UNIVERSITY FOR DEVELOPMENT STUDIES

PERCEIVED IMPLICATIONS OF ACCESS TO WATER ON MATERNAL AND CHILD HEALTH IN THE MION DISTRICT, NORTHERN REGION, GHANA

BY

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DECLARATION

Student

I hereby declare that this thesis is my own work towards the award of a Master of Public Health degree and that, to the best of my knowledge, it does not contain any material previously published by another person nor presented for the award of any degree in this university or elsewhere except for references to other people's work that have been duly acknowledged.

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DEDICATION

I dedicate this thesis to my lovely family.

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ABSTRACT

This study investigates the impact of water access on maternal and child health outcomes in the Mion district of northern Ghana, highlighting the critical importance of water for health as emphasized in Sustainable Development Goal Six. The descriptive cross-sectional study utilized mixed methods, including surveys, focus group discussions, and key informant interviews to gather data. The study had an estimated sample size of 300. Additionally, 32, qualitative interviews were conducted. Findings revealed that inadequate water access significantly affects maternal and child health services (add data that shows this eg chi 2 p-value). Health professionals often face challenges in their duties due to lack of water, and pregnant women are forced to bring their water to health facilities. Many women, including those in their third trimester, travel over five kilometers to fetch water, as water collection is traditionally the responsibility of women, with little assistance from men. The study recommends that NGOs and the district assembly work together to address water scarcity in the community. Additionally, it calls for community sensitization to encourage support for pregnant women. Improving social support for water carrying during pregnancy and after delivery is essential to mitigate related health risks. The government and Ghana Health Service should collaborate to ensure that all health facilities in the area have adequate water supply, which is crucial for effective health service delivery and the retention of health professionals.

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ABBREVIATIONS AND ACRONYMS

WHO	World Health Organization
UNICEF	United Nation International Children Education Fund
SDG	Sustainable Development Goal
AIDS	Acquired Immune Deficiency Syndromes
GoG	Government of Ghana
UN	United Nation
MDGs	Millennium Development Goals
GHS	Ghana Health Service
IPCC	International Panel on Climate Change
NGO	Non-Governmental Organization
IWA	International Water Association
GWP	Global Water Partnership
DFID	Department for International Development
GPRSP	Ghana Poverty Reduction Strategic Paper
ISODEC	Integrated Social Development Centre
UNDP	United Nation Development Programme
HAI	Hospital Acquired Infections
MCH	Maternal and Child Health
GSS	Ghana Statistical Service
ORT	Oral Rehydration Treatment
SD	Standard Deviation
DHS	Demographic Health Survey
ICDDR	International Centre for Diarrhoeal Disease Research

HoPW	Husbands of Pregnant Women
WoRA	Women of Reproductive Age

CHAPTER ONE

INTRODUCTION

1.0 Introduction

This chapter is the introductory chapter of the study, it provides the background of the study, the problem statement, the objectives of the study, the research questions, the significance of the study, the scope of the study, and the organisation of the various chapters in the study.

1.1 Background to the study

According to WHO and UNICEF (2019), over 700 million people globally lack access to improved drinking water, and three billion lack access to improved sanitation. This deficiency exposes women and children, particularly in lower-middle-income countries, to higher risks of adverse health outcomes. Achieving the Sustainable Development Goals (SDGs), especially SDGs 3 and 6, is crucial for reducing maternal, neonatal, and child mortality linked to water, sanitation, and hygiene.

Inadequate water, sanitation, and hygiene conditions are common in developing countries and pose significant risks to maternal and neonatal health. In 2021, approximately 1.9 billion people lacked basic sanitation services, and 1.2 billion lacked basic drinking water. These conditions contribute to infections, anemia, malnutrition, and developmental issues. In 2016, unsafe water and poor sanitation caused an estimated 829,000 deaths due to diarrheal diseases. Many mothers and newborns in developing countries face high infection risks due to unhygienic environments. Recent estimates show that 50% of healthcare facilities in the least-developed countries lack basic water services, 60% have no sanitation services, and 26% lack hand hygiene facilities.

Ghana faces significant challenges in ensuring safe drinking water availability. Many people, particularly in northern regions, rely on contaminated surface water. Water scarcity, particularly during the dry season, exacerbates health issues. The Ghana Health Service (GHS) reports significant maternal and child mortality in the Northern Region, partly due to inadequate water access. The situation is particularly challenging for pregnant women, who often travel long distances to fetch water, risking their health and that of their unborn children.

This study investigates the impact of water access on maternal and child health in the Mion District of Ghana's Northern Region. It aims to highlight the need for improved water sources and the importance of addressing water-related health challenges to improve maternal and child health outcomes. The results will assist stakeholders in identifying key factors for providing safe drinking water.

1.2 General Objectives

The primary objective of this study was to examine perceived impact of water accessibility on maternal and child health in the Mion District of the Northern Region of Ghana.

1.3 Specific Objectives

The study aims to achieve the following specific objectives:

1. Evaluate the distance women travel to access water and the associated health implications, particularly for pregnant women.
2. Determine the role of gender in water accessibility, specifically whether men assist in fetching water for domestic use in the area.
3. Assess water availability in health facilities and its effect on service delivery.

4. Investigate perceived impact of water accessibility on maternal and child health in the Mion District.

1.4 Significance of the Study

The findings of this study hold significant implications for policymakers in Northern Ghana, including the Ministry of Health, the Ghana Health Service, and hospital managers. The insights gained can assist in planning and designing programs to address water access issues in the region and beyond. This research can serve as a valuable reference for future studies, particularly in the study area, and can benefit stakeholders involved in developing policies and programs aimed at improving the well-being of women, children, and other vulnerable groups. By adopting pragmatic approaches to manage acute water shortages at both health facility and domestic levels, the study can help mitigate the challenges faced by women and children in accessing maternal and child health services, potentially reducing or eliminating maternal and child mortality. Additionally, the study can inspire continued efforts to enhance healthcare quality and contribute to a deeper understanding of the persistent water deficit in rural areas, thereby supporting the provision of adequate maternal and child health services.

1.5 Scope of the Study

The focus of this study is to examine water accessibility and its effects on maternal and child health delivery in the Mion district of the Northern region. The study participants comprise Ghana Health Service staff, community members such as opinion leaders,

traditional birth attendants, community-based surveillance volunteers, and women of reproductive age who receive healthcare services.

1.6 Organization of the Study

The study consists of six chapters: Chapter One provides the background of the study, the problem statement, the objectives of the study, and the significance of the study. Chapter two reviews the relevant literature on the topic. Chapter Three explains the methodology of the study, including the research design and the data collection methods. Chapter Four presents the results of the data analysis. Chapter Five discusses the findings and their implications. Chapter Six was devoted to a summary and key recommendations for policy direction.

CHAPTER TWO

LITERATURE REVIEW

2.0 Introduction

This chapter reviews the relevant literature in the research field that various studies and authors have reported. The literature analysis is guided by the study's main themes related to the specific objectives.

2.1 Global Access to Water

Access to good-quality fresh water is a growing global challenge due to pressures from agriculture, industry, households, and rising populations. Approximately one-third of the world lives in areas with moderate to severe water stress, a number projected to rise to two-thirds by 2025. The most pressing issue in developing countries is the lack of access to safe drinking water. This issue is not exclusive to underdeveloped regions; many communities worldwide struggle with providing adequate water quality and quantity due to limited resources and poor management, leading to service interruptions and contamination risks. Additionally, poor water access exacerbates health risks, including the spread of diseases like malaria and dengue. The expansion of small water systems, such as private wells, presents further challenges, as they are often unregulated and lack monitoring. Access to water remains a daily struggle, especially for impoverished populations who must pay more and travel farther for it. Even achieving basic water access 20 litres per person per day from

an improved source within a 30-minute round trip remains a significant issue, with 880 million people lacking access to improved water sources in 2008

2.2 Access to Water as Seen by International Organisations

Water resources, management, policy, regulation, supply, price, and consumption have received considerable attention across various domains. The critical role of water in human well-being and development has led to numerous global and national discussions and debates. The Global Water Partnership (2000) highlights that despite prioritizing basic human water needs, one-fifth of the world's population lacks safe drinking water, particularly affecting the poorest in developing countries. UN-Habitat (2003) reports severe water shortages in many cities, leading to high disease burdens and premature deaths.

The United Nations has long prioritized water issues, including in the Millennium Development Goals, aiming to halve the number of people without access to safe drinking water by 2015. However, as of 2006, progress was unclear. A reliable water supply is essential for poverty reduction, yet millions struggle to obtain even the most basic amount of water daily. Contaminated water accounts for 75% of illnesses in underdeveloped countries, according to a 2000 WHO report, with around 2.2 million annual deaths linked to unsafe water.

Rapid urbanization, particularly in Africa, exacerbates water scarcity, with many urban populations lacking essential water services. The issue of water privatization, particularly in Ghana, remains controversial. Proponents argue that privatization can improve efficiency and attract investment, while opponents, including many civil society

organizations, argue that it could restrict access and exacerbate inequality. The debate continues, with significant concerns about the affordability and accessibility of water for the poor.

Corruption in the water sector is a significant issue, hindering development and leading to service inefficiencies. While privatization is proposed as a solution, it remains a contentious topic. Ultimately, ensuring access to clean and safe water for all, especially the most vulnerable populations, remains a critical challenge.

2.3 Water Scarcity in Africa

The lack of access to fresh water remains a significant barrier to development in Africa, with only the humid tropical zones in Central and West Africa having adequate freshwater supplies.

By 2025, water scarcity in Africa is expected to become critical, with nearly two-thirds of the global population facing a shortage of fresh water. Water scarcity occurs when water resources are insufficient to meet demand, driven by factors such as physical limitations, economic challenges, rapid population growth, and climate change. While Sub-Saharan Africa has abundant rainfall, it still experiences economic water scarcity due to poor infrastructure and governance. The region's rainfall variability also leads to frequent floods and droughts.

According to a 2012 FAO report, water scarcity poses a major challenge to sustainable development in Africa, affecting health, education, agricultural productivity, and the risk of water conflicts. The United Nations Economic Commission for Africa emphasizes the need for investment in developing untapped water resources to enhance food and water

security. The Falkenmark Water Stress Indicator, developed in the late 20th century, measures water resource vulnerability based on average annual per capita water availability. A country is considered to experience water stress when renewable water supplies fall below 1700 m^3 per person per year and face water scarcity below 1000 m^3. Water scarcity can hinder economic development and well-being, leading to a 'water crisis.'

In 1990, only eight African countries faced water stress or scarcity, but this number has increased, with many expected to shift from water surplus to scarcity by 2025. A 2012 conference reported that by 2030, up to 250 million Africans could live in areas of high water stress, potentially displacing up to 700 million people.

2.4 Water Scarcity in Ghana

Ghana has a tropical climate influenced by its proximity to the equator, the Gulf of Guinea, and the African monsoon. Temperatures typically range from 21 to 32°C (70 to 90°F), with minimal variation between day and night. Humidity levels range from 50 to 80%, especially along the coast. Rainfall patterns vary by region: the southwestern corner is the wettest, receiving about 2,000 mm (80 in) of rain per year, while the eastern coast and the north are the driest, with less than 1,000 mm (40 in) annually.

The south experiences a bi-modal rainy season, with peaks in May-June and September-October, and a long dry season from mid-October to March. The north has a single rainy season from April to September, followed by a dry season from October to March. During the dry season, the harmattan, a dry and dusty wind from the Sahara, lowers humidity and results in hotter days and cooler nights. The hottest temperatures are typically in February-

April, while the coolest are in July-September, with more pronounced seasonal variations in the north due to its distance from the ocean.

2.5 Water Resources in Ghana

Ghana's water supply comes from three main sources: surface water, groundwater, and rainwater. Surface water provides approximately 95% of the water in urban areas and 70% in rural areas. Groundwater is the primary source for the remaining rural regions. Although rainwater harvesting is not commonly practiced in urban areas, it can supply a significant amount of domestic water in rural southern regions during the humid months of May to August.

The average annual rainfall in Ghana ranges from around 800 mm in the southeastern coastal zone to about 2,150 mm in the southwestern corner. However, rainfall is often unpredictable and varies year by year, with total annual runoff estimated at 56.4% of the rainfall. The main surface water system is the Volta River Basin, covering about 70% of the country and including rivers like the Oti, Daka, White Volta, Black Volta, Pru, Sene, and Afram. The southwestern region, covering 22% of the country, is drained by the Bia, Tano, Ankobra, and Pra rivers, while the coastal zone, covering 8%, is drained by the Ochi-Nakwa, Ayensu, Densu, and Tordzie rivers.

The country's main rock formations, sedimentary and non-sedimentary, generally provide good-quality groundwater, although some areas experience localized pollution. Groundwater is often accessed through boreholes, which are mostly community-managed in rural areas.

2.6 Water Management in Ghana

Turney (2007) argues that Water Resources Management (WRM) is an integrative concept that encompassing various water sub-sectors, such as hydropower, water supply and sanitation, irrigation and drainage, and the environment. WRM aims to incorporate social, economic, environmental, and technical dimensions into the management and development of water resources, thus enhancing accountability and sustainability. In Ghana, however, different institutions are responsible for these related sub-sectors. The Ghana Water Company Limited (GWCL) is the main body that manages and provides drinking water.

2.7 Ghana Water Company

Since its independence, Ghana has entrusted the state-owned GWCL with managing water supply systems in most urban areas, especially the administrative cities. The state has also provided the financial resources for the technical and human aspects of the water sector. GWCL's main task was to supply water, but it relied on external professionals for technical studies and detailed engineering designs. GWCL could not keep up with the country's rapid population growth and urbanization. A major drawback for the company was its lack of involvement and integration with other water sub-sectors, such as hydropower, sanitation, irrigation and drainage, and the environment. These sub-sectors are essential for implementing Integrated Water Resources Management (IWRM), which aims to incorporate social, economic, environmental, and technical dimensions into the management and development of water resources.

The lack of coordination among the different institutions responsible for various sub-sectors led to poor sanitation and hygiene conditions in most urban areas. According to Well (2005), the company has faced significant deterioration since 2000, with only 40 per

cent of the 70 per cent of taps having an irregular water supply. The urban population often had to wait for days before getting water from their taps. The company also struggled with weak management and a lack of autonomy, which resulted in considerable debt. In 2002, the company's debt was estimated at $400 million, and about 50 per cent of the water produced was unaccounted for.

The operational losses in 2003 amounted to about $ 34 million, almost equal to the total revenue. Since then, the urban population has been facing water scarcity and relying on alternative water sources (Well Factsheet, 2005). Besides the Ghana Water Company, some non-governmental organisations (NGOs) and a few local private companies are also involved in managing and providing water in the urban areas.

2.8 Water and Health in Ghana

Numerous health problems in all major cities of Ghana stem from their environment. Despite the common belief that urban areas have a higher standard of living than rural areas, a visit to Ghana shows that many urban Ghanaians lack necessities such as adequate, safe drinking water and sanitation. High-income residential areas have constant access to safe drinking water, while shanty, peripheral, and low-income urban settlements have little or no access and are often vulnerable to water contamination and poor hygiene.

People experiencing poverty in informal urban areas are generally exposed to waterborne diseases due to the uneven coverage of projects that provide clean drinking water. As a result, most of these people rely on water from unprotected sources. This is why Ghana is among the African countries that suffer the highest infant mortality and water-related diseases in the world, according to WHO (2003). Waterborne diseases, such as diarrhea,

cholera, typhoid, hepatitis A, dysentery, and vector-borne diseases, such as malaria, yellow fever, and sleeping sickness, are still prevalent in Ghana, causing severe human suffering and many deaths. Moreover, toxic substances, such as pesticides or heavy metals, or excessive or deficient amounts of natural substances, such as fluoride or iodine, have profound health implications.

2.9 Scarcity of Water in the Northern Region

Water scarcity is a pressing issue in the Northern Region of Ghana, which has an arid and semi-arid climate. This literature review explores the factors, effects, and possible solutions to water scarcity in the region based on the work of Valls (1998). The factors contributing to water scarcity are climatic conditions, insufficient water infrastructure, population growth, urbanization, and land degradation. The effects of water scarcity include health risks, food insecurity, agricultural challenges, economic costs, and social inequalities (Moulds et al., 2022). To tackle this problem, improving water infrastructure, adopting sustainable farming practices, managing and conserving water resources, and implementing climate change adaptation strategies are essential.

Water scarcity is a pressing issue in the Northern Region of Ghana, which lies within the Sahelian belt. This literature review examines the multiple factors contributing to this problem and explores its impacts on the region's socio-economic and environmental conditions. Moreover, it evaluates the existing and potential interventions that can address the challenges of water scarcity in the area (Livingston, 2021). The Northern Region has a predominantly arid and semi-arid climate, with high variability and unpredictability of rainfall. "Frequent droughts and extended dry periods reduce the availability and accessibility of water for various uses and sectors. "Water scarcity in the Northern Region

of Ghana is partly attributed to inadequate investment in water infrastructure, such as dams, reservoirs, and irrigation systems. These facilities are essential for storing and distributing water efficiently and ensuring access to dependable water sources (Raleigh, 2017).

Furthermore, water scarcity is aggravated by the rapid population growth and urbanization in the region, which escalate water demand and strain the scarce water resources. These demographic changes pose difficulties for sustainable water management. Environmental degradation, such as deforestation, improper land use practices, and desertification, also exacerbates water scarcity in the region. These processes result in soil erosion, reduced groundwater recharge, and decreased water retention capacity, compromising water availability.

2.10 Water Scarcity in Mion District

Many parts of Ghana, including the Northern Region, suffer from water scarcity. This problem poses various challenges for the region regarding water availability, quality, and accessibility, which have severe implications for the well-being and livelihoods of the local population.

The Mion District has experienced water scarcity due to multiple factors. These factors may include climate change, population growth and urbanization, insufficient infrastructure, unsustainable water management practices, and environmental degradation.

Climate change has caused erratic rainfall patterns, severe droughts, and rising temperatures, adversely affecting the region's water resources. Low rainfall diminishes the recharge of rivers, lakes, and groundwater sources, aggravating water scarcity issues.

Water resources and infrastructure in the Mion District are under stress due to rapid population growth and urbanization. As the population expands, the demand for water rises, creating more pressure on scarce water sources. Poor sanitation facilities and practices also contribute to water pollution and health hazards (Smith, 2017). The Mion District lacks adequate water infrastructure, such as dams, wells, and pipelines, which impedes the effective collection, storage, and distribution of water. Outdated or poorly maintained infrastructure can result in water losses and suboptimal water delivery systems (Livingston, 2021).

Water sources are depleted, and unsustainable water management practices, such as over-extraction and inefficient irrigation, worsen scarcity issues. The lack of awareness and coordination in water governance also aggravates the situation. A multi-faceted approach is essential to addressing water scarcity in the Mion District and comparable regions. This approach should comprise:

1. Integrated Water Resources Management (IWRM): is a process that promotes the coordinated development and management of water, land, and, related resources to maximize the economic and social welfare equitably without compromising the sustainability of vital ecosystems (Akumiah and Universitet, 2007).
2. Infrastructure development: Investing in the construction and maintenance of water infrastructure, including dams, reservoirs, boreholes, and pipelines (Donnenfeld, Crookes, and Hedden, 2018). This helps increase water storage capacity and improve water delivery systems.

3. Water conservation and efficiency: Promoting water conservation practices at the individual, community, and agricultural levels. This includes raising awareness about responsible water use, repairing leakages, adopting efficient irrigation techniques, and implementing water-saving technologies (Kulinkina *et al.*, 2020).
4. Rainwater harvesting: Encouraging the implementation of rainwater harvesting systems at the household and community levels (Achore and Bisung, 2023). This can help capture and store rainwater for various uses, reducing dependency on scarce water sources.
5. Water governance and policy: Establishing effective water governance systems and policies that ensure equitable distribution, stakeholder participation, and sustainable management of water resources (Akumiah and Universitet, 2007). This involves improving coordination between government agencies, local communities, and relevant stakeholders.

Capacity building and education: Conducting educational programs to raise awareness about water conservation, hygiene practices, and the importance of sustainable water management (Oppong *et al.*, 2022). Empowering individuals and communities with knowledge and skills can foster behavioral change and promote responsible water use.

The successful implementation of these measures necessitates the cooperation of various actors, including governmental institutions, local communities, non-governmental organizations, and other relevant stakeholders. Moreover, long-term water resource management and effective mitigation of water scarcity depend on the regular assessment, monitoring, and adjustment of the strategies.

2.11 Access to Safe Drinking Water

Access to high-quality freshwater is increasingly difficult worldwide due to growing demands from agriculture, industry, and households, alongside expanding human populations. Currently, about one-third of the global population experiences moderate-to-severe water stress, with projections suggesting this could rise to two-thirds by 2025. The severity and causes of water scarcity vary by region, with the lack of safe drinking water being particularly acute in developing countries.

However, the issue isn't limited to developing regions. Small communities everywhere, including developed countries, often struggle to provide adequate water quality and quantity due to limited resources and management challenges. Poor management and non-compliance with water standards can lead to contamination, and improper storage can exacerbate these risks, increasing the spread of diseases like malaria and dengue.

Despite these challenges, the number of small water systems has been growing. In the United States, about 1,000 new small water supply systems are established annually. In Canada, private water systems serve 9% of the population, while 16% rely on small distribution networks. In Europe, 40–50 million people, or one in ten, obtain their water from small or private supply systems. For many living in precarious conditions, securing even the minimum standard of 20 liters of safe water per person per day from an improved source is a significant challenge. In 2008, 87% of the global population had access to improved water sources, but 880 million people still lacked this basic necessity. Although progress has been made, achieving the Millennium Development Goals' target for improved water access remains a critical issue.

2.12 Access to Water in Healthcare Facilities

Access to clean water is crucial for maintaining sanitary conditions in healthcare facilities (HCFs), impacting personal hygiene, sanitation, and waste disposal. The WHO emphasizes that poor environmental health in HCFs can lead to high infection risks for patients and staff. Studies show that inadequate environmental sanitation is a major factor in hospital-acquired infections in low- and middle-income countries. Efforts to improve water, sanitation, and hygiene (WASH) should focus on integrating these needs into budget priorities, maternal and child health campaigns, and aligning with national and global targets. A 2012 UN report revealed that 13% of hospitals lacked improved water supplies, and a 2015 survey found that 39% of healthcare facilities in low- and middle-income countries, including 47% in Africa, did not have access to improved water. Reliable, year-round water supply is particularly challenging for healthcare facilities in Africa.

Most data on WASH focuses on hospitals, while secondary healthcare facilities, which provide the majority of services, are often overlooked. The UN Sustainable Development Goals aim to ensure universal access to safe drinking water and adequate sanitation by 2030. However, in 2017, 785 million people lacked basic drinking water services, and 2 billion lacked essential sanitation services. Access to water often requires multiple trips, which disproportionately affects poorer communities, particularly women and children, and can impact their health and daily life. Despite some studies suggesting improved health outcomes from water and sanitation interventions, evidence remains inconclusive, and factors like the impact of fetching water from distant sources are often overlooked. The physical and psychological strain of water collection, along with its opportunity costs, can

negatively affect the well-being and economic opportunities of those responsible for water fetching.

2.13 Distance to Water Source

During the second and third trimesters of pregnancy, women are expected to gain about one kilogram per month. However, water collection, a physically demanding task, can lead to increased weight gain during pregnancy and higher birth weights for newborns. Studies in Sub-Saharan Africa, as noted by Rosen and Vincent, found that water carrying can account for about 10% of a person's daily calorie intake, with significant variation (Sandy and Vivian, 2005; Friede and Mieke, 2009). Access to safe water can improve maternal health by reducing the need for pregnant and lactating women to carry heavy loads of water daily (Cavill, 2012). For instance, imagine being pregnant and walking a kilometer each day with a 20 kg suitcase.

Alvarez et al. (2009) analyzed data from studies conducted between 1997 and 2006 across various Sub-Saharan African countries. They found a notable association ($r = -0.399$; $P = 0.008$) between reduced maternal mortality and better access to water sources like piped water, public taps, boreholes, pumps, and protected wells.

2.14 State of Drinking Water in Rural Areas

Sustainable access to clean drinking water, proper sanitation, and good personal hygiene are crucial for improving public health in rural areas. The health of a community depends

on the quality and reliability of its water supply. Ideally, everyone should have access to effective water services. However, rural areas often face limited or unreliable water supply services, forcing residents to find alternative sources or store water at home to meet their needs. These practices can deteriorate water quality and increase exposure to waterborne pathogens, as well as raise the risk of vector-borne diseases due to improper storage.

2.15 Water Availability in Rural Settings

Globally, over 850 million people lack safe drinking water, and more than 2.5 billion lack access to sanitation facilities (WHS, 2009). Rapid improvements in water, sanitation, and hygiene could reduce global disease and mortality rates by about 9.1% and 6.3%, respectively (Pruss et al., 2016). Diarrhoea, causing around 1.9 million deaths and 4 billion new cases each year, primarily affects children under five (Boschi-Pinto et al., 2008). Developing countries account for about 19% of these deaths. India has the highest diarrhoeal death rate with over 386,000 deaths (UNICEF, 2015), while Egypt has a mortality rate of about 13.9% in children under five (UNICEF, 2021). In Indonesia, diarrhoea is the leading cause of infant mortality and health-related costs, and also the third leading cause of increased morbidity across all age groups (Gottfried, 2010). Poor water, sanitation, and hygiene negatively impact cognitive development, with early diarrhoeal infections potentially reducing height by 8 cm and IQ points by age seven or eight.

2.16 Water and Sanitation in Developing Countries

Many low and middle-income countries still lack sufficient water and sanitation services. Access to improved water sources ranges from 56% in Sub-Saharan Africa to 70% in Asia, while high-income countries nearly have universal access (Skolnik, 2012; UNICEF, 2014). In terms of sanitation, about 80% of South America has access to better facilities, compared

to around 30% in Sub-Saharan Africa (World Resources Institute, 2009). Despite progress in Asia and Oceania over the past 20 years, these regions are still behind other areas. From 1990 to 2012, Southeastern Asia saw an increase in access to piped drinking water from 17% to 30% and improved sanitation from 47% to 71% (WHO/UNICEF, 2014). However, in Oceania, access to piped drinking water decreased from 27% to 25%, and sanitation coverage remained at 35% (WHO/UNICEF, 2014).

As a result, many countries in Asia and Oceania are unlikely to meet the Millennium Development Goals for improving access to drinking water and sanitation by 2025. Significant disparities exist both between countries and within urban and rural areas.

2.17 Disparities in Access to Improved Water and Sanitation System

Disparity indicates significant gaps or inequities in access to water and sanitation, influenced by factors such as geography, socioeconomic class, race, ethnicity, and gender (Dannenberg, Frumkin & Jackson, 2011). Despite progress towards MDG targets (UN, 2014), substantial inequalities remain across regions, between urban and rural areas, and between affluent and marginalized groups. Limited research and numerous interventions have aimed to address these disparities, particularly in developing countries. Global disparities in water and sanitation access can be observed geographically and socioeconomically (UNICEF, 2014). A study using DHS data found that socioeconomic factors like income level positively correlate with access to better facilities, highlighting economic inequalities (Blakely et al., 2005). Regionally, China and India represent a large portion of those with improved access, while Sub-Saharan Africa and Oceania have the lowest coverage and highest unmet needs (WHO/UNICEF, 2014).

2.18 Vulnerable Groups in Access to Water

In many impoverished countries, water collection is primarily the responsibility of women. The lack of water and sanitation disproportionately impacts women, who are often caregivers for children vulnerable to water-related diseases (Water and Sanitation Program, 2010). Women frequently lack the financial means to access, treat, or invest in water (UNICEF, 2014). Additionally, inadequate sanitation forces women and girls in some rural areas to wait until nightfall to defecate (UNICEF, 2021). These challenges affect health, education, and human rights, with over half of the female population in some underdeveloped countries leaving school due to insufficient toilets (Water and Sanitation Program, 2010). In Sub-Saharan Africa, nearly 82% of women are responsible for collecting water (UNICEF, 2014). In many impoverished countries, water collection is primarily the responsibility of women. The lack of water and sanitation disproportionately impacts women, who are often caregivers for children vulnerable to water-related diseases (Water and Sanitation Program, 2010). Women frequently lack the financial means to access, treat, or invest in water (UNICEF, 2014). Additionally, inadequate sanitation forces women and girls in some rural areas to wait until nightfall to defecate (UNICEF, 2021). These challenges affect health, education, and human rights, with over half of the female population in some underdeveloped countries leaving school due to insufficient toilets (Water and Sanitation Program, 2010). In Sub-Saharan Africa, nearly 82% of women are responsible for collecting water (UNICEF, 2014).

2.19 Burden of Diseases Associated Water Access

Lack of water, sanitation, and hygiene has severe health impacts. Contaminated water consumption affects 768 million people worldwide, leading to diseases such as diarrhoea,

cholera, dysentery, and more (Pruss-Ustun et al., 2014). Poor sanitation also contributes to malnutrition (Skolnik, 2012). According to the WHO (2009), unimproved water and sanitation are major diarrhoeal disease risk factors, causing 580,000 and 280,000 deaths annually, respectively. Diarrhoea alone results in 361,000 child deaths each year, and WASH issues contribute to an additional 881,000 deaths from neglected tropical diseases (Pruss-Ustun et al., 2014).

Diarrhoea disease is a leading cause of illness and death in low-income countries, significantly affecting children under five (WHO, 2004). Addressing WASH risk factors could reduce the global disease burden by about 10% (Pruss-Ustun et al., 2008). Despite improvements, diarrhoea remains a major challenge (UNDP, 2006). Ensuring access to clean water, sanitation, and hygiene can significantly lower morbidity and mortality, with improvements in water supply and sanitation reducing diarrhoea morbidity by 21% and 37%, respectively. Handwashing at critical times can reduce diarrhea incidence by up to 35% (WHO/UNICEF, 2014).

2.20 Water Quality and the Prevention of Diseases

Until the late 1980s, insufficient drinking water was widely regarded as the primary cause of diarrhea disorders. However, subsequent studies have shown that various factors, including hygiene practices, sanitation, and the amount of water used for hygiene, influence the transmission of these diseases. Curtis et al. (2000) and Briscoe (1995) argue that water quality becomes crucial once other sources of diarrheal infections are eliminated through adequate sanitation. Improving a water source, such as protecting it from contamination, constructing a distribution system, or treating water before consumption, can significantly reduce the risk of diseases. For example, protecting a water source can prevent waterborne

infections like typhoid, caused by Salmonella typhi. Additionally, building a fence around the collection point can protect against contamination by humans or animals, reducing disease exposure. Improvements can also indirectly affect water-related diseases, such as incorporating better drainage in water distribution systems to reduce mosquito breeding sites, thereby decreasing malaria incidence.

2.21 Impact of Clean Water on Health

Clean drinking water is vital for human health. In 2015, 663 million people lacked basic water services, with nearly 159 million relying on untreated surface water. This was a major cause of death and illness, particularly among newborns, with over 1,800 children under five dying daily from water-related diseases. China's infant mortality rate dropped significantly from 30.1 to 9.2 per 1,000 live births between 2000 and 2015, partly due to increased piped water coverage in rural areas. This study investigates the impact of piped water on infant mortality in China, using comprehensive data from 331 counties. It addresses endogeneity issues by using GIS network analysis to create an instrumental variable based on the least-cost route for water pipelines. The focus is on neonatal mortality due to the high susceptibility of newborns to environmental hazards. Improved access to clean water is shown to significantly reduce infant mortality and have broader social benefits, including better long-term economic outcomes.

Despite improvements, significant disparities in infant mortality and piped water coverage exist across China's regions. The study's cost-benefit analysis suggests that the benefits of piped water infrastructure outweigh the costs, highlighting the importance of increasing access to clean water for improving health and social welfare.

2.22 Maternal and Child Health (MCH)

Ghana had no organized modern maternal and child health (MCH) services before 1920. Since then, all aspects of life in Ghana have undergone substantial development. Hospitals and maternity centres were set up, and a campaign to reduce maternal and infant mortality was launched. The infant mortality rate dropped from 360 in 1915 to the current national average of 121. However, the decline is not solely or even primarily attributed to MCH services, which face many challenges and issues regarding service distribution, personnel development, and coordination with related agencies. In the north of Ghana, the infant mortality rate is 234/1000, whereas in the south, the urban city of Accra has an estimated 85/1000. Trained midwives deliver only about 25% of babies; this is likely a reliable indicator of the outreach of services.

Accra, which accounts for only 10% of Ghana's population, seems to use 30% of the health services: 1/3 of all deliveries and immunizations occur in Accra, and 28% of all public health nurses, but only 15% of the community health nurses are in Accra. Another problem MCH is lack of amenities in the rural areas, such as safe water supplies, electricity, and educational facilities for children.

2.22. 1 Maternal Health

In recent years, Ghana has achieved good progress in many social development indicators, including health. Maternal and child health status depends on several factors, such as the conditions of the place of residence, school environment, and work environment, which affect their health risks and outcomes.

Environmental and social factors, such as health care and early health care seeking and treatment, educational attainment of households, especially mothers, employment, social support and economic opportunities, family incomes, and health insurance coverage, have a significant influence on maternal healthcare behaviours and health status (Ganle et al., 2014). Factors influencing maternal health also affect pregnancy outcomes and childhealth status.

Evidence indicates a high unmet need for family planning among unmarried adolescents, while modern use of family planning methods is higher among married than unmarried adolescents (GSS, 2018). Adolescent girls in rural areas and those among the poorest and least educated have a higher risk of early childbearing in Ghana. Ample evidence shows that 14% of adolescent women aged 15–19 are mothers or pregnant with their first child (GSS, 2018).

2.22.2 Child Health

Child health is a global concern. Many countries and institutions have strived to improve children's health and reduce infant mortality. However, despite the significant investments and improvements in child health in the past few decades, many children still die from diseases before their 5th birthday worldwide, and health inequity remains a considerable challenge (GBD, 2016). Technical and medical solutions, such as disease control and medical care for illnesses that cause the most deaths in children, are crucial for making fundamental improvements in health equity.

Diarrhoea and pneumonia are the leading causes of morbidity and mortality among children under five years of age in low and middle-income countries (Walker et al., 2013). According to the World Health Organisation (WHO, 2017), these diseases were responsible for nearly 2 million deaths in 2011, accounting for 30% of all childhood deaths globally. In Ghana, the prevalence rate of diarrhoea in children under five years was 13% in the 2011 Multiple Indicator Cluster Survey (MICS), with a higher proportion of urban children (64%) receiving oral rehydration therapy (ORT) than rural children (56%) (Ghana Statistical Service, 2012).

Childhood diarrhoea in Ghana reflects the inequities that disadvantage the poorest segments of the population. Cases in urban areas or relatively affluent families are more likely to receive proper management than those in rural or impoverished households. According to the Ghana Statistical Service (GSS), the incidence of suspected pneumonia among children under five years old in Ghana was 3% in 2011. The main treatment for pneumonia is antibiotics, but only 41% of the suspected cases were taken to an appropriate health provider, and 56% received antibiotics. Children in rural or poor households face barriers to accessing health care (GSS, 2012). The World Health Organisation estimates that vaccinations prevented at least 10 million deaths globally between 2010 and 2015 and protected many lives from the suffering and disability caused by diseases such as pneumonia, diarrhoea, whooping cough, measles, and polio (WHO, 2017).

However, many children in Ghana still suffer from malnutrition and other preventable childhood diseases. For instance, 18.8% of children under five years old were stunted, 11.0% were underweight, and 4.7% were wasted in 2012. These indicators also varied

significantly across wealth quintiles and geographic regions (GSS, 2014). Chronic malnutrition affects an estimated 19% of Ghanaian children, who are stunted by more than two standard deviations (SD) below the national average, while 5% are severely stunted (below − 3 SD). This is a 17% improvement since the Multiple Indicator Cluster Survey (MICS) in 2011 and a 47% improvement since the Demographic and Health Survey (DHS) in 2008.

The prevalence of stunting increases with age, reaching 28% among children aged 24–35 months. Stunting disproportionately affects males (20%) compared to females (17%), and rural areas (22%) compared to urban areas (15%). Stunting varies by region, from 10% in Greater Accra to 33% in the Northern Region. Stunting is inversely associated with education and income levels. For instance, while 25% of children in the lowest two wealth quintiles are stunted, only 9% of children in the highest quintile are stunted.

Access to safe drinking water and sanitation is a human right and essential for human health and well-being (UN-Water, 2021). However, despite global progress in this area, nearly two billion people still drink water contaminated with faeces, and more than half of the world's population uses inadequate sanitation services (WHO, 2019). Globally, 673 million people lack toilet facilities and practise open defecation (UNICEF and WHO, 2020). Poor sanitation practices contribute to various adverse health outcomes, such as diarrhoea, neglected tropical diseases, vector-borne diseases, stunting, antimicrobial resistance, anaemia, spontaneous abortion, and preterm birth. Diarrhoeal diseases, which are largely caused by poor water quality and sanitation, are among the main causes of death worldwide, especially in the developing world.

Contaminated water causes over 800,000 deaths and over 49 million disability-adjusted life years annually, mainly due to diarrhoeal diseases (UNICEF and WHO, 2020). In Ghana, 12.7% of households consume unsafe water, 80.6% lack improved sanitation facilities, and 18.8% practise open defecation. Diarrhoeal disease, which results from drinking contaminated water, is among the most common illnesses reported in Ghanaian health facilities. Moreover, diarrhoea accounts for about 25% of all under-five mortality in Ghana. A report by the Joint Monitoring Programme of the WHO and UNICEF revealed that diarrhoea kills more than 4,000 Ghanaian children every year and causes chronic malnutrition in approximately 23% of Ghanaian children due to poor water and sanitation. Therefore, safe drinking water and proper sanitation are essential for health and well-being.

Safe drinking water and proper sanitation are essential for disease prevention and nutrition improvement (UN-Water, 2021). Under Sustainable Development Goal (SDG) 6, which aims to ‘Ensure availability and sustainable management of water and sanitation for all’, the government of Ghana has set the targets of achieving universal access to safe drinking water by 2025 and eliminating open defecation by 2030. Several international and national interventions exist in Ghana to expand access to safe drinking water and proper sanitation. However, as in other countries, availability and access to these services in Ghana depend on various factors, including geographical location. Data from the latest Ghana Demographic and Health Survey (DHS) show that while nearly 90% of Ghanaian households obtain their drinking water from improved sources, only about 75% of households in the Northern region do so (Agbadi et al., 2019).

Similarly, over 70% of the population in Northern Ghana (formerly Northern, Upper East, and Upper West Regions) practices open defecation, compared to about 20% of the whole country's population (Afriyie et al., 2019). This paper focuses on SDG 6, which aims to 'Ensure availability and sustainable management of water and sanitation for all' (UN-Water, 2021).

The provision of water for healthcare services is often neglected when the priority is to supply potable water to households. However, communities and families that lack basic water infrastructure and potable water face serious health risks and need medical assistance. The incapacity of medical facilities to deliver healthcare due to their water scarcity makes these communities especially vulnerable. Safe water lowers the infection rates among some of the most susceptible groups of patients: pregnant women and their infants. Water access must be secured to ensure that health workers can offer quality care, patients can receive adequate care without water-related infections, and the hospital can operate more effectively and efficiently.

Another unfortunate reality many women encounter is the requirement to bring their water supply to the hospital. In most cases, this water is unsafe and jeopardises the health and wellbeing of women. When the health of women and their infants is guaranteed, the community's health is guaranteed.

2.23 Water Quality and Maternal Health

Besides the quantity, the quality of water may also affect pregnant women. Water quality encompasses microbiological and chemical factors (such as salinity, arsenic, and fluoride).

After an urban outbreak of Hepatitis E, the ICDCR-B (International Centre for Diarrhoeal Disease Research, Bangladesh) investigated the effect of water contamination by faecal-oral routes on pregnant women (HEV). HEV is an infection that disproportionately affects pregnant women and is mainly transmitted by faecal pollution of drinking water, with recurrent outbreaks in Asia and Africa, as the paper reports. This HEV infection is more severe in pregnant women than in the general population, resulting in adverse outcomes for both them and their infants (June et al., 2012).

Chemical pollution of the water may also harm pregnant women. The following scenarios illustrate water salinisation and arsenic pollution. A recent study (2011) examined the increased saltwater intrusion in shallow groundwater aquifers and ponds in coastal areas of Bangladesh, where more than 35 million people live. The study found that, during the dry season, when seawater and brackish ponds contaminated the drinking sources, people in these coastal communities, especially people with low incomes, consumed 212 to 8 times the WHO/FAO daily recommended intake of sodium and salt (2 grammes per day).

The study also reported that, during the dry season, there were 2.4 times more cases of hypertension or pre-eclampsia among 1,000 pregnant women with hypertension (ICDDR, 2009). Arsenic pollution in drinking water is a global problem. Estimates suggest that 136 to 178 million people drink arsenic-polluted water that surpasses the WHO/FAO drinking water standard of 10 parts per billion.

2.3 Theoretical Framework

A theoretical framework in research is a structure that guides the study by providing a comprehensive explanation of the relationships among the variables under investigation. It

consists of concepts, theories, and existing knowledge that are used to formulate hypotheses, define the research problem, and interpret the results. The theoretical framework helps to establish the foundation for the study, showing how the research fits into the broader context of existing theories and literature. It provides a lens through which the researcher views the data, making it easier to understand and explain the findings.

2.3.1 Theory-based Promotion of Safe Water Consumption

The Millennium Development Goal of reducing by half the number of people without access to safe water was achieved (United Nations Children's Fund [UNICEF] and World Health Organisation [WHO], 2012). Between 1990 and 2012, over two billion people obtained access to enhanced water sources. Despite this remarkable accomplishment, more than 780 million people (approximately 11% of the world's population) still lack access to clean drinking water (UNICEF & WHO, 2012).

Most of the people at risk reside in middle- or low-income countries (UNICEF & WHO, 2012), where 3.8% of deaths in 2004 resulted from unsafe water, sanitation, and hygiene (WASH; WHO, 2009). Diarrhoea caused by microbial pollution of drinking water or inadequate sanitation and hygiene is a major cause of death, especially among children under the age of five (WHO, 2009). However, geogenic pollution of groundwater (e.g., by arsenic or fluoride; Amini, Abbaspour et al., 2008; Müller et al., 2008) presents another health hazard that is receiving growing attention. In middle- or low-income countries, individuals act to reduce water-borne health risks because water supply is often based on households.

Decisions must be made and implemented to purchase or construct safe water solutions and to use and maintain them in the long term. However, research has demonstrated that health mitigation behaviours, such as safe water consumption, frequently do not accompany increased awareness (e.g., Opar et al., 2007; van Geen et al., 2002). Without behaviour change, any mitigation option will be futile (Cairncross & Shordt, 2004). WASH professionals increasingly acknowledge this. Governmental and non-governmental agencies have begun allocating more effort and resources to promoting health behaviours by enhancing people's risk awareness (Khan & Yang, 2012). However, these interventions often exhibit limited behavioural change impacts (e.g., Caldwell et al., 2006; Opar et al., 2007). According to the social cognition approach, interventions based on theory are more likely to produce effective behaviour change (Conner & Norman, 2005). Social-cognitive theories of behaviour posit that "people's social behaviour is determined by their subjective interpretations of reality rather than by an objective account of the situational factors" (Conner & Norman, 2005). This approach has resulted in the development of various theoretical frameworks (e.g., the Theory of Planned Behaviour [TPB], Ajzen, 1991, or the Health Action Process Approach [HAPA], Schwarzer, 2008) that have recognised several key determinants of health behaviours, such as attitudes, norms, and self-regulation. Recent research on solar water disinfection (e.g., Kraemer & Mosler, 2010, 2011; Tamas & Mosler, 2011), arsenic-removing sand filters (Tobias & Berg, 2011), arsenic-safe deep tube-wells (Mosler, Blöchliger, & Inauen, 2010), and the consumption of fluoride-free water (Huber & Mosler, 2012; Huber, Bhend, & Mosler, 2012) has demonstrated the ability of these factors to explain water and health-related behaviours (see Chapter One: Introduction).

The approach implies that interventions that modify these social-cognitive determinants will result in more effective behaviour change (Conner & Norman, 2005; Mosler, 2012). Some studies support this assumption (Abraham & Sheeran, 2005; Luszczynska & Tryburcy, 2008), but the evidence is inconsistent (Norman & Conner, 2005). This may be due to various reasons (Norman & Conner, 2005), such as the limitations of the theory underlying the interventions, e.g., low predictive power or insufficient specification (e.g., the Transtheoretical Model of Change [TTM]), or the lack of clarity on how to target the determinants. Alternatively, the null effects may be attributed to the methodological limitations of intervention studies (e.g., absence of randomised trials, inadequate comparison groups, lack of measurement or analysis of potential mediators). Michie and Prestwich (2010) urge a more rigorous application of theory at each stage.

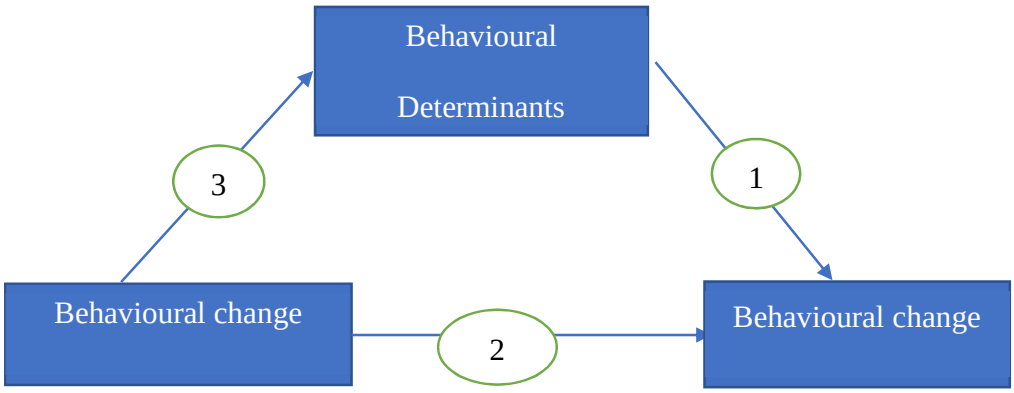

Figure 2.1: Steps Required for Developing Theory-Based Intervention.

Figure 2.1 depicts the steps required for developing theory-based interventions (Michie, Johnston, Francis, Hardeman, & Eccles, 2008).

1. Identify behavioural determinants of the target behaviour;

2. Identify behaviour change techniques (BCTs); and

3. BCTs are mapped onto the behavioural determinants.

2.3.2 Social-Cognitive Determinants of Health Behaviour

The social cognition approach suggests that individuals' thoughts mediate the connection between external influences and their behaviour (Fiske & Taylor, 1991). It posits that understanding behaviour is more effective when considering people's perceptions of external influences rather than an objective evaluation of those influences (Conner & Norman, 2005).

When developing theory-based interventions, a key decision is whether to base the approach on a specific theory or to incorporate elements from multiple theories. Lippke and Ziegelmann (2008) argue that this choice should depend on the objective of the intervention. They recommend using a single theory to test a specific behavioural change theory. However, when the goal is to enhance intervention effectiveness, as in this thesis, it is preferable to integrate elements from multiple theories (Lippke & Ziegelmann, 2008). Abraham (2012) supports this approach, cautioning that relying on a single theory could overlook important behavioural processes. He suggests that, due to the current state of theoretical integration in the behavioural sciences, intervention designers should consider a variety of change processes, which requires drawing from multiple theories (Abraham, 2012).

Additionally, combining theories can aid in theory development, given the significant overlap among existing theories (Conner & Norman, 2005; Leventhal & Mora, 2008). Therefore, this thesis aims to integrate key social-cognitive theories of health behavior into

a framework that will underpin the development of theory-based interventions. This framework will be outlined after reviewing the major health behaviour theories.

2.3.3 Health Behaviour Theories

This section starts by discussing continuum models of health behaviour and then provides an overview of health-related stage theories and integrative models. It concludes with a model that integrates the key factors identified. Continuum theories view behaviour as existing on a spectrum and suggest that the likelihood of performing a behaviour can be predicted by the strength of certain behavioural determinants (Sutton, 2005). The main continuum theories of health behaviours are then presented

2.3.4 The Health Belief Model (HBM)

The Health Belief Model (HBM; Becker, Drachman, & Kirscht, 1974; Rosenstock, 1966) is one of the oldest and most widely used models of health-related social cognition (Conner & Norman, 2005). According to this model, health-related behaviours are more likely to occur when individuals perceive a substantial threat and believe that it effectively reduces the threat (Becker et al., 1974).

The model distinguishes between two components of threat perception: perceived susceptibility and perceived severity. Perceived susceptibility (or vulnerability) refers to the personal probability of being affected by a health threat, such as arsenicosis. Perceived severity refers to the perceived negative consequences of the threat, such as facing social exclusion due to arsenicosis. The model also assumes that the perceived effectiveness of

the behaviour is influenced by the perceived benefits and the perceived barriers to performing the behaviour (Becker et al., 1974). The HBM was later enhanced by adding predisposing factors (such as demographic and psychological characteristics, e.g., gender personality) and cues to action and health motivation (Abraham & Sheeran, 2005). Health motivation refers to the importance of personal health, while cues to action denote external (e.g., communication) and internal (e.g., symptoms of arsenicosis) stimuli of health behaviour (Abraham & Sheeran, 2005). The HBM has been used to examine a broad spectrum of health behaviours, and its constructs have generally proven to be valuable, albeit with small effect sizes (see Abraham & Sheeran, 2005).

A review of interventions based on the HBM revealed successful behaviour change in 13 out of 17 (76%) studies (Abraham & Sheeran, 2005). However, some studies suffered from methodological limitations (e.g., absence of control groups), and without mediation analyses, the usefulness of the HBM for intervention design cannot be inferred (Abraham & Sheeran, 2005). In fact, in some studies, HBM predictors did not contribute to explaining the behaviours in question (e.g., Lu, 2001).

To sum up, although the HBM, perhaps owing to its simplicity, has been widely applied to understand, anticipate, and alter various health behaviours, effect sizes are typically small or not linked to HBM variables (Abraham & Sheeran, 2005).

Another limitation of the HBM is the lack of clarity on how its predictors are related (Abraham & Sheeran, 2005). Moreover, it has been proposed that essential constructs are absent (namely, behavioural intention and self-efficacy), which could enhance the

explanatory power of the HBM. The subsequent theory addressed some of these shortcomings:

2.3.5 Protection Motivation Theory (PMT)

Protection Motivation Theory (PMT), similar to the Health Belief Model (HBM), involves two appraisal routes: threat appraisal (perceived threat) and coping appraisal (perceived effectiveness of a health behaviour). PMT further elaborates on these processes. Threat appraisal focuses on the maladaptive response, weighing perceived severity and vulnerability against the rewards of the maladaptive behaviour. Despite recognizing the dangers, individuals might still engage in risky behaviours due to perceived social approval or convenience.

PMT suggests that fear motivates protective behavior, while coping appraisal considers the adaptive response. This includes belief in the effectiveness of the new behavior (response efficacy) and confidence in one's ability to perform it (self-efficacy), balanced against the costs of the behavior. Protection motivation, or the likelihood of taking protective action, is higher when the perceived severity and vulnerability outweigh the benefits of the maladaptive response, and when response efficacy and self-efficacy outweigh the costs of the new behavior.

Empirical evidence has shown that coping appraisal components, especially self-efficacy and response costs, are more powerful predictors of health behaviors than threat appraisal components. However, effect sizes tend to decrease when predicting future behaviour. While PMT has a solid theoretical foundation and has been used to predict various health behaviors, most validations have been correlational rather than experimental. Few

intervention studies have explored whether changes in PMT-related cognitions mediate behavior change. Future research should focus on experimental studies in natural settings to address these gaps.

2.3.6 Social-Cognitive Theory (SCT)

Self-efficacy, the belief in one's ability to achieve desired outcomes, is a central concept in Social-Cognitive Theory (SCT) (Bandura, 2001). It directly and indirectly influences behaviour by affecting other determinants like outcome expectancies, socio-structural factors, and goals. Outcome expectancies refer to the anticipated consequences of actions, which can be physical, social, or self-evaluative. SCT uniquely posits that outcome expectations can impact behaviour directly and indirectly through goal setting. Socio-structural factors, which include environmental barriers and facilitators, moderate the effect of self-efficacy on goals. SCT emphasizes that a person's confidence in their actions can shape their perception of these barriers and enablers. However, SCT tends to downplay the direct influence of socio-structural factors on behavior, suggesting that severe barriers can prevent the formation of intentions.

SCT also explains how self-efficacy can be developed through mastery experiences, vicarious experiences, verbal persuasion, and emotional arousal. Despite its strengths, the effectiveness of SCT-based interventions varies, potentially due to inconsistencies in applying the theory (Luszczynska & Schwarzer, 2005)

2.3.7 Theory of Planned Behaviour (TPB)

The Theory of Planned Behaviour (TPB) explains that intentions to engage in behaviour are influenced by three key factors: attitudes towards the behaviour, subjective norms, and

perceived behavioural control. Attitudes involve beliefs about the outcomes of the behaviour, subjective norms reflect beliefs about others' expectations, and perceived behavioural control refers to the perceived ease or difficulty of performing the behaviour. Together, these factors shape intentions, which, along with perceived control, predict actual behaviour. Although risk perception is not explicitly included in the TPB, it can be integrated through related concepts like attitude, which is influenced by perceived susceptibility and severity. TPB also distinguishes between instrumental attitudes (cost-benefit analysis) and affective attitudes (emotional reactions). Despite the model's focus on social factors, empirical evidence suggests that subjective norms are often weak predictors of intentions.

A limitation of the TPB is the "intention-behavior gap," where intentions do not always translate into actions. This gap may result from competing intentions, external influences, or unforeseen obstacles. Post-motivational factors, like planning and commitment, are essential for translating intentions into actions, though they are not explicitly addressed in TPB. Stage theories differ from continuum models like TPB and propose that behaviour change occurs through distinct stages. These stages involve specific transitions influenced by psychological and other factors. Interventions should be tailored to an individual's current stage to facilitate progress through the stages. Different theories propose varying numbers of stages, such as the three stages in the Integrated Change Model or the eight stages in the Multi-Stage Model of Health Behaviour Change.

2.3.8 The Transtheoretical Model of Change (TTM)

The Transtheoretical Model (TTM), developed by Prochaska and DiClemente (1983), is one of the earliest and most well-studied stage models. It outlines five stages of behaviour

change: pre-contemplation, contemplation, preparation, action, and maintenance. The transitions between these stages are influenced by various factors, including decisional balance (weighing the pros and cons of the behaviour), self-efficacy (confidence and temptation), processes of change (e.g., consciousness-raising, or seeking new information), and behavioural processes (e.g., stimulus control, using cues to prompt behaviour). Stage models, like TTM, are more intricate than continuum models because each stage can have its own set of determinants. Evaluating stage models requires experimental and longitudinal research methods. However, the vague definitions of predictors for stage transitions in many stage models make such studies challenging. An exception is the Health Action Process Approach (HAPA), which has gained popularity for addressing this issue.

2.3.9 Health Action Process Approach (HAPA)

Schwarzer (1992, 2008) developed the Health Action Process Approach (HAPA) as a health behaviour change stage theory. It integrates various social-cognitive factors from other theories, such as Social Cognitive Theory (SCT). It outlines two primary stages: motivation and volition, which are further divided into sub-stages like pre-action, intention, action, initiation, maintenance, and recovery. The HAPA suggests that factors such as action self-efficacy, outcome expectancies, and risk perception influence intentions, which in turn affect behaviour. This makes it similar to continuum theories like the Theory of Planned Behaviour (TPB). A key feature of HAPA is the emphasis on planning, including implementation intentions (specific plans on when, where, and how to perform a behavior) and coping planning (strategies to overcome barriers).

You need to use one theory that support your argument in the final work.

The model also distinguishes between different types of self-efficacy, such as maintenance, volitional, and recovery self-efficacy. Despite being presented as a stage theory, the HAPA is often treated as a causal model, akin to continuum theories. This has led to critiques that it doesn't fully capture the sequential nature of behavior change stages. Additionally, the HAPA's general approach to outcome expectancies and its focus on planning as the bridge between intention and behavior have been points of critique. Some argue that the theory does not adequately explain why some individuals follow through on their intentions while others do not, highlighting the need for considering moderators or additional determinants like commitment strength.

2.3.10 Model of Prospective Memory and Habit Development (MPMH)

The Memory for Prospective Memory Hypothesis (MPMH), developed by Tobias (2009), is a model designed to explain how memory aids (or reminders) affect behavior change. The model posits that behavior is enacted only when it is feasible, preferred, and remembered at the right moment. Preferences are influenced by motivational factors such as convictions, norms, and emotional states. A key aspect of the model is the role of memory, determined by the accessibility of the behavior in a given situation and the availability of cognitive resources and habits. Behaviour accessibility is influenced by prior behaviour, forgetting, events, and situational cues (e.g., reminders). Commitment strength, defined as the intensity of internal pressure to perform a behavior, plays a crucial role in how these cues affect behavior. For instance, even if a person prefers collecting arsenic-safe water and it is feasible, they may forget to do so if they are not reminded and lack strong commitment.

Tobias validated the MPMH with dynamic field data and agent-based simulations, demonstrating its predictive power for behaviour change. However, the model's complexity and the difficulty in measuring critical variables like accessibility pose challenges for statistical investigation. The MPMH does not include self-efficacy, though it acknowledges the importance of commitment, strength, and remembering in behaviour change processes. The model also emphasizes habits, defined as goal-directed, automatic behaviours that are strengthened by situational cues, similar to implementation intentions. Habits can be reliably measured and are significant predictors of various health behaviours. A critique of the MPMH is that habits, reflecting past behaviour, can obscure the effects of other cognitive factors, potentially leading to a loss of valuable information for developing interventions

2.3.11 Integrative Models

The review of the theories above shows considerable overlap, which has been observed by other researchers (Bandura, 2004; Conner & Norman, 2005; Lippke & Ziegelmann, 2008). Integrating the factors into one model would provide an overview of the behavioural determinants that must be considered when changing behaviour. Moreover, integration has been called for to advance the development of health behaviour theory (Leventhal & Mora, 2008; Lippke & Ziegelmann, 2008).

Some integrative models have been suggested. These will be examined in the next section, followed by the presentation of the framework for this thesis. Major theorists' model to address HIV infections: major health behaviour theorists aimed to identify the most critical factors that should be considered when investigating any behaviour (Fishbein et al., 2001).

They proposed three predictors of behaviour: environmental constraints, intention, and skills. Intention, in turn, was presumed to be influenced by self-discrepancy, advantages and disadvantages, social pressure, self-efficacy, and emotional reaction (Conner & Norman, 2005). An advantage of the model is its parsimony.

However, the model has some limitations despite including some major social-cognitive variables. It omits some important variables (for example, risk perception and commitment), incorporates constructs with questionable evidence bases (for example, self-discrepancy), and does not specify any causal relationships between the variables (except for intention) because the theorists could not reach a consensus on these (Conner & Norman, 2005).

2.3.12 Theory of Triadic Influence (TTI)

The Theory of Triadic Influence (TTI), as outlined by Flay, Snyder, and Petraitis (2009), integrates social-cognitive and other factors to explain behaviour. TTI categorizes influences on behaviour into levels of causation (from distal to proximal) and streams of influence (personal, social, and environmental). At the most proximal level, trial behaviours are the immediate predictors of behaviour, influenced by intentions. Intentions are shaped by factors like self-efficacy, behavioural control, social normative beliefs, and attitudes, similar to the Theory of Planned Behavior (TPB). More distal factors, such as self-determination, motivation to comply, and knowledge, further influence these. These, in turn, are shaped by even more distal factors, such as social competence and information, which are ultimately influenced by biological, personality, social, and cultural contexts.

The theory suggests that more proximal predictors are more specific, changeable, and easier to target in interventions. However, changes at this level are less likely to produce long-lasting or generalizable behavior changes. TTI's comprehensive approach considers various levels of influence on behavior, highlighting the importance of societal-level changes, like banning smoking in public places, for long-term impact. While individual-level interventions can yield quicker results, TTI has been criticized for not addressing post-motivational factors, which limits its effectiveness compared to other motivational theories.

2.4 Behavioural Determinants

The model identifies three critical areas of overlap among health behaviour theories: outcome expectancies, self-efficacy, and post-motivational factors. These include the main predictors of health behaviour found in the review

2.4.1 Outcome Expectancies

Outcome expectancies refer to beliefs about the potential outcomes of engaging or not engaging in a behaviour. These concepts are present in various theories, though they may be labelled differently. For example, they are called behavioural beliefs in the Theory of Planned Behavior (TPB), benefits and costs in the Health Belief Model (HBM), response efficacy in the Protection Motivation Theory (PMT), and perceived severity and vulnerability in both HBM and PMT. Normative influences, which consider the impact of social norms, are also included in some models, such as the Social Cognitive Theory (SCT) and the Health Action Process Approach (HAPA).

Unlike some models that combine outcome expectancies into a single construct, the current approach suggests examining these factors individually. This method provides more detailed information for designing behaviour change interventions. The primary outcome expectancies include beliefs about health risks (such as perceived vulnerability and severity), cost-benefit beliefs (instrumental attitude), anticipated emotional reactions (affective attitude), and normative beliefs (injunctive and descriptive norms). Additionally, beliefs about alternative behaviours are recommended for consideration, as noted in the RANAS model and PMT

2.4.2 Self-Efficacy

Self-efficacy is a critical factor for behaviour change and has been incorporated into most theories (SCT, PMT, TTM, HAPA, and TPB). According to the HAPA (Schwarzer, 2008), it is beneficial to consider at least three forms of self-efficacy: action, maintenance, and recovery. Since the current framework is a continuum model, the different self-efficacies are not associated with various stages of behaviour change but may influence any point on the behaviour change continuum. The distinction may be advantageous, as it can provide more specific information on where a person's confidence is low: the ability to initiate action, cope with barriers, or recover from relapse. Further types of self-efficacy may also be considered if deemed useful (e.g., as suggested in the I Change model, de Vries et al., 2005).

2.4.3 Post-Motivational Factors (Planning)

Among post-motivational factors, planning (such as implementation intentions and action/coping planning) is a key determinant of behaviour. Commitment strength is also crucial, as it plays a significant role in some effective behaviour change techniques (BCTs), like reminders. Planning and commitment enhance behavioural accessibility and aid in remembering, although remembering itself is not explicitly included as a mediator in the model, as it doesn't add new intervention implications. In addition to immediate behavioural determinants, personal, social, and environmental factors can predispose individuals to specific behaviours. While these factors may not directly affect behaviour, they are precursors to more immediate determinants and can provide supplementary information for designing interventions. Examples include knowledge, skills, objective barriers, and factors influencing elaboration likelihood.

Unlike some health behaviour theories, the present model does not consider behavioural intention as a determinant of behaviour. The relevance of intention has been questioned, as it may not be the most effective way to convert motivation into action. Although intentions are often strong predictors of behaviour, they can be challenging to influence directly through interventions. Instead, the model focuses on altering the antecedents of intention, such as outcome expectations. While omitting intentions may leave some variance in behaviour unaccounted for, it allows for more specific information in designing interventions.

2.5 Selecting Behavioural Determinants

The above-reviewed theories imply different criteria for choosing behavioural determinants for intervention. Specifically, the approaches differ in how and to what

extent they consider the target population's characteristics in the intervention development process.

2.5.1 One Size Fits All

Continuum theories, like the Theory of Planned Behavior (TPB), suggest that altering any behavioural determinant can increase the likelihood of behaviour change, applicable to most individuals except "outliers." These theories imply that choosing which determinants to target for intervention is already determined by the theory itself. If the theory is causal, addressing the most distant antecedents should lead to behaviour change by altering more immediate determinants. However, these interventions may have smaller effects due to the limited variance explained.

An alternative approach is to "jump into the causal chain" and directly target proximal determinants, which can yield more significant behaviour change effects even if they aren't based on the model's causes. This method is appropriate for testing theories by manipulating behavioural determinants. This approach can be cost-effective and efficient in real-life health promotion, as it doesn't require a prior assessment of population characteristics. However, it may not always work because certain factors may be more relevant to specific behaviours and populations.

2.5.2 Adaptation to Target Behaviour and Population

This approach emphasizes a tailored strategy that considers the specific characteristics of a target behavior and population, rather than applying a generic one-size-fits-all method. To design effective interventions, planners need to identify relevant behavioural determinants for the specific behaviour and population. This involves reviewing multiple theories to capture all pertinent determinants, as relying on a single theory can be limiting.

Additionally, understanding the specifics of the target behaviour and population, including cultural context, is crucial.

Intervention planners should evaluate the most influential and modifiable determinants through structured surveys and statistical analyses, such as comparing groups or assessing correlations. This helps identify the determinants with the greatest potential for behaviour change. The changeability of these determinants can also be assessed by examining their distribution within the target population. This method, which systematically incorporates theory and population characteristics, is likely to be more effective than generic interventions. However, it may not address the unique needs of specific subgroups. To mitigate this, data can be used to identify subgroups with different psychological profiles, allowing for multiple tailored interventions. Nonetheless, this approach requires significant time and resources due to the comprehensive assessment of determinants and may still not account for individual differences, which is the focus of truly tailored interventions.

2.5.3 Tailored Interventions

Tailoring refers to “a set of strategies and information that targets one specific individual, based on attributes that are distinctive to that individual, pertinent to the desired outcome, and obtained from a personal evaluation” (Kreuter, Farrell, Olevitch, & Brennan, 2000, p. 277).

2.5.4 Stage Tailored Interventions

This approach customizes interventions based on an individual's stage of change, assuming people progress through distinct stages with specific behavioural determinants. Interventions tailored to a person's current stage should facilitate movement to the next stage, while mismatched interventions could be ineffective or harmful. Reliable staging

algorithms assess an individual's stage, guiding intervention planning. However, this method's effectiveness depends on having reliable algorithms and clear predictors for each stage transition. A drawback is that stage-customized interventions often use only a few determinants, even though messages tailored to more determinants are generally more effective.

2.5.5 Menu-based interventions

This approach is the most individualized, customizing interventions based on many social-cognitive factors and potentially multiple behavioral theories. Unlike stage tailoring, which may offer a few interventions based on stages, this method can create a large number of interventions tailored to individual characteristics. While effective, it requires significant effort to develop and implement, especially in field settings. The increased complexity and costs may not be justified without evidence of cost-effectiveness. Compared to one-size-fits-all or stage tailoring, this menu-based approach offers a more personalized solution but needs further validation. Adapting interventions to specific behaviors and populations may be the best approach at this research stage.

2.6 Empirical Literature

Numerous studies have examined the effects of WSS interventions on child health globally (Jalan and Ravallion, 2003; Glado and Briceno, 2005; Bose, 2009; Kolahi et al., 2009). Waddington et al. (2009) conducted a comprehensive review of the impact of water, hygiene, and sanitation interventions on diarrhoea morbidity. They emphasised that water quality is more crucial than water supply for reducing diarrhoea. Moreover, they found that sanitation facilities were equally hygienic in lowering diarrhoea morbidity. However, as other recent reviews by the World Bank (2008) and Pattanayak et al. (2007) have pointed

out, the evidence base for the impact of WSS interventions is still weak, especially for the effects of sanitation. To the best of our knowledge, research on the influence of water and sanitation quality on child health and mortality in Egypt is scarce.

Ashour and Ahmed (1994) conducted a study in randomly selected urban and rural areas of Dakahlia governorate in Lower Egypt and Sohag governorate in Upper Egypt. They interviewed a total of 1,020 mothers in the study areas. Using logistic regression, they found that diarrhoea was likely high among children whose families disposed of refuse near the house or in surface water. The likelihood of diarrhoea decreased with household ownership of land, the mother's awareness of symptoms and causes of diarrhoea, and the mother's prior use of oral rehydration for treatment.

Abou-Ali (2003) used data from the 1995 EDHS to investigate the effects of water and sanitation on infant and child mortality in Egypt. The study employed various methods, such as parametric and nonparametric duration models. The findings showed that access to water and a modern toilet facility reduced the risk of child mortality; sanitation had a more significant impact on mortality than water.

Fuentes et al. (2006) examined WSS services and child mortality in Egypt as part of a multi-country project that utilised Demographic and Health Surveys (DHS) conducted in Cameroon, Egypt, Peru, Uganda, and Vietnam. The authors analysed the associations between mortality in the first year of life and different types of water sources and sanitation facilities. They applied logit regressions, proportional hazard models, and propensity score matching techniques to verify the reliability of their results.

The paper reported some consistent findings across the study countries: access to safe water was generally more critical for infant survival in rural areas, while access to improved sanitation facilities enhanced the chances of survival in urban areas. In Egypt, however, sanitation was not significant under any specification, though there was some indication of the effects of having access to a modern toilet facility on lowering the risk of death.

According to Thomas M. Walski (2006), from the American Water Works Association, early humans had to carry water from the source to the point of consumption, which required more effort and only provided minimal water for drinking and washing. A piped water system was discovered two millennia before Christ and still functions today. In 1942, a prestressed concrete tank was introduced, and then, from 1952 to 1960, cast-in-situ concrete became standard practice for tanks.

The National Research Council of the National Academy (2001) studied water distribution systems that carry drinking water from a centralised treatment plant or well supply to consumers' taps. These systems include pipes, pumps, valves, storage tanks, reservoirs, metres, fittings, and other hydraulic appurtenances. More than 80 per cent of the water supplied to residences is used for activities other than human consumption, such as sanitary services and landscape irrigation. Most pipe systems have a lifespan of almost 30 years, although the lifespan of pipes can vary depending on the soil and local conditions.

Harry E. Hickey (2008), in his US Fire Administration Water Supply System and Evaluation Method, focuses on the municipal water system that constantly provides water to a large area. The source for the distribution system is an underground water tank lifted

by a pump system. Harry E. Hickey (2008) also suggests that the transmission of the water system is crucial for the success of a constant supply of water without contamination.

“E. Becher Jr., Gerald J. Bizjak, and James W. Schulz (1972), in their paper on Computer Technique for Water Distribution Analysis published by the American Water Works Association, address the problem of accurately analysing the behaviour of distribution networks. They state that this problem is common to the analysis. Still, when done manually, it requires several alternatives with several factors to simplify large systems and make many assumptions to complete the calculations in a reasonable time.

These procedures do not always produce a satisfactory design. The search for a better way led them to consider electronic computers. They present the results of their analysis with different changes and discuss the errors that can cause the failure of the analysis. They suggest this problem can be solved using computers to analyse complex networks. They provide a system map showing the location, diameter, C (friction factor) number, length, and interconnection of every principal pipe in the system. They list sources, including their location, input pressure, and flow rate. They note that the source’s pressure or flow rate is generally only an estimated quantity.

They argue that manual methods have obvious economic disadvantages and are not good enough to produce the required quality of answers on all but the most elementary systems, which are quite complicated. They propose that an existing distribution system using software is needed for the analysis. They describe the distribution system situated at Indradhanu, near Damani Nagar, Solapur. They explain how they collect information and

input data through drawings and design parameters. They use this information as input for software and analyse it to get the output from the software.

They compare different alternatives of analysis for various pipe materials (Ductile Iron (DI), Cast Iron (CI), Galvanized Iron (GI) and PVC) with the existing water distribution system. They optimise the system with two alternatives and calculate the cost of each alternative to get the most economical alternative.

Maternal and infant mortality is a global and pervasive problem. In 2017, approximately 295,000 women died due to pregnancy and childbirth complications (WHOa, n.d.). The most common causes of maternal morbidity and mortality are infections, hypertension, haemorrhage, unsafe abortions, and obstructed labour.

This thesis focused on the perinatal and postnatal phases of women, as most maternal and infant deaths occur during the first six weeks after delivery (WHOb, n.d.). The report "Interagency List of Medical Devices for Essential Interventions for Reproductive, Maternal, Newborn, and Child Health" by the World Health Organisation (2015) outlines the key factors for comprehensive maternal health care and preventing perinatal and postnatal risks.

The report identifies the crucial devices and interventions for each stage of pregnancy, labour, and postnatal care. During labour and postnatal care, the essential interventions for the mother are assisted delivery (by skilled personnel and with sterile instruments), access to clean water for hand and instrument hygiene, safe cord clamping and cutting, and diagnosis and treatment of possible complications (ibid., 16, 28). The most important

interventions for the newborns are immediate resuscitation if needed, thermal care to prevent hypothermia, breastfeeding support, and the diagnosis and treatment of possible complications (ibid., 17ff, 32ff). The report from the WHO also highlights the various types of diseases that are potentially fatal, especially during the perinatal and postnatal phases, and that vary in prevalence across countries. Some examples of communicable diseases that have caused significant outbreaks in low- and middle-income countries are malaria, HIV, and cholera (Boutayeb, 2010: 532). Rylander et al. (2013) published a review article in Global Health Action on the potential effects of climate change on maternal and infant health care. Several studies indicate that the lack of clean water, increasing poverty, and malnutrition have severe impacts on pregnant women and their children. Reducing maternal morbidity is the fifth United Nations Millennium Development Goal (by 75%), which entails addressing all the risks faced by childbearing women. Climate change and natural disasters threaten maternal health (UNDP, n.d.; Rylander et al., 2013:1).

CHAPTER THREE

THE GEOGRAPHY OF THE AREA AND RESEARCH METHODOLOGY

3.0 Introduction

This chapter examines the geography of the study area and the methodology used to carry out this study.

3.1 Conceptual framework on water accessibility in Mion district, Northern-Ghana

Conceptual framework for the objectives outlined involves identifying key concepts, relationships between them, and the factors that influence these relationships. The framework will visually represent how water accessibility, maternal and child heal, distance, and gender roles are interconnected in the Mion District in Ghana. Below is the

diagram showing the relationship between the dependent variable and the independent variables.

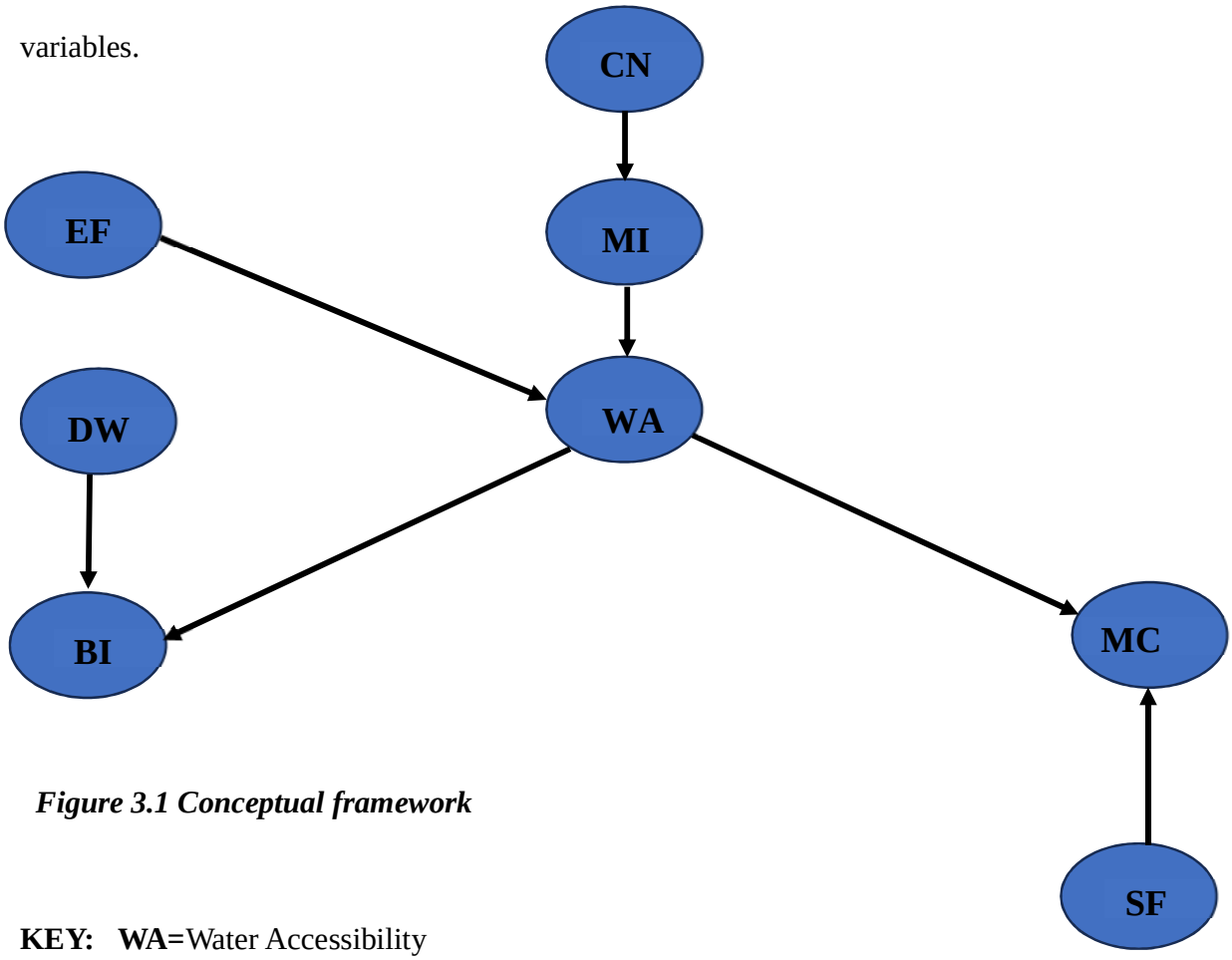

Figure 3.1 Conceptual framework

KEY: **WA**=Water Accessibility

MI=Gender roles (Men's Involvement)

CN=Cultural Norms

EF=Environmental Factors

DW=Distance to water sources

BI=Birth Implications (Pregnant women)

MC=Maternal and Child health

SF=Socio economic Factors

3.2 Profile of the Mion District

The study was conducted in the Mion District of Northern Region, Ghana. The district lies within the coordinates of 90–35◦ N, 00–30◦ W, and 00–15◦ E, along the eastern corridor of

the region. It was carved out of the Yendi Municipal Assembly to enable development to reach all communities. The district shares borders with several other districts. To the north, it borders the Gushegu Municipal and Karaga districts. To the east is the Yendi Municipal district. To the west, it borders the Tamale Metropolis, Savelugu Municipal and the Nanton district. On the south, it borders the Nanumba North District and East Gonja Municipal. The district's administrative capital and largest settlement is Sang. The district covers a land area of 2,714.1 km2 (1,047.9 sq mi) and has a population of 94, 930 people, with an average household size of 6.9 people (PHC 2021).

The Dagomba ethnic group constitutes the majority of the district's inhabitants. However, the district also hosts other ethnic groups, contributing to cultural diversity. The people of the Mion District have a rich cultural heritage, traditional practices, and lively festivals.

3.2.1 Administrative Structure

The district comprises sub-districts or electoral areas for administrative purposes. Elected representatives govern these areas and supervise local governance and development. The Nanumba Traditional Area, which significantly influences the district's culture and society, also has jurisdiction over the district.

3.2.2 Economy and Livelihoods

The district's economy relies heavily on agriculture, with most people practicing subsistence farming. The district has fertile agricultural lands that enable the production of crops such as millet, maize, yam, sorghum, groundnuts, and vegetables. The district also benefits from livestock (cattle, sheep, and goats) and poultry (birds) rearing. Furthermore, the district's economic activities involve small-scale businesses, trade, and handicrafts.

3.2.3 Infrastructure and services

The Mion district is gradually developing its infrastructure to meet the population's growing needs. The district has schools, health facilities, markets, and other basic amenities that meet the daily demands of residents. However, there may still be gaps in access to quality education, healthcare, and transport infrastructure in areas where development continues.

3.2.4 Culture and Tourism

The Mion district has a rich cultural heritage and traditional customs. Traditional festivals like the Damba Festival are celebrated enthusiastically and provide a platform for cultural performances, music, dance, and storytelling. Visitors to the district can experience the vibrant cultural traditions and interact with the warmth and hospitality of the local communities.

3.2.5 Vegetation of the Area

Various vegetation types characterize the Mion District in the northern region of Ghana. The region's vegetation is influenced by its location in the Sudanese savannah zone, representing a transition between the Guinea and Sahel zones. Here are the main vegetation types in Mion District:

Savanna grasslands: The predominant vegetation type in Mion District is savanna grasslands. It is characterized by extensive grassy areas, including species such as elephant grass (Pennisetum purpureum), seagrass (Panicum maximum), and spear grass (Imperator cylindrica). These grasses are well adapted to the region's climate and are important in supporting livestock grazing and wildlife habitat. Wooded Savanna: In some areas of the Mion District, the savannah grasslands are interspersed with scattered trees and shrubs,

forming a wooded savannah. Common tree species found in this vegetation type are the shea tree (Vitellaria paradoxa), acacia species (Acacia spp.), baobab (Adansonia digitata), and various species of the Combretaceae family.

Riparian vegetation: Riparian vegetation is found on the banks of rivers and streams. These areas have a higher density of trees and shrubs than the surrounding grasslands. Trees such as African mahogany (Khaya senegalensis), African carob (Parkia biglobosa), and tamarind (Tamarindus indica) are commonly found in riparian areas. Gallery forests: Gallery forests can be observed in some parts of the Mion district, mainly where rivers or streams are permanent. Gallery forests are characterised by denser vegetation with taller trees that form a canopy. Tree species commonly found in gallery forests include mahogany (Khaya senegalensis), ebony (Diospyros mespiliformis), and various species of the Sterculiaceae and Meliaceae families.

Agricultural fields: Due to the region's agricultural activities, cultivated areas are also important in the Mion district. These areas are used to grow millet, maize, yam, sorghum, and peanuts. In some cases, agroforestry systems combine crop cultivation with tree planting for shading, soil protection, and other benefits.

It is important to note that the vegetation in the Mion District, as in any ecosystem, may be subject to fluctuations and changes due to climate, land use practices, and human activities. In addition, further detailed studies and field investigations can lead to a more comprehensive understanding of the specific vegetation communities and plant species in the district.

3.2.6 Climate of the Area

The area has a typically tropical climate with two main seasons: a dry season (November–March), characterised by high temperatures, and a single rainy season (April–October). Therefore, this study was conducted in the following ten communities in Mion District: They are Tisung, Tamblabu, Jablajo, Kayan, Tamaya, Maliya, Lamayili, Bamagi, Dabogni, and Buguyili. We deliberately chose the Mion district. Because it is relatively new and was separated from the Yendi Municipality in 2012. Therefore, data on nutrition and health in the district is scant. Figure 3.1 below is the map of the Mion District.

3.2.7 Fertility and Mortality

The Mion District has a total fertility rate of 3.4, slightly lower than the regional average of 3.5. The general fertility rate is 102.9 births per 1000 women aged 15–49 years. The general fertility rate is 102.9 births per 1000 women in the age group of 15–49 years. The district's Crude Birth Rate (CBR) is 23.7 per 1000 population, while the crude death rate is 6.8 per 1000 live births. These rates are higher than the regional averages of 22.4 and 5.9, respectively.

3.2.8 Household Size, Composition and Structure

The population of Mion district is 94,930, and it has 8,842 households. The average household size is 9.3 people. Children make up 52.0 percent of the household population, while heads of households and other relatives account for 10.9 percent and 10.2 percent, respectively. Most (64.8 percent) households are extended families, which include the head, spouse(s), children, and the head's relatives.

3.2.9 Employment Status in the Area

Of the population aged 15 years and older, 83.5 percent are economically active, and 16.5 percent are not. Among the economically active, 98.7 percent have jobs, and 1.3 percent do not. Of those jobless, 41.1% are looking for work for the first time. Of those who are not economically active, 31.9 percent do household chores, and 30.8 percent are students. Most (92.5 percent) of the district's workforce are skilled agricultural, forestry, and fishery workers, and 2.1 percent are craft and related trades workers. Females (3.0 percent) are more likely to work in craft and related trades than males (1.3 percent), while males (95.1 percent) are more likely to work in skilled agricultural, forestry, and fishery fields than females (89.9 percent).

3.2.10 Water and Sanitation

The area is served by water bodies and sources such as Dakar and dugouts in some communities. People travel about 5 to 6 km to access these water sources on average. The main sources of drinking water in the district are boreholes. Fifty (50) boreholes are installed in one hundred and fifty-four (154) communities which only functions during the rainy season. Making water accessibility very difficult to the people especially women and the girl child. The district lacks potable water; the situation worsens during the dry season as water becomes so scarce that the people share their water sources such as the dams, streams and dugouts with animals. According to Lifetime Well for Ghana, a Non-Governmental Organisation, the water situation in 15 communities in the district was unsatisfactory and needed improvement. These communities include Tisung, Tamblabu, Jablajo, Kayan, Buli, Tamaya, Maliya, Lamayili, Bamagi, Dabogni, yimagu, Tijo, Yimsani and Buguyili.

3.2.11 Health Facilities

The districts have no hospital but with about three health centres. The health centres are located at Sang, Sambu, and Jimle. Additionally, there are seven (7) Community-Based Health and Planning Services (CHPS) Compounds located at Dabogni, Kpabia, Sapke, Jimle, Tijoe, Tanando and Tinsung, which serve to supplement the delivery of health services in the district.

3.2.12 Literacy and Education

According to the 2021 PHC report, 28.7 percent (11,090) of the population were literate, while 71.1 percent (38,372) were non-literate for both sexes, implying a very high illiteracy rate in the district (PHC 2021). The district has 71 schools, of which 64 are early childhood centres and primary schools, and seven are Junior High Schools (JHS). No senior high school is in the district, so students must go to other places for their Senior High School education.

Among the population aged 11 years and older, 22.4 percent are literate, while the remaining 77.6 percent are illiterate. Of those who are literate, 21.5 percent can read and write in English only, whereas 70.8 percent can read and write in English and a Ghanaian language. Regarding the district population aged three years and above, 68.5 per cent have never attended school, 25.7 per cent have attended in the past, and 5.8 per cent are currently attending. Of the current attendees, 8.7 per cent are in kindergarten, 55.4 per cent are at primary level, and 13.2 percent are in junior high schools. Therefore, 77.3 percent of the students in the district are in basic schools. The Mion District has 165 educational facilities, comprising 162 public and six private schools. However, the district has only 77 KG schools (74 public and three private), 77 primary schools (74 public and three private), and

11 public JHSs. The district also has one community-day secondary school and no tertiary education facility. Thus, it can be deduced that the district has an urgent need for educational development, considering the population of the district.

3.2.13 Economic Activities

The 2021 Population and Housing Census reveals that the primary occupation of the people in the Mion district is mainly farming. The district's economy is largely subsistence, with agriculture being the main occupation. Over 90 percent of the population relies on agriculture for their livelihood. Other economic activities in the district include smock weaving, agro processing (shea butter and groundnut oil extraction), meat processing, fish mongering, wholesale and retail of general goods, animal husbandry, transport, and others. These activities are mainly on a medium- and small-scale basis. The agricultural potential of the district is significant, with the land being suitable for cultivating cereals, tubers, and the rearing of animals. Animals reared in the district include cattle, sheep, goats, pigs, and poultry birds for domestic and commercial purposes. A minority is involved in small-scale manufacturing, such as smock weaving, blacksmithing, baking, mechanics, shea butter extraction, and groundnut oil extraction. Unfortunately, there are no banks or financial institutions in the area, meaning that locals must travel to Yendi or Tamale to access such services.

3.2.14 Ethnicity and Cultural Practices

Mion is a predominantly rural area inhabited mainly by Dogombas and Konkombas, with Dagombas constituting the largest ethnic group, followed by Konkombas. Akan and Moshie are also present in the area. The district's religious landscape is diverse, with Muslims, Christians, and Traditionalists being the main religious groups. Islam is the

dominant religion, with over 61.8 percent of the population identifying as Muslim, while the rest are largely adherents of traditional religion, Christianity, and other smaller religious groups. The district is known for its traditional festivals, with the Damba and Bugum (Fire Festival) being the most important. The Damba festival, celebrated in the Dagomba lunar month of Damba, corresponds to the third month of the Islamic calendar, Rabia al-Awwal. It is a twin festival, comprising “Somo” Damba and “Naa” Damba, which commemorate the birth and naming ceremonies of the Holy Prophet Mohammed (SAW), respectively.

The Bugum festival, on the other hand, is celebrated on the ninth day of the first month of the Dagomba lunar year, the Bugum “goli” (the month of fire). According to Dagomba traditions, the festival’s origin dates to when the Prophet Noah landed his Ark on Mount Ararat. The passengers lit torches to find their way around and to find the son of Prophet Noah, who failed to enter the Ark when it was set out with the believers. The Dagombas claim to be descendants of the Aad, a prehistoric Arabic ethnic group that succeeded Noah and his people.

In anticipation of these festivals, chiefs, elders, family heads, and the local folk keep a watchful eye for the moon of Damba and the arrival of the Bugum festival. It is expected to see people raising their heads towards the sky each evening, eagerly awaiting the moon to shoot up.

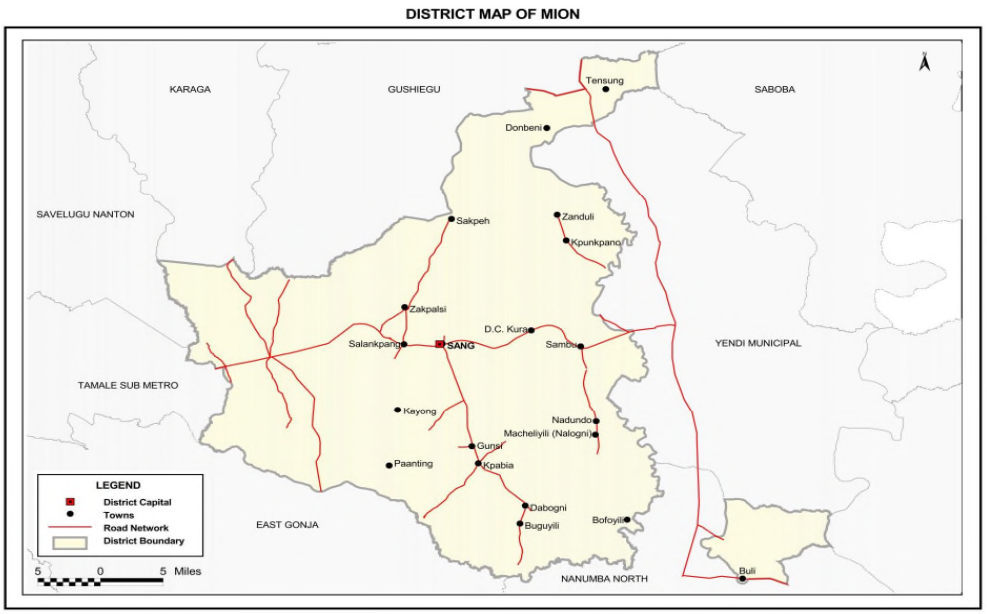

Figure 3.2 Mion District Map

3.3 Study Design

According to Sekaran (2016), a research design serves as a framework or foundation that binds all the study elements together. The present study employed a descriptive cross-sectional design with a mixed-methods approach, which was deemed appropriate given the nature of the research questions and the time constraints. A cross-sectional study is a research design that involves collecting data from multiple individuals at a single point in time, typically within a month or year. In this type of study, variables are observed and described without any manipulation. In conducting this study descriptive cross-sectional study was adopted using mix method. This method was employed due to the time allotted for and the nature of the study. The purpose of cross-sectional designs is to document current conditions, attitudes, or situations related to the topic of interest. Additionally, this design allowed for collecting data from a large sample and comparing differences between groups.

3.4 Study Population

The study population comprised women of reproductive age, husbands of pregnant women, community leaders, and healthcare workers within the designated health facilities in the Mion District. This population was selected for the study because they possessed the characteristics of interest to accurately represent the entire population under study, and to gather data from such population will help address the research problem.

Zikmund et al. (2013) have defined a population as a group of individuals, objects, or entities from which samples are extracted for measurement. Moreover, the population encompasses a system or process of interest, representing the universe of individuals to which the study findings can be applied. Salikind (2012) further characterises population as the entirety of items relevant to a statistics practitioner.

The target population is the complete group of individuals from whom a researcher may gather information to fulfil the research objectives. According to Mugenda and Mugenda (2003), the target population constitutes a comprehensive set of individuals, cases, or objects sharing common observable characteristics.

N	S	N	S	N	S
10	10	220	140	1200	291
15	14	230	144	1300	297
20	19	240	148	1400	302
25	24	250	152	1500	336
30	28	260	155	1600	310
35	32	270	159	1700	313
40	36	280	162	1800	317
45	40	290	165	1900	320
50	44	300	169	2000	322
55	48	320	175	2200	327
60	52	34	181	2400	331
65	56	360	186	2600	335
70	59	380	191	2800	338
75	63	400	196	3000	341
80	63	420	201	3500	346
85	70	440	205	4000	351
90	73	460	210	4500	354
95	76	480	214	5000	357
100	80	500	217	6000	367
110	86	550	226	7000	364
120	92	600	234	8000	367
130	97	650	242	9000	368
140	103	700	248	10000	370
150	108	750	254	15000	375
160	113	800	260	20000	377
170	118	850	265	30000	379
180	123	900	269	40000	380
190	127	950	274	50000	381
200	132	1000	278	75000	382
210	136	1100	285	100000	384

Note – N is population size. S is sample size

A sample represents a segment or subset of the population chosen for research (Bryman, 2012). A sample size refers to a collection of elements from which data is gathered (Cooper & Schindler, 2008). Mugenda & Mugenda (2008) suggest that a sample should encompass 10-30% of the population, with an ideal population sample being at least 10% but not exceeding 30% of the total population. The quantitative study involved 300 women of reproductive age, while the qualitative study included 18 participants.

The study primarily focused on women of reproductive age (WIFA), constituting 45.7% (43,383) of the Mion population. The sample size of 300 WIFA was selected using the Krejcie and Morgan (1970) chart. According to the chart above, a population of 43,383 women of fertile age corresponds to an estimated sample size of 300 as presented in the table below.

3.5 Sampling Technique

For this study, a multi-stage sampling technique was utilized. This involved an initial cluster sampling of the different zones within the district, followed by a purposive sample of communities in each with health facilities capable of providing optimal maternal and child health services. Finally, women in their reproductive age (WIFA) were selected in each community through referral or snowball sampling.

Purposive sampling was utilized to select communities with health facilities in the designated area, followed by cluster sampling to divide the district into north, south, east, and west zones, ensuring the inclusion of communities in the hinterland in the study. Specifically, communities with healthcare access were selected for the study, taking into consideration the district's geographical orientation. The communities chosen for the study

were Sambu, Kpabya, Tijo, and Tengsung, representing the east, south, west, and north, respectively. Simple random sampling was employed to select women of reproductive age for the interviews in the selected communities for the study.

3.5.1 Purposive Sampling

Opinion leaders, maternal healthcare workers, Traditional Birth Attendants (TBAs) and the spouses of pregnant women were deliberately selected for the qualitative component of this study using a purposive sampling technique. In doing this the heads of all the selected health facilities were chosen for the as key informants, some TBAs were also selected. In the same vein, community leaders, community water and sanitation agency staff were also selected for interviews.

Purposive sampling, a non-probability method, was chosen to intentionally select participants based on predetermined criteria and specific research objectives. The rationale for using purposive sampling lies in its effectiveness in targeting individuals with direct experience and knowledge relevant to the investigation's subject matter—access to water and its impact on maternal and child health in the Mion District.

To comprehensively understand the diverse facets of water accessibility and its impact on maternal and child health, this study specifically aimed to engage individuals with expertise and a profound understanding of the local water situation. Including healthcare professionals such as doctors, nurses, and midwives in the sample was deliberate to leverage their professional experiences and observations concerning health issues associated with water access.

In addition, key informants were chosen from community leaders and representatives of non-governmental organizations (NGOs) involved in water and health-related initiatives in the Mion District.

Their in-depth understanding of the local context and their work addressing water challenges and health issues provided valuable insights into the subject. To ensure a thorough investigation of the impact of water accessibility on maternal and child health, efforts were made to include participants from diverse backgrounds. Participants were chosen to represent various demographic categories, such as age, gender, socioeconomic status, and geographical location within the district. This diversity is crucial for capturing a wide range of experiences and perspectives, thereby enhancing the validity and relevance of the study's findings.

Mothers and primary carers play a crucial role in the health and well-being of children, making their perspectives essential for understanding the relationship between water access and maternal and child health. To achieve this, purposive sampling was utilised to select mothers and primary carers of children within the Mion District. This enables an in-depth exploration of their challenges, perceptions, and coping mechanisms regarding water availability and its impact on their family's health. This approach allowed the researcher to attain the required sample size by interviewing every second woman of reproductive age who resided in a household within the selected neighbourhoods throughout the study period. The size of the sample from each community was determined based on their respective population sizes.

The respondents were selected proportionate to the size of the population of the chosen communities for the study, as indicated in Table 3.2.

Table: 3.2 Targeted Population Base on the Size of the Selected Communities

Community Name	Population size	Sample Selected
Tensung	2486	96
Kpabia	2186	52
Sambu	4687	112
Tijo	2106	40
Total	**11,465**	**300**

Field Survey, 2023

The Mion District is made up of four (4) communities, with a cumulative population size of 11, 465. Of this number, a sample size of 332 was used. 300 participants were used to obtained quantitative data, whilst 32 participants were used for obtaining qualitative data. These 32 participants were used to gather the focus group discussion data, the in-depth interviews and the key informant interview.

3.5.3 Procedure for Data Collection

Bhattacharjee (2007) defines data collection as obtaining information to substantiate or illustrate specific facts. According to Sekaran and Bougie (2013), primary data refers to information gathered directly from the respondents. Observation, interviews, and questionnaires are examples of data collection tools used to obtain primary data (Bryman & Bell, 2011). To ensure the confidentiality of responses, each woman was interviewed individually. Before each interview, general information and a statement guaranteeing the confidentiality of the respondent's answers were provided. The interviews ranged from 15

to 30 minutes, depending on the respondent's pace. Responses were recorded on paper questionnaires and transcribed into a Microsoft Excel spreadsheet.

Table 3.3: Sample Size of the Population Groups

Group	Sample size	Data collection tools
Health Staff	4	Key Interview Guide
Opinion Leaders/ TBAs	8	In-depth interview guide
Husbands of Pregnant Women	20	FGD
WoRA	300	Structured Questionnaire
Total	**332**	

Field Survey, 2023

The researcher conducted four (4) focus groups discussions for the study. In each of the four selected communities, a focus group discussion was organised with five (5) participants in each group making twenty participants for the four communities. The participants were mainly women in their reproductive age group. (HoPW) constituting the focus group. A research assistant, with the assistance of the various assembly members in their respective electoral areas organised the participants for the qualitative data collection. The tools were designed in such that the themes were in line with the research questions.

Additionally, the researcher conducted further probing to gain clarity on responses that appeared ambiguous. The interview with the health worker at the CHPS complex in the Buguyili neighbourhood was conducted in solitude. The feedback helped enhance the understanding of issues identified in the earlier interviews.

3.5.4 Sources of Data

Data for this study was sourced from both primary. The primary data was sourced using tools such as the in-depth interview guides, focus group discussion guide, survey questionnaire as well as observation checklist.

3.5.5 Data Collection Tools

Data collection tools are instruments and methodologies used to gather information from various sources in a structured and systematic manner. These tools are essential in research, evaluation, and other data-driven activities to obtain accurate and reliable data. The choice of tool depends on the type of data being collected, the research design, and the objectives of the study. Some common data collection tools include: Surveys and Questionnaires, Interviews, Observations**,** Focus Groups among others.

3.5.5.1 Survey Questionnaire

In all 300 questionnaires were administered to the respondents. The questions were asked in such that the responses to them addressed the research objectives and research question. The respondents for the survey were selected proportionate to the population in their respective populations as indicated in Table 3.2. Meaning the higher the population of the community the higher the sample selected. It was in this vain that the sample for Sambu was higher and the lowest was Kpabia.

3.5.5.2 Focus Group Discussions

Group discussions led by the researcher to gather qualitative data on specific topics. They provide insights into participants' attitudes, perceptions, and experiences. This was also employed in this study to collect information from 32 people as a form of qualitative data to enhance the study.

3.6 Data Analysis and Presentation

The quantitative data was analysed using Microsoft Excel 2016 and the Statistical Package for the Social Sciences (SPSS) version 29.0 for Windows. The results were then simplified and presented in frequency tables to enhance comprehension. Content and narrative analysis were also used to present the qualitative data findings. A chi-square analysis was conducted to establish the association between the key indicators at a confidence level of 95%. A significance level of $p < 0.05$ was deemed statistically significant.

3.7 Ethical Issues

Clearance and approval were obtained from the Ethical Review Committee of the Ghana Health Service to ensure ethical compliance. Verbal consent was also obtained from each participant before conducting the interviews.

3.8 Pre-Testing

The questionnaires underwent a pre-test in the Nantong District, located in the Northern Region, which shares similar characteristics with the communities in the Mion District. This exercise facilitated the identification of any areas of ambiguity in the questionnaires and provided the researcher with an estimate of the time required to administer the questionnaires. After the pre-test, necessary modifications were made to the questionnaires before they were deemed suitable for use in the field.

CHAPTER FOUR

PRESENTATION OF RESULTS

4.0 Introduction

This chapter presents the socio-demographic factors and analysis of the data aligned with the specific research objectives. The data is systematically analysed and discussed to address the research questions and objectives.

4.1 Socio-Demographic Characteristics of Respondents

The socio-demographic data was mainly focused on the reproductive women in the selected communities of the study. The women had an average age of 31 years, with the youngest being 16 years old and the oldest being 42 years old. Out of 300 respondents, 19% were between 11 and 20 years old, 29% were between 21 and 30, 27% were between 31 and 40, and 25% were 41 and older. The highest number of respondents fell within the 21-30 age group, indicating that early marriage is still common in the area. Concerning religion, the population in the area is predominantly Muslim, with 89% of the women being married. Most of the respondents had no formal education, (83%) of the respondents had no formal basic education, 38 respondents (13%) had dropped out of primary school, 11 respondents (4%) had completed JSS/JHS, and the remaining seven respondents (2%) had completed SSS/SHS/TEC. Regarding how long they had resided in these communities, the minimum duration was more than five years.

Table 4.1: Demographic Characteristics of Respondents (n=300)

Variable	Responses	Frequency(n)	Percent (%)
Age/years	11-20	63	21.0
	21-30	100	33.0
	31-40	92	31.0
	41 and above	45	15.0
Religion			
	Islam	265	88.0
	Christianity	30	10.0
	Traditional	5	2.0
Marital status			
	Single	33	11.0
	Married	267	89.0
	Separated	0	0.0
Level of education			
	None	244	83.0
	Primary	38	13.0
	JHS	11	4.0
	Sec/Tec	7	2.1
Occupation			
	Farmer/Fisherman	200	67.0
	Trader	80	27.0
	Others	20	6.0
Stay in community?			
	Since birth	200	67.0
	1-5years	30	10.0
	6-10 years	45	15.0
	11 years above	25	8.0

Source: Field Survey, 2023

This study aimed to examine water accessibility and its effects on maternal and child health. The results below address this objective by analysing the water sources, distances, and time reproductive women especially pregnant women spend to source water for their household needs. Figure 4.1 and Table 4.2 provide a detailed analysis.

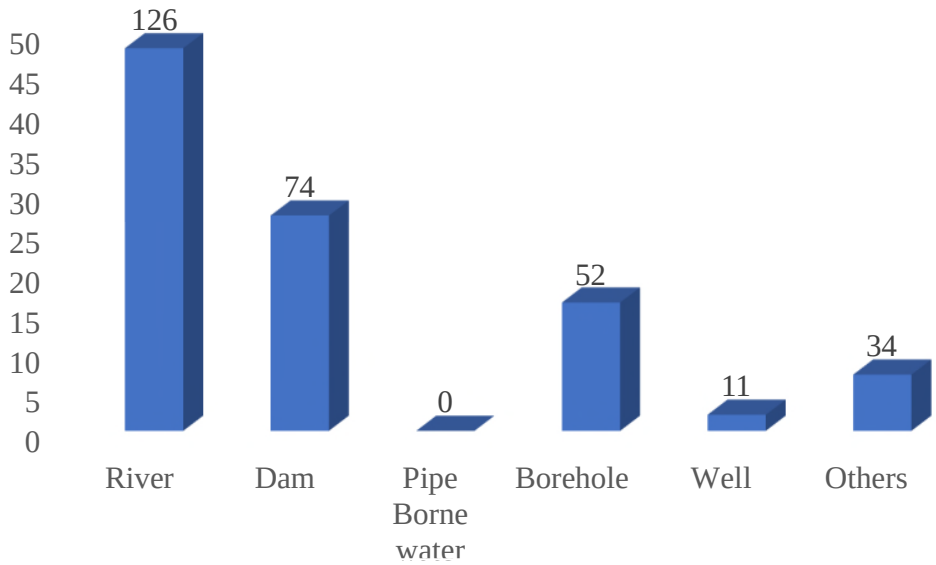

Figure 4.1 Sources of water to the homes in the community

Source: Field Survey, 2023

In a focus group discussion organised for men in the area reported the various water sources which include; rainwater, river, stream and the dam. The focus group discussions revealed that the men's responses were consistent with the women's responses. They reported that, "In this area our major sources of water are rain water during the rainy season, streams and dugouts. We have a number of boreholes but they are white elephants"

In a similar discussion with the midwife of the Tigo health centre she reported as follows: "the borehole is the best for us here but unfortunately it is only during the raining season that we get water from the borehole. Hmm it actually makes health delivery very difficult in this community. All my staff run to Tamale due to lack of clean water in the community".

Some of the participants did not understand the concept of safe-drinking water well, as they identified streams and dams as their water sources and deemed them safe for drinking. According to the WHO ranking, treated water delivered through pipes to the home is the best source of water for drinking and other domestic purposes (WHO, 2022). However, this survey data showed that this option was unavailable in the community. Although 16 women mentioned boreholes as sources of their household water supply, the two focus group discussions did not reflect that. The low access to safe drinking water exposed these pregnant women to the adverse health risks of unsafe water consumption.

The responses from the two focus group discussions confirmed that all the women had to travel some distance to access water in the community. None of the women reported travelling more than 5 kilometres to fetch water. However, 86% of the women spent less than an hour accessing water, and 74% still claimed they spent more than 30 minutes bringing water to their homes. These responses might be influenced by the season when the data was collected. The focus group discussions revealed that the time spent on accessing water varied depending on the availability of rainwater. One respondent said, “This day, because of the rainwater, they do not go far. Less than one hour these days, but can sometimes spend up to two more hours during the dry season”. Another respondent from the husbands’ FGD echoed this sentiment, saying, “Depending on the season, they can spend more than one hour each time they go to fetch the water.” These responses suggested that accessing water during the dry season was more time-consuming. The midwife also agreed with this observation. Fourteen percent of the women even said they spent more than one hour accessing water. This could limit the pregnant woman’s time for other essential self-care activities.

This study aimed to examine the distance pregnant women travel to access water in the area. The results presented below show the data collected to address this objective. The analysis covers the water sources, the distances, and the time pregnant women in the community spend fetching water for their households. Table 4.2 and Figure 4.2 provide a detailed overview of the findings.

Table 4.2 Women Access to Water

Variable	Responses	frequency
Does this community have access to safe drinking water?	YES (%)	108
	NO (%)	192
Do you have to cover a distance to fetch water?	Yes	300
How much distance do you cover to get water?	1-5km	300
	6- 10km	0
How much time do you take to get water to home?	0-30mins	126
	31-60miuns	106
	1 hour more	68

Source: Field Survey, 2023

From table 4.2. it was discovered that almost all the women in the district had to travel to long distance to fetch water for their household needs. Some travel not less than 4km to access water for their household needs and this water was reported not to be pure or portable. As reported by one of the women during a focus group discussion: “We spent more than two hours to travel to and from to access water. The water we even get we compete with cattle for the water. The water is Maddy and not good for human consumption” FGDI

This result resonates well with that of the quantitative study that revealed that most of the women travel long distance to access water. The people reported that the only time they easily

get water is during the rainy season. As reported by an elder in one of the study communities. *"Hmmm! In this village our women travelled long distance to access water. The only time we get water closed to us is during the rainy season. It has even affected our eating pattern. Women will go searching for water from 4pm to 6pm and when they return, they have to start cooking hence some of us eat our dinner at 8 to 9pm. This is not good for our health*". II 1.

For the first objective, most women interviewed were asked about the difficulty of accessing water and its effects on maternal and child health. One woman in a focus group discussion stated, "Yes, water accessibility is difficult, and I think it affects maternal and child health. But we have no choice." Another pregnant woman shared, "It is hard for us pregnant women. Some men help their wives, and others do not." She added, "The woman sitting right by me delivered her baby on her way back from the stream where she went to fetch water. It was just by God's intervention; she would have died in the process."

Regarding gender roles in accessing water for household consumption, it was revealed that women are primarily responsible. 88% of the women stated that it was their responsibility to fetch water for the household, while only 12% indicated that others fetched water for them. None of the women mentioned their husbands assisting them in accessing water. Figure 4.2 illustrates these responses, with the category "Other" comprising caregivers such as the woman's daughter (3), mother (2), sisters (2), other relatives (1), and husband's relatives (2).

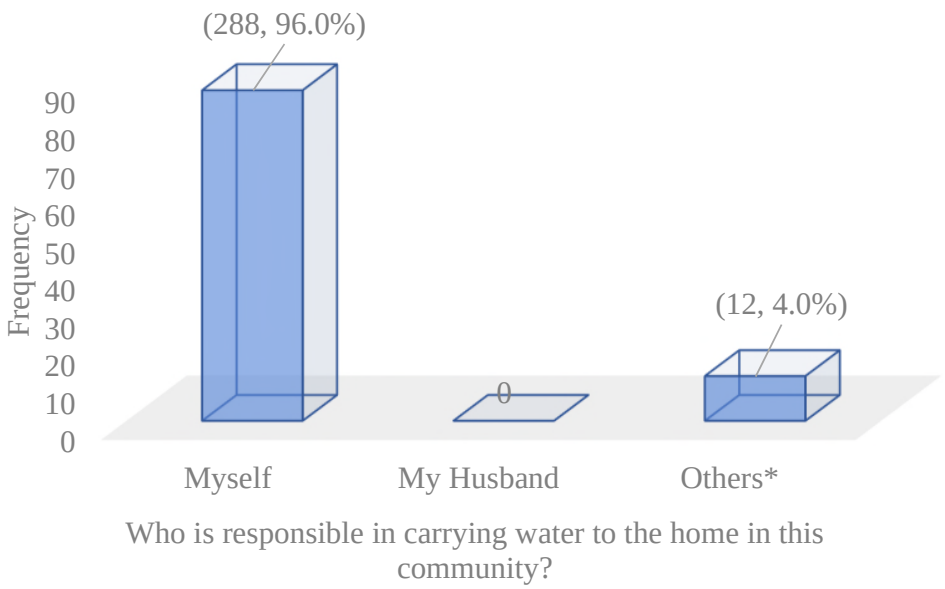

Figure 4.2 person responsible for carrying water home.

The focus group discussion explored the issue of water fetching responsibility for household needs, and the participants reported the following: “Here, it looks like a taboo for a man to fetch water for the wife, even the very day you are to give birth, you have to do your work before birthing.” Source: FGD 4

The focus group discussions revealed that water fetching was “mostly done by women and girls” in the area. The midwife confirmed this, saying, ‘Oh yes. Women and girls are the ones who fetch water in this community. They keep doing it even when they are pregnant.’ In an interaction with some selected pregnant women in a focus group discussion they reported as follows:

Hmmm! My brother, look at my state, I still go to the other village to fetch water for my husband to bath and to use it to cook for the family. “I lost 3 pregnancies due to water

carrying. The doctors advised me not to carry load but if I don't do who will do for me? I don't want people to call me irresponsible woman and my co wife will laugh at me".

Table 4.3: The Role of Husband in Helping Pregnant Women's Access Water

Variable	Responses		
	YES(%)	NO(%)	I don't Know(%)
Are there instances you were exempted from carrying water to the home?	26	252	22
Have you ever been exempted from carrying water during pregnancy?	49	251	0
Does your husband assist you in carrying water to the home when you are pregnant?	0	300	0
Does your husband exempt you from carrying water when you are pregnant?	16	284	0

Source: Field Survey, 2023

The community leaders stated that women receive some help from boys and a few men who use bicycles and motorbikes to fetch water from a large dam in a neighbouring community during the dry season when the local stream dries up due to the harmattan. The husbands' group confessed that they offer little help this season and only occasionally assist their wives.

However, they did not specify how they supported their wives in other seasons. Based on her observations, the midwife said that she was unsure if women get any assistance from their husbands. She added that she mostly saw women and girls carrying water and sometimes boys, but rarely men. They gave conflicting answers when asked if there was a

need to assist the women. The husbands agreed that there was a need, but the leaders disagreed and claimed that some women were lazy and used their pregnancy as an excuse to avoid work. They also said there were no exemptions for women during pregnancy unless they were sick or advised by a nurse or a doctor.

Whose duty it is to get water to the house? Most (88%) of the pregnant women said they were responsible for fetching water to the house. The remaining 12% said they received help from other female relatives, either from their own or their husband's family. The same question elicited different and shocking responses from the male-dominated FGDs. The community leaders said that women and girls mainly did water fetching, while the husbands' group noted that it was the woman's duty. These responses reflect the patriarchal nature of these communities, where gender roles are clearly defined and enforced for both sexes.

Despite the claims of those in charge of fetching water for the house that they receive some assistance from their husbands, the focus group discussions reveal that boys and men only help in severe and prolonged dry seasons when all the nearby water sources dry up. In a focus group discussion conducted with the men (husbands), one of them said the following: "In this (rainy) season, we do not help because there is plenty of water for them, but in the off or dry season, when women must travel long distances to find water, we use our motorbikes and bicycles to help our wives fetch water. We also help the women fetch water for funerals and other festive occasions." The community leaders group also mentioned the involvement of "boys" in such cases. Source: Field Survey, 2023 focus group discussion in Jimi community.

Regarding exemptions from fetching water, the women unanimously indicated that no social norms mandate relieving them of this duty, even when they are pregnant. The brief and straightforward responses from the FGDs corroborated the women's position, as the men seemed reluctant to discuss the issue of exempting women from fetching water during pregnancy. They only acknowledged the need to exempt pregnant women from bringing water if there was a medical reason.

This was reported by one of the participants during a FGD. "I was experiencing complications during my pregnancy, so the doctor issued a report that advised me to avoid carrying heavy loads such as water and firewood. The nurse summoned my husband and warned him that if he let me continue doing such tasks, I would endanger my life. Since then, he has been fetching water and performing various chores for me." They only listen to the advice of a medical officer. These responses align with the midwife's answer to the same question: 'I hardly see men carrying water. In these communities, pregnant women receive minimal or no assistance from men or their spouses in accessing water for domestic use.

The third objective of the study was 'to assess the distance women travel to access water and its health implications for pregnant women.' Regarding this objective, most participants reported that fatigue was a common problem when they had to carry water over long distances. The details of this response are summarised in Figure 4.3**.**

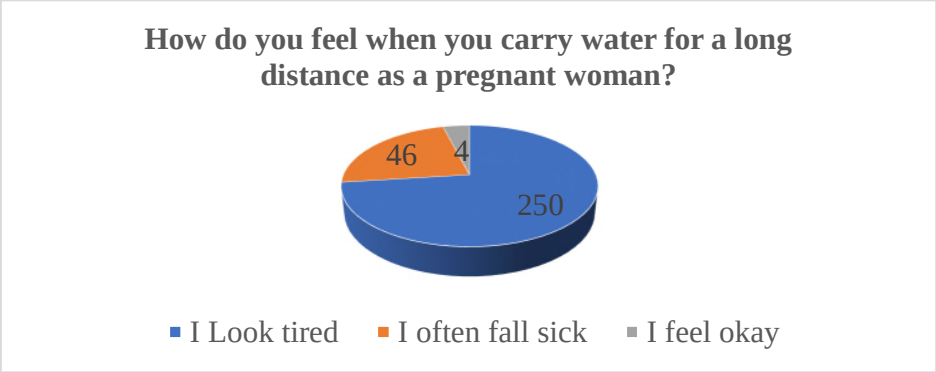

Figure 4.3 Feelings of Pregnant Women for Carrying Water for a Long Distance

Out of 82 respondents, all reported that carrying water for long distances can adversely affect their health and that of their foetuses. However, only a few knew the specific risks involved in this practice.

Table 4.4 Challenges Pregnant Woman May Face Because of Water Access.

Variable Or Question	**Responses**		
	YES(%)	NO(%)	I don't Know (%)
Do you think the distance you cover to carry water can affect you and the unborn child?	282	15	3
Are you aware of the likely consequences	272	18	10
Do you think the comm't water source is safe?	254	25	21
Are there any know diseases in this community that can be attributed to your water source?	239	21	40

Source: Field Survey, 2023

On the quality of water, the community leaders acknowledged that the water quality was very poor and that it becomes 'muddy', but they were unaware of any diseases associated with it. The husbands' group claimed that they had been drinking it for a long time without

any problems. The husbands' group claimed that they had been drinking it for a long time without any problems. However, the midwife identified some of the water-related diseases she frequently treated, such as diarrhoeal diseases and dysentery.

The focus group discussions did not reveal any awareness of the risks posed by unsafe water to pregnant women and their babies. The midwife confirmed in the informant interview those pregnant women also suffered from the same diseases that she had mentioned earlier.

The husbands denied any adverse effects of carrying water but admitted that carrying water for long distances could harm them, although they did not know the exact impact as they were not health workers. The community leaders offered some possible consequences for the second question: 'Carrying water for a very long distance can induce preterm labour. Excessive weight and stress can result in congenital disabilities later.' The midwife cited some complaints that she had received from pregnant women who attributed them to carrying water: 'Some of them come complaining of body pains and back pains. I have cases of pregnant women who have fallen under the weight of the water.'

The focus group discussion indicated that the men concurred with most women regarding the effects of pregnant women carrying water for long distances. The community leaders group proposed two different outcomes: 'Carrying water for a very long distance can lead to premature delivery' and 'Excessive weight and stress can cause birth anomalies later on'. An earlier study reported that pregnant women who were overburdened, especially with weight-bearing activities like carrying water, had lower weight gain for them and their babies than those who had sufficient support and rest (de Silva, M. A., 1992).

4.2 Correlation and Test of Significance.

The objective of the study was 'to examine the effects of water sources and safety on maternal and child health in the area'. The statement that elicited responses from the respondents based on this objective was: The water sources in the community compromise the safety of maternal and child health in the area. Tables 4.5 show the responses of the respondents in the area using five Likert scale 1=Strongly Agree, 2=Agree, 3=Strongly Disagree, 4=Disagree, 5=Uncertain.

Table 4.5 The Impact Water Sources on the Safety of Maternal and Child

Response	Frequency	Percentage
Strongly agreed	267	67
Agreed	25	25
Strongly disagreed	4	4.0
Disagreed	3	3.0
Uncertain	1	1.0
Total	**300**	**100**

Source: Field Survey, 2023

This was an interaction with one of the heads of the health facilities "Hmm!" Water scarcity is a serious issue at this facility. It has a negative impact on my staff. Many are frequently absent from work because they cannot access water. There is a borehole here, but filling a bucket of water takes a long time. "The midwife in this facility left because of the water shortage in the area. This has compromised the quality of delivery services in the area, as the women must bring a gallon of water when they come for delivery.

This was corroborated by the assemblyman for the Kpabya electoral area. In an interview with him, he said, *"My* sister. Water scarcity is a major problem in this community. Health staff are reluctant to work in our facility because of the insufficient or nonexistent water supply. Any health worker who agrees to come will not stay for more than two years. We

cannot blame them because their health is also important. Our women prefer to deliver at home, supervised by a TBA, rather than going to the health facility because they cannot bring water to the facility to assist their delivery."

The Information on the fourth objective was obtained from a key informant interview with the midwife. Her responses are presented below.

Theme 1: Does your facility have access to safe potable water?

'Not exactly, as the only safe water available is from a borehole in the community that is also unreliable.'

Theme 2: What is your facility's source of water?

'During this season, we collect rainwater in this tank (she gestured to a small poly tank at the left corner of the facility). However, when the rainy season ends, we will have to rely on the borehole in town.'

Theme 3: Is the water safe enough for service delivery?

'No, but that is what we have for now.'

Theme 4: Are there instances where you run out of water at your facility for service delivery?

'Oh yes. Normally, during the dry season, when the rains no longer come'.

Theme 5: Are there instances in which you refer cases to other facilities due to the non-availability of water in the facility?

'No, we treat the dam water by filtering it for other uses and reserve the borehole water for delivery and other sensitive clinical use in emergency situations.

How does water availability influence the provision of maternal and child health services in your facility? 'Access to water is challenging here, especially during the dry season. We have to allocate a lot of time to collect water for our own (domestic) and the facility's use.' How does this affect your clients, the patients, in terms of their clinic attendance? It affects the patients' arrival time at the facility, as most of the mothers prefer to complete their household chores, which include fetching water, before coming to the clinic.' 'The community health nurse often comes back from the field late during that period, as they would leave her to look for water. And when she is about to close, they would show up individually, making her stay longer than usual in the communities.'

To assess the distance women, travel to access water and its health implications for pregnant women, a chi-squared test was conducted with the time taken to get water as the independent variable and the outcome indicators of the effect of water carrying on maternal health and the potential impact of the distances covered on maternal and child health as the dependent variables. The results are shown in Table 4.6. The p-values suggest that there is a significant association between the variables. Still, the distances the women cover do not influence their perception of the risk they face by travelling to access water for their health and that of their unborn child.

In an interview with some of the women during a focus group discussion one of the women reported as follows: “I do not go to the health centre for delivery because, if you go there to deliver the nurses will ask you to go and bring water since they don’t have water. Carrying water from my village to the health facility in Sang I decided to use the village Traditional Birth Attendant (TBA)” FGD 4.

Source: Field Survey, 2023

Further testing of water sources and the impact of water safety and fear of water quality on maternal and child health are illustrated in Table 4.7.

How do you feel when you carry water for as a pregnant woman for the following durations?				
		Feel okay	**Look tired**	**Fall sick**
0-30mins	22	3	19	0
31-60mins	64	1	48	15
1hour more	14	0	6	8

Do you think the distance you cover to carry water can affect you and the unborn child?		
Yes	No	I don’t know
13	9	0
54	6	1
12	0	2

Source: Field Survey, 2023

The key informant interview revealed that the only health facility serving the two communities lacks direct access to safe water. She stated that this affects their work as they sometimes must 'treat the dam water by filtering it for other uses'. This additional task could reduce the time they devote to healthcare service delivery. She emphasised that 'access to water is challenging here during the dry season. We spend valuable time collecting water for our own (domestic) and the facility's use'.

Regarding the patients, she said, 'It affects the patients' arrival time at the facility, as most of the mothers prefer to complete their household chores, which include fetching water, before coming to the clinic. 'The community health nurse often comes back from the field late during that period, as they leave her to look for water. And when she is about to close, they would show up individually, making her stay longer than usual in the communities.' Obtaining safe water for quality health service provision is a challenge in this part of the district. This could also affect the services provided for pregnant women and children.

4.3 Perceived effects of access to water on health

The final objective of the study was 'to investigate the access of health facilities to water and its impact on service delivery'. The community's lack of access to water sources adversely affects healthcare service delivery in the area. Tables 4.8 show the responses of the respondents in the area using the Likert scale 1=Strongly Agree (SA), 2=Agree (A), 3=Strongly Disagree (SD), 4=Disagree (D), 5=Uncertain (U).

Table 4.8 Perceived effects of Access to Water Source on Health Care Service Delivery

Response	Frequency	Percentage
Strongly agreed	259	67
Agreed	31	25
Strongly disagreed	3	4.0
Disagreed	5	3.0
Uncertain	2	1.0
Total	**300**	**100**

Source: Field Survey, 2023

CHAPTER FIVE
DISCUSSION OF RESULT

5.1 Demographic Factors

The participants for the study were selected using a purposive sampling method, but they still represented a diverse background. The average age of the pregnant women was 28 years. A high percentage (72%) of these women were Muslims, consistent with the 2021 census findings for the Northern region and Mion district (GSS, 2021). This was also slightly higher than the Muslim population reported in another study with teenagers in the same district (Iddrisu, 2015). Most (90%) of the women were married, which was higher than the national marital status recorded in the recent census. Over 85% of the pregnant women had never been to school, and were noted to be farmers. These were in line with those reported for the district by the last two censuses (GSS, 2010, 2021).

5.2 Empirical Findings

The major finding of the study based on the various objectives are itemised below.

Objective one: To explore water accessibility and its impact on maternal and child health.

The women in the study had to travel some distance to access water. A large proportion (76%) spent over 30 minutes fetching water at home. The main water sources for the communities were rainwater, rivers, streams, and dams, which were all unsafe. The study found that the distance travelled by women of reproductive age to access water in the area severely affected maternal and child health.

Objective two: To determine the role of men in providing water for their wives in the area.

Most (88%) of the women carried their water. The remaining 12% were assisted by other female relatives but not by men or husbands. No husband helped a pregnant woman carry water. The only exceptions for pregnant women were when they were ill or advised by the health workers to avoid carrying water. Moderate exercises have been documented by researchers in different contexts to be beneficial for foetal growth, delivery or labour processes, and overall maternal and child health (Hartmann and Bung, 1999; Baciuk et al., 2008; Wright et al., 2011; and Mota et al., 2015). Extreme stress, such as travelling long distances and carrying heavy weights during pregnancy, has adverse effects on maternal health and pregnancy outcomes (Hartmann and Bung, 1999; Meierhofer et al., 2022).

Regarding how they felt after fetching water, the majority (73%) reported tiredness, while another 23% said they 'felt sick' and only 4% said they 'felt okay'. A high percentage of the interviewed pregnant women believed that carrying water for a long distance could harm the woman and her unborn baby. A lower percentage (37%) said they were aware of some possible consequences of carrying water for a long-distance during pregnancy. The midwife stated that some women complained of bodily and back pains, as mentioned in the literature above. She recounted some incidents of pregnant women falling while carrying water. A systematic review of forty-two studies by Geere et al. (2018) concluded, "Overall, the studies suggest that water carriage is associated with negative aspects of the water carriers' health."

The review identified some of the adverse effects as pain, fatigue, perinatal health problems, violence against vulnerable people, and inconclusive evidence of an association with stress or self-reported mental health and general health status (Geere et al., 2018). A

recent study from the Nepal region of India also reported that "back pain (61%), with about 18% of this pain being horrible to excruciating; pain in the knees (34%); uterine prolapse (11.3%); and at least one spontaneous abortion (9%) was associated with water carrying uphill during pregnancy, not to mention pains in the hips" (Meierhofer et al., 2022).

Most of the women claimed that their water was safe, regarding the safety of the drinking water sources in the community. However, this is doubtful, considering the definition of safe water on the WHO website (2022) and the women's responses shown in Figure 4.1 above. Although only 39% of them were aware of a disease that could be contracted by drinking water from the community water sources, as many as 82% thought that the quality of water they used in the community threatened them and their unborn babies.

Patel et al. (2019) confirmed their fears that unsafe water and unsanitary conditions had adverse effects on pregnancy outcomes. From the FGDs, the community leaders acknowledged the potential risk of using the water in the community, while the husbands' group defended their position that the community water posed no risk with statements such as "We have been drinking it for a long time without any problem" and "That is what we have had over the years."

However, there is documented evidence of using unimproved water sources and their danger to the general population (WHO, 2022), pregnant women, and babies (Giorgia Gon et al., 2014; Patel et al., 2019). In their study, Giorgia Gon et al. (2014) concluded that unimproved water access was a significant risk factor for pregnancy-related mortality in Afghanistan. The midwife's report of 'diarrhoea diseases and dysentery' among pregnant

women indicated that the threat of unsafe water to the health of the mother and unborn child was fundamental in the communities.

Objective three: To assess the distance women travel to access water and its health implications for pregnant women.

Carrying water over long distances made 73% of the women feel tired, and another 23% felt sick. Bodily pains and backaches were common challenges reported by the water carriers. The unsafe water source caused some waterborne diseases, such as diarrhoea and dysentery. This was consistent with the results of Fink et al. (2011), which indicated that access to improved water was associated with a lower risk of diarrhoea (OR = 0.91, 95% CI 0.88–0.94) and a lower risk of mild or severe stunting (OR = 0.92, 95% CI 0.89–0.94). In conclusion, the study showed that the results presented in this article strongly highlighted the enormous health consequences of lacking access to water and sanitation for children aged <5 years in low- and middle-income countries.

Objective four: To examine health facilities access to water and how that influences service delivery. The difficulty of accessing water for the health facility hinders health service delivery, as health workers spend much time searching for water. It also raises operational costs, as they must treat their water before using it. Moreover, it adversely affects women's time management for attending health facilities for antenatal and postnatal services.

CHAPTER SIX

SUMMARY, CONCLUSION AND RECOMMENDATION.

6.0 Introduction

This chapter summarises the main findings of the study. It proposes some key recommendations that, if implemented, will enhance maternal and child health delivery in the area and beyond. This will also improve the overall health of the population in the area, because water is a crucial element in the health delivery system and poverty reduction.

6.1 Summary

The women in the study had to travel some distance to access water. A large proportion (76%) spent over 30 minutes fetching water at home. The main water sources for the communities were rainwater, rivers, streams, and dams, which were all unsafe. The study found that the distance travelled by women of reproductive age to access water in the area severely affected maternal and child health.

Most (88%) of the women carried their water. The remaining 12% were assisted by other female relatives but not by men or husbands. No husband helped a pregnant woman carry water. The only exceptions for pregnant women were when they were ill or advised by the health workers to avoid carrying water.

. for Carrying water over long distances made 73% of the women feel tired, and another 23% felt sick. Bodily pains and backaches were common challenges reported by the water carriers. The unsafe water source caused some waterborne diseases, such as diarrhoea and dysentery. In conclusion, the study showed that the results presented in this article strongly

highlighted the enormous health consequences of lacking access to water and sanitation for children aged <5 years in low- and middle-income countries.

ced to fetch water over long distances, affecting their health and leading many to opt for traditional birth attendants over skilled deliveries at health facilities. The water obtained was often unsafe, exacerbating the health risks for women and children.

6.2 Conclusion

In conclusion, this study highlights the severe and multifaceted challenges posed by inadequate water access in the communities examined. None of the communities had access to potable water, placing an immense burden on women who were solely responsible for fetching water, often without any assistance from men. The lack of water in health facilities further compromised maternal and child health services, forcing expectant mothers to carry water to health centers, which deterred many from seeking skilled care. Consequently, water shortages led to a preference for traditional birth attendants and contributed to a decline in skilled deliveries. Additionally, the scarcity of water discouraged health professionals from working in these areas, exacerbating the already dire situation. Ultimately, this study underscores the urgent need for sustainable solutions to improve water access, thereby enhancing the health and well-being of women, children, and the broader community.

6.3 Recommendations

The study made the following recommendation after the study;

- The district assembly should Improve water infrastructure by establishing safe and reliable water sources closer to communities. This would reduce the health risks associated with long water collection journeys and alleviate the burden on women.

- Promote gender equity by encouraging male family members to share the responsibility of water fetching. Community engagement initiatives should address the predominant role of women in water collection to support their well-being and ensure healthy pregnancies.
- The assembly, Ghana health service should provide resources and support to health facilities to ensure a consistent and reliable water supply, enhancing health service delivery and minimizing operational disruptions.
- Develop and implement awareness campaigns to educate pregnant women and communities about the risks of carrying water over long distances during pregnancy. Emphasize the benefits of moderate exercise and the potential health risks associated with heavy physical activity, with the help of the commission of civil education.

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