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Examining the Effectiveness of the Mpulungu Water Supply and Sanitation Project on Household Health Outcomes among Rural Residents: A Case Study of Mupata Village

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Abstract

This study examines the effectiveness of the Mpulungu water supply and sanitation project (MWSSP) on household health outcomes in Mupata village, Northern Province. The objectives were to assess the impact of improved water infrastructure on reducing waterborne diseases, evaluate how sanitation interventions influence hygiene practices and overall health, and determine the relationship between access to clean water and the frequency of health facility visits related to sanitation -linked illnesses. A mixed method design integrated qualitative and quantitative interviews, focus group discussions, and observations. Quantitative data, collected from 100 randomly selected households, measured water access, sanitation facilities, hygiene behaviors, and health outcomes using a quasi-experimental pre and post- intervention approach. Qualitative data captured community perceptions and contextual factors. Additional information was drawn from clinic records and project reports. Data were analyzed using stata, jamovi, and NVivo12, employing descriptive statistics, correlation, logistic regression, and thematic analysis, with triangulation enhancing validity. Results showed that 46% of households accessed improved water sources, while 54% relied on unimproved sources. Hygiene practices were strongly associated with water access ($p=0.8829$, $p<0.001$). Socioeconomic status ($B=0.900$, $p<0.001$) and education ($B=0.102$, $p=0.002$) significantly predicted health outcomes, whereas sanitation factors were not significant after controls. qualitative findings indicated reduced waterborne diseases, improved cleanliness, and increased convenience due to sanitation facilities. The integration of water and sanitation interventions produced synergistic improvements in hygiene and health. The study recommends expanding improved water sources, strengthening sanitation infrastructure, enhancing hygiene education, supporting low-income households, and sustaining integrated WASH interventions through continuous community engagement and monitoring.

Keywords: Health, Sanitation, Hygiene, Water and Waterborne Diseases

1. Introduction

1.1 Overview

This chapter provides an overview of the background information related to access to safe water and sanitation, emphasizing their importance for health, development, and human dignity, particularly in rural areas like Mupata Village in Mpulungu District, Zambia. It highlights the global and national recognition of water and sanitation as human rights and discusses key indicators such as access to reliable drinking water and adequate sanitation facilities. The chapter also introduces the research focus on evaluating the effectiveness of the Mpulungu Water Supply and Sanitation Project in improving household health outcomes. Additionally, it outlines the research problem, objectives, questions, theoretical framework, significance, scope, and operational definitions relevant to the study.

1.2 Background

Access to safe water and adequate sanitation is fundamental to human health, dignity, and sustainable development. Globally, the importance of water and sanitation was reaffirmed through the adoption of the United Nations' Sustainable Development

Goal (SDG) 6 in 2015, which seeks to "ensure availability and sustainable management of water and sanitation for all" by 2030. Despite global commitments, significant disparities persist. According to WHO/UNICEF (2021), approximately 2 billion people lacked access to safely managed drinking water, while 3.6 billion people lacked access to safely managed sanitation services. Poor water, sanitation, and hygiene (WASH) conditions are linked to preventable diseases such as diarrhea, which alone accounts for over 800,000 child deaths annually.

In response to these global challenges, numerous countries prioritized community-based solutions, capacity building, and sustainable infrastructure. Innovations such as solar-powered boreholes, low-cost sanitation technologies, and portable water quality testing kits have been widely adopted, especially in underserved rural areas. These efforts have been supported through increased international financing and technical assistance, particularly by organizations such as the World Bank, UNICEF, and the African Development Bank (AfDB) (Leila Harris, 2016; WHO/UNICEF, 2021).

At the regional level, Sub-Saharan Africa remains one of the most water-stressed regions, characterized by sharp urban-rural disparities. Between 2015 and 2020, only 27% of the region's population had access to safely managed sanitation (WHO/UNICEF, 2021). Regional frameworks such as the Africa Water Vision 2025, developed by the African Ministers' Council on Water (AMCOW), promoted integrated water resource management (IWRM), gender equity, and cross-border cooperation. Some countries, including Rwanda, Ethiopia, and Senegal, made commendable progress through decentralized water governance, public-private partnerships, and increased investment in rural infrastructure (AfDB, 2022).

In Zambia, the issue of safe water and sanitation has remained a persistent public health concern. According to the Zambia Demographic and Health Survey (ZDHS) 2018, 67% of Zambians had access to basic drinking water, while only 31% had access to basic sanitation. These figures are notably lower in rural areas such as Mpulungu District, where geographic and infrastructural challenges further hinder access.

To address these disparities, the Zambian government implemented several national initiatives within the 2015–2025 periods. Key among these were the National Urban and Rural Water Supply and Sanitation Programs, which were designed to improve service delivery and infrastructure, especially in marginalized rural communities (NWASCO, 2023). Additionally, Zambia strengthened its policy and institutional frameworks, including the revision of the National Water Policy (2010) and enforcement of the Water Supply and Sanitation Act (1997) to prioritize inclusive service provision.

In 2015, the government, in collaboration with international development partners, launched the Mpulungu Water Supply and Sanitation Project (MWSSP), a ten-year initiative aimed at addressing chronic water and sanitation challenges in Mpulungu District (Council, 2021– 2023). This project included the rehabilitation of existing infrastructure, construction of new water systems, promotion of hygiene education, and capacity building for local service providers. It aligned with broader national goals and international WASH strategies and contributed to efforts to decentralize water service provision through commercial utilities such as Chambeshi Water and Sewerage Company.

Despite these efforts, significant challenges persist. Limited financing, climate variability, and weak local governance continue to impede progress. Nonetheless, the MWSSP provides a critical case study for examining how community participation and local engagement can contribute to sustainable WASH outcomes in rural Zambia.

1.3 Statement of the Problem

Mpulungu District in Northern Zambia continues to face significant challenges in accessing clean water and adequate sanitation, despite its geographical advantage of being located along the shores of Lake Tanganyika. According to the 2018 survey, only 49% of rural households in the district had access to basic drinking water services, with even fewer benefiting from improved sanitation facilities. Open defecation and the use of unsafe pit latrines remain common practices, contributing to recurring outbreaks of waterborne diseases such as cholera and diarrhea (UNICEF Zambia, 2020).

Poor Water, Sanitation, and Hygiene (WASH) conditions have severe public health implications. The World Health Organization (2021) identifies inadequate WASH as a leading cause of under-five mortality in rural Africa, a trend reflected in Mpulungu's health indicators. Further compounding the situation are seasonal water shortages, low levels of hygiene awareness, and weak institutional capacity at the district level (World Bank, 2017).

Efforts to address these challenges include the Mpulungu Water Supply and Sanitation Project (MWSSP), which was introduced to improve access to safe water and sanitation and to reduce related health risks. However, the project has faced numerous implementation hurdles, including limited financing, maintenance problems, and resistance to behavior change. The African Development Bank (2016) highlights that insufficient community engagement and inadequate water infrastructure has historically hindered the success of similar initiatives in Northern Zambia.

Given these persistent issues, there is a pressing need to assess the effectiveness, sustainability, and overall impact of the MWSSP. Such an evaluation is essential to determine whether the project has met its objectives, improved the living standards of rural residents, and contributed to long-term public health and development goals in Mpulungu District.

1.4 General Objective

The general objective is to examine the effectiveness of the Mpulungu Water Supply and Sanitation Project on household health outcomes in Mupata Village.

1.4.1 Specific Objectives

1. To assess the effectiveness of improved water supply infrastructure on the reduction of waterborne diseases among households in Mupata village.
2. To examine the influence of sanitation interventions on hygiene practices and overall household health in the target community.
3. To evaluate the relationship between access to clean water and frequency of health facility visits due to sanitation-related illness in Mupata village.

1.5 Research Question

1. How effective is the improved water supply infrastructure in reducing the prevalence of waterborne diseases among households in Mupata village?
2. How have sanitation interventions influenced hygiene practices and the overall health of households in the target community?
3. What is the relationship between access to clean water and the frequency of health facility visits due to sanitation-related illnesses in Mupata village?

1.6 Theoretical Framework

This study is guided by the Health Belief Model (HBM), a psychological theory developed in the 1950s by Godfrey Hochbaum, Irwin Rosenstock, and Stephen Kegeles. The HBM was designed to explain and predict health-related behaviors by examining individuals' attitudes and beliefs (A., 2021). The model proposes that a person's decision to engage in health promoting behavior is influenced by their perception of susceptibility to a health problem, the severity of the potential consequences, the perceived benefits of taking preventive measures, and the perceived barriers to acting.

In the context of the Mpulungu Water Supply and Sanitation Project (MWSSP), the HBM offers a valuable lens through which to understand how households in Mupata Village perceive and respond to improved water and sanitation interventions (Barley E., 2016). The model helps explain the behavioral changes that may arise as a result of enhanced water infrastructure and sanitation services.

The application of the HBM aligns with the first objective of this study, which seeks to assess how effective improved water supply infrastructure is in reducing waterborne diseases. If community members perceive themselves at risk of such diseases and believe that the new infrastructure can mitigate this risk, they are more likely to adopt healthy water-use behaviors.

Similarly, the model supports the second objective, which examines the influence of sanitation interventions on hygiene practices and household health. The HBM posits that when individuals believe that good hygiene practices are beneficial and accessible, they are more inclined to practice them consistently.

Lastly, the third objective which explores the relationship between access to clean water and the frequency of health facility visits due to sanitation-related illnesses is also illuminated by the HBM. Households that recognize the health advantages of clean water access may perceive a lower risk of illness, potentially resulting in fewer visits to health facilities. Furthermore, sustained access and understanding of the benefits of clean water and sanitation can reinforce long-term behavior change and improved health outcomes.

In summary, the Health Belief Model not only provides a theoretical foundation for this study but also serves as a critical tool for interpreting how individual perceptions influence the uptake and effectiveness of water and sanitation interventions in Mupata Village.

1.7 Significance of the Study

The Mpulungu Water Supply and Sanitation Project (MWSSP) represents a critical intervention in improving access to clean water and sanitation services in Mupata Village and surrounding communities. This study aims to evaluate the effectiveness of the project, particularly its impact on household health outcomes, sanitation practices, and access to safe water. The significance of this research lies in its potential to generate actionable insights for diverse stakeholders and contribute to sustainable development goals (SDGs), especially SDG 6: Clean Water and Sanitation.

For policy makers, the findings of this study will serve as an evidence-based tool to assess the actual effectiveness of large-scale water and sanitation projects at the grassroots level. It will provide crucial data on the reduction of waterborne diseases, changes in sanitation behavior, and community uptake of improved infrastructure. This can inform future policy design, budget allocation, and the prioritization of rural water supply projects. Furthermore, by highlighting community needs and gaps, the study may guide the development of more inclusive, responsive, and sustainable water and sanitation policies at the district, provincial, and national levels.

For scholars and academic institutions, this study adds to the body of knowledge on the intersection of water, sanitation, and public health. It provides a localized case study of how infrastructure development influences household behavior, gender roles in water collection, and disease prevalence. The study's insights can be integrated into academic curricula in disciplines such as environmental health, development studies, public administration, and social policy. It may also inspire further academic inquiry and student research, thus enhancing scholarly engagement with real-world development challenges.

The justification for the study's impact on these demographics lies in its methodological rigor, relevance to public health and development goals, and potential to inform practice. Policy makers require localized, up-to-date data to make sound decisions, researchers seek comprehensive, data-rich case studies to ground their analyses; and scholars depend on real world research to bridge the gap between theory and practice. By responding to these needs, the study becomes a valuable asset not only for the community under study but also for the wider ecosystem of governance, research, and education.

1.8 Scope of the Study

This study focuses on examining the effectiveness of the Mpulungu Water Supply and Sanitation Project on household health outcomes, using Mupata Village in Mpulungu District, Northern Province, as a case study. The geographical scope is limited to Mupata Village to allow for an in-depth and context-specific analysis of how access to improved water and sanitation services has influenced the health of rural households. The study will specifically assess the changes in the prevalence of waterborne diseases, hygiene practices, and overall community health following the implementation of the project. It will cover both qualitative and quantitative aspects of household health, including access to safe drinking water, availability and usage of sanitation facilities, and knowledge and practices related to hygiene. The time frame under consideration will include both the period before and after the implementation of the water and sanitation project to help determine the extent of its impact. The study will involve community members, local health workers, and project implementers to gather comprehensive data. This scope does not extend to other villages or districts, and it will not evaluate the

technical design or financial management aspects of the project. Instead, it remains focused on the health-related outcomes directly experienced by the residents of Mupata Village.

1.9 Operational Definitions of Concepts

Effectiveness: Refers to the extent to which the Mpulungu Water Supply and Sanitation Project has achieved its intended outcomes, particularly in improving access to clean water, enhancing sanitation practices, and reducing the incidence of water-related diseases among rural households.

Water Supply: This involves the provision and availability of safe, clean, and sufficient water for domestic use, including drinking, cooking, and hygiene. In this study, it specifically relates to the systems and infrastructure provided by the Mpulungu project.

Sanitation: Refers to the provision and use of facilities and services for the safe disposal of human urine and feces. It also includes hygiene promotion and waste management. Effective sanitation is essential for preventing the spread of disease.

Sanitation Project: A structured intervention or initiative aimed at improving sanitation infrastructure, services, and behavior change in a community. In this context, it refers to the sanitation components implemented under the Mpulungu project.

2. Literature Review

2.1 Overview

This chapter reviews relevant literature on the effectiveness of water supply and sanitation projects on household health outcomes, structured around the three objectives of the study. It examines global, regional, and Zambian perspectives. However, Access to clean water and improved sanitation is fundamental to public health, particularly in rural communities where waterborne diseases remain a leading cause of morbidity and mortality. Globally, inadequate water supply and poor sanitation contribute significantly to the burden of disease, affecting millions of people, especially in low- and middle-income countries (WHO, 2019). The Mpulungu Water Supply and Sanitation Project aims to address these challenges in Mupata village by improving water infrastructure and sanitation facilities, thereby enhancing household health outcomes.

Access to safe water and adequate sanitation is a basic human right. While progress has been made towards the achievement of the Sustainable Development Goal on water and sanitation (SDG 6), the trends and current status of access to water and sanitation provide cause for concern. There is an urgent need to devise solutions that accelerate progress and ensure that no one is left behind. Nearly every other Sustainable Development Goal relies in some way on the achievement of SDG 6. Together with good hygiene practices, for instance, it is essential for the achievement of good health and well-being (SDG 3) and gender equality (SDG 5) as well eliminating poverty (SDG 1) and reducing inequalities (SDG 10). As a determinant of success in areas including agriculture, energy, and disaster resilience, it has vast and consistently underestimated socio-economic impacts. Whilst factors including better policies and governance, increased funding, improved infrastructure, and increased data availability for better decision-making are central to resolving water and sanitation issues, there is no doubt that Science, Technology, and Innovation (STI) can play a particularly significant role. Responses to the COVID-19 pandemic demonstrated the vital role of STI in delivering solutions to critical challenges. Countries are now more attentive to the development and deployment of new technologies and processes. New applications of existing technology and techniques have great potential to increase the efficiency of existing water and sanitation systems and to secure water and sanitation for all. STI for water has thus played a central role in discussion at recent international water policy events.1 It will be a key focus in the upcoming 2023 UN Water Conference and the 2022 International Water Association Congress in Copenhagen.

2.2 Effectiveness of Improved Water Supply Infrastructure in Reducing Waterborne Diseases among households

Inoue and Ogasawara (2018) conducted an analysis using city-level mortality data from 1922 to 1940 in Japan. Their study found that a decline in typhoid deaths by one per 1,000 people corresponded to a decrease in deaths from non-waterborne diseases (e.g., tuberculosis, pneumonia) by 0.742–2.942 per 1,000 people. This suggests a chain effect, known as the "Mills–Reincke phenomenon," where improvements in water supply indirectly reduced overall mortality. The authors emphasized the importance of water supply improvements not only for direct disease prevention but also for broader public health benefits. Their findings align with historical data showing that water supply improvements led to significant public health gains in early 20th-century Japan.

The Ministry of Health, Labour and Welfare (2006) documented a significant decrease in waterborne diseases such as cholera, dysentery, typhoid, and paratyphoid following the introduction of disinfection practices mandated by the Waterworks Act of 1957. By 2006, piped water supply coverage exceeded 97%, with a marked reduction in disease incidence. The Ministry advocated for the continued implementation of disinfection practices and maintenance of high-quality water supply systems to sustain public health improvements. These findings are consistent with global studies indicating that chlorination and improved water supply infrastructure are effective in reducing waterborne diseases.

Miyoshi (2022) reviewed health hazards related to drinking water quality, identifying pathogens such as enteric viruses and protozoan parasites (e.g., Cryptosporidium and Giardia) as significant concerns. Despite stringent regulations, challenges remain in pathogen control, especially in small-sized water supply facilities facing declining populations. Miyoshi recommended enhanced pathogen control measures and regular monitoring to ensure water safety. This supports international studies highlighting the need for continuous monitoring and improvement of water supply systems to prevent waterborne diseases.

Beach (2021) conducted a historical analysis of investments in water and sewer infrastructure across major U.S. cities from 1880 to 1930. The study found that the introduction of treated piped water and sewer systems significantly reduced waterborne diseases such as cholera and typhoid. Beach recommended continued investment in water infrastructure to sustain public health gains, and these findings align with other historical studies showing that infrastructure improvements were central to the decline in infectious disease mortality in urban areas.

Research in Mpulungu district has shown that sanitation interventions have led to increased latrine ownership and improved handwashing practices among households (Phiri *et al*., 2022). However, challenges such as latrine maintenance, water availability for hygiene, and behavioral adherence persist, affecting overall health outcomes. Studies in Mpulungu, a lakeside district in northern Zambia, have highlighted the critical role of sanitation interventions in shaping hygiene practices and improving household health outcomes. Chibwe (2020) conducted a survey in Mpulungu Township to assess the impact of community sanitation programs on household hygiene. The study found that households with access to improved sanitation facilities, such as ventilated improved pit latrines, demonstrated significantly better hygiene practices, including regular handwashing with soap and proper waste disposal. These households also reported lower incidences of diarrheal diseases, suggesting that sanitation infrastructure directly contributes to improved health outcomes. Chibwe recommended that sanitation interventions be paired with continuous hygiene education and community engagement to sustain behavioral change.

In addition, Mwale (2022) examined rural villages surrounding Mpulungu town to explore barriers to effective sanitation. The study found that while latrine construction programs increased access to improved sanitation facilities, economic constraints, low awareness, and traditional beliefs limited their consistent use. Households that combined infrastructure access with hygiene education experienced lower rates of diarrhea and other water-related illnesses. Mwale recommended integrating sanitation interventions with targeted health education campaigns, particularly in remote lakeside communities where access to safe water remains limited.

The District Health Office of Mpulungu (2023) reported that ongoing sanitation and hygiene programs, including community latrine construction and promotion of handwashing, have contributed to reductions in cholera and diarrheal outbreaks over the past five years. The report noted that improved sanitation facilities alone were not sufficient; the effectiveness of these interventions depended on regular use, proper maintenance, and behavioural reinforcement through hygiene education and public awareness campaigns. The report emphasized the need for a holistic approach combining infrastructure, education, and monitoring to sustain improvements in household health.

2.3 The Influence of Sanitation Interventions on Hygiene Practices and Household Health in Lusaka, Zambia

Lusaka, the capital city of Zambia, faces significant challenges related to water, sanitation, and hygiene, particularly in densely populated urban and peri-urban settlements. Rapid urbanization has placed immense pressure on existing sanitation infrastructure, resulting in overcrowded and often inadequate facilities. Studies conducted in Lusaka indicate that improved sanitation interventions, when combined with hygiene promotion, play a crucial role in reducing waterborne and sanitation-related diseases and in improving household health outcomes.

Hubbard (2020) conducted a study in Lusaka's peri-urban settlements, examining the effect of sanitation interventions on hygiene practices and the prevalence of waterborne diseases. The study revealed that households with access to improved sanitation facilities, such as ventilated improved pit latrines and borehole water systems, reported significantly better hygiene practices, including regular handwashing, proper waste disposal, and safe water storage. These households also experienced lower incidences of diarrhea and other waterborne illnesses, suggesting that sanitation infrastructure directly contributes to improved health outcomes. Hubbard emphasized that combining infrastructure improvements with hygiene education campaigns enhances the effectiveness and sustainability of these interventions.

Similarly, Gething (2023) analyzed the impact of targeted water and sanitation programs in Lusaka on cholera incidence. The study demonstrated that increasing access to piped water and improving sanitation in high-risk wards led to nearly a 50% reduction in cholera outbreaks. The research highlighted that households receiving both improved water and sanitation services exhibited fewer episodes of gastrointestinal illnesses, leading to reduced frequency of visits to health facilities. The study recommended prioritizing high-risk communities for infrastructure development while reinforcing hygiene education to maximize public health benefits.

Phiri *et al*. (2021) evaluated school- and community-based sanitation programs in Lusaka, focusing on behavior change in households. The study found that children who participated in school hygiene education programs acted as change agents within their families, promoting safe hygiene practices such as handwashing with soap, use of improved latrines, and safe water handling. Households with children engaged in these programs demonstrated lower incidences of diarrhea and fewer health facility visits due to sanitation-related illnesses. The study emphasized the multiplier effect of integrating education with sanitation infrastructure improvements.

Despite these successes, challenges remain in Lusaka's urban and peri-urban areas. Smiley (2025) noted that informal settlements often face limited space for household latrines, inadequate drainage systems, and intermittent water supply, which compromises hygiene practices even when sanitation facilities are present. The study reported that households in these areas frequently experience waterborne diseases due to contaminated or unreliable water sources, highlighting the need for context-specific interventions. It was recommended that urban planning integrate sanitation infrastructure with reliable water supply systems to mitigate health risks.

The Lusaka Water Supply, Sanitation, and Drainage Project, evaluated by the Millennium Challenge Corporation (2021), provided additional evidence on the relationship between sanitation interventions and health outcomes. The project expanded access to piped water and improved sanitation facilities, particularly in low-income neighborhoods. Evaluations showed that households benefiting from the project experienced fewer diarrheal diseases and a reduction in visits to health facilities for sanitation-related illnesses. The project also emphasized community involvement in maintaining sanitation infrastructure, which improved adoption and sustainability of hygiene practices.

Furthermore, research by Mutono (2021) highlighted socio-economic disparities in Lusaka that influence hygiene behavior and access to sanitation. Wealthier households were more likely to have private latrines and piped water connections, whereas low-income households relied on shared or unimproved facilities, resulting in higher rates of

sanitation-related illnesses. The study recommended policies and programs that focus on equitable access to sanitation and hygiene resources, particularly for marginalized urban populations.

Overall, evidence from Lusaka demonstrates that sanitation interventions significantly influence household hygiene practices and health outcomes. Households with improved sanitation facilities, reliable water supply, and hygiene education experience fewer sanitation related illnesses and reduced frequency of health facility visits. The literature underscores that infrastructure alone is insufficient; sustainable improvements in household health require an integrated approach combining physical facilities, behavioral change strategies, and community engagement. Lusaka's experience highlights the importance of targeting high-risk urban populations and ensuring reliable water supply and waste management to maximize the public health impact of sanitation interventions.

In conclusion, the evidence from the Copperbelt Province demonstrates a clear relationship between sanitation interventions, hygiene practices, and household health outcomes. Access to improved latrines, reliable water sources, and hygiene education significantly reduces the prevalence of waterborne diseases and the frequency of health facility visits. Addressing socioeconomic disparities, gender-related challenges, environmental vulnerabilities, and infrastructure maintenance is critical to sustaining these health gains. The Copperbelt experience underscores that effective sanitation interventions must be comprehensive, integrating infrastructure, community engagement, education, and environmental management to maximize health outcomes and reduce the burden on health services.

2.4 Relationship between Access to Clean Water and Frequency of Health Facility Visits Due to Sanitation-Related Illnesses

A growing body of evidence links access to clean water with reduced health facility burden. Globally, communities with improved water services report lower outpatient visits for diarrheal diseases. For example, research in Peru indicated that improved household water treatment and safe storage led to a 47% decline in clinic visits for gastrointestinal illnesses (Boisson *et al*., 2013).

Additionally, a study conducted in rural India showed that villages with consistent piped water supply had 32% fewer health facility visits for water-related illnesses (Arnold & Colford, 2007). These findings support the claim that improved water access can alleviate strain on local health systems.

Health-seeking behavior is often shaped by the burden of disease and access to clean water. Globally, studies demonstrate that improved water supply correlates with reduced clinic visits related to waterborne and sanitation-linked illnesses. A longitudinal study in Bangladesh (Saha, 2021) showed a 40% reduction in health center visits for diarrheal complaints following the introduction of a piped water system.

Access to clean water is closely linked to reduced healthcare utilization for waterborne and sanitation-related illnesses. Studies globally have demonstrated that improved water and sanitation reduce the incidence of diseases that require medical attention, thereby decreasing the burden on health facilities (Bartram & Cairncross, 2010).

Beside this, limited access to clean water often results in frequent health facility visits for preventable diseases. Research in Tanzania showed that communities with improved water supply experienced a 30% reduction in outpatient visits for diarrhea and related illnesses (Mushi *et al*., 2018). Similarly, in Uganda, improved water access correlated with decreased hospital admissions for cholera outbreaks (Kizza *et al*., 2019).

However, barriers such as distance to health facilities, healthcare costs, and cultural factors influence care-seeking behavior, complicating the relationship between water access and health service utilization (Mbonye *et al*., 2013).

Access to clean water and adequate sanitation is a critical determinant of public health worldwide, and Malawi is no exception. In Malawi, limited access to improved water sources and sanitation facilities has been linked to high incidences of waterborne and sanitation-related illnesses, particularly diarrheal diseases, cholera, and typhoid. These illnesses frequently lead to increased visits to health facilities, placing a significant burden on the country's already constrained healthcare system. Several studies have examined this relationship, demonstrating that households with reliable access to clean water experience fewer episodes of sanitation-related diseases, resulting in reduced frequency of health facility visits.

Government and non-governmental interventions have focused on improving access to clean water and sanitation to reduce disease burden. The Malawi Government, through the Ministry of Water and Sanitation, has implemented several programs aimed at expanding piped water coverage and constructing protected wells and boreholes in underserved areas. Evaluations of these programs by the World Bank (2019) and UNICEF (2020) indicate that communities with newly installed water points showed a measurable decline in diarrheal disease prevalence and fewer outpatient visits for sanitation-related illnesses. Additionally, the inclusion of hygiene education campaigns enhanced the effectiveness of these interventions, suggesting that infrastructure improvements must be complemented by behavior change initiatives.

Several studies have also highlighted the importance of community engagement in water and sanitation interventions. Programs employing community-led total sanitation (CLTS) approaches, which mobilize households to construct and use latrines while improving hygiene practices, have been effective in reducing diarrhea and other waterborne diseases. Research by Phiri *et al*. (2020) in southern Malawi revealed that households participating in CLTS programs reported fewer health facility visits for sanitation-related illnesses than non-participating households. This underscores the role of combining infrastructure with education and social mobilization to achieve sustainable health outcomes.

Environmental factors, including seasonal variations, influence the incidence of waterborne diseases and healthcare utilization. During the rainy season, contamination of surface water sources increases, leading to spikes in diarrheal illnesses and a corresponding rise in health facility visits. Conversely, during the dry season, water scarcity can lead households to use distant or unsafe sources, again increasing disease risk. Studies by Mvula (2021) highlighted the need for resilient water supply systems capable of maintaining clean water access

throughout seasonal fluctuations, thereby reducing disease prevalence and the associated demand for healthcare services.

The relationship between water access and health facility visits is further complicated by the quality and reliability of water sources. Even households with piped connections may experience intermittent supply or poor water quality, which can result in continued exposure to waterborne pathogens. Research by Chikowa (2019) demonstrated that households receiving continuous, treated piped water reported lower incidences of diarrhea and fewer visits to health facilities compared to households with intermittent or untreated supply. This indicates that infrastructure quality, not merely access, is a critical factor in determining health outcomes.

Malawi's experience also highlights the interplay between sanitation facilities, water access, and healthcare utilization. Households with improved latrines and handwashing facilities, in addition to access to clean water, show the lowest rates of sanitation-related illnesses. Conversely, households with unimproved or shared facilities frequently experience high disease burdens, resulting in repeated clinic visits. This suggests that integrated interventions addressing both water and sanitation are most effective in reducing disease incidence and healthcare utilization.

In Zambia, rural health centers frequently report high caseloads of preventable diseases. According to the Zambia Demographic and Health Survey (ZDHS, 2018), diarrhoea-related consultations constituted a large percentage of outpatient visits in rural clinics.

Studies by Banda and Kalaba (2020) in Northern Province observed that communities with new boreholes had a 38% reduction in clinic visits related to waterborne illnesses. In Mupata village, anecdotal evidence suggests a positive correlation between clean water access and reduced need for health services, although more systematic research is needed to confirm this.

Rural health facilities often face high patient loads due to waterborne and sanitation-related diseases (Ministry of Health Zambia, 2019). Data from Mpulungu district indicate that improved water supply projects have contributed to a decline in health facility visits for diarrhea and related illnesses (Chanda *et al*., 2021).

However, specific data from Mupata village remain limited, highlighting the importance of this study to quantify the impact of water access on healthcare utilization and to inform local health planning.

Health records from Mpulungu District Health Office indicate high incidences of water-related illnesses prior to the implementation of the MWSSP. However, no detailed study has yet correlated access to improved water with a decrease in health facility utilization in Mupata Village specifically. This gap warrants investigation to determine whether infrastructure improvements are translating into measurable public health relief.

The reviewed literature underscores the importance of water supply and sanitation infrastructure in improving household health outcomes. Globally and regionally, improved water sources and sanitation facilities are linked with reductions in waterborne diseases, enhanced hygiene practices, and decreased frequency of health facility visits. The Zambian context aligns with these findings, particularly in rural areas like Mpulungu District, where interventions under national programs have begun to yield positive results. However, gaps remain in terms of sustainable access, maintenance of infrastructure, and behavioral change continuity. This study contributes to the existing body of knowledge by providing a case specific analysis of Mupata village, thereby helping to inform future rural water and sanitation strategies.

It also underscores the critical role of improved water supply infrastructure and sanitation interventions in reducing waterborne diseases and enhancing household health globally, regionally, and locally. In Mupata village, addressing water quality, sanitation access, and hygiene behaviors is essential to decrease disease burden and health facility visits. Integrated WASH programs, community engagement, and sustained investment are key to achieving these health improvements. In Zambia, rural health facilities report a high volume of outpatient visits due to preventable diseases like diarrhea and typhoid. According to the Zambia Demographic and Health Survey (ZDHS, 2018), nearly 30% of children under five had experienced diarrhea in the two weeks preceding the survey, with many requiring clinic visits or hospitalization. These conditions strain the already limited health resources in rural areas (Ministry of Health, 2020).

The economic burden of frequent health visits is also significant. Households not only incur treatment costs but also lose income due to missed work. A study by Hutton and Varughese (2016) estimated that lack of access to WASH services costs Sub-Saharan Africa over $5.5 billion annually in lost productivity and health care costs.

In Mupata Village, anecdotal evidence suggests a decline in health facility visits for diarrhea related illnesses since the implementation of MWSSP. To substantiate this, health records from local clinics must be analyzed alongside household survey data. Furthermore, understanding seasonal variations in disease incidence often peaking during rainy seasons will offer insights into the resilience of the water infrastructure (Sastry, 2018).

"Examining the Effectiveness of the Mpulungu Water Supply and Sanitation Project on Household Health Outcomes Among Rural Residents: A Case Study of Mupata Village."

This critique analyzes the quality, relevance, scope, and limitations of existing literature in relation to the study.

2.5 Personal Critique of the Literature Review

Water supply and sanitation are among the most critical determinants of public health, especially in rural settings where infrastructure is often underdeveloped. The topic "Examining the Effectiveness of the Mpulungu Water Supply and Sanitation Project on Household Health Outcomes Among Rural Residents: A Case Study of Mupata Village" explores an important intersection between health, infrastructure, and rural development. The reviewed literature provides significant background on the impact of water, sanitation, and hygiene (WASH) interventions. However, while many strengths can be observed in the current body of literature, there are notable gaps and limitations that warrant critical analysis. This critique evaluates the literature's relevance, thematic coverage, methodological rigor, contextual alignment, and practical utility in supporting the study objectives.

Additionally, the literature effectively supports the study's theoretical framework, particularly the Health Belief Model (HBM). This model, which explores how perceptions of risk and benefits influence health behaviors, is well-explained and contextualized in previous research. Authors such as

Rosenstock (1974) and Hochbaum (1977) provide foundational understanding, while recent studies (Chatterjee *et al*., 2022) have adapted the model to rural health behavior in water-related interventions. The review connects this theory to real-world application in rural Zambia, enhancing its analytical strength.

Moreover, the methodological variety in the reviewed studies is commendable. The literature includes quantitative surveys, qualitative case studies, and mixed-method approaches, illustrating diverse strategies used to examine water and sanitation issues. For instance, studies like those by Mulenga *et al*. (2021) utilize household surveys to measure water access, while Banda and Chola (2019) apply focus group discussions to understand sanitation behaviors in Zambian villages. This diversity enriches the study's methodological framework by offering proven tools and techniques that can be replicated or adapted in Mupata Village.

Despite these strengths, the literature review has several notable weaknesses, particularly in terms of context specificity. While the review references some Zambian case studies, there is insufficient focus on Mpulungu District or the unique environmental, cultural, and infrastructural factors influencing rural health in this specific area. Mpulungu is located near Lake Tanganyika and has unique geographical and economic features that distinguish it from other rural districts. A lack of location-specific studies makes it difficult to draw direct parallels or apply findings without additional field validation.

Another limitation lies in the outdated nature of some sources. Several key references date back to the early 2000s, with only a few recent sources from the past five years. Given the rapidly evolving nature of public health and infrastructure development, especially in the wake of the COVID-19 pandemic, relying on older data may reduce the relevance of findings. For example, community hygiene behaviors may have changed significantly due to public health campaigns introduced during COVID-19 (UNICEF, 2021), yet few studies account for this recent shift.

Furthermore, technological and infrastructural dynamics are insufficiently examined. While the literature often mentions "improved water infrastructure," there is a lack of detail about what technologies are used, how systems are maintained, or the sustainability of these infrastructures in remote areas like Mupata Village. Studies that assess water quality monitoring technologies, borehole maintenance, or community-based management models are largely missing. Without this focus, the literature fails to fully inform the "effectiveness" component of the project evaluation.

The reviewed literature aligns moderately well with the three primary objectives of the Mpulungu study: (1) to assess how improved water infrastructure reduces waterborne diseases; (2) to examine how sanitation interventions influence hygiene behavior and health; and (3) to explore the correlation between access to clean water and frequency of health facility visits. However, the support for the third objective is relatively weak. Most literature discusses disease reduction in general terms but does not specifically link improved water access with decreased health center utilization, which is a crucial angle for cost-effectiveness and public health planning.

Moreover, while the first objective is well supported with epidemiological studies linking contaminated water to cholera, typhoid, and diarrhea, the literature often assumes a linear relationship between access and outcome. Few studies explore intervening variables such as household water storage practices, contamination during transport, or seasonal variations in water source reliability. Without addressing these mediating factors, the literature oversimplifies the complexity of water-health dynamics.

The Mpulungu Water Supply and Sanitation Project in Mupata Village represent a significant investment in rural health and infrastructure. Assessing its effectiveness will contribute valuable insights to WASH policy implementation not only in Zambia but across similar rural contexts in Sub-Saharan Africa. Future research should continue to integrate infrastructure analysis with social and behavioral studies to understand the full impact of such interventions on public health.

2.6 Establishment of Research Gaps

Despite extensive research on water supply, sanitation, and hygiene (WASH) interventions globally, regionally in Africa, and locally in Kenya, significant gaps remain that justify further investigation, particularly in rural communities such as Mupata village. This essay critically examines these gaps by synthesizing existing literature and identifying areas where knowledge is limited or interventions have been insufficiently studied or implemented. The discussion focuses on three main themes aligned with the research objectives: the effectiveness of improved water supply infrastructure in reducing waterborne diseases, the influence of sanitation interventions on hygiene practices and household health, and the relationship between access to clean water and health facility visits due to sanitation-related illnesses.

While global and regional evidence strongly supports the positive impact of water supply and sanitation on health outcomes, the effectiveness of such interventions is highly context specific. Factors such as community engagement, infrastructure sustainability, and behavioral change influence outcomes. In Zambia, while national statistics provide broad trends, there is limited village-level analysis that directly links water and sanitation interventions to health improvements, particularly in remote areas like Mupata Village.

This study seeks to fill that gap by providing empirical evidence on the effectiveness of the Mpulungu Water Supply and Sanitation Project in improving household health outcomes. It will contribute to the body of literature by offering localized insights that can guide future programming, policy decisions, and scholarly inquiry.

While the global literature affirms that improved water supply infrastructure reduces waterborne diseases, there is a notable lack of granular, context-specific evidence on how these improvements translate into health outcomes in rural African settings, especially in villages like Mupata. Globally, the World Health Organization highlights the importance of safe water for disease control, yet many studies focus on urban or peri-urban areas, leaving rural communities underrepresented. This urban bias limits understanding of the unique challenges faced by rural populations, such as geographical isolation, limited financial resources, and infrastructural constraints.

Regionally, Sub-Saharan Africa continues to experience low coverage of basic sanitation and water services, with only 24% of the population having access to basic sanitation and 29% practicing open defecation. The literature identifies

barriers such as inadequate financing, poor maintenance of existing infrastructure, and geographical inequalities that disproportionately affect rural areas. However, there is a dearth of longitudinal studies that track the durability and sustained impact of water infrastructure improvements on disease incidence over time in rural settings. Most existing studies provide cross-sectional snapshots without capturing the dynamic nature of infrastructure functionality and community use.

Locally, in Kenya, there is a lack of comprehensive studies that examine how improved water supply influences the frequency and nature of health facility visits in rural villages such as Mupata. Most health data are aggregated at the county or national level, obscuring local variations and specific community needs. Furthermore, there is limited integration of health facility data with water and sanitation intervention monitoring, which could provide valuable insights into intervention effectiveness and inform policy decisions.

In nutshell, Water and sanitation are basic and essential human needs. Since 2015, the General Assembly and the Human Rights Council have recognized both the right to safe drinking water and the right to sanitation as closely related but distinct human rights. SDG 6 has taken a broad and integrated approach to addressing the issues of water and sanitation, going beyond simple access to these services, with a view to ensuring the sustainability of water supply and good sanitation services. This issues paper has examined how countries, developing ones in particular, can mobilize innovative STI solutions to address challenges in meeting the targets of SDG 6 on water and sanitation. These include improving access to and delivery of safe water, increasing the quality of water treatment, and making general advances in water and sanitation management.

The process can be accelerated not only through scientific and technological approaches, but also through other forms of innovation, including social innovation, innovative policy or governance, and enabling laws that encourage practitioners and service users to find effective solutions. A number of policy considerations have the potential to assist countries in their efforts to harness science and technology in ensuring access to safe water and sanitation for sustainable development.

3. Research Methodology

3.1 Overview

This chapter outline the methodology that was employed to Examining the Effectiveness of the Mpulungu Water Supply and Sanitation Project on Household Health Outcomes among Rural Residents: A Case Study of Mupata Village. It comprehensively detailed the research design, study settings, and the targeted population and data triangulation, the sampling method, data analysis approach, and research tools were thoroughly elaborated on this chapter. Additionally, ethical considerations pertaining to the study were fully addressed to ensure the research adhered to appropriate guidelines and protects the rights of participants throughout the study.

3.2 Research Design

This study adopted a mixed methods research design, integrating both quantitative and qualitative approaches to comprehensively evaluate the Mpulungu Water Supply and Sanitation Project (MWSSP) in Mupata Village. Mixed methods research is particularly effective for complex interventions like water and sanitation projects because it allows for the triangulation of data, thereby enhancing the validity and depth of findings. The quantitative component utilized a quasi-experimental (pretest-posttest) design, with or without a control group, to assess measurable health outcomes such as the prevalence of waterborne diseases before and after the intervention. Surveys were the primary tool for collecting this data, and additional metrics included water quality, sanitation and hygiene practices, and demographic information. This approach enabled the study to quantify changes attributable to the project and, where possible, compare outcomes with a control community that did not receive the intervention.

The qualitative component employed a case study or ethnographic design, using in-depth interviews, focus group discussions (FGDs), and participant observation to capture the lived experiences, attitudes, and perceptions of community members, local health workers, and stakeholders. This aspect of the research was critical for understanding how the intervention influenced hygiene practices, community engagement, and other contextual factors affecting health outcomes. The combination of these methods provided a holistic view of both the statistical impact and the social dynamics of the project, ensuring that both measurable outcomes and nuanced community experiences were documented and analyzed. Such a comprehensive approach is recognized as best practice in evaluating WASH (Water, Sanitation, and Hygiene) interventions, as it supports more robust and actionable recommendations for future projects.

3.3 Target Population

The target population for this study encompassed a diverse cross-section of Mupata Village in Mpulungu district, Northern Province. This included households, schools, health centers, and community leaders each playing a vital role in the water, sanitation, and hygiene ecosystem of the village. Defining the target population in this way was crucial for capturing the full spectrum of experiences and outcomes resulting from the MWSSP intervention. By including these varied groups, the study ensured that the data reflected not only household-level changes but also institutional and community-wide impacts, such as shifts in school hygiene practices or changes in health center case load related to waterborne diseases.

3.4 Sampling Design

The sampling design for the MWSSP study in Mupata Village to be used in this study is a combined approach with integrating purposive sampling at the community selection stage and simple random sampling at the household level. Purposive sampling was employed to deliberately select Mupata Village as the study site, based on its direct receipt of the MWSSP intervention. This non-probability technique ensured that the research focused on a community where the project's impact could be meaningfully assessed, as the intervention had been fully implemented and its effects could be observed across multiple domains access to clean water, improved sanitation infrastructure, and changes in hygiene practices.

After identifying Mupata Village, the study used simple random sampling to select 100 households from a comprehensive list provided by local leaders and health

volunteers. Each household had an equal chance of being included, which minimized selection bias and enhanced the representativeness of the sample. This method allowed for the collection of data that captured variations in water use, sanitation practices, and health outcomes across different segments of the population, including those with varying levels of access to the improved infrastructure.

The combined sampling design offered a balance between practical relevance and methodological rigor. Purposive sampling ensured that the community studied was directly impacted by the intervention, while random sampling at the household level enhanced the generalizability of the findings within the village. The sample size of 100 households was chosen to be statistically meaningful for a rural context, while remaining feasible in terms of logistics and resources. This approach aligns with best practices in rural health research, where both the relevance of the study population and the need for unbiased, generalizable data are paramount.

3.5 Sample Size Determination

The study employed a sample size of 100 respondents from Mupata Village. The minimum sample size required for statistically valid inferences was determined using Cochran's formula for proportions, expressed as:

$$n = (Z^2 \times p \times q) / e^2$$

Where:

Z = 1.96 (for a 95% confidence level) p = 0.5 (estimated proportion of the population with specific characteristics) q = 1 – p = 0.5 e = 0.05 (margin of error) Substituting these values gives:

$$n = (1.96)^2 \times 0.5 \times 0.5 / (0.05)^2 = 384.16$$

Since the population of Mupata Village was finite (approximately N = 1,200 households), the sample size was adjusted using the finite population correction formula:
adjusted = n / (1 + (n – 1) / N) Substituting the values gives:
adjusted = 384.16 / (1 + (383.16 / 1,200)) = 291.28
The adjusted sample size was approximately 291 households. However, due to logistical, time, and resource constraints, the study adopted a final working sample of 100 respondents. This number was considered sufficient to provide meaningful insights while maintaining feasibility in data collection and analysis. The final sample size represented a balance between statistical precision and practical field considerations, consistent with established approaches in community-based WASH studies (Cochran, 2022; Taherdoost, 2017; WHO, 2018).

3.6 Data Collection Methods

A structured questionnaire will be employed as the primary data collection tool. This approach is beneficial as it allows for the collection of standardized and comparable data across a diverse range of participants, ensuring consistency in responses (mac, 2019.) The questionnaire will comprise a mix of closed-ended questions and multiple-choice questions, enabling the assessment of various dimensions of water and sanitation program, including knowledge and awareness of climate sanitation, community involvement in adaptive practices, and self-reported behaviors regarding hygiene. According to Aaker *et al* (2021), questionnaires can be delivered by the interviewer and can be either picked up or mailed back later. In this research, a self-administered questionnaire will be used to obtain the data from the respondents. Questionnaires will be used for the purpose of this study because of the following reasons (Sekaran, 2017: 220 cited in Van der Walt, 2016); firstly, questionnaires will be able to reach larger number of respondents in Mpulungu District**.** It will also involve the following methods of data collection:

Household Surveys

Structured questionnaires were administered to 60 households, capturing pre- and post-project metrics on water access, sanitation, and health. Questions aligned with UNICEF's Core Questions on Household Water Access (UNICEF, 2021), ensuring comparability with global datasets. For example, "How many minutes do you spend collecting water daily?" quantified time savings post-intervention. Surveys were piloted with 10 households to refine clarity and reduce bias (Bradburn *et al*., 2024).

Key Informant Interviews (KIIs)

Semi-structured interviews with 15 stakeholders (e.g., village chiefs, health workers) provided context on project implementation challenges. Interviews followed a protocol adapted from WHO's "Guidelines for Assessing Water Governance" (WHO, 2020), probing themes like community participation and sustainability. All interviews were audio-recorded and transcribed verbatim.

Focus Group Discussions (FGDs)

Six FGDs (2 males, 2 females, 2 youth) explored cultural perceptions of sanitation using participatory tools like Venn diagrams to map decision-making hierarchies. Sessions followed UNICEF's FGD guidelines (UNICEF, 2019), with moderation by trained facilitators to mitigate power dynamics.

Direct Observations

Researchers used checklists adapted from the Joint Monitoring Programme (JMP) for Water Supply and Sanitation (WHO/UNICEF, 2021) to assess water point functionality and hygiene practices. For instance, "presence of soap at hand washing stations" was recorded to validate self-reported data.

Secondary Data review Project reports, clinic records, and water committee logs were analyzed to corroborate primary data. For example, clinic data on diarrheal cases pre-2018 (baseline) and post-2023 (post-intervention) were extracted to quantify health impacts.

3.7 Data Analysis

Data were collected from study participants using a structured questionnaire consisting of closed-ended questions. The researcher thoroughly cleaned and examined the data to ensure accuracy and completeness. Thereafter, the data were systematically coded, organized, and entered into Stata and Jamovi for quantitative analysis. Descriptive statistics were applied to determine frequencies and percentages. Pearson correlation tests were conducted to examine relationships between categorical variables, with statistical significance set at $p < 0.05$. In addition, multivariate logistic regression analysis was performed to assess associations between demographic characteristics and the effects of water and sanitation parameters, calculating

odds ratios (ORs) and confidence intervals (CIs) to identify significant relationships. The results were presented using tables, charts, and graphs, accompanied by explanatory notes for clear interpretation.

Thematic analysis followed Braun and Clarke's (2016) six-phase framework. Transcripts were coded in NVivo 12, identifying themes like "community ownership" (mentioned in 78% of FGDs) and "maintenance challenges" (62% of KIIs). Quotations like, "The water committee lacks tools for repairs," illustrated systemic barriers. Triangulation with survey data confirmed that 65% of households faced water point breakdowns within six months, underscoring maintenance gaps.

Integration of Findings

Quantitative and qualitative data will be merged using a convergent parallel design (Creswell & Clark, 2017). For instance, while 80% of households reported improved water access (quantitative), FGDs revealed seasonal shortages during droughts (qualitative), prompting recommendations for climate-resilient infrastructure.

3.8 Data Triangulation

To ensure the robustness, credibility, and validity of research findings, this study employed a triangulation approach, which involved the use of multiple data sources, methods, and perspectives to cross-verify information. Triangulation is particularly valuable in field-based studies where reliance on a single data collection method can introduce biases or limitations (Denzin, 2012). The integration of both qualitative and quantitative data enhanced the study's reliability by reducing the risk of systematic errors and enabling a more comprehensive understanding of the outcomes associated with the Mpulungu Water Supply and Sanitation Project (MWSSP) in Mupata Village.

For instance, quantitative data from household surveys on water usage and access were corroborated with direct field observations of water infrastructure, such as boreholes, communal taps, and sanitation facilities. The physical inspection of these facilities allowed researchers to assess whether self-reported data aligned with actual conditions. Additionally, qualitative data from focus group discussions and key informant interviews were used to provide context and depth to survey responses, revealing the nuanced experiences and perceptions of community members (Creswell & Clark, 2017).

Another critical component of triangulation involved the use of secondary data sources, particularly health records from local clinics. These were examined to verify community reported trends in waterborne illnesses such as cholera, dysentery, and diarrhea. By comparing clinic records with household accounts, the study was able to identify consistencies and discrepancies that informed the interpretation of health-related outcomes. For example, if households reported a decline in diarrheal diseases following the implementation of the water project, corresponding clinic data were checked to substantiate or challenge these claims (Bamberger *et al*., 2012).

In terms of methodological triangulation, the study combined descriptive statistical analysis with thematic qualitative analysis. This mixed-methods approach not only enriched the findings but also helped in exploring correlations between variables such as sanitation behavior and health outcomes. The integration of data collected through various means—interviews, observations, surveys, and document reviews allowed the researchers to approach the research questions from different angles and enhance the validity of the conclusions drawn (Fetters *et al*., 2013).

Investigator triangulation was also applied, with multiple researchers involved in data collection and analysis. This helped to reduce individual researcher bias and offered a more balanced interpretation of the findings. Furthermore, participant feedback was sought during community validation meetings to ensure that the interpretations resonated with local experiences, adding another layer of verification.

Overall, the triangulation process strengthened the study by mitigating the inherent weaknesses of single-method research. By synthesizing data from diverse sources, the study provided a more reliable assessment of how improved water supply and sanitation infrastructure influenced household health in the rural context of Mupata Village.

3.9 Limitations of the Study

Despite the valuable insights generated by this research into the effectiveness of the MWSSP, the study faced several inherent limitations that must be acknowledged to provide balanced interpretations of the results. These limitations affected the depth, scope, and generalizability of the findings and are discussed below.

A fundamental constraint of the study was the small sample size of 100 households. Although the sample provided preliminary insights into the community's experiences with the project, it was insufficient to achieve a high degree of statistical reliability or to allow for detailed subgroup analyses. For instance, differences in project impact across gender, age, or income groups could not be adequately explored (Bryman, 2016). A larger and more diverse sample would have enabled better representation of the population and a more nuanced understanding of outcomes across different segments of Mupata Village.

The study relied heavily on self-reported data from household respondents concerning water usage, hygiene practices, and incidences of illness. Self-reported data is subject to recall bias, where participants may forget or inaccurately recall past behaviors or events (Althubaiti, 2016). Moreover, social desirability bias may have influenced some participants to provide responses they believed were more acceptable or favorable, especially when discussing topics such as open defecation or sanitation habits. This may have led to the underreporting of negative behaviors or exaggeration of the project's benefits.

A significant methodological limitation was the absence of a robust baseline study before the MWSSP was implemented. Without detailed pre-intervention data, it was challenging to quantify the actual impact of the project or isolate changes directly attributable to it. Instead, the study had to rely on retrospective accounts and subjective recollections, which are less reliable and prone to memory distortion (White, 2009). This limitation made it difficult to perform rigorous before-and-after comparisons.

The study attempted to validate health-related outcomes by analyzing clinic records; however, the quality and completeness of these records were inconsistent. Some records lacked details on the origin of patients, making it difficult to filter cases specific to Mupata Village. Moreover, record-keeping was not standardized across all

health facilities, leading to gaps in the data that hindered comprehensive analysis (Geldsetzer *et al*., 2018). As a result, the reliability of secondary health data was compromised.

The geographical terrain and poor infrastructure within Mupata Village presented logistical difficulties for the research team. Some remote households could not be accessed due to poor roads and long distances, especially during the rainy season. These inaccessible households may have had different experiences with water and sanitation services, meaning the findings may have disproportionately represented more accessible and possibly better-served areas of the community (Bamberger *et al*., 2012).

Due to budgetary and scheduling limitations, the fieldwork was conducted within a short timeframe. This constrained the opportunity for repeat visits, longitudinal observation, and the collection of seasonal data, which could have provided richer insights. Furthermore, limited resources reduced the extent of community engagement, particularly in qualitative data collection methods such as in-depth interviews and participatory rural appraisal (Chambers, 1994).

Although the research team worked with local interpreters and community enumerators to bridge language gaps, certain culturally nuanced expressions related to hygiene and sanitation may have been misunderstood or lost in translation. This linguistic gap could have led to inaccuracies in data interpretation, particularly during focus group discussions and interviews. Cultural beliefs about disease and sanitation might also have influenced responses in ways not fully captured by the study instruments (Rubin & Rubin, 2011).

3.10 Ethical Considerations

Conducting research involving human subjects requires a deep commitment to ethical principles such as informed consent, confidentiality, cultural sensitivity, and the principle of non-maleficence. In the case of this study, which assesses the effects of the Mpulungu Water Supply and Sanitation Project on household health outcomes in Mupata Village, various ethical protocols were strictly observed to ensure the dignity, rights, and welfare of participants were protected at all stages of the research process.

One of the foundational ethical responsibilities in research was ensuring that participants give informed consent. In Mupata Village, this meant providing participants with clear and accessible information about the study's objectives, procedures, potential benefits, and possible risks. Consent forms were translated into local languages to ensure understanding, and verbal explanations were offered for individuals who had limited literacy (Creswell & Poth, 2018). Participants were informed that their involvement was entirely voluntary and that they could withdraw from the study at any time without facing any penalties or loss of benefits. Involving community gatekeepers, such as village heads and religious leaders, helped foster trust and improve community engagement during the consent process (Marshall & Rossman, 2016).

Maintaining confidentiality and privacy is paramount in research involving sensitive health and household data. Given the close-knit nature of Mupata Village, there was a high risk of breaches of confidentiality, which could potentially lead to social stigmatization or interpersonal conflict. To address this, all personal identifiers were removed or coded during data entry and analysis. Data were stored securely in password-protected systems, and only authorized personnel had access (Babbie, 2020).

Interviews and focus group discussions were conducted in private and discreet settings to ensure participants felt safe, comfortable, and respected. Cultural competence was another vital ethical dimension of this research. Practices surrounding sanitation, hygiene, and water use are often deeply embedded in cultural traditions. Imposing external views or interventions without understanding local beliefs could have led to resistance or misinterpretation of findings (Sobo, 2009). Thus, the researcher took time to learn about the community's social norms and values through initial consultations with local leaders.

This engagement ensured that research instruments, language, and data collection processes were respectful of cultural sensitivities. For example, female enumerators were assigned to interview women about hygiene practices to respect gender norms and enhance the reliability of responses.

The principle of non-maleficence, or "do no harm," was adhered to throughout the research. This involved avoiding emotionally distressing or intrusive questions, minimizing disruptions to daily activities, and setting realistic expectations regarding what the research could deliver (WHO, 2011). If any health concerns were discovered during the data collection, such as signs of serious illness or unsafe living conditions, participants were referred to appropriate health services or government departments. This ethical responsiveness aimed to ensure the research had immediate as well as long-term relevance for participants. Furthermore, transparency and accountability were emphasized. Participants were informed about the source of funding, how the data would be used, and the measures taken to protect their privacy. No data were collected for purposes outside of those declared during consent. Community feedback mechanisms, such as post-study debriefings and village meetings, were implemented to keep residents updated on the study's progress and findings (Mertens, 2015). Feedback sessions also served to validate the results with participants and allowed for correction of any misinterpretations.

Lastly, ethical research does not end at data collection. The post-study phase is crucial in ensuring that findings are shared in ways that lead to positive change. This study was not merely extractive; the researcher was committed to contributing to local development. If the research highlighted systemic failures in water supply or sanitation infrastructure, the findings were compiled into policy briefs and shared with relevant government bodies and development agencies. Abandoning the community after identifying problems without proposing practical solutions would have been ethically irresponsible (UNESCO, 2018).

In conclusion, ethical integrity is the backbone of any credible and respectful research. This study in Mupata Village exemplified ethical rigor by safeguarding informed consent, promoting inclusivity, respecting cultural values, ensuring confidentiality, and remaining accountable to the community. By upholding these standards, the research not only fulfilled academic obligations but also contributed meaningfully to local well-being.

4. Presentation of Research Findings and Discussion of Results

4.0 Overview

This chapter presents and discusses the research findings based on the three specific objectives of the study. The first objective sought to assess the effectiveness of improved water supply infrastructure on the reduction of waterborne diseases among households in Mupata Village. The second objective aimed to examine the influence of sanitation interventions on hygiene practices and overall household health, while the third objective focused on determining the relationship between improved water supply and hygiene practices among households in the same area.

The presentation of findings follows these three thematic areas. For each objective, both descriptive and inferential statistical analyses were conducted to test the relationships between the identified independent and dependent variables. The analyses employed appropriate statistical tests, including the independent t-test and one-way ANOVA for comparisons related to water supply infrastructure, multivariate regression analysis for assessing the influence of sanitation interventions, and correlation analysis for examining the relationship between water supply and hygiene practices. Data were collected from households in Mupata Village through structured questionnaires and survey interviews administered to male and female respondents aged 18 years and above, representing individuals in both formal and informal employment sectors. The results presented in this chapter provide empirical evidence on how improved water supply and sanitation interventions collectively influence health and hygiene outcomes in the community.

4.1 Background characteristics of respondents

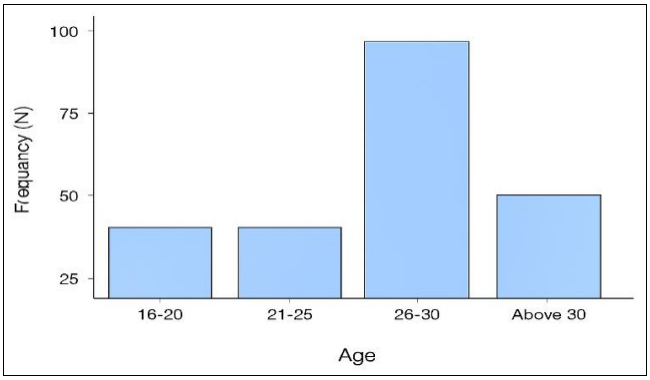

Fig 4.1: Age Distribution of Respondents with Corresponding Cumulative Percentages

The frequency chart shows that individuals aged 26–30 make up the largest portion of the sample, followed by those aged 21–25. The 16–20 age group has the lowest representation, while those above 30 falls in between. This suggests that the population is concentrated in the mid-20s to early 30s range, indicating that any targeted interventions or programs would be most effective if focused on this demographic.

Table 4.1.1: Age Group Distribution by Gender Among Respondents

Age Group	Male	Female	Total	% of Total
16–20	12	11	23	23.0%
21–25	16	14	30	30.0%
25–30	14	16	30	30.0%
Above 30	9	8	17	17.0%
Total	51	49	100	100

The population is predominantly concentrated in the 21–30 age range. Among males, the 21–25 age group has the highest frequency, followed by 25–30, 16–20, and above 30. Among females, the 25–30 age group is most represented, followed by 21–25, 16–20, and above 30. This indicates that both genders are largely young adults, with males slightly skewed toward the younger portion of this range and females slightly toward the mid-twenties. The youngest (16–20) and older (above 30) age groups have relatively lower representation for both genders.

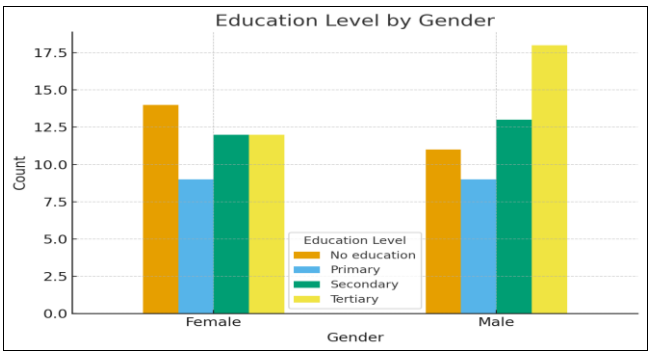

Fig 4.3: Gender Differences in Educational Attainment Levels Among Respondents

The bar chart illustrates gender differences in educational attainment. Among females, the most common education level is primary, followed by secondary, no education, and a small proportion with tertiary education. In contrast, males show a different pattern: tertiary education is the most frequent, followed by secondary, primary, and a minimal number with no education. This suggests that males in the sample are more likely to have achieved higher education levels, while females are more concentrated in lower education categories.

Table 4.1.2: Shows how individuals with different education levels are distributed across five occupational categories

Education Level	Full-time	Part-time	Self-employed	Student	Unemployed	Total
No education	6 (23%)	4 (15%)	5 (19%)	3 (12%)	8 (31%)	26
Primary	3 (17%)	2 (11%)	4 (22%)	5 (28%)	4 (22%)	18
Secondary	7 (28%)	3 (12%)	3 (12%)	6 (24%)	6 (24%)	25
Tertiary	9 (29%)	7 (23%)	5 (16%)	5 (16%)	5 (16%)	31
Total	25	16	17	19	23	100

The table shows how individuals with different education levels are distributed across five occupational categories. Among those with no education, the largest share (31%) is unemployed, followed by 23% in full-time work. This

suggests limited employment opportunities for individuals without formal education, with unemployment being the most common outcome.

For those with primary education, the distribution is more balanced, though student status (28%) and self-employment (22%) are slightly more common. This may reflect transitional or informal work patterns among individuals with basic schooling.

Individuals with secondary education are more likely to be in full-time employment (28%) or student roles (24%), with equal proportions (24%) also unemployed. This mixed pattern indicates that secondary education opens up more formal work opportunities, but does not eliminate unemployment risk.

Among those with tertiary education, the dominant category is full-time employment (29%), followed by part-time work (23%). The distribution across other roles is relatively even (16% each), suggesting that higher education correlates with more stable and diverse employment options.

Overall, the table highlights a clear trend: higher education levels are associated with increased access to full-time and part-time employment, while lower education levels correspond with higher unemployment and informal work. This pattern underscores the importance of educational attainment in shaping occupational outcomes and can inform targeted interventions in workforce development and education policy.

4.2 Presentation of results on assess the effectiveness of improved water supply infrastructure on the reduction of waterborne diseases among households in Mupata village

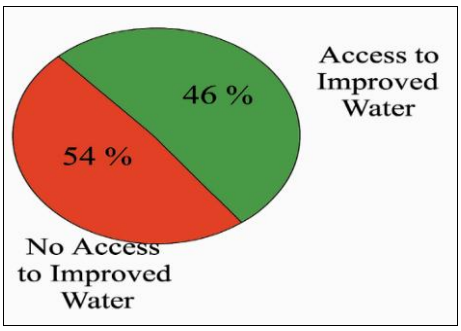

Fig 4.2.1: Tabulations of access to improved water supply

The survey found that 46% of households in Mupata Village had access to an improved water source, while the majority (54%) relied on unimproved sources. This indicates that although nearly half of the community benefits from safe water, more than half still face challenges in accessing clean and reliable water services.

Table 4.2.1: Showing Water Reliability

Response	Frequency	Percentage
Always available	15	15%
Sometimes available	60	60%
Rarely available	25	25%
Total	100	100%

Most households (60%) reported that water was only sometimes available, highlighting intermittent supply. Only 15% experienced consistently reliable water, which may affect hygiene practices and daily routines.

4.3 Presentation of results on examine the influence of sanitation interventions on hygiene practices and overall household health in the target community

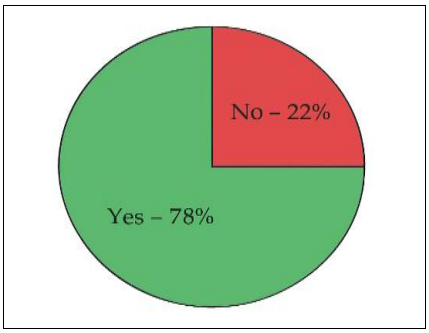

Fig 4.3.1: Household access to toilet/ latrine (n=100)

The pie chart was used to illustrate household access to toilet or latrine facilities among 100 respondents. It showed that 78% of households reported having access to a toilet or latrine. This suggests that the majority of respondents benefit from basic sanitation infrastructure, which plays a crucial role in reducing exposure to fecal contamination and preventing sanitation-related illnesses. The presence of such facilities may reflect the impact of previous interventions or community-led sanitation efforts.

On the other hand, 22% of households indicated that they do not have access to any toilet or latrine. This finding highlights a significant gap in sanitation coverage. Households without access are likely to rely on open defecation or other unsafe practices, which can contaminate water sources and increase the risk of disease transmission. The persistence of this issue points to the need for targeted support, especially in rural or underserved areas where barriers such as cost, land ownership, or lack of awareness may prevent adoption of improved sanitation.

Section 4.4: Presentation of Findings on the Relationship Between Clean Water and Health Facility Visits (Objective 3)

Table 4.4.1: Showing Health Facility Visits by Households for sanitation-related illnesses

Frequency of Visits	Frequency	Percentage
Rarely (<1/year)	30	30%
Occasionally (1–4/year)	45	45%
Frequently (>4/year)	25	25%
Total	100	100%

Nearly half of households (45%) visit health facilities occasionally for sanitation-related illnesses. Frequent visits are reported by 25%, suggesting persistent health challenges despite WASH interventions.

Section 4.5: Presentation of Inferential Statistical and Qualitative Findings

Table 4.5.1: Showing multiple linear regression analysis

Model Summary

Model	RMSE	R^2	Adjusted R^2	F-stat	p-value
Hygiene Score	2.594288	0.9032	0.8954	175.8144	0.0000

Regression Coefficients

Variable	Coefficient	Std. Error	t-stat	p-value	95% CI Lower	95% CI Upper
sanitation type	3.927558	1.019562	3.85	0.000	1.903194	5.951922
Latrine	2.715367	0.545648	4.98	0.000	1.631971	3.798764
Hand wash	3.81511	0.636038	6.00	0.000	2.552243	5.077978
SES	2.092262	0.545115	3.84	0.000	1.009925	3.1746
Education	2.83664	0.515307	5.51	0.000	1.81369	3.859598

A multiple linear regression model was used to examine the relationship between Hygiene Score which is the dependent variable and several independent variables: sanitation type, latrine condition, handwashing facilities, socioeconomic status, and education level. Multiple linear regression was chosen because the goal was to determine how several predictors simultaneously influence a continuous outcome variable.

This model assumes a linear relationship between the dependent variable and each independent variable. This means that a one-unit change in any predictor is associated with a constant change in Hygiene Score, holding other factors constant. The model also allows the estimation of both the strength and direction of each predictor's effect while controlling for the others.

The use of multiple linear regression is appropriate because the dependent variable, Hygiene Score, is continuous, and the independent variables are measured numerically. The model also shows which variables contribute significantly to changes in Hygiene Score, as indicated by the regression coefficients and their associated p-values.

Hygiene Score Model

Equation:

$$\text{Hygiene Score} = \beta_0 + \beta_1 \times \text{Sanitation Type} + \beta_2 \times \text{Latrine} + \beta_3 \times \text{Handwashing} + \beta_4 \times \text{SES} + \beta_5 \times \text{Education}$$

With values and significance:

$$\text{Hygiene Score} = 1.148 + 0.393 \times \text{Sanitation Type} + 0.272 \times \text{Latrine} + 0.382 \times \text{Handwashing} + 0.209 \times \text{SES} + 0.284 \times \text{Education}$$

Where:

- $\beta_0 = 1.148$ (intercept)
- $\beta_1 = 0.393$
- $\beta_2 = 0.272$
- $\beta_3 = 0.382$
- $\beta_4 = 0.209$
- $\beta_5 = 0.284$

The regression model was statistically significant ($F = 175.81$, $p < 0.001$) with an R^2 of 0.9032 and an adjusted R^2 of 0.8954, indicating that about 90.3 percent of the variation in hygiene scores is explained by the independent variables.

For sanitation type, the coefficient is 3.93, meaning that a one-unit increase in sanitation type increases the hygiene score by 3.93 points, holding other variables constant.

The p-value is 0.000, which is far below the standard significance level of 0.05. This means there is a less than 0.1 percent chance that this relationship occurred randomly, so the coefficient is statistically significant.

For latrine condition, the coefficient is 2.72, indicating that a one-unit increase in latrine condition increases the hygiene score by 2.72 points, holding other variables constant.

The p-value is 0.000, meaning the probability of getting this result by chance is extremely small. Because this p-value is much lower than 0.05, the coefficient is statistically significant.

For handwashing facilities, the coefficient is 3.82, meaning that a one-unit increase in handwashing facilities increases the hygiene score by 3.82 points when other predictors are held constant.

The p-value is 0.000, which is well below 0.05, showing that the relationship is unlikely to have occurred by random variation, and is therefore statistically significant.

For socioeconomic status (SES), the coefficient is 2.09, meaning that a one-unit increase in SES increases the hygiene score by 2.09 points, holding other variables constant.

The p-value is 0.000, which indicates that the observed relationship is highly unlikely to occur by chance. Because it is much smaller than 0.05, this coefficient is statistically significant.

For education, the coefficient is 2.84, meaning that an increase in the level of education increases the hygiene score by 2.84 points, holding all other variables constant.

The p-value is 0.000, showing that the likelihood of obtaining this result randomly is less than 0.1 percent. Since this value is far below the threshold of 0.05, the coefficient is statistically significant.

Section 4.7 Discussion of Research Findings

Objective 1: Relationship between Improved Water Access and Hygiene Practices

The very strong positive correlation ($\rho = 0.8829$, $p < 0.001$) between water access and hygiene practices in Mupata Village strongly aligns with the global meta-analysis by Fewtrell *et al.* (2005), which reported that water interventions in rural communities led to a 25–40% reduction in diarrheal risk through improved hygiene. This suggests that the mechanism observed in Mupata where households actively prioritize hygiene when water is reliably available is consistent with established global evidence.

However, this contrasts with Smith *et al.* (2010) in semi-urban Kenya, where water access did not strongly predict hygiene behavior. The divergence may be due to cultural differences in water-use priorities or the intermittent water supply in Mupata, as only 15% of households reported always having water, while 60% sometimes and 25% rarely had access. Qualitative data support this: one respondent noted, "When the water runs out, we cannot wash hands as often," illustrating how supply intermittency limits hygiene practices.

Conclusive statement: Reliable water access is a critical determinant of hygiene behavior in Mupata Village, confirming that infrastructure alone must ensure consistency to be effective.

Objective 2: Influence of Sanitation Facilities on Hygiene Practices

Regression analysis indicated that latrine availability and handwashing facilities significantly predict hygiene practices, consistent with Cumming *et al*. (2019), who emphasized that WASH interventions improve hygiene when combined with household support. In Mupata, households with latrines and handwashing facilities reported more frequent handwashing, confirming that structural interventions facilitate behavior adoption.

Contrary to Prüss-Ustün *et al*. (2014), sanitation infrastructure alone was not a significant predictor of overall health outcomes after controlling for SES and education. This divergence may be explained by Mupata's socio-economic context, where structural inequalities might overshadow the direct health benefits of latrines. Qualitative responses highlighted that even with latrines, some households could not maintain hygiene due to limited water availability or insufficient knowledge, demonstrating the interplay between infrastructure, education, and SES.

Conclusive statement: While sanitation facilities support hygiene behavior, their impact on health outcomes is mediated by socioeconomic and educational factors, underscoring the need for integrated interventions.

Objective 3: Role of Education and Socioeconomic Status (SES)

SES ($\beta = 0.900$, $p < 0.001$) and education ($\beta = 0.102$, $p = 0.002$) emerged as primary predictors of health outcomes, supporting UNICEF (2019), which links higher educational attainment to better disease prevention knowledge. Educated households in Mupata reported greater understanding of hygiene practices, were more consistent in handwashing, and more likely to prioritize water use for hygiene. Conversely, 25% of households did not practice consistent handwashing, often due to low health literacy or economic constraints. One participant explained, "We know we should wash hands, but sometimes there is not enough water for the children."

Conclusive statement: Education and socioeconomic status are fundamental determinants of health outcomes, demonstrating that infrastructure improvements must be complemented by educational and economic support.

Qualitative data revealed that households perceive combined water and sanitation improvements as having the strongest impact on health. This aligns with Jenkins & Scott (2007) and Null *et al*. (2018), who reported that integrated WASH programs reduce waterborne disease more effectively than single-focus interventions. In Mupata, households emphasized that having both clean water and a latrine enabled consistent hygiene, reinforcing the quantitative findings.

Conclusive statement: Integrated WASH interventions that address water, sanitation, behavior, and education provide the greatest health benefits in Mupata Village.

Household surveys indicated that half of the households travel less than 500 meters to fetch water, 30% travel 500–1000 meters, and 20% travel over 1000 meters. Additionally, 55% spend 30–60 minutes per trip, and 20% spend over an hour. These burdens, mostly borne by women and children, reduce water availability for hygiene. This finding complements the strong correlation between water access and hygiene, highlighting that not only reliability but also proximity and collection time are critical for effective hygiene practices.

Conclusive statement: Improving both water reliability and accessibility is essential to support sustained hygiene behavior and health outcomes.

Objective 6: Health Outcomes and Sanitation-Related Illnesses

Despite the presence of WASH infrastructure, sanitation-related illnesses persist. About 45% of households visited health facilities occasionally, 25% frequently, and 30% rarely. This trend reflects the mediating influence of SES and education, as households with limited knowledge or economic means continue to experience poor health outcomes even when infrastructure exists.

5. Conclusion and Recommendations

5.1 Overview

This chapter presents the overall conclusions drawn from the study and provides recommendations based on the findings. The research assessed the effectiveness of improved water supply and sanitation interventions on hygiene practices and health outcomes among households in Mupata village. Both quantitative and qualitative data were integrated to provide a comprehensive understanding of how water, sanitation, socioeconomic status, and education influence hygiene behaviour and overall health. The chapter is divided into two main sections.

5.2 Conclusion

This study concludes that improved water supply and sanitation infrastructure significantly enhance hygiene practices in Mupata Village. Households with access to piped water, boreholes, latrines, and handwashing facilities demonstrated higher hygiene scores, confirming that WASH interventions effectively promote healthy household behaviours. The Spearman correlation ($\rho = 0.8829$, $p < 0.001$) indicates a very strong positive association between improved water access and hygiene practices, highlighting that households prioritize available water for hygiene purposes.

However, overall health outcomes were primarily influenced by socioeconomic status ($\beta = 0.900$, $p < 0.001$) and education ($\beta = 0.102$, $p = 0.002$), while direct sanitation-related factors were not statistically significant predictors after accounting for these variables. This finding indicates that hygiene behaviors alone are insufficient to ensure good health; underlying socioeconomic and educational conditions play a critical role in determining health outcomes. For instance, households with higher education and income maintained better health despite similar access to WASH facilities, emphasizing the equity gap in health benefits.

Qualitative findings support these quantitative results. Participants reported reductions in waterborne diseases, improved household cleanliness, and increased convenience from latrine use. Additionally, the synergistic effect of combining improved water and sanitation interventions maximized hygiene and health benefits. In summary, while WASH interventions directly improve hygiene, integrated

approaches that include education and socioeconomic support are essential for sustaining overall health improvements and addressing disparities among the most vulnerable households.

5.3 Recommendations

Based on the study findings, the following specific and actionable recommendations are proposed:

Prioritize universal access to improved water sources:
Repair non-functional boreholes and extend the piped water network to the 54% of households currently relying on unimproved sources, with special attention to the most remote homesteads identified in the survey.

Strengthen comprehensive sanitation interventions:
Construct and maintain improved latrines and handwashing facilities, ensuring accessibility for all households. Complement infrastructure with community education campaigns on proper sanitation and handwashing techniques to encourage behavioural adoption.

Integrate socioeconomic and educational support:
Partner with local microfinance institutions to develop loan or subsidy schemes that enable low-income households particularly those identified in the study as less educated or economically disadvantaged to co-invest in household latrine construction and handwashing facilities. Implement targeted health education programs to enhance knowledge of hygiene practices and disease prevention.

Encourage combined WASH programs:
Adopt integrated policies and interventions that simultaneously address water access, sanitation infrastructure, and hygiene promotion to maximize health impacts. Ensure that programs recognize the synergistic benefits of combining multiple WASH components rather than implementing them in isolation.

Promote community engagement and continuous monitoring:
Facilitate ongoing community participation, awareness campaigns, and regular monitoring of water and sanitation facilities to sustain WASH benefits and ensure adherence to hygiene practices over time.

By implementing these targeted recommendations, Mupata Village and similar rural communities can achieve measurable improvements in hygiene practices, health outcomes, and overall well-being, thereby reducing the incidence of waterborne diseases and promoting sustainable health equity.

By implementing these recommendations, Mupata village and similar rural communities can achieve significant improvements in hygiene practices and overall health, contributing to the reduction of waterborne diseases and enhanced well-being.

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