kara, 2011). Typically, until about a year once they are originally infested, people with Guinea worm disease have no indications and it is not before the worm is about to emerge from the surface that people start to feel ill.

When this happens, the symptoms of Guinea worm disease may include: fever, nausea and vomiting, diarrhea, shortness of breath, swelling, coughing, pain, and swelling where the worm is in the organism (often the legs and feet), blistering as the worm slices via the surface (Robyn & Richard, 2019). In addition, Robyn & Richards (2019) reported that guinea worm disease is not always lethal, but it can cause significant problems, permanent injuries, and financial difficulty for those involved because the pain involved is often so extreme that it makes it impossible for people to work, go to school, or care for themselves or others (Robyn & Richard, 2019). There is no antidote to eliminate GWD, according to the WHO, nor is there any medicine to treat patients. Prevention, however, is possible and the successful introduction of prevention measures has brought the illness to the brink of eradication (WHO, 2019a). WHO proceeded to state the following techniques as validated in the prevention of GWD, providing greater access to better sources of drinking water to deter infection, treating water before drinking from open water bodies, introducing vector protection through the use of larvicide temephos, preventing drinking water pollution by urging patients to stop wading into water, reducing transmission (WHO, 2019a). Like many neglected tropical diseases, Robyn & Richard (2019) notes that there is no diagnosis or unique prescription for the care of GWD. Alternatively, rehabilitation usually includes extracting the worm in a prolonged and painstaking process (Robyn & Richard, 2019). This technique can include: submerging the infected portion of the body in water to coax the worm into peeking more out of the wound, washing the wound and area surrounding it to avoid infection, wrapping a few inches of the worm around a stick or piece of gauze as it coaxes out to keep the worm from remaining into the body and encouraging more of it to come out. For days or weeks, this process is replicated every day before the worm is eventually released (Robyn & Richard, 2019).

2.5.4. Water – WASHED diseases

Infections caused by improper personal hygiene arising from insufficient water supply are water-washed diseases. If citizens have sufficient quantities of clean water available for personal hygiene, these illnesses can be avoided (National Academies of Science, 2007). Water Washed Diseases are diseases where disruption of transmission (and therefore management) is accomplished by adequate exposure to appropriate sanitation, washing and personal hygiene (Water Research Commission, 2003). According to the South African Water Research Commission, when there is inadequate clean water for washing and personal hygiene, or when there is contact with polluted water, water-washed illnesses emerge (Water Research Commission, 2003). These include illnesses that may be transmitted from person to person, such as scabies, trachoma and polio (poliomyelitis), lice and tick-borne, typhus and diarrheal illnesses (Gleick, 2002).

Trachoma is a contagious bacterial infection frequently associated with malnutrition and lack of good hygiene and triggered by the bacteria of Chlamydia trachomatis that damage the skin, cornea, and eyelid conjunctival cover. It is the world's leading contagious cause of blindness of which about 80 million people worldwide have active trachoma and most of them are infants, which is primarily found in tropical or semi-tropical countries (Frank & Andrew, 2019). Furthermore, the dissemination of trachoma is intensified by inadequate hygiene, cramped living environments and limited clean water and toilets, and disease transmission exists mainly between children and women who care for them (Soheila, 2018). Trachoma occurs by direct contact (e.g. contact with healthy children and an infected child's tainted fingertips or sharing of polluted towels, handkerchiefs, or other tissues used to clean the secretion of the skin) or eye seeking fly (such as the filth or bazaar fly) (Mariotti & Prüss, 2000). Trachoma signs and effects typically affect all eyes and can include: slight itching and inflammation of the eyes and eyelids, mucus or pus-containing discharge from the eyes,

swelling of the eyelids, light aversion (photophobia), pain in the eye. But the condition progresses steadily, and until adulthood, the most painful signs do not arise (Mayo, 2018). Trachoma blindness is practically absolutely preventable at a reasonably low cost, according to Frank & Andrew; this can be done by teaching sanitation and hygiene, especially face cleanliness, and treating all infected individuals early in the disease phase with oral antibiotics or antibiotic eye ointment within a heavily infected population (Frank & Andrew, 2019). Reducing fly species may also help eradicate a significant source of infection through appropriate management of animal and human waste, which can also enhance hygienic conditions through reducing breeding grounds for flies and enhancing access to local fresh water bodies (Mayo, 2018). The WHO categorically claimed, according to Solomon et al (2006), that there is no trachoma vaccine available, but prevention is feasible and it has established a trachoma prevention and care plan with the aim of eliminating it by 2020 (Solomon et al., 2006). The Healthy strategy includes: surgery for the treatment of advanced types of trachoma, antibiotics for the treatment and prevention of infection, facial cleanliness and changes in the environment, particularly in water, sanitation and hygiene (fly control) (Solomon et al., 2006). Antibiotics are helpful in the treatment of early cases of trachoma, while early treatment may avoid long-term complications, and more advanced cases can require surgery as the eyelashes that expand inward into the eye are repositioned by the operation. This can help limit further scarring of the cornea and prevent further loss of vision (Kierstan & Elena, 2019).

Polio (also known as poliomyelitis) is a particularly infectious illness caused by a nervous system-attacking virus, and children younger than 5 are more likely than any other age to catch the virus. Polio is spread as a highly contagious virus by contact with contaminated faeces. The infection can also be ingested by items such as toys that have come close to contaminated faeces. People living in areas with restricted access to running water or flush

toilets frequently get polio from polluted drinking water from tainted human waste (Shannon, 2016). Furthermore, the WHO further clarified that the virus is transmitted mainly through the faecal-oral route or, less commonly, by a typical vehicle (e.g. infected water or food) and multiplies in the intestine, from which it can penetrate the nervous system and cause paralysis (WHO, 2018d). According to Christine & Stephen (2018), in households with poor sanitation and hygiene or cramped conditions, the highest transmission of virus exists (Christine & Stephen, 2018). Many infections with poliovirus cause viral asymptomatic replication that is confined to the dietary tract. However, about 24 percent of those infected experience clinical signs and symptoms such as fever, headache and sore throat (considered a mild disease) after an incubation period of about 7-10 days (range, 4-35 days) (WHO, 2019f). In order to mitigate the risk of spread in susceptible countries, the availability of clean water, better sanitary standards and hygiene is necessary and immunization is the basis for polio eradication (ECDPC, 2018). The plan for eradicating polio, according to the Global Polio Eradication Initiative (GPEI), is focused on avoiding infection by immunizing every child before transmission ceases and a polio-free world (GPEI, 2014).

According to the WHO Polio Study 2016, inactivated polio vaccine (IPV) and oral polio vaccine (OPV) are two separate versions of vaccination used to immunize or defend against polio. The inactivated polio vaccine (IPV) is made up of inactivated (killed) strains of all three forms of poliovirus. IPV is provided by intramuscular injection and a trained health nurse must prescribe it. IPV induces antibodies against all forms of poliovirus in the blood. These antibodies inhibit the transmission of the virus to the central nervous system in the event of infection and guard against paralysis. However, the oral polio vaccine (OPV) consists of live, attenuated (weakened) poliovirus strains of one or three varieties of poliovirus. In this manner, IPV prevents infection but does not avoid transmission of the virus. OPV is administered orally and can be delivered by volunteers and does not require

qualified health professionals or sterile injection devices. This vaccine has three distinct forms, trivalent OPV protects against all forms of poliovirus, bivalent OPV protects against types 1 and 3 polioviruses and monovalent OPVs defend against only type 1 or type 3 poliovirus (WHO, 2016). Charles & Jerry (2018) said that after a person has been infected with the virus that causes polio, there is no medication that can heal polio, but early intervention and supportive therapies such as bed rest, pain reduction, proper diet, and physical therapy will help alleviate long-term symptoms of muscle weakness to prevent deformities from developing over time (Charles & Jerry, 2018). The WHO also accepted, buttressing the aforementioned point, that there is no remedy for polio, only medication to relieve the effects. To activate the muscles, heat and physical exercise are used and antispasmodic medications are given to calm the muscles (WHO, 2017c). This makes it very important for the availability of clean water, better hygienic standards and sanitation to reduce the risk of spread in infectious countries and the basis of polio eradication is immunization (ECDPC, 2018).

2.5.5. Water based diseases

Parasites that spend part of their life cycle in water cause water-based diseases (Kebbede, 2018). There are diseases spread through contact with polluted water, such as outdoor swimming, where the causative microorganism lives in bodies of water, usually in secondary hosts such as snails (Water Research Commission, 2003). Gleick (2002) added that parasites present in intermediate species living in polluted water, including dracunculiasis, schistosomiasis, and other helminthes, cause water-based diseases (Gleick, 2002).

2.7. Theories and/ frameworks on the relationship between WASH practices and WASH related diseases

2.7.1. Theory of Change

The research developed a conceptual structure by following the principle of transition, as Figure 2.2 shows the conceptual WASH portion model inside households (Antwi-Agyei et al., 2017). The chain shown in Figure 2.3 shows that the expected benefits of enhanced WASH and health are dependent on a combination of decreased exposure to pathogens and pathogens.

Improved basic service standard (e.g. more desirable and sufficient latrines; adequate availability of water) (Antwi-Agyei et al., 2017). In fact, decreased contamination depends on different vital persons and household behaviors: washing hands and using facilities for defecation and proper treatment, along with a healthy physical setting, of both solid and liquid waste (sewage) and faecal sled (Antwi-Agyei et al., 2017). Sufficient clean latrines, hand washing with soap (HWWS) services, and culturally fitting products for post-defecation cleaning are part of a healthy physical environment. Changes in person and household behavior rely on both the successful promotion of hygiene and the provision of desirable sanitation and hygiene facilities (Antwi-Agyei et al., 2017). Finally, the requirements for the accomplishment of impacts often rely on a range of supporting administrative requirements, including sufficient cleaning and handwashing water, the provision of constant costs for consumables such as soap and maintenance, the tracking and oversight mechanism, and active hygiene and health commissions (Antwi-Agyei et al., 2017).

CONCEPTUAL MODEL OF WASH COMPONENTS BASED ON THE THEORY OF CHANGE

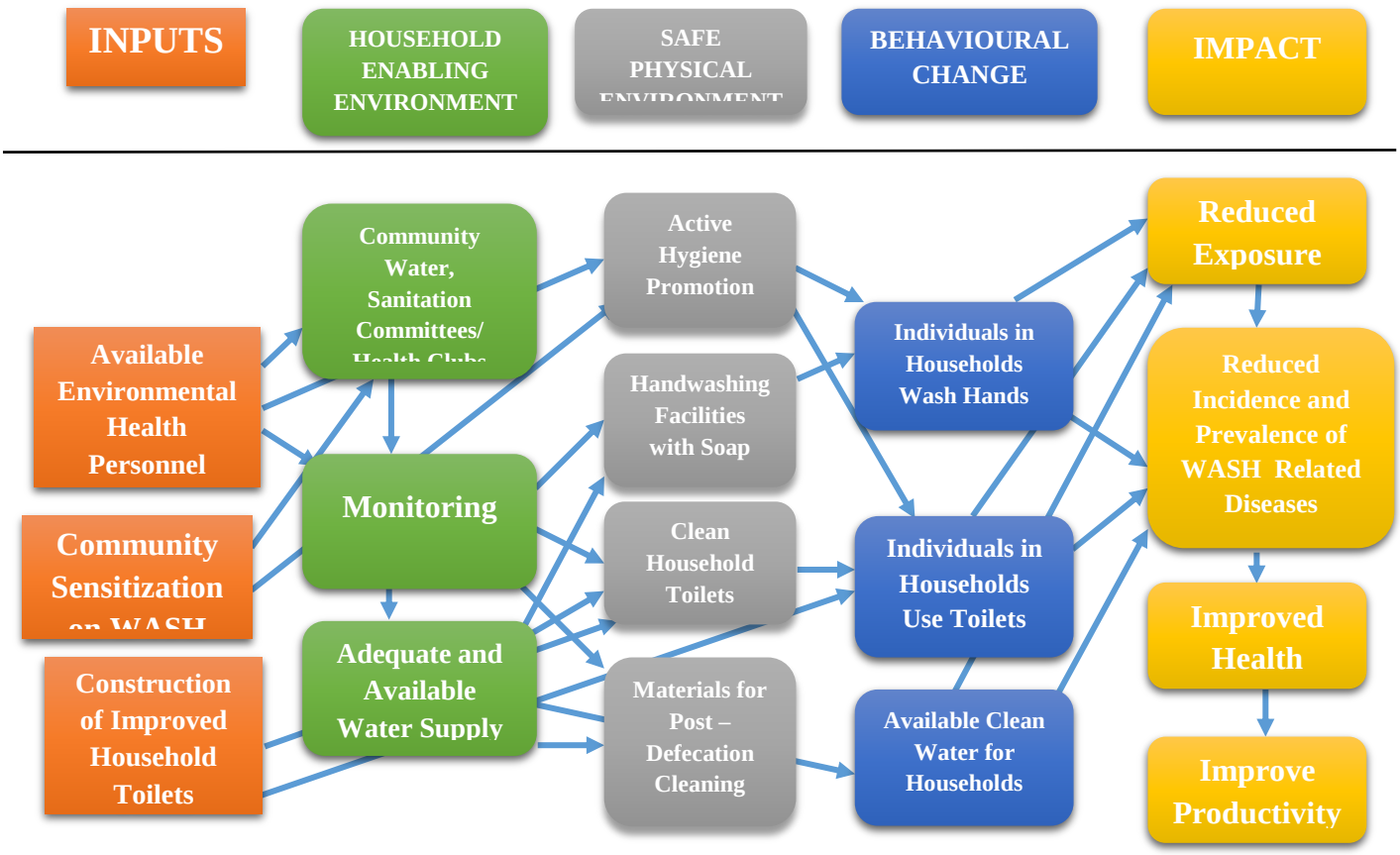


Figure 2. 3 Conceptual Framework on WASH

Source (Saboori et al., 2011)

2.7.2. Theory of Integrated Behavioural Model (IBM) on WASH

IBM is a paradigm of behavioral change that considers three dimensions (contextual, psychosocial, technology variables) and functions at five levels (structural, community, household, individual, habitual) (Delea, Solomon, Anthony, & Freeman, 2018). The development of this model, according to John Hopkins University, enables analyses that consider the various levels of control at the macro, meso and micro levels that can form actions and thus encourage the gathering of data before introducing disease prevention activities or interventions for a detailed and full range of applicable determinants, both systemic and behavioural (Johns Hopkins University, 2014).. John Hopkins also clarified that

the social component encompasses human situations and situations that impact behavioural change and the implementation of digital technologies to facilitate improvement. The psychosocial factor encompasses mental, social and psychological determinants, including philosophy and socio-cultural norms. The technical factor involves qualities that affect acceptance and survival of technology, goods, and devices (Johns Hopkins University, 2014). Five aggregate levels, broadly similar to levels in multi-level models, have been defined by IBM-WASH as a structure (Dreibelbis et al., 2013). First and foremost, Dreibelbis, Peter, et al (2013) clarified that the framework's social / structural level refers to the large governmental, societal, or cultural variables that impact activities in each of the three dimensions, including variables such as regulations, environment, geography, geology, and food manufacturing and commercial distribution. Second, the physical and social environment in which people are nested, as well as the formal and informal frameworks that define individual perceptions, are addressed at the community level. It is similar to both structural and neighbourhood variables (Dreibelbis et al., 2013). In addition, Dreibelbis, Peter, et al (2013) have observed that the interpersonal / household level reflects relationships between individuals and others with whom they are closely connected, including members of the household, intimate friends and neighbours. Factors at this stage include household tasks and duties, household income, injunctive and specific expectations, ambitions, guilt, sharing access to a commodity, and models of conduct. Socio-demographic variables such as age and ethnicity, human cognitive variables, and attitudes towards the commodity, hardware, or behaviour are said to involve the individual level (Dreibelbis et al., 2013).

The Habitual Level is the final level of the model system. This degree, nested inside the entity, represents the fact that over the course of the day, the risk and need for WASH-related behaviours are replicated, and the different mechanisms or incidents that may contribute to particular behavioural effects. The IBM paradigm also focuses on factors linked to habit

development, provided growing evidence of the significance of habit and automaticity in facilitating and sustaining behaviour change (Dreibelbis et al., 2013). The IBM WASH system offers a conceptual and ecological approach to understanding the multi-level interrelated factors that impact WASH-related risk of disease and prevention efforts in a given setting. The models analyse the three effect variables, explicitly contextual, psychosocial and technological influences, each functioning at five levels: institutional, culture, family, individual and habitual. Until introducing WASH-related disease prevention practices or services, it also encourages the gathering of evidence for a detailed and accurate range of specific determinants, both systemic and behavioural (Johns Hopkins University, 2014).. Table 2.1 below shows the various three dimensions in relation to the five levels of the IBM for WASH framework.

Table 2. 1 : Integrated Behavioural Model Applied to WASH – Related Diseases Prevention

Levels	Contextual Factors	Psychosocial Factors	Technological Factors
Societal/ Structural	Government/Community policy and support for: Disease programs and WASH programs WASH – related disease programs Climate: Wet and Dry Seasons	Leadership, advocacy and political commitment Donor-driven priorities	Industry support and donations Maintenance of water sources and latrines
Community	Built and physical environment, Health committees, Access to functional latrines, sewers, potable water, waste disposal Vector densities	Local leadership and promotion, Social norms and shared values about hygiene and sanitation, collective efficacy, social cohesion, stigma	Type, availability and access. Individual versus collective ownership
Households	Location Household structure Gender roles Animal proximity	Injunctive and descriptive norms. Perceived benefits, Behaviour modelling	Resources Cost
Individual	Demographics	Values and aspirations related to nurturing and cleanliness Family history, current and past experiences Motivations: Perceived threat, fatalism Perceived benefits Consequences, sanctions Knowledge, self-efficacy	Knowledge Acceptance
Habitual	Favourable environment for repletion of positive behaviour	Existing hygiene and sanitation practices, exposure	Convenient access Ease of routine use

Source: (Dreibelbis et al., 2013).

2.8. Empirical Evidence on WASH Practices

2.8.1. Empirical evidence on drinking water practices

In a cross – sectional study conducted by Pradhan et al. (2018) on knowledge and practice of participants about various disinfection methods for household water treatment in India. Out of total 250 participants around 60% were knowledgeable about boiling water followed by chlorination (27%), Settling (7.2%), Cloth filter (4%) respectively (Pradhan et al., 2018). In another study conducted in Kenya by Bitew et al. (2017), more than half of the respondents 431 (51%) had obtained their water from an unimproved water source (largely unprotected spring, 39.3% and stream/river water 10.3%). The remaining 414 (49%) had obtained water from improved water sources, mainly from protected spring (16.2%), protected hand-dug well (12.5%), or piped water (14.4%). Nearly a quarter of the (51%) households who obtained their water from an unimproved water sources had used at least one of the water treatment alternative methods, of which 102 (52.3%), 49 (25.1%), 40 (20.5%), and 4 (2.1%) had used plain sedimentation, boiling, straining with clean cloth/ local sieves, and chlorine solution, respectively (Bitew et al., 2017).

Finally, 357 (44.8 percent) of the overall research participants of 797, in a report by Belay, Dagnew and Abebe (2016) in Ethiopia, treated water at home using various methods of treatment. More than half of 213 (59.7 percent) boil water, 74 (20.7 percent) settle and stand, and 70 (19.6 percent) have used chlorine chemicals (Wuha Ager and Bishagary) for water treatment purposes available on the local market (Belay, Dagnew, & Abebe, 2016). Boiling was not a promotional practice in Lantagne and Yates (2018) study, but 14 percent of households reported boiling in DRC as a tool used in household water treatment, indicating how boiling is regarded as a common form of household water treatment (Lantagne & Yates, 2018). Though the use of boiling as a water treatment method at the household level continue

to decline to make way for more contemporary and scientifically advance water treatment methods as indicated by Geremew et al (2018), between the period of 2005 to 2016 in their article "Appropriate household water treatment methods in Ethiopia: household use and associated factors based" explicitly indicated that, 2.7% and 2.2% of households had reportedly used boiling as water treatment methods between the period of 2005 to 2016 respectively(Geremew et al., 2018).

2.8.2. Empirical evidence on sanitation practices

The remarkable tale of how Madagascar rose in just three years from 10 to 10,000 villages free of open defecation should not be forgotten as facts with respect to CLTS as 7007 Open Defecation Free (ODF) communities have been accomplished by the introduction of the Global Sanitation Fund initiative known as the Fonds d'Appui pour l'Assainissement; 728 ODF fokontany (sub-community level units) and 15 whole ODF commune units Through a joint initiative by UNICEF, the Ministry of Public Health and Sanitation, and SNV in Kenya, 457,716 individuals benefited from the sanitation program proclaimed Open Defecation Free (ODF) by 976 villages in the world) (SNV, 2016).

Empirical evidence indicates that 2,5 billion people worldwide lack adequate sanitation and more than 1 billion people continue to practice open defecation, a significant public health concern (WHO, 2015a). Two-thirds of Asians and sub-Saharan Africans remain without an access to adequate sanitation infrastructure. 1.2 billion people, of which more than half live in India, lack access to basic sanitation and have to defecate in the open (Mara, Lane, Scott, & Trouba, 2010; WHO & UNICEF, 2013). In sub-Saharan Africa, with 19 countries in sub-Saharan Africa, 70 percent of the population exists without access to basic sanitation, with less than a fifth of the country using an advanced sanitation facility (Cross, Hickling, & Coombes, 2014). The lowest in Africa is West Africa, with 24% improved sanitation

(UNICEF/WHO, 2018). Ghana 's increased sanitation coverage has not crossed 15 percent for a long time, according to an observational survey by World Vision. This suggests that access to sanitation facilities and utilities is open to just 15 out of every 100 Ghanaians, while the remainder are left defenceless against the unavoidable effects (World Vision, 2017). In another UNICEF survey, Ghana ranks among all the lower middle-income countries with the lowest sanitation standard, while richer than many. This is according to David Duncan, Director of Water Sanitation and Hygiene (WASH) at UNICEF. He said that about 60 % of the population used communal toilet facilities, 15% used improved ones, 6% unimproved, and 19% performed open defecation and demanded that toilets be designed to survive the environment and be easily cheaper for the poor (GNA, 2017).

2.8.3. Empirical evidence on hygiene practices

Even though a couple of WASH related institutions have shown interest in hygiene promotion, most interventions so far have been restricted to school children, while the matter remains unresolved within households and communities (UNICEF, 2017). In a cross-sectional analysis performed by Johnson et al (2015) on the evaluation of water, sanitation, and hygiene habits and related factors in Benin, 9.7 percent (58) households had strengthened hygiene behaviour out of a sample size of 600 households and 16 percent (96) had persistent availability of soap for washing hands at home (Johnson et al., 2015). While there are not enough objective statistics to allow a global estimation of the population with handwashing facilities and hygiene habits, but the available data clearly indicate that only 15 percent of the population in sub-Saharan Africa had access to a simple soap and water washing hands facility (WHO, 2019e).

2.9. Empirical Evidence on incidence of WASH related diseases

Globally, in 2017, according to James et al. (2018), upper respiratory infections (17·1 billion), diarrhoeal diseases (6·29 billion), and oral disorders (3·60 billion) were the three leading category 3 causes of diseases in terms of event cases for all ages, all sexes combined and place. Despite a decline in age-standardised occurrence rates of upper respiratory infections of 2·6 percent, from 232,815 new cases to 226,802 new cases per 100,000 individuals, these case ranks remained constant for the top three causes between 1990 and 2017 (James et al., 2018).

In an empirical retrospective and cross – sectional study conducted by Ucheh et al (2017) with a sample size of 159 in Zaria Nigeria the incidence rate of diarrhea among children under 5 years was 51.8% within two weeks of study, making it about half the population of all children who attended clinic (Ucheh, Eleojo, Tyoalumun, & Nanpen, 2017). A total of 17,740 cases of diarrhea were registered in the district from January 2012 to December 2016 in an investigated pattern analysis of the incidence of diarrhea at facility level in the Jasikan District of the Volta Region in Ghana, with an incidence rate of 1.85 percent during the study period. The rate was high among under – five children with a total of 9556 per 100,000 population case incidence per person - year (196 incidence rate) within the 5 year study period (Tetteh et al., 2018).

Furthermore, the incidence rate of malaria as a WASH – related disease globally stands at 63 cases per 1000 population at risk from 2010 to 2016 though declined steadily from 76 with 18% decline rate, WHO still consider the 63 cases per 1000 population very high and alarming (WHO, 2017d).

According to the World Bank's compilation of development indicators, collected from officially recognised sources, malaria incidence (per 1,000 populations at risk) in Ghana was registered at 266 in 2015 (World Bank, 2016).

In a cohort study performed by Natama et al (2018) in the Nanoro Health District (NHD) in the central-western region of Burkina Faso at 85 km from Ouagadougou across clinical episodes with 12 months' follow-up period, the prevalence of malaria as a WASH-related disease is 1.03 per child-year babies and increased from 0.27 per child-year at 0-3 months of age to 1.92 per child-year (Natama et al., 2018).

In 2015, an estimated 17 million cases of typhoid and paratyphoid fever diseases occurred worldwide, mainly in South Asia, South East Asia, and sub-Saharan Africa, according to the Global Disease Burden Survey 2017, with both the prevalent burden and occurrence occurring in South Asia (Radhakrishnan et al., 2018; World Health Organization, 2017). Although the majority of typhoid fever cases occur in Asia and Africa, there are substantial geographical variations, both within and inside countries. Data from the population-based surveillance research Diseases of the Most Impoverish (DOMI), led by the International Vaccine Institute (Seoul, South Korea), reported the total occurrence of 493.5 cases per 100,000 individual-years in children aged 5-15 years in an urban slum in Kolkata, India (Ochiai et al., 2008; Radhakrishnan et al., 2018). Between January 2003 and January 2004, a similar event was observed in Dhaka, where the occurrence of typhoid fever was reported at 200 cases per 100,000 person-years (Naheed et al., 2010; Radhakrishnan et al., 2018). A recent publication explains population-based research in 12 sites in 10 nations across sub-Saharan Africa of typhoid fever and invasive nontyphoidal Salmonella disease, with prevalence rates ranging from 0 to 383 cases per 100,000 person-years across the 12 sites (Marks et al., 2017; Radhakrishnan et al., 2018). In another report, since 1988, cases of wild

poliovirus have fallen by more than 99 percent, from an estimated 350 000 cases then to 33 confirmed cases in 2018. However, infants in all countries are at risk of developing polio as long as a single infant stays affected. Failure to remove polio from these last remaining strongholds could contribute to as many as 200,000 new cases annually, worldwide, within 10 years (WHO, 2019f).

2.10. Empirical evidence on the association between WASH practices and incidence of WASH – related diseases

The relation between WASH activities and diseases associated with WASH is inextricable (Ersel, 2015). Considering what has been addressed with the F-diagram, the most recent report indicates that sufficient WASH avoids the deaths of 361,000 children under the age of five or 5.5 percent of deaths in that age group (Esteves Mills et al., 2016; Prüss-Ustün et al., 2014). In comparison of health impact assessments of water, sanitation interventions, 61 person for water experiments, 12 observations comparing unimproved and enhanced situations, and only 2 observations comparing unimproved sanitation and sewer connections are found this shows relative risk reductions for different movements up the water supply and sanitation ladders.

The instantaneous risk range for water interventions for all diarrhea disease studies is 0.66 (95 % confidence interval [CI]: 0.60–0.71) and 0.72 (95 % CI: 0.59–0.88) for drainage strategies (Abdalla, Apramian, Cantley, & Cullen, 2017; Wolf et al., 2014). An earlier review of 25 researchers investigating the association between sewerage and diarrhea or other similar results reported an average risk ratio of 0.70 (95 % CI: 0.61-0.79), which improved to as much as 0.40 when starting sanitation conditions were very poor and requires progress (Abdalla et al., 2017; Norman, Pedley, & Takkouche, 2010)..

In some other recent conceptual model by Wolf and colleagues, which included 11 randomized, quasi-randomized, case-control or observational design trials and illustrated bias by methodological methods, it was observed that better hygiene can minimize diarrheal disease by 28% and that there are major differences in disease reduction attributable to clean sanitation and type (Esteves Mills et al., 2016; Wolf et al., 2014). This is consistent with other research that have shown that 12 hand washing measures in 9 countries have produced a median reduction in diarrhea incidence of 35 percent (World Bank, 2003). The relationship between agreement with the experimental incidence of Guinea Worm Disease (GWD) and lack of access to better drinking water supplies is well established (Biswas et al., 2013; Henderson, Fontaine, & Kyeyune, 1988). Communities classified as endemic to dracunculiasis by the Guinea Worm Eradication Programme, such as Savelugu in northern Ghana, are highlighted for access to better water sources. Over the years, access to better drinking water sources has offered a sustainable alternative for eradication in endemic areas, where 196 cases of GWD were registered in 2009 globally (Biswas et al., 2013).

Ghana has accomplished an unprecedented record of decreasing the number of cases of dracunculiasis (GWD) from 3358 cases in 2007 to just 501 cases in 2008, 242 cases in 2009 and the last eight cases in 2010 leading to a substantial rise in the proportion of cases contained since 2007 (above 84%). This represents the introduction of increased sources of drinking water in northern Ghana as part of the Guinea Worm Eradication Project (GWEP) in Savelugu (Biswas et al., 2013).

In addition, a comprehensive analysis of the effects of the provision and use of latrines on Soil-Transmitted Helminth (STH) infections of Neglected Tropical Disease (NTD) in 2012 found that the probability of combined STH infection was decreased by around 50 percent globally (Mills et al., 2016; Ziegelbauer et al., 2012). Both WASH strategies by Strunz et al

(2014) were considered in another recent study, where 94 qualifying studies were identified, five of which were RCTs. The study found that WASH access and procedures were largely associated with reduced risks of STH infection universally, irrespective of the poor standard of studies (Mills et al., 2016; Strunz et al., 2014).

A systematic review of the impact of bathing, sanitation and hygiene on the prevention of trachoma was published by Stocks and colleagues in 2014. The results of earlier studies based on the WASH based components of the SAFE approach were substantiated in this study. Eighty-six qualifying studies that documented an impact of WASH on trachoma were found, and in 11 of the 15 meta-analyses performed, the investigators found evidence of a connection between enhanced WASH conditions and exposures and reduced trachoma (Mills et al., 2016; Stocks et al., 2014). Between facial washing and lower levels of trachoma, the strongest correlation was found. A strong correlation was also observed for access to sanitation, while distance to the source of water had a smaller impact. Although a number of studies have demonstrated a correlation between an increased quantity of water and a decreased risk of trachoma, a limited number of publications have precluded the likelihood of meta-analysis. The analysis concluded that good evidence existed to support the WHO SAFE technique 'F' and 'E' components and the relevance of WASH in trachoma removal strategies (Mills et al., 2016; Stocks et al., 2014). The value of WASH has long been recognized and should not be underestimated in avoiding schistosomiasis (Mills et al., 2016).

A comprehensive analysis of the relationship between water, sanitation and schistosomiasis found a total of 44 qualifying studies documenting infection with schistosomiasis in people who had access to clean water and sufficient sanitation or did not have access to it. Both of which were cross-sectional, safe water sources were associated with slightly lower

schistosomiasis odds and lower odds were correlated with good sanitation as well (Grimes et al., 2014).

2.11. Empirical evidence on socio-cultural factors influencing WASH practices

As seen in the Wasonga, Okowa and Kioli (2016) study in Kenya, WASH activities are strongly influenced by socio-cultural and traditional variables, which revealed that water problems are gendered and the use is socially and culturally categorized as water use is enforced by the person who brings it, who is the household woman in most cases and often accompanied by her children who are usually girls. The study further showed that, in addition to the collection and processing of water by women, water treatment is influenced by cultural practices such as the use of a clay pot. The use of a large "guns" traditional clay pot to store drinking water was traditional and was found in almost all household. The use of a large-mouth traditional pot was chosen because it makes the water cool and hence makes the water cool "nice to drink". This has an effect on water safety as women have to take over water treatment at the level of the household, which was left most of the time to household children (girls) (Wasonga, Okowa, & Kioli, 2016).

In Kenya's Nyakachi community, proof of sanitation and health practices revealed that while the prevalence of pit latrines was found in most homes, its use cannot be assured as it is engrossed in beliefs and culture that discourages to share the same latrine with in-laws (father and mother) and older children is forbidden and children faeces are disposed of in the open fields. In the words of Ochido, 38 years old, *"A latrine used for the mother or father in-law is not to be used by the daughters or sons and even latrines cannot be used at night because they harbour evil spirits"* (Wasonga et al., 2016, P.5).

In comparison to this, in a descriptive approach by Routray et al (2015) in Odisha, India, men who defecated in the open reported that their daily practices were not followed by the use of latrines, and that latrines were meant for women, as they stay home most of the period and thus require them. Test participants typically observed that latrine users were mainly by women, in specific the newly-wed daughter-in-law. There are increasing instances of latrine construction in Odisha, as we found in the sample group, where the primary reason for the latrine installation was the arrival of the newly wed bride into the family or social trends like as 'no toilet, no wife' (Pattanayak et al., 2009; Routray et al., 2015; Stopnitzky, 2011).

2.12. Conclusion

Literature revealed that despite the initiatives, investments, policies, international treaties and developmental goals put in place by governmental and nongovernmental agencies and world developmental bodies towards improving WASH Practices and the elimination of preventable WASH – related diseases, barriers still exist which affects WASH practices at the households, community, regional, national and global levels. Literature also provides empirical evidence on WASH practices, incidence of WASH – related diseases, association between WASH practices and incidence of WASH – related diseases and factors influencing WASH practices to aid in attaining an appreciable levels of water sanitation and hygiene practices though a little has been achieved, but a lot more need to be done to reach a good threshold to rid the individuals, households, communities, regions, nations and the world from poor WASH practices and other associated health problems. However, literature has failed to address the association that exits between WASH practices and the incidence of WASH – related diseases with which this study seeks to investigate on.

CHAPTER THREE

METHODOLOGY

3.1. Study Area

3.1.1. Study Location and Size

The Tamale Metropolis is one of the 16 districts in the Northern Region. It is situated in the centre of the region and shares its borders with the Municipalities of Sagnarigu in the west and north, the District of Mion in the east, East Gonja in the south and Central Gonja in the south-west in the Savannah region. The Metropolis has a total estimated land area of 646.90180sqkm (Ghana Statistical Service, 2014). The geographical location of the Metropolis is between latitudes 9º16 and 9º 34 North and longitudes 0º 36 and 0º 57 west. There are two (2) sub-metros (Tamale Central and Tamale South) of 116 villages in the Metropolis, and eight (8) zonal councils.

3.1.2. Population

Based on the 2010 Population and Housing Census predictions, Tamale Metropolis's projected total in 2018 was 360,579 (Ghana Statistical Service, 2014), comprising 1.20 percent of the nation 's population. There are 30,050 houses serving 54,882 households within the metropolis, with an average household size of 6.5 individuals per household. Males make up 42.60 per cent and females make up 57.4 per cent. The percentage of the population living in urban areas (80.8 percent) is higher in the metropolis than those living in rural areas (19.1 percent). The metropolis does have a 99.1 ratio with sex. The demographic of the metropolis is youthful (almost 36.4% of the demographic is under 15 years), reflecting a large based pyramid of the population that tapers off with 5.1% reflecting a small proportion of the elderly (60 years and older). The total age dependence ratio for the Tamale

metropolis is 69.4 for every 100 working people. Again, dependence in rural areas (86.5) is higher than dependence in urban settings (65.7) (Ghana Statistical Service, 2014).

3.1.3. Social and cultural structure

Historically, with lower population numbers, the Northern Area of the country has had extensive ground cover and the Tamale Metropolis is no different. After many people of diverse ethnic backgrounds began moving from other places to settle there, this region began to experience rapid population growth, rendering it a cosmopolitan region. The majority are Dagombas and the Metropolis is also home to other ethnic groups such as Gonjas, Mamprusis, Akan, Dagaabas and groups from the Upper East Region. Other nationals from Africa and other countries around the globe are also present in the Metropolis. The region has strong cultural traditions that are expressed in events such as annual celebrations, naming ceremonies and marriage ceremonies. Damba, Bugum (fire festival) and the two Muslim Eid festivals (Eid Fitr and Eid Adha) are some of the festivals which are celebrated annually in the Metropolis. Muslims are the majority of the population in Tamale Metropolis (90.5 percent), followed by Christians (8.8 percent), and other religious affiliations are about 0.7 percent. Catholics have the highest percentage of 3.0 percent among Christians, followed by Pentecostal / Charismatic (2.4 percent) and Protestants (2.4 percent). In the metropolis, the proportion of traditionalists is (0.3 percent) (TaMA, 2010).

3.1.4. Geographical features

Generally, with a few small slopes, the Metropolis is located about 180 meters above sea level. This geographical feature of the land is ideal for road building, power expansion and general development work in the region. Just one single precipitation a year is recorded by the Metropolis.

There are scarcely endowed water bodies in the Metropolis. The poor groundwater water level is due to this. A few intermittent streams that provide water during the rainy season and dry out during the dry season are the only natural water supplies. Both these streams have their Tamale headwaters, which are found on higher level. In addition, several artificial dams and dug-outs were designed either by individual members of the society or by Metropolis Non-Governmental Organisations. The Builpela and Lamashegu dams are two such dams. These dug-outs are used for both livestock and for domestic water sources. The Metropolis already has, despite this bad drainage condition has potential for agricultural production if it could be dammed for irrigational purposes (TaMA, 2010). The Nyohini and Agric Forest Reserves are two forest reserves in the middle part of the Metropolis. Although these forest reserves are infiltrated and used for commercial purposes, these areas are used by certain segments of the population as an open place for defecation, thereby growing basic sanitation dangers in the metropolis (TaMA, 2010).

3.1.5. Economic activities

In the metropolis, nearly 63.3 percent of the population aged 15 years and over is economically active and 36.7 percent are not economically active. 92.6 percent of the socially active population are working, while 7.4 percent are unemployed. With 33.0 percent working in the service and manufacturing sector, followed by crafts and allied trades with 21.5 percent, 17.6 percent specialized farming and fishing, 8.6 percent simple professions, and 8.1 percent, 5.1 percent, 2.4 percent, 2 percent, 1.4 percent engaged in specialists, factory and equipment operations, supervisors, technicians and clerical employees, respectively. A higher proportion of them are students (56.0 percent), 20.9 percent fulfil domestic tasks for those who are not socially involved, and 12.4 percent are either too young or too elderly to work. For the first time, about five out of ten (52.9) unemployed people are looking for jobs in the metropolis (Ghana Statistical Service, 2014).

3.1.6. Literacy and education

60.1 percent of the population aged 11 years and over are literate and 39.9 percent are non-literate. The proportion (69.2 percent) of literate males is higher than that of females (51.1 percent). Five out of ten persons can speak and write both English and Ghanaian languages (54.8 percent). Of the people aged 3 years and older (84,897) who are actually attending school in the metropolis, 52.9% are men and 45.1% are women. Males make up 58.6 percent of people who have attended school in the past, and females make up 41.4. This suggests that males have greater shares for both those who have attended school in the past and those that are present. 15.1 percent of those actually attending school are in nursery, 18.2 percent in JSS / JHS, 12.5 percent in SSS / SHS, and the highest percentage is in primary school (40.0 percent). Tertiary institutions are actually attended by just 5.7 percent of the population 3 years and older in the metropolis (Ghana Statistical Service, 2014).

3.1.7. Health infrastructure

The Metropolis has nineteen (19) health facilities excluding the Tamale Teaching Hospital. The breakdown is as follows; 19 government health facilities made up of two (2) government hospitals- Tamale West hospital and Tamale Central (old) hospital; five (5) government clinics or health centres- Builpela Health Centre, Industrial Area Clinic, Nyohini Clinic, Tamale Central RCH Clinic, Vittin RCH Clinic, three (3) rehabilitation centres; Tamale Central Rehabilitation Centre, Dungu Nutrition Education Centre and Zuo Nutrition Education Centre, three (3) CHPS zones; Kotingli CHPS zone, Lahagu CHPS zone, Fooshegu CHPS zone; and one (1) community initiated clinic in Kpanvo. The metropolis can also boast of five (5) private health facilities which includes KABSAD Clinic, SDA Clinic, Shiekhinah Clinic in Wamale, Rabito Clinic and Haj Adams Clinic (TaMA, 2010).

3.2. Study Approach/Design

Mixed approaches are the analysis methodology used in this research work. The mixed method approaches is an approach that incorporates or combines both qualitative and quantitative analysis concepts. The quantitative method examined the practice of water, sanitation and hygiene (WASH), the prevalence of WASH-related diseases and the association within the Tamale Metropolis between WASH practices and WASH-related diseases. The qualitative approach was used within the Tamale Metropolis to investigate the socio-cultural variables that affect WASH practices.

The explanatory mixed approach study design is used to perform this research work. In order to better understand the study issue and to explain the quantitative results, independent collection and analysis of quantitative data accompanied by collection and analysis of qualitative data was involved (Almalki, 2016; Klassen, Creswell, Plano Clark, Smith, & Meissner, 2012). By putting the different outcomes together, the two data sets are combined in the interpretation or by transforming data to facilitate integrating the two data types during the analysis (see Figure 3.1).

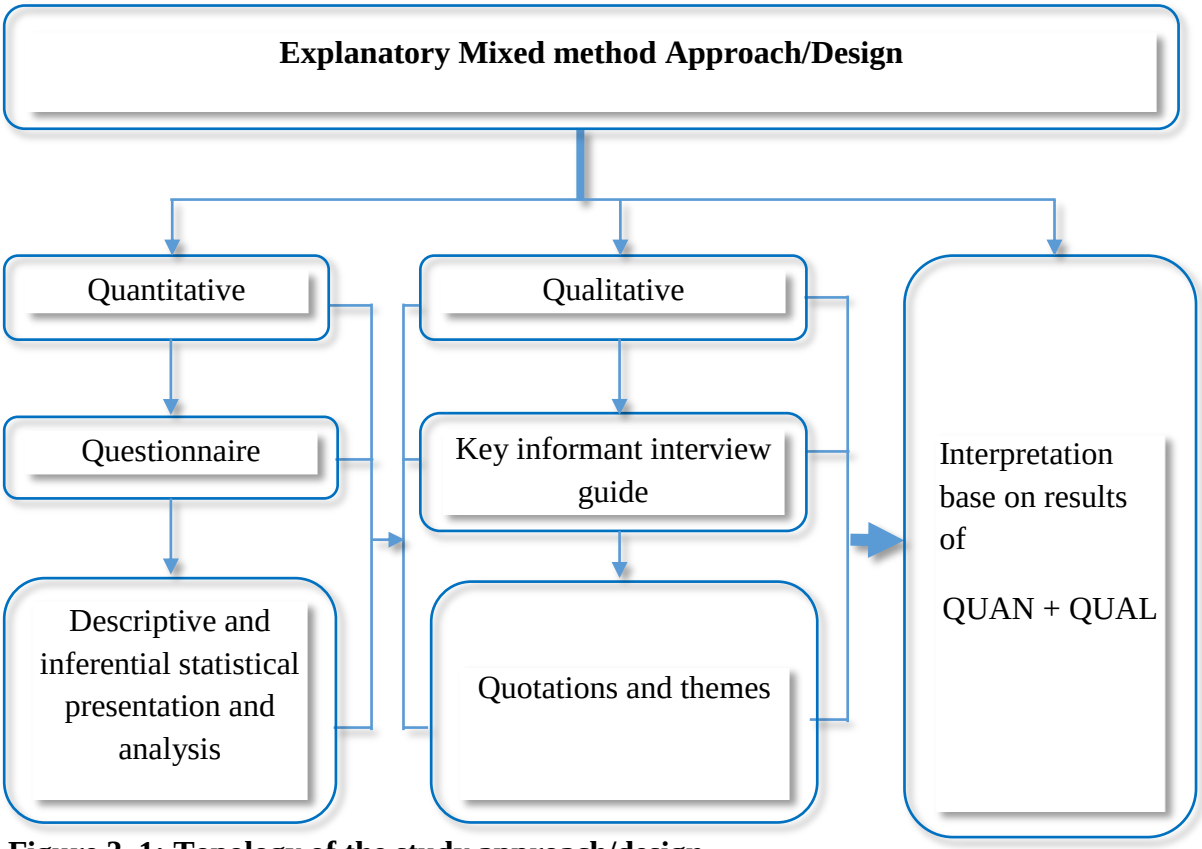


Figure 3. 1: Topology of the study approach/design

Source: Author's Construct, 2019.

3.3. Sources/Types of Data

The study resorted to primary sources of data. The study generated first- hand information from the field as primary data collection source was used to collect both quantitative and qualitative data types. Qualitative data included diverse perspectives and opinions of respondents on the socio-cultural factors that influence WASH practices within the Tamale Metropolis whilst the quantitative data include types of toilet facilities, main source of drinking water, water treatments methods, major disease types within household among others in relation to Water, Sanitation and Hygiene (WASH) practices, incidence of WASH-related diseases within households and background information of respondents (age, sex, level of education, employment status, religion and marital status).

3.4. Study population and sampling

3.4.1. Study population

The study targeted household heads and key informants comprising community leaders. As the main target units, household heads were included to seek information about the practices of water, sanitation and hygiene, the WASH-related diseases that affect them and other household members and the socio-cultural factors that may or may not inhabit their practices of WASH. This aided in the analysis of the study variables to make conclusion on the association between WASH practices and WASH – related diseases. Community leaders served as key informants to provide information on the various socio-cultural factors that hinders or promote WASH practices within the Metropolis.

3.4.2. Inclusion and Exclusion Criteria

Inclusion criteria

All household heads within the Tamale Metropolis were given equal chance to be included. Community leaders within sampled communities were also included in the study as key informants.

Exclusion criteria

Households residing outside of the Tamale metropolis were not included or considered in this research work as well as community leaders outside the Tamale Metropolis were excluded from the study.

3.4.3. Sample size determination

A sample size of 401 household was statistically determined based on the Cochran's formula (Cochran, 1977):

$$\mathbf{n} = \frac{\boldsymbol{X^2 * N * P * (1-P)}}{\boldsymbol{(ME^2 * \{N-1\}) + (X^2 * P * \{1-P\})}}$$

- n is the sample size (?)
- X is confidence level of 95% with 1.96 SD of π
- N is Total number of Households (HH) in Tamale Metro (54,882 HHs {Projected 2010 PHC to 2018})
- ME is Margin of Error 5% (0.05)
- P is Population Proportion 50% (0.5)

$$n = \frac{1.96^2 * 54{,}882 * 0.5 * (1-0.5)}{(0.05^2 * \{54{,}882-1\}) + (1.96^2 * 0.5 * \{1-0.5\})}$$

$$n = \frac{3.84 * 54{,}882 * 0.5 * 0.5}{(0.0025 * 54{,}881) + (3.84 * 0.5 * 0.5)}$$

$$n = \frac{52{,}687}{137.20 + 0.96}$$

$$n = \frac{52{,}687}{138.20}$$

$$n = 381.23 \cong 381$$

The sample size calculated was further divided by the confidence level of 95% i.e. 381 ÷ 0.95 to attain a working sample size of 401. This is to account for contingences such as non – respondents or recording errors in the course of the data collection.

The study involved twenty (20) key informants who aided in giving insight views on the study objective with regard to the socio-cultural factors that hinders or promotes WASH practices in their respective communities and they included one (1) community leaders from each of the twenty (20) sampled communities in the study.

3.4.4. Sampling strategy

A multiple stage sampling technique was used.

First and foremost, a simple random sampling procedure was used to sample ten (10) communities based on a sample frame (list of communities) from each of the two (2) sub-metros to get twenty (20) sampled communities in total.

In addition, a comprehensive sampling of houses / residential structures was carried out to select twenty (20) houses from each of the twenty (20) sampled communities based on a list of community house numbers collected from a Tamale-based Non-Governmental Organisation (NGO) Innovation for Sustainable Impact (ISI). Simple random sampling technique was then used to select one (1) household from selected houses with multiple households and purposefully selected the household heads as the respondents.

Secondly, a purposeful sampling strategy was used to pick one (1) community leader to participate in the study as key informants from each of the twenty (20) sampled populations.

3.5. Methods and tools of data collection

3.5.1. Household Survey

A household survey to obtain quantitative data from household heads was conducted. By using standardized questionnaires as a suitable data collection instrument, the survey approach was operationalized since structured questionnaires are simple to administer, friendly to complete and fast to score. Questionnaires were administered to household heads to gather data on the characteristics of both respondents and their households, including background information (age, gender, level of education, marital status), economic status (income levels, job status), drinking water supplies, forms of household toilet facilities, methods of water treatment, diseases. To ensure appropriateness and precision, the questionnaire was translated into the local language (Dagbanli) and back into the English language. The socio-demographic characteristics of respondents, including age, gender and educational history, were linked to the first part of each questionnaire. In reference to each of

the research objectives, the other parts of each questionnaire were arranged. The questionnaire was performed via face-to - face interviews. To make data processing simple, the questionnaires included closed-ended objects.

3.5.2. Key informant interviews

Key informant interviews were granted to twenty (20) community leaders, one (1) from each of the twenty (20) sampled communities as key informants to solicit their insightful views in relation to the study objectives in respect of socio-cultural factors that hinders or promotes WASH practices within the Tamale Metropolis. These were conducted by a team of five (5) trained research assistants on the key informant interview guide which was translated into the local language (Dagbanli) and back to English language after the interviews. The trained research assistance met community leaders in their respective homes to conduct these interviews. Each key informant interview lasted between 15 – 20 minutes and was audio-recorded per the permission of the interviewees. Key informant interviews were appropriate for this study because they gave insightful and indigenous views on the socio-cultural factors hindering or promoting various WASH practices within the Metropolis. This was done using interview guide to aid in conducting face – to – face in – depth interviews with key informants to ensure consistency and accuracy of data collection.

3.5.3. Observation

Direct observation was employed to assess drinking water treatment and storage facilities presence, availability and condition of sanitation facilities, provision of soap and water for handwashing (hygiene), and WASH-related maintenance. Observation enabled the study to confirm the WASH practices within households to complement the responses of the household heads. This was conducted using a structured observation form or guide on WASH

as recommended by WHO. The observation was successfully done by appropriately ticking on the form what facility is available within a household.

3.6. Study Variables

The dependent variable in the study was the incidence of WASH related diseases. Whilst the independent variables comprised WASH practices; sources of drinking water, methods of water treatment, types of toilet facilities, types of hygiene facilities and socio-cultural factors and Type of WASH facilities available (cost, user friendliness).

3.7. Data Processing and Analysis

To avoid unwanted access to the sensitive information of respondents, the quantitative data gathered in the field was entered and stored on a personal computer with an encrypted security password. Duplicates of these files were stored for secure storage and fast retrieval on Google drive, Dropbox and Cloud drive as needed at any point in time. Field-collected qualitative data was transcribed, typed and saved on a personal computer and copied to Google Drive, Dropbox and Cloud Drive.

Data cleaning was performed after the processing of data from the field. To ensure precision, continuity and appropriateness, rigorous editing was done. This included verifying the authenticity and continuity of the details on each questionnaire and in the research notebook in relation to the study's goals, as well as coding the data obtained from the field to ensure consistency. Data was analysed quantitatively using the Statistical Package for Social Sciences (SPSS) components such as descriptive statistics and inferential statistics, and excel. In this study, both descriptive and inferential studies were carried out. Statistical analytical tools like diagrams, graphs, pie charts and tables have been used to interpret and present quantitative data. To establish the relation between WASH practices and the incidence of WASH-related diseases, inferential statistical analysis was performed using chi-square (X^2)

analysis. This was achieved cross tabulating in a-two – way table, respondents recall on incidence of WASH – related diseases on the fortnight (Last 2 weeks) prior to the survey with various WASH practices within households to determine the significance of the association between each practice and the disease incidence at the 5% significance level using Excel.

With regards to qualitative analysis, field notes on WASH issues; the perceptions, views and opinion of the interviewees (key informants) were inductively coded and thematically analysed. The results (themes) were presented with support of direct quotations from the transcripts.

3.8. Ethical Consideration

Access approval for the research work was obtained from the Tamale Metropolitan Health Directorate. Informed written consent was soughed from household heads and key informants prior to administration of the data collection instruments. Confidentiality regarding the data collected from the survey was ensured. The harm involved in this study to participant was the ability of the study to exposed individuals and households who practice unlawful behaviour with regards to WASH and the benefit accrued from the study was for participants to help the study understand WASH practices within study area. Participants were assured of no risk attach to this study in the written consent form as all vital data concerning respondents were encrypted and stored appropriately.

CHAPTER FOUR

RESULTS

4.1. Socio – Demographic Characteristics of Respondents

Out of the 401 respondents (household heads) sampled for the quantitative arm of the study, 398 responded, representing a response rate of 99.25%. From Table 4.1, out of the 398 respondents, 49.7% of them were urban dwellers, 35.2% lived in rural areas and 15.1% in Peri – Urban areas. Majority of the respondents were males, thus; 369 representing 92.7%. With regards to marital status, 89.9% of the respondents were married. The predominant religion is Islamic religion with 92.7%, followed by Christianity with 6.5% and Traditionalist/Spiritualist with 0.8% of the total respondents. Respondents without formal education (None) were 56.7%, Tertiary education 12.1%, Junior High School education 11.6%, Senior High School and Primary School education with 10.1% and 9.5% respectively. Occupational type did not vary greatly between farming and general trading accruing proportions of 33.9% and 27.1% respectively. Educationist accrued a proportion of 13.6% of the total respondents, drivers, mechanics and tailors were 6.8%, 6% and 5.3% and others which included masons, electricians, carpenters, steel benders among other artisanship represent 3% of the respondents.

Table 4. 1: Demographic Characteristics of the Respondents (Household Heads) (n=398)

Variables		Frequencies	Percentage %
Residential location	Urban	198	49.7%
	Peri-Urban	60	15.1%
	Rural	140	35.2%
Sex	Female	29	7.3%
	Male	369	92.7%
Marital Status	Single	4	1.0%
	Married	358	89.9%
	Devoiced	15	3.8%
	Widowed	19	4.8%
	Separated	2	0.5%
Religion	Islam	369	92.7%
	Christianity	26	6.5%
	Traditional/Spiritualist	3	0.8%
Educational level	None	226	56.7%
	Primary School	38	9.5%
	Junior High School	46	11.6%
	Senior High School	40	10.1%
	Tertiary	48	12.1%
Occupation	Trader	108	27.1%
	Driver	27	6.8%
	Mechanic	24	6.0%
	Educationist	54	13.6%
	Food Vendor	2	0.5%
	Tailor	21	5.3%
	Farming	135	33.9%
	Unemployed	10	2.5%
	Retired	5	1.3%
	Others	12	3.0%

Source: Author's Field Survey, 2019.

The median age of the respondents is 51years with a minimum and maximum age range of 24 and 86 years respectively. The median household size is 13 people within a range of 2 to 46 people.

4.2. Determining household WASH Practices

4.2.1 Household water supply sources (improved vs unimproved)

Majority (64.1%) of households draw water from improved sources (consisting of all forms of pipe borne water, hand dug well with hand pump, sachet water, borehole with hand pump and hand dug well with concrete lining, bucket and cover). 35.9% draw water from unimproved sources (consisting of stream/river/pond, and unprotected well without concrete lining nor cover) (Figure 4.1).

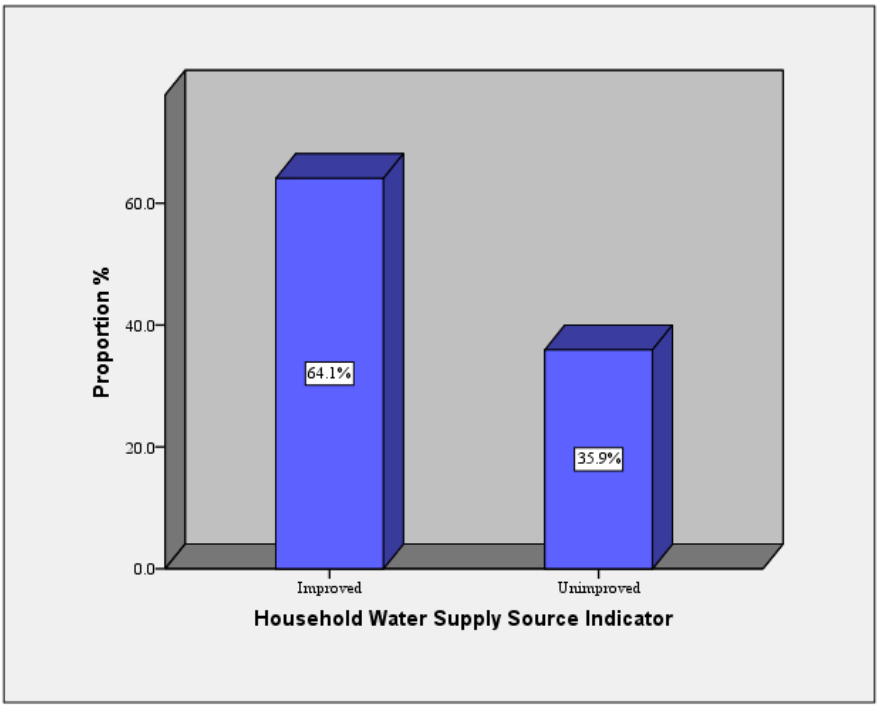


Figure 4. 1: Coverage of Improved and Unimproved Water Sources

4.2.2 Specific household water supply practices

Table 4.2 presents the specific main potable water sources for the various households, household water treatment practices, average household daily water supply and their water drawing times. As shown on Table 4.2, 34.4% of the respondents use stream as their main household water supply source, 30.7% use public standpipe, 24.1% use piped to yard, 7% of them use piped to house, 1.3% use Tanker Truck services whiles 1% use borehole with pump.

Only 0.3%, 0.5%, 0.5%, 0.3% use hand dug well with pump, hand dug well with concrete lining and sachet water as household water supply sources respectively.

Furthermore, majority of the households do not practice any form of water treatment before use. As shown on Table 4.2, 68.6% of the respondents do not practice any form of water treatment before use whilst only 31.4% practice water treatment before use. On water treatment methods practiced, out of the respondents who practiced some form of water treatment methods, 62.1% of them use cloth filters, 28% of them use disinfections as water treatment method, 7.7% of them resort to boiling and 2.2% of them use household filters as method of water treatment.

Averagely, the mean hours of daily water supplied to households is 8.6 hours with a minimum range of 0 and a maximum of 24 hours daily and that for water fetching time is 16 mins 20 seconds ranging between a minimum of 0 and a maximum of 60 minutes as presented in Table 4.2

Table 4.2: Specific household potable water supply practices

Variables		Frequency	Percentage %
Main source of drinking water	Stream/River/Pond	137	34.4%
	Sachet water	1	0.3%
	Tanker Truck	5	1.3%
	Unprotected well without concrete lining nor cover	2	0.5%
	Hand dug well with concrete lining, bucket and cover	2	0.5%
	Hand dug well with hand pump	1	0.3%
	Borehole without hand pump	4	1.0%
	Public taps/Standpipe	122	30.7%
	Piped water to yard or plot	96	24.1%
	Piped water into house	28	7.0%
	Total	**398**	**100%**
Water Treatment	Yes	125	31.4%
	No	273	68.6%
	Total	**398**	**100.0%**
Methods of Drinking water Treatment	Boiling	14	7.7%
	Cloth filters	113	62.1%
	Disinfection (Aqua tabs, PUR, Alum, Tab 10s etc)	51	28.0%
	Household filters	4	2.2%
	Total	**182**	**100.0%**

Variable	Range (Hours/Mins)	Mean (Hours/Mins)	Std. Deviation
Average Water Supplied hours	0 – 24	8.60	9.80
Average Time taken to fetch water	0 – 60	16.20	38.93

Field Survey Data, 2019.

4.2.3. Sanitation Practices

Figure 4.2 illustrates the results on household ownership of toilet facilities as gathered from the survey and confirmed by the direct observations. The results revealed that majority of households in the study area have no household toilets. 79.9% of households did not have household toilets as compared with 20.1% of the households with their own toilet facilities.

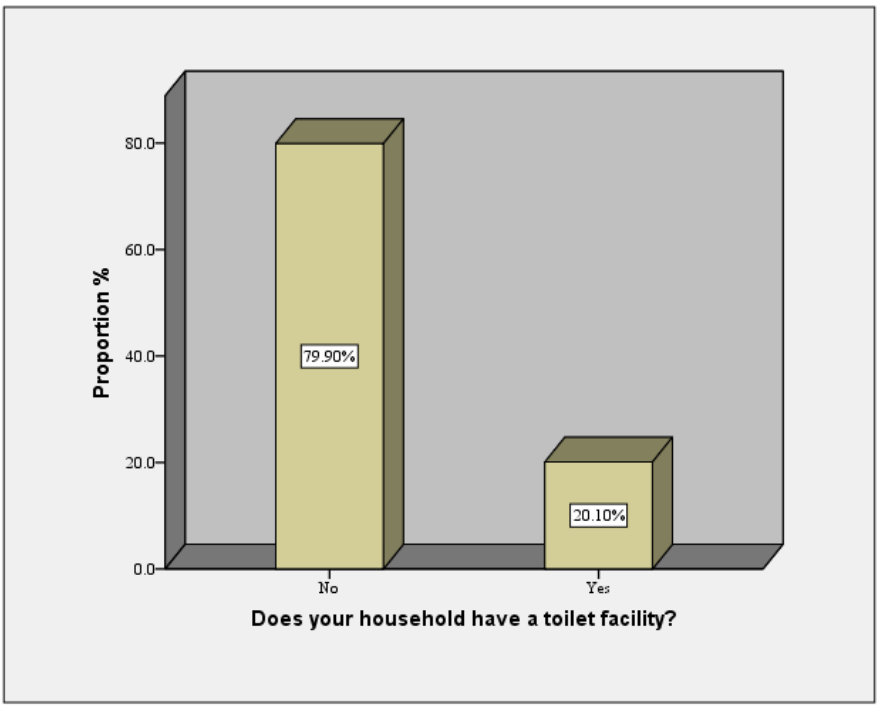


Figure 4. 2: Ownership of Household Toilet Facility

As also shown in Figure 4.3, 81.41% of the households use unimproved toilet facilities, whilst 18.59% use improved toilet facilities.

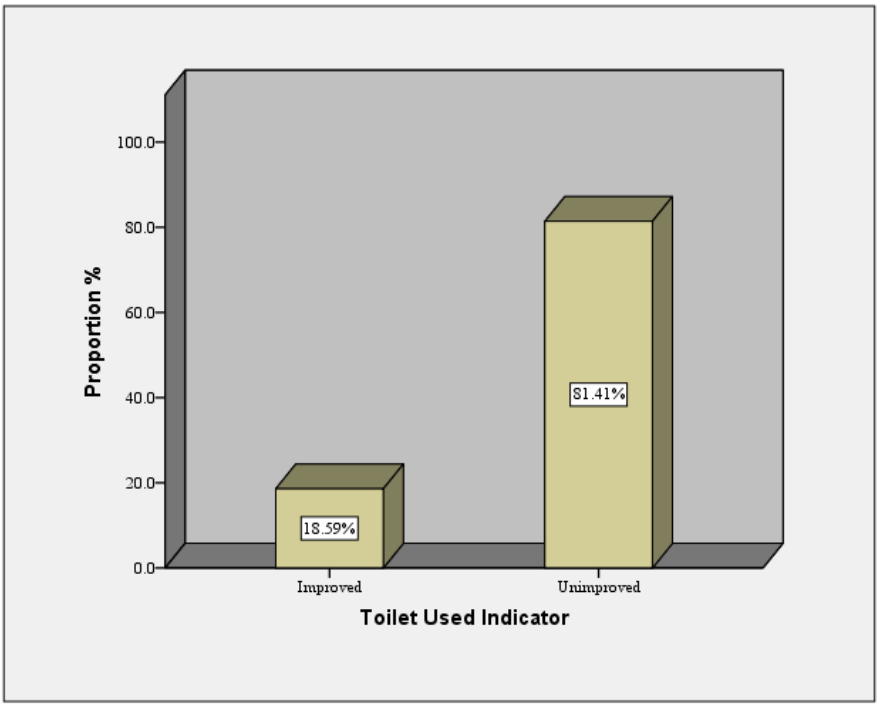


Figure 4. 3: Use of Improved and Unimproved Toilet Facilities

Furthermore, 42.5% of the households with toilet facilities own flush to septic tank toilet, 30% own VIP/pit latrine with slab, 23.8% own Flush/Pour flush to pit toilet facility, 7.5% own Pit latrine without slab, 5% own composting toilets and 2.5% own flush to piped sewer system (Table 4.3). According to Table 4.3, 58.5% of the households practice open defecation, 59.80% use public latrines, 6.5% use school or health facilities toilet, whilst 0.5% and 0.2% of the households use chamber pot and other facilities respectively as alternative places of convenience. Out of 398 households sampled, 78.9% do not have solid waste containers whilst 21.1% have solid waste containers in the study area (Table 4.3). Table 4.3 also shows that, out of multiple responses, 43.6% of households disposed solid waste at a designated area, 43% of them burn or burry their solid waste, 31.8% disposes of solid waste within household yard, 8% disposed of elsewhere, 2.9% and 2.5% disposed of by informal and formal waste service providers respectively.

Table 4.3: Household Type of Toilet Facilities Used, Distribution of Alternative Household Place of Convenience, Household Solid and Liquid Waste Disposal

Variables		Frequency	Percentage
Types of Toilet Facilities	Flush to piped sewer system	2	2.5%
	Flush to septic tank	34	42.5%
	Flush/pour flush to pit	19	23.8%
	Composting toilet	4	5.0%
	VIP/pit latrine with slab	24	30.0%
	Pit latrine without slab/open pit	6	7.5%
	Total	**89**	**100%**
Alternative Places of Convenience for Adults (multiple responses applied)	Chamber Pot	2	0.5%
	At facilities (e.g. school, health clinic)	26	6.5%
	Open defecation (Forest/Bush/Fields)	233	58.5%
	Other	1	0.2%
	Communal/public latrine	238	59.80%
Solid Waste Container	No	314	78.9%
	Yes	84	21.1%
	Total	**398**	**100.0%**
Alternative Method of Solid Waste Disposal (multiple responses applied)	Buried or burned	135	43.0%
	Formal service provider	8	2.5%
	Informal service provider	9	2.9%
	Designated waste disposal area	137	43.6%
	Elsewhere	25	8.0%
	Within household yard	100	31.8%

Field Survey Data, 2019.

4.2.4. Hygiene Practices

From Table 4.4, 97.2% households practice handwashing before eating, 81.8% of them practice handwashing after going to toilet, 61.4% of them after handling children's faeces, whereas 60.6% of households practice handwashing before cooking, 39.1% after working out and 1.9% practice handwashing on others. Moreover, 80.2% of households had soap or something else for handwashing and 19.8% do not have anything for proper handwashing. For those households with soap or something else for handwashing, 98.4% use soap (liquid or

Bar) for handwashing, 1% use ash and 0.6% of households use sand for handwashing practices. (Table 4.4).

From Table 4.4, 71.9% households do not have water designated for handwashing (from tap or storage) whilst 28.1% have. On other observations, 85.7% households do not have facilities for handwashing (Basin, Bucket, Sink) whilst 14.3% have. Out of the households without facilities for handwashing, table 4.4 further revealed that 93.5% use ablution kettles for handwashing practices.

Table 4.4: Household Hygiene Practices at Critical Periods and Observations on Households Hygiene Practices

Variables		Frequency	Proportion %
Handwashing Practices	After handling children's faeces	223	61.4%
	After going to toilet	297	81.8%
	After working out	142	39.1%
	Before start cooking	220	60.6%
	Before start eating	353	97.2%
	Others	6	1.7%
Soap or Something Else for Handwashing	No	79	19.8%
	Yes	319	80.2%
	Total	**398**	**100.0%**
Materials for Handwashing	Soap (Bar or Liquid)	314	98.4%
	Ash	3	1.0%
	Sand	2	0.6%
	Total	**319**	**100.0%**
Water for hand washing (from tap, storage etc.)	No	286	71.9
	Yes	112	28.1
	Total	**398**	**100**
Facility for hand washing (basin, bucket, sink, etc.)	No	341	85.7
	Yes	57	14.3
	Total	**398**	**100**
Other Observations	Others	22	6.5
	Ablution Kettle	319	93.5
	Total	**341**	**100**

Field Survey Data, 2019.

The results from the direct observations established that 85.68% do not have functioning handwashing facilities and 14.32% have functioning handwashing facilities and this is illustrated in Figure 4.4.

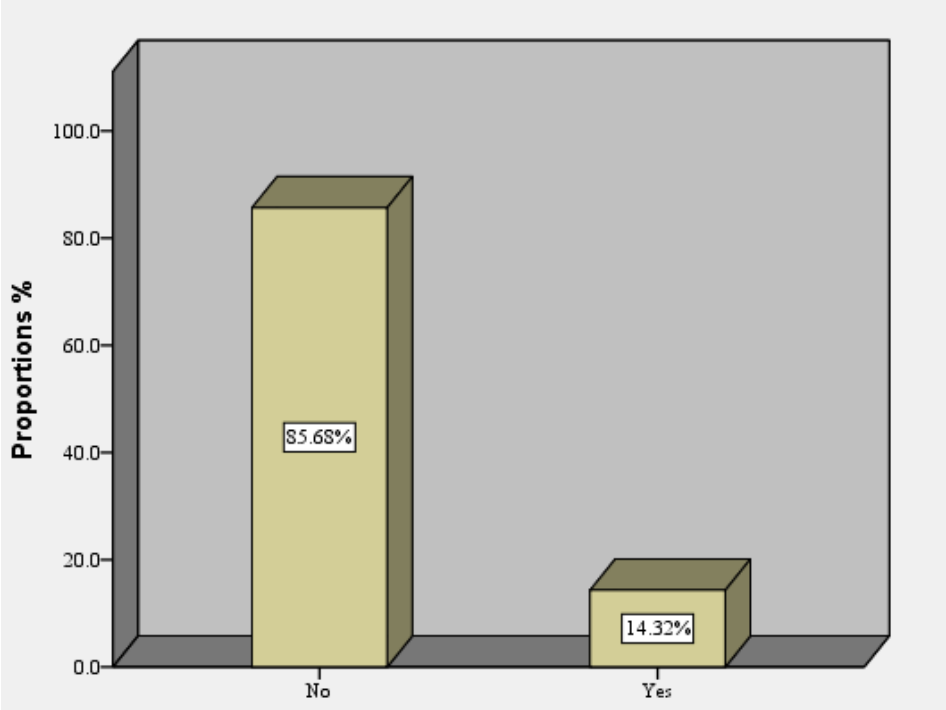


Figure 4. 4: Coverage of Household Functioning Handwashing Facilities

4.3. Determining Incidence of Water Sanitation and Hygiene (WASH) Related Diseases

4.3.1. Household WASH – Related Disease Awareness

From Figure 4.5, awareness on various WASH – related diseases among households indicated that, URI and Malaria had a 100% awareness rate, 99.5% for Polio, Guinea Worm Disease, Diarrhea and Cholera respectively, 96.23% for Dysentery, Typhoid 86.68%, Trachoma 73.37%, Yellow Fever and Sleeping Sickness with 70.60% and 60.30% awareness rates respectively.

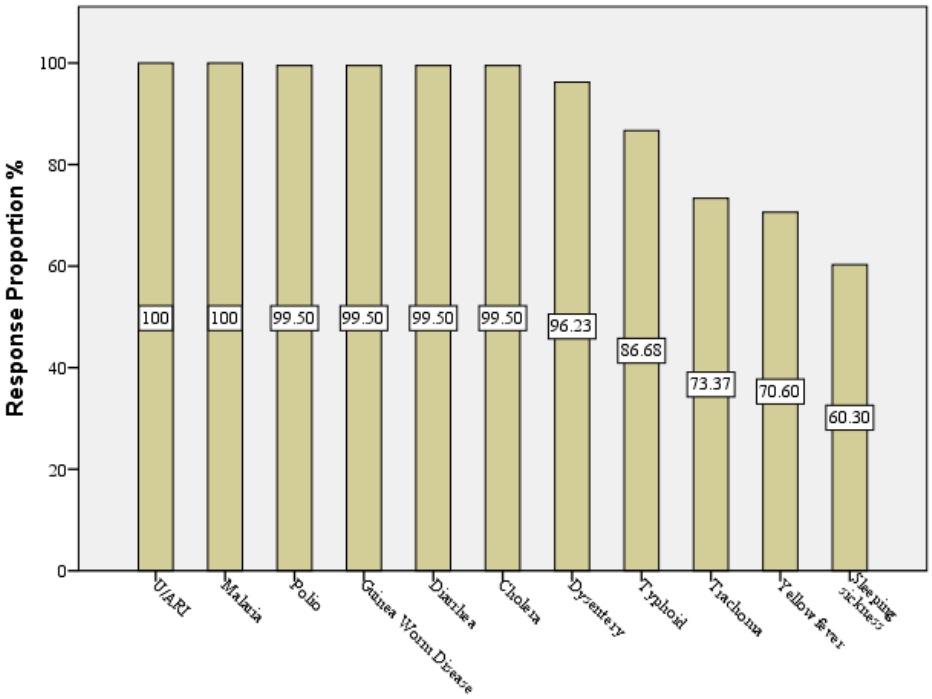


Figure 4. 5: WASH – Related Diseases Awareness among Households

4.3.2. Household Recall on WASH – Related Disease Occurrence within Last 2 weeks

Figure 4.7 below illustrates WASH – Related diseases occurrence in households within the recall periods of two weeks (fortnight) to the survey.

Out of 23.8% respondents who had recalled at least one WASH related diseases within last 2 weeks' period to survey, Malaria occurred in 96 households representing (30.1%) within the last 2 weeks' periods, U/ARI occurred in 92 households representing (28.8%), Diarrhea in 44 households which represent 13.8%, Dysentery 36 (11.3%), Typhoid 31 (9.7%), Cholera 14 (4.4%), Yellow Fever 3 (0.9%), Trachoma 2 (0.6%), sleeping sickness 1 (0.3%). Polio and Guinea Worm Disease as well recording 0 occurrence in households respectively within 2 weeks (fortnight) to the survey.

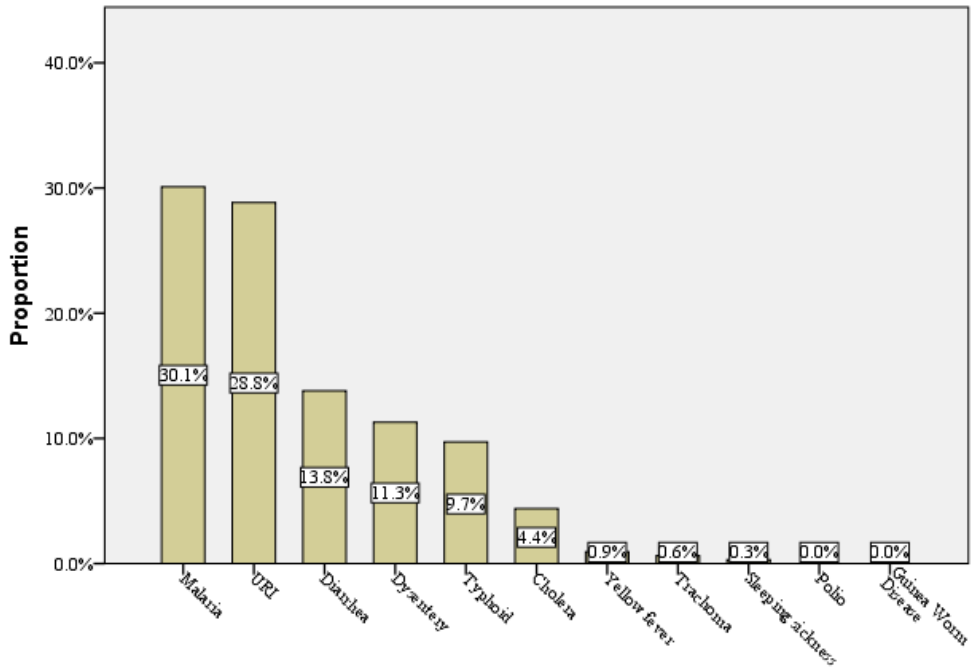


Figure 4. 7: WASH – Related Diseases Occurrence in Households within Last 2 weeks

4.4. Association between WASH Practices and Incidence of WASH – Related Diseases

Respondents recall on incidence of WASH – related diseases on the fortnight (Last 2 weeks) prior to the survey was cross tabulated in a 2 – way table with various WASH practices within households to determine the significance or the association between each practice and the incidence.

4.4.1. Association between Household Water Supply Source, Water Treatment and Methods of Water Treatment and Incidence of WASH – Related Diseases (Last 2 Weeks / Fortnight)

Table 4.5 presents the results of the relationship between WASH practices and the incidence of WASH related diseases. The results showed that improved water sources (X^2 =6.565, p=0.010) and water treatment (X^2=16.622, p=0.000) were statistically significantly associated with the incidence of WASH- related diseases. Those households that draw water from improved sources reported a lower incidence (16.8%) of WASH related disease compared to those households that draw water from unimproved sources (28.2%). Also, those households that treated water before use reported only 11.2% of WASH-related disease occurrence

compared to the 30.1% reported by those who did not treat water before use. However, there was no significant association between water treatment methods and the incidence of WASH – related diseases (X^2=3.206, P=0.524).

Table 4.5: Cross Tabulation of Indicator of Water Supply Source, Water Treatment and Water Treatment Methods and Incidence of WASH – Related Diseases (Last 2 Weeks / Fortnight)

Water supply source Indicators		Last 2 weeks (fortnight)		Pearson Chi - Square	
		No (%)	Yes (%)	Chi – Square Value (X^2)	P - Value
Improved		119(83.2)	24(16.8)		
Unimproved		183(71.8)	72(28.2)	**6.565**	**0.010**
Water Treatment	Yes	111(88.8)	14 (11.2)	**16.622**	**0.000**
	No	191(69.9)	82 (30.1)		
Water Treatment Methods	Boiling	14 (100)	0	**3.206**	**0.524**
	Cloth Filter	101(89.3)	12 (10.7)		
	Disinfection (Aqua Tabs, PUR, Tab 10s)	191(69.9)	82 (30.1)		
	Household Filter	3 (75)	1 (25)		

Field Survey Data, 2019.

4.4.2. Association between Household Toilet Facilities and Incidence of WASH – Related Disease

Table 4.6, the bivariate analysis of the relationship between household toilet indicators and incidence of WASH – related diseases (fortnight). The results show that there is no statistically significant associations between the incidence of WASH – related diseases and using improved toilet facilities (X^2=1.172, p=0.279). No statistically significant association was also reported between household types of toilet use and the incidence of WASH – related disease (X^2=4.63, p=0.591). However, this was not the case as similar analysis was done on

households' alternative place of convenience and the incidence of WASH – related disease which produced a statistically significant association (X^2= 15.170, p=0.010).

Table 4.6: Cross Tabulation of Household Toilet Facilities, Type Toilet Used, Alternative Place of Convenience and Incidence of WASH – Related Diseases (Fortnight)

Household Toilet Indicator	Last 2 weeks (fortnight)		Pearson Chi - Square	
	No (%)	Yes (%)	Chi – Square Value (X^2)	P - Value
Improved	51 (68.9)	23 (31.1)		
Unimproved	251 (77.4)	73 (22.6)	**2.406**	**0.121**
Household Toilet Facility				
No	245(77)	73(23)		
Yes	57(71.2)	23(28.8)	**1.172**	**0.279**
Types of Household Toilet Facilities				
Flush to piped sewer system	29 (100)	0		
Flush to septic tank	24 (70.5)	10 (29.5)		
Flush/pour flush to pit	12 (63.2)	7(36.8)	**4.635**	**0.591**
Composting toilet	3 (75)	1(25)		
VIP/pit latrine with slab	16 (66.7)	8 (33.3)		
Pit latrine without slab/open pit	6 (100)	0		
Alternative Places of Convenience for Adults				
Communal/public latrine	149 (70.6)	62 (29.4)		
Open defecation (Forest/Bush/Fields)	178 (76.3)	55 (23.7)		
At facilities (e.g. school, health clinic)	14 (53.9)	12 (46.1)	**15.170**	**0.010**
Chamber Pot	1 (50)	1 (50)		
Other	1 (100)	0		

Field Survey Data, 2019.

4.4.3. Association between Household Solid, Liquid Waste Disposal and Incidence of WASH – Related Disease (Last 2 Weeks / Fortnight)

Table 4.7 reveals that there were statistically insignificant associations between the presence of household waste containers and incidents of WASH – related diseases (X^2=0.877,

p=0.349). A statistically insignificant association was also reported between the analysis of liquid waste disposal and incidence of WASH – related diseases (X^2=11.226, p=0.082). The association between the mode of solid waste disposal and the incidence of WASH – related diseases was statistically significant (X^2=37.542, p=0.000). The results show that the collection of waste by informal service provider was associated with the highest (77.8%) incidence of WASH-related diseases.

Table 4.7: Cross Tabulation of Household Solid, Liquid Waste Disposal and Incidence of WASH – Related Diseases (Last 2 Weeks / Fortnight)

Household Waste Container	Last 2 weeks (fortnight)		Pearson Chi - Square	
	No (%)	Yes (%)	Chi – Square Value (X^2)	P - Value
No	235 (74.8)	79 (25.2)		
Yes	67 (79.8)	17 (20.2)	**0.877**	**0.349**
Household solid waste disposal				
Collected by formal service provider	5 (62.5)	3 (37.5)		
Collected by informal service provider	2 (22.2)	7 (77.8)		
Disposed of in designated waste disposal area	100 (73)	37 (27)	**37.542**	**0.000**
Disposed of within household yard or plot	85 (85)	15 (15)		
Buried or burned	109 (80.7)	26 (19.3)		
Elsewhere	12 (48)	13 (52)		
Household Liquid waste disposal				
Sink/drain connected to sewer	2 (66.7)	1 (33.3)		
Sink/drain connected to septic tank	3 (100)	0		
Sink/drain connected to pit	3 (75)	1 (25)		
Sink/drain connected to soak pit	3 (100)	0	**11.226**	**0.082**
Sink/drain connected to open drain or open ground	93 (66.9)	46 (33.1)		
Disposed directly to open ground or water body	197 (80.4)	48 (19.6)		

Field Survey Data, 2019.

4.4.4. Association between Household Hygiene Practices and Incidence of WASH – Related Disease (Last 2 Weeks / Fortnight)

Table 4.8 presents a chi – square analysis on the side of handwashing practice and its association with incidence of WASH – related diseases. The results showed that there was no significant association between the incidence of WASH – related diseases and handwashing

practices (X^2=4.810, p=0.568) as well as the functionality of the handwashing facilities (X^2=0.567, p=0.451). However, handwashing with soap or something else was statistically significantly associated with the incidence of WASH – related diseases (X^2=5.499, p=0.018). Those households that practice handwashing with soap reported only 14% of WASH-related disease occurrence compared to the 26.7% that was reported by those households that do not practice handwashing with soap.

Table 4.8: Cross Tabulation of Household Handwashing Practices and Incidence of WASH – Related Diseases (Last 2 Weeks / Fortnight)

Handwashing Practices	**Last 2 weeks (fortnight)**		**Pearson Chi - Square**	
	No (%)	Yes (%)	Chi – Square Value (X^2)	P - Value
Before start cooking	171 (77.7)	49 (22.3)		
Before start eating	274 (77.6)	79 (22.4)		
After going to toilet	227 (76.4)	70 (23.6)		
After handling children's faeces	171 (76.7)	52 (23.3)	**4.810**	**0.568**
After working out	105 (73.9)	37 (26.1)		
Others	6 (100)	0		
Do you have soap or something else that you use for hand washing in your household?				
No	68 (86)	11 (14)		
Yes	234 (73.3)	85 (26.7)	**5.599**	**0.018**
Is there a functional handwashing facility at toilets used by the household?				
No	261 (76.5)	80 (23.5)		
Yes	41 (71.9)	16 (28.1)	**0.567**	**0.451**

Field Survey Data, 2019.

4.5. Qualitative Analysis of Key Informant Interviews on Socio-cultural Factors that Promotes or Hinders Water, Sanitation and Hygiene (WASH) Practices

4.5.1. Islam Religious Practices

In a key informant interview with an Imam in Ward I (one of the study communities); he had this to say when he was asked about how the perennial poor WASH practices can be improved in the study;

> *"The community is predominated by Muslims and in Islamic religious practice; the use of clean water is what Islamic religion asks every Muslim to use for drinking and any other purpose [.....]this can promote use of clean water in the community".* **Community Imam (Ward I).**

In another interview with Imam of Sabonjida, quoting from the holy Quran, the Imam said

> *"Allah himself said he is clean and dislike what is unclean, therefore, Islam religious practice encourages cleanliness than anything since a Muslim must use clean water to perform ablution so must water for drinking and other purposes be clean".* **Imam (Sabonjida).**

On sanitation, overcoming this perennial poor sanitation problem have been a nightmare for all and sundry as it constantly makes residents susceptible to various infectious WASH – Related diseases, in response the imam was of the view that;

> *"It is haram in Islam to defecate in the open and if members of this community follows the Islamic teachings very well, everyone will stop the habit of open defecation because, Islam curses a person who harms his neighbours through his actions".* **Community Imam (Ward I)**

It is clear that handwashing practices and for that matter hygiene in the study area have not been encouraging as even at critical periods most households failed to practice good hygiene, however, the imam have this to say in his response to that;

> *"Islam promote handwashing at all times, when going to toilet, Islamic teachings advice that you go with water to clean yourself after defecating and a person is not clean to pray if he/she does not clean the anus with water after defecating. The prophet Mohammed said…… cleanliness is half of faith (Iman) and also that the key to salat (prayers) is cleanliness".* **Community Imam (Ward I)**

4.5.2. Dagbon Traditional Practices

Predominantly Dogomba settlements where most communities of the study area are of Dagbon descent. The Dagbon traditional ways of life become an essential factor in the influence of WASH – practices within the study area as levels of sanitation keeps deteriorating among settlements within communities, but the Dagbon tradition in practices can promote good sanitation practices, in response to this Tuu Naa a sub – chief have this to say;

> *"Hahaha….by tradition and culture, a person should not be easily seen when defecating, it is important to find a hiding place for that thing. Emm … culture of Dagbon use to even promote sanitation by building what is called Salgah Doo for aged household members who can no longer go far from human settlement and water bodies to defecate to prevent indiscriminate defecation around homes and water bodies".* **Sub Chief (Sagnarigu Dungu)**

In another interview with the chief of Nima Fong on sanitation practice, he responded that;

> *"Yes as a chief, I don't support open defecation even if our culture doesn't say anything about it. I have had several open defecation cases in this palace where community member's reports individuals who uses their uncompleted buildings as*

toilets and I have set bi – laws that individuals involved in such act should be made to clean the uncompleted building and pay a fine to the chiefs palace……. that was how my fathers and grandfathers in Dagbon use to deal with open defecation cases" **Chief (Nima Fong)**

Adding her voice in response to the above theme, Magahajia of Jerigu also stated that

"By Dagbon tradition, women are responsible for supply and management of water in this community so it is our duty as women to ensure that we always provide clean water to our households for drinking and other purposes to prevent diseases". **Magahajia (Jerigu)**

4.5.3. Women roles

The central business of WASH at the household level remains the preserve of women. Men involvement only relates to the initial installation and building of pipelines for water and sanitation and hygiene facilities such as toilet and handwashing. Interviewing Magahajia of Jerigu, she responded that;

"Women are responsible for supply and management of water in this community, but culture of the community does not hinder or regulate the way women fetch water from source. But in our social gathering we the women leaders urge our colleague women to always filter or boil water before the household drinks it because our only source of water is from the dam and it is not clean to drink it direct". **Magahajia (Jerigu)**

In another interview with Tuutingli Magahajia she said;

"The dam is our only source of water for all purposes, so whether cultural norms or not that is what we use and we know it's not clean, due we women sometimes go to get pipe borne water from Sawaba but its far and we have to walk for hours just to ensure that we have enough water for our households". **Magahajia (Tuutingli)**

Sharing her side of the story in an interview, a unit committee member in Dabokpa New Settlement said;

> *"In this community women are not allowed to enter public toilet at night, this is due to allege bad spirit women who use public toilets at night have experienced, so at night when you want defecate and your house does not have toilet, you go to the bush at the nearby".* **Unit Committee Member (Dabokpa New Settlement).**

4.5.4. Local governance and Water, Sanitation and Hygiene (WASH) Practice

The local government system plays a very critical role in the practice of WASH in communities, most especially the sanitation and hygiene component of WASH. This leaves the responsibility of managing public toilets and damping sites as well as monitoring of the prospects of various WASH practices within households in the hands of assembly members of various electoral areas. In a key informant interview with assemblyman of Aboabu electoral area, he stated that;

> *"Well sanitation is poor in this community due to income levels, some households will tell you they have no money to build a household toilet facility and they defecate in the open; even to pay 20p to access the public toilet is a problem for some households".* **Assemblyman (Aboabu)**

The assemblyman for Gumbihini North also responded in an interview that;

> *"Gumbihini in general has been noted by the Tamale Metro Assembly as the cleanness in terms of sanitation, this is due to our readiness to hold on to the culture of communal labour where we always come together to clean the community. But the population of Gumbihini North is so large that the few public toilets are not able to serve us all and we also have a problem that effects the management of the various public toilets as local government authority, political party foot soldiers hijack the*

toilets and do not clean them as required, so people prefer open defection than using the public toilets". **Assemblyman (Gumbihini North)**

"The urban nature of our community makes it difficult for people to defecate in the open, only a few does that and they do it in the forest, majority of the community members use the public toilet and a few have household toilets". **Assemblyman (Zogbeli Unit 2)**

CHAPTER FIVE

DISCUSSIONS

5.1. Introduction

This chapter aimed at discussing the results of the study. The discussions are based on the linkages between the results of the study and previous studies. This is aimed at finding either relationships or distortions concerning the topic. The topic under the discussions is aimed at investigating the association between WASH practices and the incidences of WASH-related diseases in Tamale Metropolitan Area in the Northern Region, Ghana.

5.2. Water, Sanitation and Hygiene (WASH) practices

The study found that majority (64.1%) of the households in the study area draw water from improved sources (consisting of all forms of pipe borne water, hand dug well with hand pump, sachet water, borehole with hand pump and hand dug well with concrete lining, bucket and cover). Also, 35.9% draw water from unimproved sources (consisting of stream/river/pond, and unprotected well without concrete lining or cover). Though majority of households draw water from improved sources, much still need to be done in terms of water supply to protect a significant number of households from a possible outbreak of WASH related disease. The study findings are in line with Armah et al (2018) with result of 89% of households in Ghana having access to improved source of water between the period 2010 - 2015 (Armah et al., 2018). With regards to specific main portable water source for various households, the study reveals 34.4% of the household use stream as their main household water supply source, 30.7% use public standpipe, 24.1% use piped to yard, 7% of them use piped to house, 1.3% use Tanker Truck services whiles 1% use borehole with pump. This is in alignment to the study conducted by Abebaw, Tadesse and Mogues (2011) in Ethiopia on access to Improved Water Source and Satisfaction with Services Evidence from

Urban and Rural Ethiopia with a result that 57.9% households use stream, pond and river as main water source, 24% use hand dug well with pump, 4.1% public standpipe, and 0.57% private standpipe or tap (Abebaw, Tadesse, & Mogues, 2011). This signifies that households within the Tamale Metropolis are still susceptible to the outbreak of WASH related diseases given that majority of households still use stream a major source of water.

Further results from the study indicates that majority (68.6%) of the households do not practice any form of water treatment before use and 31.4% practice water treatment before use. The result is attributable to the fact that from the study about 64.1% of households generally draw water from improve sources within Tamale Metro and for that matter there is no need for treatment of any kind. Likewise, in a study by Belay, Dagnew and Abebe (2016) in Ethiopia, among the total study participants only 44.8 % of them treated water at their household using different modality of treatment approaches and 55.2% of the study participants do not treat water at their households (Belay et al., 2016).

On water treatment methods practiced, out of the respondents who practiced some form of water treatment methods, 62.1% of them use cloth filters, 28% of them use disinfections as water treatment method, 7.7% of them resort to boiling and 2.2% of them use household filters as method of water treatment. The presence of WASH NGOs within the study area who provide some form of education and other materials like nets for cloth filtering on WASH to households for free encourages households to practice some form of water treatment methods more especially cloth filtering. This falls in line with a cross – sectional study conducted by Pradhan et al. (2018) on knowledge and practice of participants about various disinfection methods for household water treatment Out of total 250 participants around 60% use and were knowledgeable about boiling water followed by chlorination (27%), Settling (7.2%), Cloth filter (4%) respectively (Pradhan et al., 2018).

The study results revealed that majority of households in the study area have no household toilets. 79.9% of households did not have household toilets as compared with 20.1% of the households with their own toilet facilities. This revelation made by the study has an adverse effect on the quest for the fight against open defecation as households without toilet facilities coupled with untidy public toilet facilities encourage residents to defecate indiscriminately irrespective of the consequences that may arise. The study result sides with other study findings. WHO (2015) data show that worldwide, 2.5 billion people lack basic sanitation (toilet facilities) (WHO, 2015a).

Also from the study results 81.41% of the households use unimproved toilet facilities, whilst 18.59% use improved toilet facilities. The likelihood of a general outbreak of WASH related diseases is high with majority of households using unimproved toilet facilities as flies and other disease causing agents can easily spread diseases after skulking over faeces from these unimproved toilets. Siding with the study result, World Vision empirical report, Ghana's improved sanitation coverage has not exceeded 15% for a long time. This means that only 15 in every 100 Ghanaians have access to sanitation facilities and services, while the rest are left defenceless against the inevitable consequences (World Vision, 2017). Mara, Lane, Scott and Trouba (2010), two-thirds of people who live in Asia and sub-Saharan Africa, 1.2 billion people, of whom more than half live in India, lack even an improved sanitation facility and must defecate in the open (Mara, Lane, Scott, & Trouba, 2010).

In assessing the WASH facilities in relation to toilet usage, the study found that 58.5% of the households practice open defecation as alternative place of convenience. The study also revealed that almost half of the households (59.8%) use public latrines. The absence of household toilets is the major factor for open defecation. It was another revelation that most households use shared toilet facilities from schools; lorry stations and other institutional or

communal facilities. This results coincides with a GNA (2017) report that according to UNICEF Chief of Water Sanitation and Hygiene (WASH), David Duncan. He said about 60 per cent of the populace used shared toilet facilities, 15 per cent used improved ones, six per cent unimproved, and 19 per cent practiced open defecation and asked that toilets be built to withstand the weather and be made affordable for the poor (GNA, 2017).

From the study results, 80.2% of households had soap or something else for handwashing and 19.8% do not have anything for proper handwashing. For those households with soap or something else for handwashing, 98.4% use soap (liquid or Bar) for handwashing, 1% use ash and 0.6% of households use sand for handwashing practices. This result looks favourable in the quest to reducing communicable diseases within the study area. However, the study result rather contradicts with other study findings, Johnson et al (2015), in a cross sectional study conducted on assessment of water, sanitation, and hygiene practices and associated factors in Benin, out of a sample size of 600 households, 9.7 % (58) households had improved hygiene behavior and 16 % (96) had permanent availability of soap at home for handwashing (Johnson et al., 2015).

Also the latter part of the study was done at the preliminary levels of the maiden COVID 19; where hygiene education has been intensified. Though respondents had information on the benefits of hygiene practices, they had intensified hygiene education during the peak of certain pandemics, like that of the COVID 19. The study found that households' awareness level on the hand washing with soap was higher and effective. Interactions with the households indicated that they had good information on the effectiveness of soap. According to the households, hand washing without soap is equivalent to that of water without sanitation or the vice versa. Further interactions with the households revealed that in the absence of

soap, households use ash as a detergent. The use of soap according to the households has been approved by WASH Partners across the study area and beyond.

5.3. Incidence of WASH – Related Diseases

The study result indicates 23.87% recalled disease occurrence within the last two weeks (fortnight) to the survey. Of the 23.87% respondents who had recalled at least one WASH related diseases within last 2 weeks period to survey, Malaria occurred in 96 households representing (30.1%) within the last 2 weeks periods, U/ARI occurred in 92 households representing (28.8%), Diarrhea in 44 households which represent 13.8%, Dysentery 36 (11.3%), Typhoid 31 (9.7%), Cholera 14 (4.4%), Yellow Fever 3 (0.9%), Trachoma 2 (0.6%), sleeping sickness 1 (0.3%). With Polio and Guinea Worm Disease recording 0 occurrence in households respectively. This results siding with other study findings WHO report (2017), estimated the incidence rate of malaria as a WASH – related disease worldwide stands at 63 cases per 1000 population at risk from 2010 to 2016 though dropped steadily from 76 with 18% drop rate, WHO still consider the 63 cases per 1000 population very high and worrying (WHO, 2017d). Tetteh et al (2018) trend study of incidence of diarrhea at the facility level in Jasikan District of the Volta Region in Ghana, a total of 17,740 cases of diarrhea were reported in the district from January 2012 to December 2016 with an incidence rate of 1.85% within the period under study was observed. The rate was high among under – five children with a total of 9556 per 100,000 people case incidence per person - year (196 incidence rate) within the 5 year study period (Tetteh et al., 2018).

The results showed that improved water sources (X^2 =6.565, p=0.010) and water treatment (X^2=16.622, p=0.000) were statistically significantly associated with the incidence of WASH- related diseases. This shows that an improvement in water quality coverage through improved sources and treatments would have a positive impact of reducing the incidence of

WASH related diseases by 6.565 and 16.622 cases per 100,000 people within the study area as there was an association between improved water sources and water treatment and the incidence of WASH related disease. In line with other study findings, Eshete, Robele, Beyene and Mengistie (2020), in their analysis, the main sources of water for drinking, and other domestic purposes like cooking and washing, type of water storage, water treatment were significantly associated with diarrhea WASH related disease (Eshete, Robele, Beyene, & Mengistie, 2020). .

Study analysis was done on households' alternative place of convenience and the incidence of WASH – related disease which produced a statistically significant association (X^2= 15.170, p=0.010). This result implies that for every single activity of unimproved sanitation practices there is a potential of an increase of 15.170 cases of WASH related disease per 100,000 people within the study area as there is a positive study also reveals that there was statistically insignificant associations between the presence of household waste containers and incidents of WASH – related diseases (X^2=0.877, p=0.349). The association between the mode of solid waste disposal and the incidence of WASH – related diseases was statistically significant (X^2=37.542, p=0.000). Linkages between household solid and liquid waste disposal and WASH-related diseases, statistical results indicated that effective and final disposal of waste materials (solid and liquid) reduces contamination levels, thereby reducing or eradicating sanitary related diseases. According to households, as solid disposals improve, disease causing and transmission agents reduce drastically, paving way for improved environmental conditions. It is imperative to note that most of the diseases that are found in poor sanitary areas are drastically or even non-existent in improved sanitary areas. Relating this results to other findings, Boadi (2004), in the multivariate test of variance, solid waste burning showed a significant association with the incidence of respiratory infections in adults (p = 0.004, 95% CI), and children (p = 0.010, 95% CI) (Boadi, 2004).

The study assessed the relationship between household hygiene practices and WASH-related diseases with a statistical observation that; an effective and improved hygiene practice reduces disease infection rates. etc.) (Johnson & Paull, 2011).

5.4. Sociocultural Factors that Promote or Hinder Water, Sanitation and Hygiene (WASH) Practices

In assessing the socio-cultural practices that promote or hinders WASH practices, the study found it positive to state that; there is an effective linkage between way of life and hygiene. For instance, choosing to live with a group of people whose cultures promote hand washing with soap at ceremonial grounds will serve a good purpose in living a hygienic life than those whose cultures do not accept hygiene practices.

A qualitative result from the study found that religion is generally seen as a significant part of identity of an individual or a community, Islamic religion can have a significant influence on WASH practices within the area as key informants were quoted "*The community is predominated by Muslims and in Islamic religious practice; the use of clean water is what Islamic religion asks every Muslim to use for drinking and any other purpose [.....] this can promote use of clean water in the community"* **Imam (Ward I)**.

"Allah himself said he is clean and dislike what is unclean, therefore, Islam religious practice encourages cleanliness than anything since a Muslim must use clean water to perform ablution so must water for drinking and other purposes be clean" **Imam (Sabonjida)**. The influence of religion cannot be overlooked in the lives of individuals and households as majority of people believe in the saying of their religious leaders and their holy scriptures and this can combine with already existing strategies to enhance good WASH practice in the study area. The study results coinciding with other study findings, Participants in Khuan, Shaban, and Van De Mortal (2018) suggested that hand grooming is a basic tenant

of Islam. *As one respondent proposed: "In fact, hand hygiene is necessary. It is actually part of the religion [sic] obligation" (*Islamic Scholar 3). In addition, they suggested that it was important for all religious organizations to be clean, as this quotation shows: *"I think that all religions need us to be clean and it is specifically stated in the holy books of Christianity and Islam"* (Nurse 2) (Khuan, Shaban, & Van De Mortel, 2018, P. 231).

The study results also indicated religion can as well play a significant role through key informant interview to improve sanitation practices in the study area; "*It is haram in Islam to defecate in the open and if members of this community follows the Islamic teachings very well, everyone will stop the habit of open defecation because, Islam curses a person who harms his neighbours through his actions".* With the fear of possible punishment from Allah from an avoidable curse, continue religious sermons in churches and mosques by pastors and imams can help change the behaviours of culprit who engage in open defecation practice. This result sides with other study finding by Hope and Jones (2014), The instructions set forth in the Qur'an notified Muslim members that they would be held responsible not only because it was a "sign" of Allah, but also because it was essentially divine property, for their use of the setting. Participants concluded that obedience to an all-seeing god acted as a driving force for sustainable climate regulations irrespective of whether anyone would notice these actions: *"It goes back to the idea that our Lord often monitors [...] you have the obligation and you will be informed about it"* (Hope & Jones, 2014).

The study discovered that water issues are gendered and its use is traditionally classified. Water use is controlled by the female of the household since it is their preserve to fetches it, sometimes escorted by her children who are mostly girls. However, men provide money for water to be bought and the management remains the work of the woman. This was revealed in one of the study key informant results quotes; *"By Dagbon tradition, women are*

responsible for supply and management of water in this community so it is our duty as women to ensure that we always provide clean water to our households for drinking and other purposes to prevent diseases". **Magahajia (Jerigu)**. Moreover, results on women role in WASH also revealed on this point as further quotes indicates that; *"in our social gathering we the women leaders urge our colleague women to always filter or boil water before the household drinks it because our only source of water is from the dam and it is not clean to drink it direct". .*

The study also revealed that women are not allow to use public latrines due to the fear of but spiritual attach at night as captured in one of the study key informant interviews *"In this community women are not allowed to enter public toilet at night, this is due to allege bad spirit women who use public toilets at night have experienced, so at night when you want defecate and your house does not have toilet, you go to the bush at the nearby".* This means that women are forced to resort to other alternative places of convenience most especially the practice open defecation which does not help in the fight for good sanitation practices at household level. Similar to this results is a findings made by Wasonga et al (2016), "*A latrine that is used by the mother or father in-law is not to be used by the daughters or sons and also latrines should not be used at night since they harbor evil spirits"*(Wasonga et al., 2016a, P. 4).

CHAPTER SIX

SUMMARY OF FINDINGS, CONCLUSION AND RECOMMENDATION

6.1. Introduction

This chapter presents the summary of major findings and conclusions of the study. It also makes recommendations for future research and practices. The study assessed the association between WASH practices and the incidence of WASH – related diseases in the Tamale Metropolitan Area Ghana.

6.2. Summary of Major Findings

6.2.1 WASH practices in the Metropolis

- Majority (64.1%) of households draw water from improved sources. 34.4% of households uses stream as major source of drinking water supply and 0.3% uses sachet water for drinking as the least.
- Majority (68.6%) of households do not practice any form of water treatment method. 62.1% of households who practices some form of water treatment method use cloth filtering.
- On average water is supplied to households within 8.6 hours a day and households who go to fetch water uses 16 minutes on average.
- 81.4% of households within the study area use unimproved toilets facilities. Majority (79.9%) of households in the study area does not have toilets and out of those household with toilets, 42.5% use flush to septic tank toilet.
- Almost half (49.3%) of households practice open defecation as alternative place of convenience. 78.9% do not have solid waste containers and 43.6% disposed – off solid waste in a designated area.
- 97.2% of households practice handwashing before eating. Majority (80.2%) of households have soap or something else for handwashing, out of which 98.4% uses

soap (liquid or bar) for handwashing. 85.68% of households do not have functioning handwashing facilities at home and 93.5% of households use ablution kettles for handwashing practices.

6.2.2 Incidence of WASH-related diseases

- 32.41% of respondents recalled the occurrence of WASH – related diseases within last month to survey and 23.87% of respondents recalled occurrence of WASH – related diseases in their households with the last two weeks (fortnight) to survey.
- 30.1% Malaria incidence occurred out of the 23.8% respondents who had recalled at least one WASH related diseases within last 2 weeks period to survey, 28.8% U/ARI occurred in households within that period, 13.8% of Diarrhea cases, Dysentery 11.3%, Typhoid 9.7%, Cholera 4.4%, Yellow Fever 0.9%, Trachoma 0.6%, sleeping sickness 0.3%.

6.2.3. Association between WASH practices and WASH-related diseases

- The incidence of WASH-diseases was statistically significantly associated with the use of improved water sources (X^2 =6.565, p=0.010), water treatment (X^2=16.622, p=0.000), alternative place of convenience (X^2=15.170, p=0.010), type of household solid waste disposal system (X^2=37.542, p=0.000) and presence of soap for handwashing (X^2=5.599, p=0.018).
- Those households that draw water from improved sources reported a lower incidence (16.8%) of WASH related disease compared to those households that draw water from unimproved sources (28.2%).
- Those households that treated water before use reported only 11.2% of WASH-related disease occurrence compared to the 30.1% reported by those who did not treat water before use.

- The collection of waste by informal service provider was associated with the highest (77.8%) incidence of WASH-related diseases
- Those households that practice handwashing with soap reported only 14% of WASH-related disease occurrence compared to the 26.7% that was reported by those households that do not practice handwashing with soap

6.2.4 Socio-cultural factors influencing WASH practices

- The qualitative data revealed Islamic religion, Dagbon tradition and the predominant role of women in WASH as the socio-cultural factors influencing WASH practices.

6.2 Conclusion

In conclusion, there is a significance association between water supply source, water treatment and the incidence of WASH related diseases within the study area.

There is a low level of water treatment due to majority of respondents drawing water from improved sources within the study area and also the majority practice of cloth filtering is attributable to the work of various NGOs within the study area who provides education and filtering materials to households.

A conclusion is thereby drawn that, the limited number of households with toilet facilities have a great influence on the practice of open defecation within the study area.

Conclusively, household's attitude towards handwashing on other critical periods apart from eating is very poor and that can lead to the spread of infectious diseases. Also the use of ablution kettles among households for handwashing practices leads to a very small proportion (6.5%) of households with functioning handwashing facilities.

Conclusion derived from this is that WASH – related diseases occurrence varies among households with respect to time.

The conclusion drawn from these facts is that improved water sources can influence the health status of a household and also when there is an improved water source, water treatment does not significantly affects the household health.

Concluding from these established facts, there is no association between household's toilet indicators, households with toilet facilities and households type of toilet facilities used and the incidence of WASH – related diseases within the study area.

Women play a significant role in WASH practices among households within the study area and globally as a whole.

6.3 Recommendations

From the finding and conclusions established in this study, the following proposed recommendations are made to enable stakeholders in this academic study to implement appropriate programmes and projects to improve WASH practices and the general health statuses within the study area and the country as a whole.

1. With the current wave of health and disease as well as poor sanitation awareness, many NGO's are in the system helping individuals and households to construct very affordable in – house toilet facilities. More of such NGOs should be lured by the Tamale Metropolitan Assembly to the area to help in bridging the household toilet facility deficit i.e., CRS, iDE etc.
2. The Tamale Metropolitan Assembly through their development agents should collaborate with other stake holders in the sanitation sector to institute some bye – laws and intensify the enforcement of existing bye – laws by making the construction

of households' toilet facilities in both existing and new houses springing up in the study area compulsory and enforcing same.

3. Religion has a lot of influence on residents in both the Islamic and Christian sects, therefore authorities can channel the quest for good sanitation and hygiene practices through religious sermons in Churches on Sundays and Mosques on Friday prayers as a religious obligation in the practice of good sanitation and hygiene by quoting verses from the holy books (Bible and Quran) that serves as religious mandates to each individual and families.
4. As majority dump refuse (solid waste) in designated areas, authorities should ensure that these refuse dump sites are cleared and refuse containers are emptied frequently to discourage open defecation around these sites.
5. A reasonable fee should as well be charged for dumping refuse at these designated areas (dumping Sites) to augment the budget of the Tamale Metropolitan Assembly to ensure timely and frequent clearance and emptying of dumping sites and refuse containers.
6. Open defecation should be made a criminal act backed by law of Ghana where culprits should be fined to pay a huge amount of money or serve a jail sentence should they fail to pay such amount. This will scare people from practicing open defecation within the study area and the country as a whole.
7. Hygiene education should not be ceased among children of school going age to instil habit of good hygiene practice in them at critical periods (e.g. after visiting toilet etc).

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APPENDIXES I

UNIVERSITY FOR DEVELOPMENT STUDIES
SCHOOL OF ALLIED HEALTH SCIENCES
DEPARTMENT OF PUBLIC HEALTH

INFORM WRITTEN CONSENT

My name is…… and I am a graduate student, school of Allied Health Sciences, at the University for Development Studies. I am inviting you to participate in a research study. Involvement in the study is voluntary, so you may choose to participate or not. I am now going to explain the study to you. Please feel free to ask any questions that you may have about the research; I will be happy to explain anything in greater detail.

I am interested in learning more about water, sanitation and hygiene and it's related – diseases. You will be asked questions about your drinking water source, sanitation facilities, hygiene and some diseases. This will take approximately 10 – 20 min. of your time. All information will be kept **CONFIDENTIAL.** In any articles I write or any presentations that I make, I will use a made-up name for you, and I will not reveal details or I will change details about where you work, where you live, any personal information about you, and so forth.

The benefit of this research is that you will be helping us to understand WASH practice. There is no risk participating in this study. If you do not wish to continue, you have the right to withdraw from the study, without penalty, at any time.

Do you wish to participate in this research study?

YES ☐ NO ☐

APPENDIXES II

UNIVERSITY FOR DEVELOPMENT STUDIES
SCHOOL OF ALLIED HEALTH SCIENCES
DEPARTMENT OF PUBLIC HEALTH

HOUSEHOLDS QUESTIONNAIRE

ASSESSING THE ASSOCIATION BETWEEN WATER, SANITATION AND HYGIENE (WASH) PRACTICES AND THE INCIDENCE OF WASH RELATED DISEASES WITHIN THE TAMALE METROPOLITAN ASSEMBLY

Date: _____ Questionnaire Number_____

Start Time: _____ End Time: _____

Household Number: _____ Community:_____

Sub – District: _____

SECTION A: SOCIODEMOGRAPHIC CHARACTERISTICS

A1. How old were you at your last birth day?

☐☐ Years

A2. Sex

Male ☐ Female ☐

A3. What is your current marital status?

- ☐ Single
- ☐ Married
- ☐ Devoiced
- ☐ Widowed
- ☐ Separated
- ☐ Cohabitation

A4. What is your religious denomination?

- ☐ Islam
- ☐ Christianity
- ☐ Traditional/Spiritualist
- ☐ No Religion

A5. What is your level of education?

- ☐ None

A6. What is your occupation type?

- ☐ Trader
- ☐

- ☐ Primary
- ☐ Junior High School
- ☐ Senior High School
- ☐ Tertiary

Commercial Driver

- ☐ Mechanic
- ☐ Educationist
- ☐ Food Vendor
- ☐ Tailor
- ☐ Food Vendor
- ☐ Others……

A7. What is the size of your household?

☐☐☐ Members

SECTION B: HOUSEHOLD WATER SUPPLY SOURCE, TREATMENT AND STORAGE

QUESTIONS	RESPONSES
B1. What is the main source of drinking water for members of your household?	☐ Stream/River/Pond ☐ Unprotected well without concrete lining nor cover ☐ Rain water collection ☐ Hand dug well with concrete lining, bucket and cover ☐ Hand dug well with hand pump ☐ Borehole with hand pump ☐ Public taps/Standpipe ☐ Piped water to yard or plot ☐ Piped water into house ☐ Bottled water ☐ Sachet water ☐ Tanker Truck
B2. Does your household use other sources of water for drinking and other purposes?	Yes [ ] No [ ] *{If No skip to B5}*
B3. Please state the main source and other sources for each use of water?	Main source Other source

select from this list of sources by writing numbers attach 1 Stream/River/Pond 2 Unprotected well without concrete lining nor cover 3 Rain water collection 4 Hand dug well with concrete lining, bucket and cover 5 Hand dug well with hand pump 6 Borehole with hand pump 7 Public taps/Standpipe 8 Piped water to yard or plot 9 Piped water into house 10 Bottled water 11 Sachet water 12 Tanker Truck 0 None	Drinking - …… Cooking …… …… Washing clothes …… …… House cleaning …… …… Bathing …… …… Other (write down…… …… ……
B4. Is water always available from your main water source?	☐ Yes, water is always available ☐ No, water is available most of the time ☐ No, water is available some of the time ☐ No, water is rarely available ☐ Don't know
B5. How many hours per day is water supplied on average?	[ ] Hours : [ ] Minutes ***{111 – Don't Know}***
B6. Who usually goes to the source to fetch the water for the household?	☐ Mother, wife, aunt, sister, sister-in-law ☐ Father, husband, uncle, brother ☐ Daughter, niece ☐ Son, nephew ☐ Other……

B7. Is there any reason why these persons usually go to fetch water for the household?	Yes [ ] No [ ] {*If No skip toB9}*
B8. If Yes, what are the reasons? {*multiple select}*	Fetching water is the responsibility of; ☐ Women of the household ☐ Daughters and nieces (girls) ☐ Males of the household ☐ Every member of the household ☐ Others……
B9. Do you have access to sufficient quantity of water for use within your household?	Yes [ ] No [ ] {*If Yes skip to B11 }*
B10. What was the (main) reason you were unable to access sufficient quantities of water when needed?	☐ Water is not available from source ☐ Water is too expensive ☐ Source is not accessible ☐ Other (specify)
B11. Do you have any problems with fetching water from the source?	Yes [ ] No [ ] {*If No skip to B13 }*
B12. If yes, what are the problems *{select as many as apply}*	☐ Long wait times ☐ Only available some times of the day ☐ (trucking, water rationing, poor aquifer) ☐ Safety concerns ☐ Bad taste/smell Others……
B13. How long does it take to go to source to fetch water and come back?	…… minutes ***{111 – Don't Know, 666 – Water on premises}***
B14. How satisfied are you with your access to water?	☐ Very satisfied ☐ Satisfied

	☐ Unsatisfied ☐ Very unsatisfied
B15. What are your coping strategies if there is not enough safe drinking water?	☐ Always able to get enough safe drinking water ☐ Everyone drinks less ☐ Use unsafe water sources Borrow from neighbours
B16. Do you treat water before drinking?	Yes [ ] No [ ] {*If No skip to B18}*
B17. If yes, how do you usually treat your drinking water?	☐ Boiling Disinfection (Aqua tabs, PUR, Tab 10s etc.) ☐ Cloth filters ☐ Household filters ☐ Leave bottled water in the sun (solar disinfection) ☐ Other……..
B18. Does your household have a water storage container for drinking water? *{This includes the container used for transporting if it is also used for storage}*	Yes [ ] No [ ] {*If No skip to B24}*
B19. What type of container does your household use to store water?	☐ Jerry can (Kuffour Gallon) ☐ Bucket ☐ Basin ☐ Bottle ☐ Saucepan

	Drums Other…….
B20. How does your household remove water from your drinking water storage container?	☐ Tap ☐ Cup/ladle/dipper/scoop ☐ With hand ☐ With bottle ☐ Pour from the container ☐ Other……
B21. Is the container protected? {*enumerator should observe}*	Yes [ ] No [ ]
B22. I would very much like to see your household's drinking water storage container - would you kindly show it to me?	Yes [ ] No [ ]
B23. How often does your household usually clean the drinking water storage container?	☐ Daily ☐ Several times per week ☐ Once a week ☐ Once a month ☐ Once every half year ☐ Less often than half yearly ☐ Don't know
B24. What informs your household choice for source of water supply?	☐ Cost/Household income ☐ Availability ☐ Distance to house/compound ☐ Quality of water ☐ Other……
B25. How much does your household usually pay per day for the water (for all purpose and	GH¢……..

sources)? { *If the household is consuming bottled/sachet water, these expenditures should be included}*	*{111 – Don't Know, 666 – Water on premises}*
B26. How much does your household usually pay per month for the water (for all purposes and sources)? { *If the household is consuming bottled/sachet water, these expenditures should be included}*	GH¢……... *{111 – Don't Know}*
B27. What were the total initial water related expenses for your household, this includes connection fee, initial contribution and own expenditures for materials etc.?	GH¢……... *{111 – Don't Know. 888 Nothing }*

SECTION C: HOUSEHOLD SANITATION (TOILET FACILITIES, LIQUID AND SOLID WASTE MAMGEMENT)

C1. Does your household have a toilet facility?	Yes [ ] No [ ] *{If No skip to C7}*
C2. What kind of toilet facility does your household use?	☐ Flush to piped sewer system ☐ Flush to septic tank ☐ Flush/pour flush to pit ☐ Flush/pour flush to elsewhere ☐ Composting toilet ☐ VIP/pit latrine with slab ☐ Pit latrine without slab/open pit ☐ Bucket ☐ Hanging toilet ☐ Other……
C3. Do you share this facility with others who are not members of your household?	Yes [ ] No [ ]
C4. Where is this toilet facility located?	☐ In own dwelling ☐ ☐

	In own yard / plot Elsewhere……
C5. Has your (pit latrine or septic tank) ever been emptied?	Yes [ ] No [ ]
C6. The last time it was emptied, where were the contents emptied to?	☐ Removed by service provider to a treatment plant ☐ Removed by service provider and buried in a covered pit ☐ Removed by service provider but don't know where ☐ Emptied by household and buried in a covered pit ☐ Emptied by household to uncovered pit, open ground, water body or elsewhere ☐ Other (specify)……
C7. Where do you and other adult household members (excluding children under 5) usually go to defecate? *{Multiple Choice}*	☐ Communal/public latrine ☐ Open defecation (Forest/Bush/Fields) ☐ Plastic bag ☐ At facilities (e.g. school, health clinic) ☐ Other…….....
C8. Where do children under 5 from this household usually go to defecate? *{Multiple Choice}*	☐ Communal/public latrine ☐ Open defecation (Forest/Bush/Fields) ☐ Plastic bag ☐ At facilities (e.g. school, health clinic) ☐ Other…….....

C9. If question C7 is public latrine, what are the problems related to the use of public latrines? *{Multiple Choice}*	☐ Latrine is too far away ☐ Too many people using latrines ☐ Not clean ☐ No one responsible for cleaning ☐ Insufficient water ☐ Latrine is full ☐ Bad smell/many flies ☐ Open defecation around latrines ☐ Not private ☐ No separation between men and women ☐ Route to the latrine is not safe ☐ Latrine is not safe ☐ Only use at night (not private during day) ☐ Only use during day (not safe at night)
C10. How satisfied are you with your access to latrines?	☐ Very satisfied ☐ Satisfied ☐ Unsatisfied ☐ Very unsatisfied
C11. Do you have waste containers at home?	Yes [ ] No [ ]
C12. If No., how does your household usually dispose of garbage/solid waste?	☐ Collected by formal service provider ☐ Collected by informal service provider ☐ Disposed of in designated waste disposal area ☐ Disposed of within household yard or plot ☐ Buried or burned ☐ Disposed of elsewhere ☐ Don't know

C13. Who is in charge of waste disposal in your family?	☐ Father ☐ Mother ☐ Children ☐ Others
C14. If children then	☐ Boys ☐ Girls
C15. How do you dispose of household water used for cooking, laundry and bathing?	☐ Sink/drain connected to sewer ☐ Sink/drain connected to septic tank ☐ Sink/drain connected to pit ☐ Sink/drain connected to soak pit ☐ Sink/drain connected to open drain or open ground ☐ Disposed directly to open ground or water body ☐ N/A (cooking, laundry and bathing is done away from the household) ☐ Don't know

SECTION D: HOUSEHOLD HYGIENE PRACTICES

D1. Is there a functional handwashing facility at toilets used by the household?	Yes [ ] No [ ]
D2. Do you have soap or something else that you use for hand washing in your household?	Yes [ ] No [ ]
D3. What are they?	☐ Soap {Bar or Liquid Soap} ☐ Ash ☐ Sand
D4. Do you or any member of your household *(excluding children under 5 years)*	

wash your hands after visiting the toilet?	Yes [ ] No [ ]
D5. Do children under 5 years wash their hands after visiting the toilet?	Yes [ ] No [ ]
D6. When do you and your household members normally practice proper handwashing (handwashing with soap)	☐ Before start cooking ☐ Before start eating ☐ After going to toilet ☐ After handling children's faeces ☐ After working out ☐ Others……
D7. Have you or any of your household members heard of hygiene message before?	Yes [ ] No [ ]
D8. If yes, where did you or any of your household members heard it?	☐ Television ☐ Radio ☐ Friends ☐ Neighbours ☐ Others……..

SECTION E: HOUSEHOLD HEALTH AND DISEASES

E1.Have you ever heard of any of these diseases? {*multiple select}*	Diarrhea Yes [ ] No [ ] Dysentery Yes [ ] No [ ] Cholera Yes [ ] No [ ] Typhoid Yes [ ] No [ ] Malaria Yes [ ] No [ ] U/ARI Yes [ ] No [ ] Yellow fever Yes [ ] No [ ] Trachoma Yes [ ] No [ ] Polio Yes [ ] No [ ] Sleeping sickness Yes [ ] No [ ] Guinea Worm Disease Yes [ ] No [ ]

E2. Have any of your household members suffered from any of these diseases in recent times? {*multiple select}*	Diarrhea Yes [ ] No [ ] Dysentery Yes [ ] No [ ] Cholera Yes [ ] No [ ] Typhoid Yes [ ] No [ ] Malaria Yes [ ] No [ ] URI Yes [ ] No [ ] Yellow fever Yes [ ] No [ ] Trachoma Yes [ ] No [ ] Polio Yes [ ] No [ ] Sleeping sickness Yes [ ] No [ ] Guinea Worm Disease Yes [ ] No [ ]
E3. If yes, when did the most recent incident happen?	☐ Last 2 weeks ☐ Within Last month ☐ Last 6 months ☐ Last 12 months ☐ Last 2 years ☐ Last 5 years
E4. If yes to E2, what was the age of the person who had suffered from these diseases? {*multiple select}*	☐ Adult men ☐ Adult women ☐ Children (5 – 17 years) ☐ Children (under 5 years)
E5. Has anyone in your household died of Dysentery, Typhoid, diarrhea, Cholera, Malaria?	Yes [ ] No [ ] {*If No skip to E8}*
E6. If yes E5, when did the most recent incident happen?	☐ Last 2 weeks ☐ Within Last month ☐ Last 6 months ☐ Last 12 months ☐ Last 2 years ☐ Last 5 years
E7. What was the age of the person	☐ Adult men

who died from these diseases? {*multiple select*}	☐ Adult women ☐ Children (5 – 17 years) ☐ Children (under 5 years)
E8. Have you yourself, suffered from any one of them?	Yes [ ] No [ ]
E9. If yes E8, when did the most recent incident happen?	☐ Last 2 weeks ☐ Within Last month ☐ Last 6 months ☐ Last 12 months ☐ Last 2 years ☐ Last 5 years
E10. How would you protect yourself and your household members from these diseases? By……. {*multiple select*}	☐ Practice of regular Hand wash with soap. ☐ Safe Drinking Water (Extraction, Transport and Storage). ☐ Safe Excreta Disposal (Using approved sanitation facilities). ☐ Safe and proper food handling. ☐ Exclusive Breast Feeding (under 5 years children). ☐ Safe and proper disposal of liquid and solid waste.
END OF QUESTIONNAIRE THANK YOU FOR BEING PART OF THIS STUDY	

APPENDIXES III

OBSERVATIONAL GUIDE

WASH PRACTICES IN HOUSEHOLDS

Guide Number _____ Household Number:_____

Community: _____ Sub – District: _____

Flies in the compound?	☐ Yes	☐ No
Are faeces on the path to the house?	☐ Yes	☐ No
Are faeces around the house?	☐ Yes	☐ No
Are faeces on the compound?	☐ Yes	☐ No
Is the compound clean (swept)?	☐ Yes	☐ No
Are weeds around house?	☐ Yes	☐ No
Is cooked food covered?	☐ Yes	☐ No
Waste water from washing cooked utensils poured in the yard?	☐ Yes	☐ No
Is stored water covered?	☐ Yes	☐ No
Any household toilet seen?	☐ Yes	☐ No

Observation about access to toilet

- ☐ Path is clear
- ☐ Dense vegetation in front of toilet
- ☐ Waste or debris on path
- ☐ Major crevice or potholes on path
- ☐ Mud on path
- ☐ Entrance to toilet is obstructed
- ☐ Other observation…….
- ☐ None

Observations about toilet

- ☐ Visible faecal residues in and around the drop whole or the basin

- ☐ Visible faecal residues on the floor, wall or door
- ☐ Visible used anal cleansing material (e.g. toilet paper)
- ☐ Surface flow of sewage
- ☐ The toilet smells bad (stinks)

Observations of hand washing

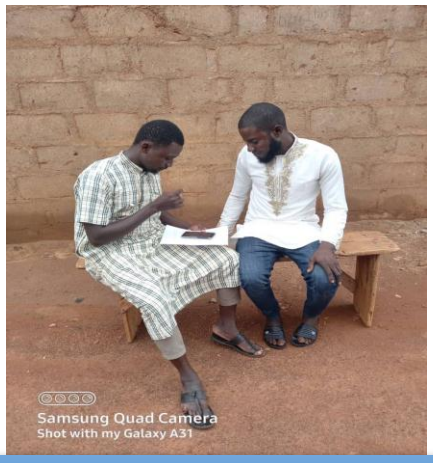
- ☐ Soap
- ☐ Water for hand washing (from tap, storage etc.)
- ☐ Facility for hand washing (basin, bucket, sink, etc.)
- ☐ Other……

Soap and water for hand washing seen?	☐ Yes	☐ No
Is waste well kept?	☐ Yes	☐ No
Any household waste dump seen?	☐ Yes	☐ No
Faeces seen in the dump?	☐ Yes	☐ No

APPENDIXES IV

FIELD PICTURES

Miss Ilham Napari with a respondent



Mohammed Hafiz with a respondent

Drinking Water Source for the people of Jerigu

A household toilet facility in Chanshegu

A WC household toilet Facility in Worizehi

A KVIP household toilet facility in Worizehi

A Pour to flush household toilet facility in Gumbihini