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Enhancing Public Health through Improved Access to Safe Drinking Water and Reducing Cholera Outbreaks: A Case Study of Borehole Accessibility and Cholera Outbreaks in Mvurwi, Phase 1, Zimbabwe.

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APPROVAL FORM

The undersigned certify that they have read the dissertation and have approved its submission for marking confirming that it conforms to the departmental requirements on research entitled: "Enhancing Public Health through Improved Access to safe drinking water and reduce cholera outbreaks: A Case Study of Borehole Accessibility and Cholera Outbreaks in Mvurwi, Phase 1, Zimbabwe." Submitted by Ruvimbo R Gutu B212207B in partial fulfilment of Bachelor of Science Honours Degree in Development Studies.

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DECLARATION

I hereby declare that this thesis has been the result of my original efforts and investigations, and such work has not been presented elsewhere for degree assessment. All additional sources of information have been acknowledged using references.

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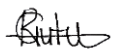

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DEDICATION

This research is dedicated to my parents.

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My utmost gratitude is directed to God Almighty, for the strength and good health to carry out this research project to completion. I would want as well to express my appreciation to my research supervisor Doc Siziba. This research would have been aborted without your patience and consistence in encouraging as well as guiding me. My siblings together with my lovely parents, you cannot be thanked enough. You always believe in me. May God Bless you.

ABSTRACT

Access to safe drinking water is a critical component of public health and sustainable development, particularly in regions susceptible to waterborne diseases such as cholera. This study investigates the relationship between borehole accessibility and the prevalence of cholera outbreaks in Mvurwi, Phase 1, Zimbabwe. Using a mixed-methods approach, the research combined household surveys (n=90), key informant interviews, focus group discussions, and secondary data to assess water source usage, community perceptions of water quality, and the effectiveness of local water management strategies.

Findings reveal that while 63% of households primarily rely on borehole water, significant challenges remain regarding equitable access, maintenance, and community trust in water management structures. Alternative sources included Piped water (Municipal), River/Stream, Well (Protected), Well (Unprotected) and Rainwater Harvesting, of which 37% of households reportedly use. Households using alternative water sources such as rivers or unprotected wells reported a higher incidence of diarrheal diseases and suspected cholera cases. Furthermore, the study identifies a clear correlation between well-maintained boreholes, active community management, and improved health outcomes.

The results underscore the importance of not only expanding borehole infrastructure but also ensuring consistent maintenance, effective community-based management, and water quality monitoring. Recommendations include enhancing training for Borehole Water Management Committees (BWMCs), improving transparency in community contributions, and increasing policy support for rural water systems. This case study provides valuable insights for public health policymakers, development practitioners, and local authorities seeking to reduce cholera outbreaks through improved water infrastructure in semi-urban Zimbabwean communities.

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List of Abbreviations

WHO	World Health Organization
UN	United Nations
UNDP	United Nations Development Programme
UNICEF	United Nations International Children's Emergency Fund
BWMC	Borehole Water Management Committee
FGD	Focus Group Discussion
KII	Key Informant Interview
SDG	Sustainable Development Goal
WASH	Water, Sanitation, and Hygiene
SPSS	Statistical Package for the Social Sciences
CDC	Centers for Disease Control and Prevention
NGO	Non-Governmental Organization
ILO	International Labour Organization
ZIMSTAT	Zimbabwe National Statistics Agency

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CHAPTER 1: PROBLEM SETTING

1.1 Introduction

Access to safe drinking water is an essential component of public health and a basic human right as recognized by the United Nations (UN). This right becomes particularly critical in rural and peri-urban areas where waterborne diseases such as cholera can have devastating impacts. Zimbabwe, a country in southern Africa, has faced recurring cholera outbreaks largely attributed to inadequate water infrastructure and poor sanitation (Gomis et al., 2020). Mvurwi, located in the Mashonaland Central Province, exemplifies these challenges. The town's reliance on boreholes for water access has positioned it as a focal point for examining the link between water accessibility and public health outcomes.

The significance of safe water access cannot be overstated. Safe drinking water is crucial for preventing waterborne diseases, which are a major cause of morbidity and mortality in many developing countries. Cholera, an acute diarrheal disease caused by the ingestion of water or food contaminated with the bacterium Vibrio cholerae, is one such disease that thrives in environments where water and sanitation infrastructure are inadequate. The World Health Organization (WHO) estimates that there are 1.3 to 4.0 million cases of cholera each year, resulting in 21,000 to 143,000 deaths worldwide (World Health Organization, 2024). In Zimbabwe, cholera outbreaks have been a recurring issue, particularly during periods of economic instability and environmental stress, such as droughts (Gomis et al., 2020).

This chapter will provide a comprehensive overview of the relationship between borehole accessibility and cholera prevention. It will outline the significance of safe water access, detail the conditions contributing to cholera outbreaks in Mvurwi, and establish the context for the study. By examining the factors that influence water accessibility and public health outcomes, this study aims to contribute to the development of targeted interventions that can improve water access and reduce the incidence of cholera in Mvurwi and similar communities.

1.2 Background

Waterborne diseases remain a significant public health challenge in many developing countries, particularly where water infrastructure is inadequate (Mazhar et al., 2021). These diseases, including cholera, are predominantly spread through contaminated water and pose severe risks in regions where clean water is scarce (International Labor Organization, 2020). Cholera, an acute diarrheal illness caused by the bacterium Vibrio cholerae, can lead to severe dehydration

and death if not promptly treated. The disease thrives in environments with poor sanitation and limited access to safe drinking water, making it a major concern in many parts of the world.

In Zimbabwe, cholera outbreaks have historically claimed thousands of lives, with notable epidemics occurring in 2008–2009 and 2018 (UNDP, 2020; UNICEF, 2019). These outbreaks were largely attributed to compromised water systems and poor hygiene practices (Mason et al., 2019; WHO, 2019). The 2008–2009 epidemic, for instance, was one of the worst in the country's history, resulting in over 4,000 deaths and affecting more than 100,000 people (Mason et al., 2019; WHO, 2009). The recurrence of such outbreaks highlights the persistent vulnerabilities in Zimbabwe's water and sanitation infrastructure (UNDP, 2020; UNICEF, 2019).

Mvurwi, a rapidly growing town in the Mashonaland Central Province, exemplifies these challenges. With a limited public water supply, the town has had to rely heavily on boreholes as a primary source of water. Boreholes, while crucial in mitigating water shortages, present their own set of issues. Uneven distribution of boreholes means that not all residents have equal access to safe water. Additionally, contamination risks and maintenance challenges can compromise the quality of water obtained from these sources (Su et al., 2021). Contaminated boreholes can become breeding grounds for waterborne diseases, including cholera, if not properly managed.

The need to evaluate borehole accessibility and its effectiveness in reducing cholera outbreaks is thus urgent for informing public health strategies. Understanding the factors that influence the accessibility and quality of borehole water can help in designing targeted interventions to improve water safety and prevent future outbreaks. This study aims to provide a comprehensive analysis of these factors in Mvurwi, contributing to the broader efforts to enhance public health and ensure safe water access in Zimbabwe and similar contexts.

1.3 Problem Statement

The persistent cholera outbreaks in Mvurwi signal deep-rooted issues related to water accessibility and public health management. Despite efforts to provide alternative water sources such as boreholes, the incidence of cholera has not been entirely eradicated. This points to potential gaps in the water distribution system, community awareness, and the sustainability of water infrastructure (Ngubo and Mubangizi, 2020). By assessing the role of borehole accessibility in Mvurwi, this study seeks to identify challenges and opportunities for reducing cholera outbreaks, thus contributing to improved health outcomes in the region.

1.4 Significance of the Study

The significance of this study extends to both public health practitioners and policymakers, offering critical insights into the role of borehole access in mitigating cholera outbreaks. By examining the specific context of Mvurwi, this research provides valuable data that can inform broader water infrastructure development projects in similar rural and semi-urban areas across sub-Saharan Africa (Singh and Chudasama, 2020).

Improved access to boreholes has the potential to significantly reduce the frequency and severity of cholera outbreaks. This study highlights the importance of ensuring that boreholes are not only available but also properly maintained and equitably distributed. By addressing these factors, the research underscores the need for comprehensive water management strategies that prioritize both the quality and accessibility of water sources.

Understanding borehole usage, water quality control, and community engagement in Mvurwi could offer a replicable model for other regions facing similar public health challenges (Mazenda et al., 2022). The findings from this study can be used to develop targeted interventions that enhance the effectiveness of boreholes in providing safe drinking water, thereby reducing the incidence of waterborne diseases.

Moreover, this research supports evidence-based decision making that aligns with efforts to enhance health resilience and promote sustainable water access (Beall and Piron, 2015). By providing empirical data on the relationship between borehole accessibility and cholera prevention, the study contributes to the development of policies and programs that are grounded in scientific evidence and tailored to the specific needs of communities.

In summary, the significance of this study lies in its potential to inform public health strategies, guide policy development, and promote sustainable water management practices. By addressing the critical issue of water access in Mvurwi, the research aims to contribute to the broader goal of improving public health outcomes and ensuring safe drinking water for all.

1.5 Research Aim

This study aims to assess the impact of borehole accessibility on cholera outbreaks in Mvurwi, Phase 1, Zimbabwe, to inform public health strategies to enhance community health through improved safe water access and cholera prevention.

1.6 Research Objectives

The study is structured around the following objectives:

- To assess the current state of borehole accessibility in Mvurwi.
- To identify the relationship between borehole water quality and the frequency of cholera outbreaks.
- To evaluate the effectiveness of community-based water management strategies.

1.6.1 Research Questions

To achieve the research objectives and guide the investigation, this study will address the following key questions:

- What is the current state of borehole accessibility in Mvurwi, Phase 1, in terms of Distribution, Functionality and Community Access?
- Is there a statistically significant relationship between borehole water quality and the frequency of cholera outbreaks in Mvurwi, Phase 1?
- How effective are the current community-based water management strategies in Mvurwi, Phase 1, in ensuring Borehole Sustainability, Water Quality Maintenance, Community Ownership and Participation?

1.7 Scope and Limitations

Geographical Focus: The research is confined to Mvurwi, a town in the Mashonaland Central Province of Zimbabwe. This specific focus allows for a detailed and context-specific analysis of the challenges and opportunities related to borehole use in this area.

Timeframe: The study covers the initial phase of borehole installation, providing insights into the immediate impacts on water accessibility and public health. This timeframe is crucial for understanding the early outcomes and identifying any immediate issues that need to be addressed.

Key Areas of Investigation:

Physical Accessibility: Assessing the distribution and accessibility of boreholes to different parts of the community. This includes mapping borehole locations and evaluating the ease of access for residents.

Water Quality Management: Investigating the quality of water obtained from boreholes, including potential contamination risks and the effectiveness of water quality control measures.

Community Practices: Examining how the community uses boreholes, including practices related to water collection, storage, and usage. This also involves understanding community engagement and participation in maintaining borehole infrastructure.

Limitations

Seasonal Variability: Water quality and cholera incidence can vary significantly with seasons. For instance, the rainy season may lead to increased contamination risks, while the dry season might affect water availability. This seasonal variability could influence the study's findings and may require additional data collection over different seasons to provide a comprehensive understanding.

Reliance on Secondary Data: In some cases, the study may rely on secondary data where primary data is not accessible. This could include historical data on cholera outbreaks, water quality reports, and other relevant information. The reliance on secondary data may introduce limitations related to data accuracy, completeness, and relevance to the current context.

Community Engagement: The level of community engagement and participation in the study could impact the quality and reliability of the data collected. Limited participation or reluctance to share information may affect the study's findings and the ability to draw comprehensive conclusions.

1.7 Definition of Terms

To ensure clarity and understanding, the following key terms are defined as they apply to this study:

Borehole: A deep, narrow hole drilled into the ground to access water from underground aquifers for domestic, agricultural, or industrial use (Gibberd, 2022).

Cholera: An acute diarrheal illness caused by the ingestion of food or water contaminated with the bacterium Vibrio cholerae (International Labor Organization, 2020).

Safe Drinking Water: Water that is free from contaminants and is safe for human consumption, as defined by World Health Organization (WHO) guidelines (Schoch, 2020).

Accessibility: The ease with which residents can physically reach and obtain water from boreholes, taking into account distance, availability, and functionality (Clark et al., 2019).

Public Health: The practice of preventing disease, prolonging life, and promoting health through organized efforts and informed choices of society, organizations, public and private sectors, communities, and individuals (Robeyns, 2021).

Outbreak: The occurrence of cases of disease above what is normally expected in a defined community, geographical area, or season (Hirsch et al., 2021).

Community Management Practices: Strategies employed by local community members to maintain, monitor, and ensure the functionality and sustainability of shared resources like boreholes (Ngumbela, 2021).

1.8 Organization of Study

This study is organized into five chapters, each focusing on specific aspects of the research:

Chapter 1: Introduction This chapter provides the background to the study, highlighting the significance of access to safe drinking water and its implications for public health. It outlines the research problem, objectives, research questions, and hypotheses that guide the investigation. The scope and limitations of the study are also described here, along with the definitions of key terms.

Chapter 2: Literature Review The literature review explores existing scholarly work related to borehole accessibility, water quality, and the incidence of cholera outbreaks. This chapter discusses theoretical frameworks and empirical studies that provide context and support for the research questions and hypotheses. Key studies on public health, water accessibility, and cholera prevention strategies are examined to identify knowledge gaps and align with the study's focus.

Chapter 3: Research Methodology This chapter details the research design, including the type of study (qualitative, quantitative, or mixed methods), sampling techniques, data collection methods, and data analysis procedures. Ethical considerations and the justification for the chosen methodology are also explained, ensuring the study's reliability and validity.

Chapter 4: Results and Discussion The findings from the data collection are presented in this chapter, accompanied by an analysis that connects the results to the research questions and hypotheses. The discussion includes an interpretation of the data about existing literature, highlighting any new insights or discrepancies. The implications of these findings for public health policies and practices are also explored.

Chapter 5: Conclusion and Recommendations The final chapter summarizes the main findings of the study and discusses their implications for public health and water accessibility in Mvurwi.

Recommendations for policy, practice, and future research are provided to guide stakeholders in improving water management and reducing cholera outbreaks. The chapter concludes with final thoughts on the study's contribution to knowledge and its potential impact on similar public health issues.

This structured approach ensures that the study systematically addresses the research objectives while maintaining coherence and clarity throughout the document.

1.9 Conclusion

This chapter has provided a comprehensive context and background to the present study, focusing on the importance of enhancing public health through improved access to safe drinking water as a strategy to mitigate cholera outbreaks in Mvurwi, Zimbabwe. The study's objectives, related research questions, and the essential elements of the topic have been clearly outlined. Additionally, this chapter has highlighted the limitations and delimitations of the study and offered a detailed overview of the organization of the research, outlining the structure and content of each chapter.

By setting a foundational framework, this introductory chapter positions the study within its broader public health and water management context, emphasizing its relevance and urgency. This groundwork serves to guide the subsequent chapters, ensuring a coherent flow and alignment with the study's objectives. The research now advances to a thorough literature review and the theoretical framework, which will provide insights and a scholarly backdrop for understanding the critical aspects of borehole accessibility and cholera prevention in Mvurwi.

CHAPTER 2: LITERATURE REVIEW

2.1 Introduction

Access to safe drinking water is universally recognized as a fundamental human right and a cornerstone for public health (UN General Assembly, 2010). Water is not only essential for

hydration and basic hygiene but also plays a critical role in preventing the spread of infectious diseases. The World Health Organization (WHO, 2018) underscores that inadequate water quality and limited access to clean water are significant contributors to public health crises, particularly in low-income and developing regions. The situation becomes more dire in areas where water infrastructure is either absent or insufficiently maintained, leading to the propagation of waterborne diseases like cholera, dysentery, and typhoid (PrüssUstün et al., 2019).

Cholera remains one of the most severe waterborne diseases affecting millions globally. The disease is prevalent in regions with compromised water supplies and poor sanitation, making it an indicator of inequalities in public health infrastructure and access (Ali et al., 2015). The consequences of cholera outbreaks extend beyond health, impacting economic stability and social structures within affected communities (Kirchhoff et al., 2020). This chapter explores existing literature on the relationship between water access and public health outcomes, with a particular emphasis on cholera. It also investigates the significance of borehole infrastructure as a preventive measure and evaluates lessons learned from global experiences in water management and disease prevention.

2.2 Global Overview of Water Access and Public Health

Safe water access is integral to sustainable development and overall human well-being. The United Nations Development Programme (UNDP, 2020) points out that achieving Sustainable Development Goal 6 (Clean Water and Sanitation) is vital for alleviating global health disparities and reducing mortality rates associated with waterborne diseases. Despite global efforts, more than 785 million people still lack access to basic drinking water services, with the majority living in sub-Saharan Africa and South Asia (WHO/UNICEF, 2019). These populations face heightened vulnerability to diseases, as inadequate water supply and poor sanitation create breeding grounds for pathogens (Hunter et al., 2010).

The health implications of inadequate water access extend beyond direct disease transmission. Poor water quality can affect nutrition, as contaminated water may compromise food safety and lead to malnutrition, especially in children (Ngure et al., 2014). Additionally, the time spent fetching water, often borne by women and children, can impede education and limit economic productivity (Sorenson et al., 2011). The United Nations has recognized these challenges, advocating for integrated water resource management as a solution to strengthen resilience against public health threats and ensure equitable water distribution (UN Water, 2020).

Innovative approaches and targeted investments in water infrastructure have shown promising results in many developing countries. For example, programs that focus on community-based water management, supported by technological interventions such as solar-powered boreholes, have improved access to safe drinking water and reduced disease incidence (Sarpong & Ansah, 2019). Nevertheless, challenges remain, including financial constraints, insufficient technical expertise, and geopolitical instability that can disrupt water projects (World Bank, 2021).

2.3 Cholera: Causes, Transmission, and Impact

Cholera is an acute diarrheal disease caused by the bacterium Vibrio cholerae, which is typically transmitted through contaminated water or food (CDC, 2022). It thrives in environments where sanitation is poor and water systems are compromised, making it a persistent threat in regions with inadequate infrastructure (Mintz et al., 2001). The primary symptoms of cholera include severe watery diarrhea, vomiting, and rapid dehydration, which, if not treated promptly, can lead to death (WHO, 2022). The rapid progression of cholera means that timely access to medical treatment and clean water is crucial for prevention and control (Sack et al., 2004).

The environmental factors influencing cholera transmission are significant. Cholera outbreaks often coincide with natural events such as floods, which can overwhelm existing water systems and facilitate the spread of the disease (Rebaudet et al., 2013). Urban areas with dense populations and poor drainage are particularly vulnerable, as untreated sewage can contaminate water sources (Clemens et al., 2017). According to a study by Jabeen et al. (2011), interventions that improve water quality, such as chlorination and the use of boreholes, have proven effective in reducing the incidence of cholera and other waterborne diseases.

The global impact of cholera is both health-related and economic. In addition to causing severe morbidity and mortality, cholera can disrupt community structures by straining healthcare systems and diverting resources from other health initiatives (Ali et al., 2015). Economically, cholera outbreaks can reduce workforce productivity and hinder economic growth, especially in low-income settings where resources are already scarce (Kirchhoff et al., 2020). For example, the 2008- 2009 cholera outbreak in Zimbabwe highlighted the fragile nature of water and health infrastructure in the region, resulting in over 4,000 deaths and exposing the urgent need for reliable water sources like boreholes (Mason et al., 2019).

Effective cholera prevention requires a multifaceted approach that includes improving access to clean water, strengthening sanitation systems, and promoting hygiene practices (WHO,

2022). Boreholes play a crucial role in this context by providing a controlled and relatively secure water source. Research indicates that when communities gain access to boreholes, the risk of cholera and other waterborne diseases decreases significantly due to the reduced reliance on potentially contaminated surface water (Sibanda & Mudzengerere, 2013). This underscores the importance of integrating borehole infrastructure into broader water management and public health strategies.

2.4 Water Infrastructure and Disease Prevention

The availability and quality of water infrastructure are fundamental to public health and the prevention of waterborne diseases. Safe water infrastructure encompasses a range of systems, including boreholes, piped water, and protected wells, that ensure the delivery of uncontaminated water (WHO, 2017). Boreholes, in particular, are recognized for their effectiveness in providing reliable access to clean water, especially in rural and peri-urban areas where centralized water systems are often inadequate or nonexistent (Hoko & Hertle, 2006).

Boreholes tap into groundwater, which is generally safer from surface contaminants like sewage and agricultural runoff. This reduces the community's dependence on surface water, which can be highly susceptible to pathogens, including Vibrio cholerae, the bacterium responsible for cholera (Gundry et al., 2004). Properly drilled and maintained boreholes can significantly diminish the prevalence of waterborne diseases by ensuring a consistent supply of potable water (Clasen et al., 2015). For instance, a study by Gundry et al. (2006) highlighted that communities with functioning boreholes experienced fewer cases of diarrhea compared to those relying on untreated surface water.

However, the success of borehole systems in preventing disease depends on multiple factors, including regular maintenance, proper construction, and effective community management. A poorly constructed borehole or one with damaged linings can become a conduit for contamination if surface water infiltrates the well (Hoko, 2005). The importance of continuous maintenance and regular water quality monitoring cannot be overstated. Insufficient oversight can lead to the presence of pathogens and harmful chemicals, which compromise the effectiveness of boreholes as a safe water source (WaterAid, 2018). In addition, training local community members to manage and repair boreholes has been shown to improve the longevity and functionality of these systems (Harvey & Reed, 2007).

Integrating borehole infrastructure into broader water, sanitation, and hygiene (WASH) programs is essential for maximizing health outcomes. The World Health Organization (2020)

recommends coupling borehole projects with public health campaigns that promote safe water storage and hygiene practices to enhance disease prevention. The combined approach ensures that while clean water is accessible, the community also adopts behaviours that mitigate the risk of contamination during collection, storage, and use (Curtis & Cairncross, 2003).

2.5 The Situation in Zimbabwe

Zimbabwe's water infrastructure has been under significant strain for decades due to a combination of economic, political, and environmental challenges. The most severe cholera outbreak occurred in 20082009, revealing critical vulnerabilities in the nation's public health system and water infrastructure. During this period, more than 100,000 cases were reported, resulting in approximately 4,000 deaths (Mason et al., 2019). The crisis was exacerbated by deteriorating infrastructure, limited funding, and inadequate maintenance of water systems, which left many residents reliant on unprotected water sources (Mpofu et al., 2018).

The underlying causes of Zimbabwe's water crisis include ageing infrastructure that has not kept pace with population growth, poor investment in water facilities, and frequent power shortages that impede water treatment and distribution (Dube, 2021). Rural and semi-urban areas, such as Mvurwi, are particularly affected as residents often depend on rivers and shallow wells, which are easily contaminated during heavy rains or floods (Chirenda & Sithole, 2021). The reliance on these unsafe water sources significantly increases the risk of cholera and other diarrheal diseases, perpetuating a cycle of poor health and economic hardship (Matsika et al., 2018).

Government and nongovernmental organizations have made efforts to improve water infrastructure, focusing on borehole drilling and rehabilitation projects. However, these initiatives often face logistical challenges, including resource constraints and inadequate community involvement (UNICEF, 2016). The lack of consistent water quality testing further undermines these efforts, as contaminants may go undetected until they cause health issues (Hoko, 2005).

2.6 Borehole Access and Public Health Outcomes

Borehole access has been identified as a crucial intervention for improving water safety and public health, especially in regions lacking centralized water systems. Boreholes reduce reliance on surface water, which is prone to contamination and outbreaks of waterborne diseases such as cholera (Sibanda & Mudzengerere, 2013). The ability of boreholes to provide

continuous access to clean groundwater has proven beneficial in reducing the frequency and severity of cholera outbreaks (Clasen et al., 2015).

However, while boreholes contribute to improved health outcomes, their effectiveness is contingent on proper management and equitable distribution. Maintenance challenges, including mechanical failures and water table depletion, can limit the long-term benefits of borehole use (Chirenda & Sithole, 2021). Regular water quality testing is essential to ensure that groundwater remains free of contaminants such as nitrates and heavy metals, which pose long-term health risks (Smith et al., 2014).

Studies in rural South Africa and other sub-Saharan regions have shown that increased access to boreholes significantly correlates with reduced disease incidence. For example, research conducted by Ngwenya and Kgathi (2006) demonstrated that communities with operational boreholes reported fewer cases of diarrhea and waterborne diseases compared to those without. Similar outcomes were observed in Zambia and Malawi, where borehole projects, combined with community education on hygiene practices, led to marked improvements in public health (Mutale et al., 2017).

Community involvement in borehole projects is critical for their sustainability. When communities take part in decision-making and maintenance, borehole systems are more likely to remain functional and effective (Harvey & Reed, 2007). Challenges such as uneven distribution of boreholes, which can create disparities in access, need to be addressed to ensure that all community members benefit equally (Moyo & Chigumira, 2020). Policies that promote participatory management and provide funding for regular maintenance can enhance the overall success of borehole initiatives and contribute to sustained improvements in public health outcomes.

2.7 Factors Influencing the Effectiveness of Boreholes

Boreholes are a vital part of water infrastructure that can significantly improve public health outcomes by providing reliable access to clean water. However, their effectiveness in reducing diseases like cholera is influenced by several interrelated factors:

Quality and Maintenance: The quality of borehole construction and ongoing maintenance play a crucial role in ensuring their effectiveness. Poorly constructed or inadequately maintained boreholes can become contaminated, turning a source of safe water into a potential health hazard. Factors such as improper sealing, cracked linings, or mechanical failures can allow

surface contaminants to infiltrate groundwater (Hoko, 2005). Maintenance activities should include periodic cleaning, the repair of damaged components, and the protection of borehole openings from potential contaminants. A study by Fisher et al. (2015) revealed that boreholes in sub-Saharan Africa with regular maintenance schedules had lower contamination levels compared to those without systematic checks. Moreover, the lack of funding and trained personnel for ongoing borehole maintenance is often a barrier to sustained water safety (Harvey & Reed, 2007).

Community Engagement: Community participation in the management and maintenance of boreholes is critical for their long-term sustainability. When community members are involved, they are more likely to develop a sense of ownership, leading to better care and adherence to water safety practices (Carter et al., 1999). Engaging local leaders and training volunteers to handle basic maintenance and oversight tasks can also bridge the gap left by resource-limited governmental support (Harvey & Reed, 2004). Research has shown that community-led water projects often outperform externally managed ones due to localized knowledge and invested interest in maintaining the resource (Marks & Davis, 2012).

Water Quality Testing: Regular water quality testing is essential to identify and address potential contaminants that could compromise borehole water safety. Contaminants such as faecal coliforms, heavy metals, and nitrates can seep into groundwater due to nearby agricultural activities, sewage leaks, or industrial processes (Smith et al., 2014). Routine microbiological and chemical testing can ensure that borehole water meets health standards and remains safe for consumption. A report by UNICEF (2016) indicated that community water projects with established water testing protocols experienced fewer outbreaks of waterborne diseases compared to those without such measures. Additionally, public reporting of water quality results can enhance trust and encourage the use of boreholes over potentially unsafe alternatives (Clasen et al., 2015).

Financial and Policy Support: Sustained funding and policy backing are necessary to support the ongoing functionality of boreholes. Investments in training programs, spare parts, and water quality monitoring equipment are essential for maintaining borehole efficacy (WaterAid, 2018). Policies that promote public-private partnerships can also improve access to financial resources and technical expertise, enabling better long-term maintenance (World Bank, 2021). In regions where governments have established regulatory frameworks for borehole operation and

maintenance, communities have experienced fewer issues with water quality and infrastructure failures (Moyo & Chigumira, 2020).

Environmental Factors: The effectiveness of boreholes can be influenced by local environmental conditions. For example, groundwater levels can fluctuate due to seasonal changes or overextraction, affecting the reliability of the water supply (Ngwenya & Kgathi, 2006). Droughts and other climatic events can also impact groundwater recharge rates, potentially leading to borehole failure during critical periods. Mitigating these risks requires the implementation of sustainable water management practices and contingency planning (Sarpong & Ansah, 2019).

2.8 Gaps in Literature and Research Justification

While extensive research exists on the role of boreholes in improving water access and public health, there is a notable lack of studies focusing specifically on Mvurwi, Zimbabwe. Most research in Zimbabwe has centered on national trends or urban water systems, overlooking the unique challenges faced by semi-urban and rural communities such as Mvurwi (Moyo & Chigumira, 2020). These areas often have distinct issues related to water access, such as reliance on mixed water sources and limited infrastructure support, which are not adequately addressed by broader studies.

Moreover, existing studies rarely delve into the sociocultural dynamics that influence the effectiveness of borehole projects in semi-urban settings. Understanding local perceptions of borehole water quality, trust in public health interventions, and willingness to participate in maintenance efforts is essential for crafting sustainable solutions (Chirenda & Sithole, 2021). This research aims to fill these gaps by examining the specific impact of borehole accessibility on public health in Mvurwi, with an emphasis on reducing cholera outbreaks. By focusing on this case study, the research will contribute localized insights that can inform broader policy and intervention strategies in similar communities across Zimbabwe and beyond.

2.9 Theoretical Framework

The study adopts the “Water Poverty Nexus” theory, which postulates that limited access to clean water perpetuates cycles of poverty and poor health outcomes (Sullivan, 2002). This theory emphasizes that water scarcity or poor water quality not only impacts health directly through increased disease prevalence but also indirectly by hindering economic productivity

and educational opportunities (PrüssUstün et al., 2019). Improved access to clean water can break this cycle by fostering better health, enabling communities to allocate time and resources to productive activities rather than disease management (Ngure et al., 2014).

Applying this theoretical framework, the study will assess how borehole access impacts both health and socioeconomic conditions in Mvurwi. It will explore whether improved water infrastructure contributes to a reduction in cholera cases and how this shift influences broader community wellbeing. By analyzing borehole access through the Water Poverty Nexus, the study seeks to demonstrate that water interventions are not only health-promoting but are also crucial for enhancing economic resilience and reducing poverty in vulnerable communities (World Bank, 2021).

2.10 Conclusion

The literature reviewed underscores the critical role of reliable water infrastructure in promoting public health and preventing waterborne diseases such as cholera. Boreholes, as part of a broader water supply strategy, offer a viable solution for communities lacking access to safe and reliable water sources, particularly in rural and semi-urban areas. However, their effectiveness is contingent on several factors, including quality construction, regular maintenance, community engagement, water quality testing, and supportive financial and policy frameworks. The evidence points to the need for holistic approaches that integrate borehole access with comprehensive water, sanitation, and hygiene (WASH) programs to maximize public health benefits.

The situation in Zimbabwe, marked by recurring cholera outbreaks and challenges in water access, illustrates the intersection of inadequate infrastructure, economic constraints, and public health vulnerability. The 2008-2009 cholera outbreak, which resulted in over 4,000 deaths, highlighted the severe implications of insufficient water infrastructure and inadequate disease prevention measures. It also emphasized the urgent need for targeted interventions, including investments in borehole construction and maintenance to ensure consistent access to clean water (Mason et al., 2019). In towns like Mvurwi, where dependence on unprotected water sources persists, boreholes can play a transformative role if managed and maintained effectively.

Despite the recognition of boreholes as a practical intervention, gaps in the literature highlight the limited focus on specific, localized studies, especially in semi-urban areas like Mvurwi.

Most research has emphasized urban centers or taken a nationwide perspective, leaving a critical gap in understanding the unique challenges and opportunities present in smaller communities (Moyo & Chigumira, 2020). This study aims to address these gaps by exploring the specific impact of borehole access on public health in Mvurwi, particularly concerning the reduction of cholera outbreaks.

Moreover, the theoretical framework applied in this research—the Water Poverty Nexus theory—provides a comprehensive lens through which to examine the broader implications of water access on community wellbeing. This framework posits that improving water access can have far-reaching effects beyond health, contributing to economic productivity and poverty alleviation (Sullivan, 2002). By investigating how enhanced borehole access can disrupt the cycle of poor health and poverty in Mvurwi, this study seeks to offer valuable insights that inform policy, strengthen community resilience, and guide future interventions.

In summary, while boreholes are proven to enhance access to safe water and reduce disease transmission, their long-term success depends on multilayered strategies that consider technical, social, and policy dimensions. This research will contribute to a deeper understanding of how borehole infrastructure can be leveraged effectively in semi-urban Zimbabwean contexts, offering practical recommendations for enhancing public health and achieving sustainable water access. The findings aim to support both local and national efforts in creating resilient water systems that are capable of withstanding environmental, economic, and public health challenges.

CHAPTER 3: RESEARCH METHODOLOGY

3.1 Introduction

This chapter outlines the research design and methods utilized to explore the relationship between borehole access and public health outcomes, with a specific focus on reducing cholera outbreaks in Mvurwi, Zimbabwe. The study aims to assess whether improved borehole access can effectively lower the incidence of cholera and other waterborne diseases, enhancing public health in this semi-urban setting. To achieve this, the chapter covers various components, including the study's research design, the chosen study area, data collection methods, sampling techniques, and the approaches used for data analysis.

The research design is selected to ensure the collection of both quantitative and qualitative data, allowing for a holistic view of borehole accessibility, community water use, and health outcomes. A mixed methods approach provides a comprehensive understanding by incorporating statistical analysis of health data and subjective insights from community members and stakeholders involved in water management. Additionally, this chapter explains the criteria used to select the sample population and the tools deployed to gather data, including surveys, interviews, focus group discussions, and water quality tests. Each method is carefully chosen to ensure data reliability and validity, aligning with the study's objectives and research questions.

3.2 Research Design

The study adopts a "mixed methods research design", combining both quantitative and qualitative data collection and analysis techniques. This approach is particularly suitable for addressing the complex and multidimensional nature of water access and public health outcomes. Quantitative data provides measurable insights into borehole access levels, water quality, and cholera incidence rates, while qualitative data captures the lived experiences, perceptions, and opinions of community members and stakeholders regarding borehole accessibility and public health.

The choice of a mixed methods approach is driven by the study's need to explore not only the statistical relationship between borehole access and cholera outbreaks but also the social, economic, and environmental factors that influence this relationship. By triangulating quantitative and qualitative data, the study enhances the depth and reliability of its findings, offering a robust basis for analyzing both objective and subjective dimensions of borehole access.

The study employs a "case study design", focusing on Phase 1 of Mvurwi in Mashonaland Central Province. A case study approach allows for an in-depth examination of specific issues within a real-life context, providing detailed insights that would be difficult to obtain through broader or more generalized research designs. This approach is particularly effective in exploring the unique challenges associated with water infrastructure in Mvurwi, where access to safe drinking water remains inconsistent. Case studies are beneficial for capturing the complex interactions between community water resources, public health, and disease prevention in a localized setting, making them ideal for examining how borehole access

impacts cholera prevention in Mvurwi. Additionally, the case study design enables the researcher to delve into infrastructure limitations, community engagement, and maintenance practices that may affect borehole functionality and sustainability in Phase 1 of Mvurwi.

3.3 Study Area

The study is conducted in "Mvurwi", a town located in the Mashonaland Central Province of Zimbabwe, approximately 100 kilometers north of the capital city, Harare. Mvurwi serves as an important case for exploring water access and public health issues in semi-urban Zimbabwean communities. The town has a population of around 30,000, with Phase 1 being a densely populated section where residents face considerable challenges in accessing clean water. The area is characterized by a semiarid climate, which makes water scarcity a recurrent issue, particularly during the dry season.

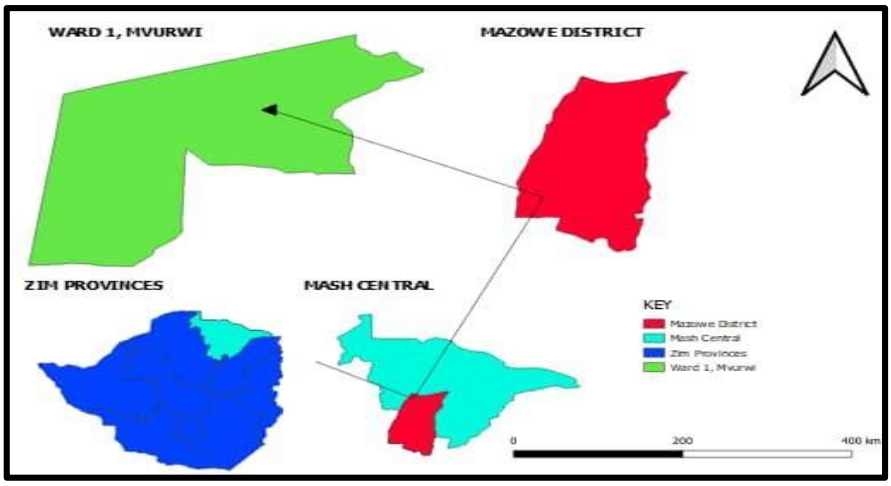
The town relies on a combination of water sources, including municipal piped water, boreholes, rivers, and unprotected wells. However, the reliability and quality of these sources vary significantly. Municipal water supply infrastructure is often outdated and insufficient, leading to frequent shortages. Consequently, many residents depend on alternative sources, such as rivers and shallow wells, which are prone to contamination. These unprotected sources often contain harmful bacteria, including 'Vibrio cholerae', the bacterium responsible for cholera (Matsika et al., 2018). During the rainy season, runoff from agricultural fields and informal settlements exacerbates the risk of water contamination, further elevating public health risks.

Phase 1 of Mvurwi is particularly vulnerable to waterborne diseases like cholera due to limited access to protected water sources. Although boreholes have been installed in some areas, not all residents have easy access, and borehole maintenance has been inconsistent due to financial and logistical constraints. Many boreholes in Mvurwi are community-managed, but a lack of training and resources often leads to operational failures and prolonged downtimes. As a result, households frequently resort to using river water or other unprotected sources, especially during periods when boreholes are nonfunctional. This reliance on unprotected sources has been linked to recurring outbreaks of cholera and other waterborne diseases, placing a significant burden on local healthcare facilities (Dube, 2021).

By focusing on Phase 1 of Mvurwi, this study addresses a critical need for localized research that considers the unique water infrastructure, socioeconomic conditions, and public health challenges faced by semi-urban communities in Zimbabwe. The insights gained from this study may inform targeted interventions, including improved borehole management, regular water

quality testing, and enhanced community engagement in water resource management, all of which could contribute to better health outcomes in similar communities.

Figure 1: Map of Mvurwi Phase 1



Source: Secondary data

3.4 Target Population

The target population for this study includes various groups within Mvurwi, Zimbabwe, specifically in Phase 1, as well as key stakeholders involved in water management and public health. The study focuses on three main groups: households, local health professionals, and community leaders or borehole managers. By including these diverse groups, the study aims to obtain a comprehensive understanding of how borehole access impacts public health and to gather multiple perspectives on water access and its role in preventing cholera.

Households: Households in Phase 1 of Mvurwi represent the primary population for the study. This group includes families who rely on different water sources, including boreholes, rivers, and unprotected wells, for their daily water needs. Households provide critical information on water access patterns, hygiene practices, and the health impacts they have experienced, especially with regard to cholera outbreaks. By surveying a diverse sample of households, the study will capture variations in water access and health outcomes, reflecting differences in socioeconomic status, household size, and proximity to borehole infrastructure. The

perspectives of women, who are often responsible for collecting water and maintaining household hygiene, are particularly valuable in understanding daily water usage patterns and waterborne disease risks.

Local Health Professionals: Health professionals in Mvurwi, such as nurses, doctors, and public health officials, provide insights into the relationship between water access and disease patterns in the area. Health professionals have observed the impact of waterborne diseases like cholera and can offer expert opinions on the factors that contribute to outbreaks and how improved water infrastructure could mitigate these risks. This group also provides data on reported cholera cases, the burden on healthcare facilities, and any preventive measures currently in place. Their input helps to triangulate the information obtained from households and adds a clinical perspective to the analysis.

Community Leaders and Borehole Managers: Community leaders, such as local government officials and traditional leaders, along with individuals involved in borehole management, are integral to understanding the functionality, accessibility, and sustainability of boreholes in Phase 1 of Mvurwi. These stakeholders can provide details about borehole maintenance practices, community engagement, and challenges faced in sustaining borehole infrastructure. Their insights on community level initiatives, funding, and resource constraints offer a holistic view of the operational and logistical aspects that influence borehole effectiveness in providing safe water.

3.5 Sampling Techniques

To ensure that the study accurately represents the diverse experiences and perspectives in Phase 1 of Mvurwi, a combination of stratified random sampling and purposive sampling techniques is employed. This multimethod approach enhances the reliability and validity of the findings by capturing a wide range of experiences related to water access, health outcomes, and community involvement in water management.

3.5.1 Stratified Random Sampling for Households

Stratified random sampling is used to select households for participation in the study. This method is particularly suitable for the research, as it allows for the division of the population into distinct subgroups, or strata, based on certain characteristics that may influence water

access and health outcomes. These strata could include households with access to boreholes, those without, and households with varied socioeconomic backgrounds. By ensuring that each stratum is represented in the sample, stratified sampling captures variations in water usage patterns, reliance on different water sources, and health conditions within the community.

Sample Size: 90 households were selected for the survey, ensuring a statistically significant sample size that represents the population of Phase 1 in Mvurwi. This sample size allows for reliable analysis of water access patterns and health outcomes.

Sample Size Determination:

The required sample size was calculated using Cochran's formula for proportions:

were

Z=1.96 for a 95 % confidence level,

(maximum variability), and

(±10 % margin of error).

Substituting gives

Because Phase 1 of Mvurwi has a finite population of 1,377 households (Zimstat Census, 2022), we applied the finite-population correction:

Finally, we rounded up to 90 households to ensure adequate power and to account for potential non-response.

Selection Process: Households within each stratum are selected randomly to reduce selection bias and ensure that the sample accurately reflects the target population's diversity.

3.5.2 Purposive Sampling for Key Informants

Purposive sampling is used to select key informants, including local health professionals and community leaders or borehole managers. This sampling method is suitable for individuals who possess specialized knowledge and experience regarding water access and health in Mvurwi. These informants are chosen based on their expertise, roles, and relevance to the study, as they provide valuable qualitative data on water infrastructure, public health, and community challenges.

Sample Size for Key Informants: 10 key informants, including 5 local health professionals and 2 community leaders(Councilor and Headman) and 3 borehole committee members, will be interviewed. This sample size is sufficient to provide depth and richness to the qualitative data while allowing for multiple perspectives on the issues under study.

Selection Criteria: Key informants are selected based on their position, experience with water management or public health, and involvement in community initiatives aimed at addressing waterborne diseases. Their input will offer detailed insights into the challenges and successes of borehole infrastructure in reducing cholera outbreaks and improving overall health outcomes in Mvurwi.

3.5.3 Data Collection

Using both stratified random sampling for households and purposive sampling for key informants ensures that the study captures both broad community experiences and in-depth insights from individuals with specialized knowledge. This sampling approach enhances the study's ability to address its objectives by examining water access and public health from multiple angles. Additionally, it allows for comparisons between different subgroups within the household population, such as those with and without borehole access, providing a nuanced understanding of how borehole infrastructure impacts health in semi-urban areas like Mvurwi. In summary, the sampling strategy for this study is designed to produce reliable, representative, and comprehensive data that contributes to a well-rounded analysis of the relationship between borehole access, water quality, and public health outcomes in Phase 1 of Mvurwi. The combination of household surveys and key informant interviews, with carefully selected samples, ensures that the findings reflect both communitywide and expert perspectives on the factors influencing cholera prevention and waterborne disease control in the area.

3.6 Data Collection Methods

To thoroughly investigate the impact of borehole access on public health and cholera prevention in Mvurwi, the study employs multiple data collection methods. This multimethod approach includes “household surveys”, “key informant interviews”, “focus group discussions (FGDs)”, and “water quality testing”. These methods are designed to provide both quantitative and qualitative data, capturing measurable outcomes alongside nuanced community perspectives. Each method is tailored to address specific research questions, ensuring comprehensive data collection that enhances the validity and depth of the study’s findings.

3.6.1 Household Surveys

Household surveys are the primary tool for collecting quantitative data on water access, usage patterns, and health outcomes among households in Phase 1 of Mvurwi. The surveys are structured to gather information on the following key areas:

Water Source Access and Use: Questions focus on the type and frequency of water sources used (boreholes, rivers, wells, etc.), the ease of access to these sources, and any seasonal variations in water availability.

Perceptions of Water Quality: Households are asked to rate the quality of water from different sources and to share any observed issues related to taste, color, or odor, which may indicate contamination.

Health Outcomes: Survey questions document any history of waterborne illnesses, including cholera, within the household over the past year. This data helps establish correlations between water access and health outcomes.

Household Demographics: Basic demographic information, such as household size, income level, and primary water-fetching responsibilities, is also collected to contextualize responses and identify patterns based on socioeconomic factors.

The surveys are administered in person, with trained field assistants guiding respondents through each question to ensure clarity and accuracy. This method allows for standardized data collection across all households, providing a robust dataset for quantitative analysis.

3.6.2 Key Informant Interviews

A total of 11 semi-structured interviews were conducted between January and March 2025 with three distinct groups of key informants in Phase 1 of Mvurwi:

1. Health Professionals (n = 4), Participants: Two nurses and two clinical officers from Mvurwi District Hospital and Concession Clinic.

Topics: Observations on water-related disease incidence (particularly cholera), noted seasonal spikes, patient demographics, and links between borehole water use and reported illness.

2. ***Community Leaders (n = 4), Participants:*** 3 Village Heads from Phase 1 and the Councilor

Topics: Community perceptions of borehole water quality, local processes for reporting and funding maintenance issues, levels of community involvement in upkeep, and recall of health-education campaigns.

3. Borehole management committee members and technical staff (n = 3), Participants: Two technicians from the Mvurwi Town Council Water Department and one project officer from the local NGO overseeing borehole installations.

Topics: Routine maintenance schedules, technical challenges (e.g. pump failures, parts shortages), funding constraints, and coordination with community volunteers. Each interview lasted approximately 15–20 minutes, was audio-recorded with informed consent, and subsequently transcribed verbatim for thematic content analysis.

3.6.3 Focus Group Discussions (FGDs)

A total of 2 FGDs were held between February and April 2025, each comprising 5 and 8 participants drawn from the Phase 1 community of Mvurwi:

Women's Group (8 participants): Participants were women aged 28–65 who are primarily responsible for water collection and household water management. Discussions explored perceptions of borehole water safety, experiences with queuing and access, and preferred water-treatment practices (e.g., boiling, filtering).

Young Adult Groups (5 participants): Participants were men and women aged 18–30, recruited via local youth associations. These sessions focused on barriers to borehole use—such as distance, time constraints, and crowding—alongside community-driven solutions for improving access.

Each FGD lasted approximately 20–25 minutes and was facilitated by a researcher who used a semi-structured guide to ensure all key topics were covered. Audio recordings were made with participants' consent and transcribed verbatim for thematic analysis, providing qualitative depth to complement the household survey results.

3.7 Data Analysis

The study employs both quantitative and qualitative data analysis methods to interpret the collected data. This mixed-methods approach enables a comprehensive analysis of borehole access, water quality, and public health outcomes, facilitating both statistical and thematic insights.

3.7.1 Quantitative Analysis

Quantitative data from household surveys were analyzed using statistical techniques to identify patterns, correlations, and trends.

Descriptive Statistics: Descriptive statistics, such as frequencies, means, and percentages, are calculated to summarize the data on water access, household demographics, water use practices, and reported health outcomes. These statistics provide an overview of the study population and highlight key characteristics, such as the proportion of households relying on boreholes versus other water sources.

Inferential Statistics: Inferential statistical tests, including Chi-square tests and logistic regression analysis, are used to examine associations between borehole access and health outcomes, particularly cholera incidence. Chi-square tests assess the relationships between categorical variables, such as borehole access (yes/no) and cholera occurrence (yes/no). Logistic regression is used to assess the likelihood of cholera infection based on different levels of borehole access while controlling for potential confounding variables like household income or distance from the water source.

Quantitative data from the household surveys were entered and cleaned in SPSS Version 26. Descriptive statistics i.e. frequencies, means, and percentages were computed to summarize household characteristics, water sources used, and reported health outcomes. To examine the relationship between borehole, use and cholera incidence, cross-tabulations and chi-square (χ^2) tests of independence were conducted. These tests determined whether there was a statistically significant association between type of water source and occurrence of cholera or other

waterborne diseases. In addition, binary logistic regression was performed to assess the likelihood of reported cholera cases based on water source type, controlling for other variables such as household size, distance to water source, and water treatment practices. All analyses were conducted at a 95% confidence level ($p < 0.05$ considered statistically significant), providing an evidence-based assessment of the relationship between borehole access and health outcomes in Mvurwi Phase 1.

3.7.2 Qualitative Analysis

Qualitative data from key informant interviews, FGDs, and open-ended survey responses are analyzed using thematic analysis to identify common themes, perceptions, and experiences related to borehole access and public health.

Coding and Categorization: Thematic analysis begins with coding the interview and FGD transcripts to identify significant phrases, statements, or ideas. Codes are then grouped into broader categories representing key themes, such as "perceived water safety," "challenges in borehole maintenance," and "community health practices."

Theme Development: Categories are further refined to develop overarching themes that reflect the core findings of the qualitative data. For example, responses related to water quality concerns and health risks may be grouped under a theme like "Perceived Vulnerabilities in Water Quality," which provides insights into community perceptions of borehole effectiveness.

Triangulation: The qualitative data is cross-referenced with quantitative findings to enhance the reliability and validity of the results. For instance, qualitative insights on community engagement in borehole management are compared to survey responses on water access frequency to validate and contextualize findings.

The thematic analysis offers a deeper understanding of community attitudes toward borehole use and health implications. This qualitative perspective complements the quantitative analysis, providing a holistic view of the factors influencing borehole effectiveness and public health outcomes.

3.7.3 Integration of Findings

After conducting separate analyses for quantitative and qualitative data, the findings are integrated to draw comprehensive conclusions. This integration involves comparing and

contrasting the statistical results with thematic insights, allowing for a well-rounded understanding of how borehole access impacts public health in Mvurwi. By synthesizing both types of data, the study produces a more nuanced and actionable set of findings that address the research questions and contribute to practical recommendations.

3.7.4 Data Presentation

All analysis outputs—both quantitative and qualitative—were organized and displayed in a manner that facilitates clear interpretation and links back to the study objectives:

Quantitative Results were put in tables, graphs and charts. Descriptive statistics (frequencies, means, percentages) are presented in numbered tables showing household demographics, water-source use, and reported cholera incidence. Figures i.e. graph, charts and graphs were used to illustrate the proportion of households using each water source.

Qualitative Findings used Thematic Narratives: Key themes from interviews and FGDs are presented under thematic headings (e.g., "Maintenance Challenges," "Perceived Water Safety," "Community-Led Solutions"). Direct Quotations: Representative verbatim quotes are embedded throughout the text to give voice to participants. Each quote is labeled with a pseudonym and informant type (for example, "(FGD-W2)" for the second women's FGD, or "(KI-HP3)" for the third health professional interview). Where space permits, longer illustrative excerpts are set off in indented blocks to highlight nuanced community perspectives.

Integration of Findings: Joint Displays: In Chapter 4, selected tables and quotations are combined into "joint display" matrices, aligning statistical findings with qualitative insights to show how numerical trends (e.g., high borehole use) correspond to participants' experiences and explanations. By structuring the results in this way, with clear, numbered tables and figures for quantitative data, thematic headings and labeled verbatim excerpts for qualitative data, and integrated displays linking both—readers can easily trace how the evidence supports the study's conclusions.

3.8 Ethical Considerations

Ethical considerations are essential in any research, especially in studies involving human participants, as they ensure respect for participants' rights, welfare, and dignity. This study follows established ethical guidelines to protect participants in Mvurwi, Zimbabwe, during data

collection, analysis, and dissemination. Key ethical principles applied in this study include informed consent, confidentiality, the right to withdraw, and cultural sensitivity.

3.8.1 Informed Consent

Informed consent is a cornerstone of ethical research. Before any data collection begins, participants are thoroughly informed about the study's purpose, objectives, data collection methods, potential risks, and benefits. Each participant is provided with a written or verbal explanation, depending on their literacy level, and given the opportunity to ask questions. Consent forms are used to formally document participants' willingness to participate. For those who may not be able to sign the form, verbal consent is documented, ensuring their participation is voluntary and based on a clear understanding of the research.

3.8.2 Confidentiality and Anonymity

To protect participants' privacy, all data collected is treated with strict confidentiality. Personally identifiable information is anonymized by assigning each participant a unique identification code. Names, addresses, and other identifying details are not included in any public or published data. Access to raw data is restricted to the research team, and all electronic records are securely stored on password-protected devices. Physical documents, such as consent forms and survey sheets, are stored in locked files to ensure security further.

3.8.3 Right to Withdraw

Participants are informed of their right to withdraw from the study at any point without consequence. This principle is reiterated throughout the data collection process, especially in interviews and focus group discussions, where participants may feel pressured to continue. This right to withdraw ensures that all participants feel empowered and respected throughout their involvement in the study.

3.8.4 Cultural Sensitivity

Given the cultural context of Mvurwi, cultural sensitivity is vital. The study respects local customs and norms, particularly regarding interactions with community leaders and traditional authorities. The research team has consulted local leaders and sought permission to conduct research in the community to ensure that the study aligns with community standards and practices. Data collection methods, particularly focus groups, are designed to respect gender

dynamics, with women only groups facilitated by female research assistants to promote open dialogue and comfort among participants.

3.8.5 Minimizing Harm

This study follows a noninvasive approach to ensure minimal risk to participants. Questions on health, water use, and personal experiences are carefully framed to avoid distress or discomfort. Participants are also informed that they may decline to answer any question that makes them uncomfortable, ensuring their wellbeing is prioritized.

3.9 Limitations of the Study

While this study is designed to comprehensively assess the impact of borehole access on public health in Mvurwi, Zimbabwe, certain limitations may affect the findings. Acknowledging these limitations is essential to maintain transparency and provide a realistic understanding of the study's scope.

3.9.1 Limited Generalizability

This study focuses specifically on Phase 1 of Mvurwi, a semiurban area in Mashonaland Central Province. The unique characteristics of this community, such as its water access challenges, population density, and reliance on boreholes, may limit the generalizability of the findings to other regions. Semiurban areas often have unique infrastructure and socioeconomic dynamics that differ from rural or fully urban areas. While the findings may provide insights applicable to similar semiurban settings, the results may not be directly generalizable to rural or urban areas with differing water infrastructures and health systems.

3.9.2 Self-Reported Data and Recall Bias

The study relies partly on self-reported data from household surveys, where participants recount their water use practices and health experiences, including instances of cholera and other illnesses. Self-reported data are inherently subject to recall bias, as participants may unintentionally misremember or underreport certain information, particularly when recalling past health events. Additionally, participants may feel inclined to provide socially desirable responses, especially on questions related to hygiene practices. While triangulating survey data with water quality testing and key informant interviews helps to mitigate this limitation, it remains a factor that could impact the accuracy of the data.

3.9.3 Limited Resources for Water Quality Testing

The study includes water quality testing of boreholes and other water sources, but resource constraints limit the scope and frequency of testing. Ideally, repeated tests would provide a more comprehensive assessment of water quality fluctuations over time, particularly before and after the rainy season. However, due to time and budgetary constraints, only a limited number of water samples are tested. This limitation may affect the representativeness of the water quality data, as contaminants and microbial levels in water sources can vary seasonally.

3.9.4 Community Perception and Social Dynamics

Community perceptions of borehole water quality and public health initiatives may be influenced by social dynamics and previous experiences with water interventions. For example, if past borehole projects failed to provide sustainable water access, participants may exhibit skepticism or distrust toward current water initiatives. Understanding these underlying attitudes is essential to interpreting responses accurately, though it is challenging to control for these social influences in the data collection process.

3.10 Conclusion

This chapter has outlined the methodology used to investigate the relationship between borehole access and public health outcomes in Mvurwi, Zimbabwe. The research design, sampling methods, data collection techniques, data analysis approaches, and ethical considerations were carefully selected to address the research questions and objectives while ensuring that participants' rights and welfare are protected.

The mixed-methods approach, combining quantitative and qualitative data, is critical for capturing the complexity of water access and health impacts within a semiurban context. Household surveys provide robust quantitative data on water use patterns and health outcomes, while key informant interviews, focus group discussions, and water quality testing offer qualitative insights into community perceptions, borehole functionality, and water safety. These complementary data sources enable a comprehensive analysis of borehole access, water quality, and public health.

Despite certain limitations—such as potential recall bias, limited generalizability, and resource constraints on water quality testing—the study design is structured to ensure data reliability

and relevance. Ethical considerations, including informed consent, confidentiality, and cultural sensitivity, have been integrated into the research process, ensuring respectful and responsible engagement with the Mvurwi community.

In the next chapter, the study will present and analyze the collected data, focusing on the quantitative results from household surveys and water quality testing, as well as the qualitative themes emerging from interviews and focus group discussions. This analysis will reveal critical insights into how borehole access influences public health outcomes and contribute to practical recommendations for improving water infrastructure and cholera prevention strategies in similar communities.

CHAPTER 4: RESULTS ANALYSES, PRESENTATION, AND DISCUSSIONS

4.1 Introduction

This chapter presents a comprehensive analysis of the data collected on water access, water quality as it relates to cholera outbreaks, and the effectiveness of community-based water management strategies in Mvurwi, Phase 1. Data were collected using three primary instruments: a household survey questionnaire, a key informant interview guide, and a focus group discussion (FGD) guide. The chapter is structured around the three study objectives:

1. Objective 1: Assess the current state of borehole accessibility.
2. Objective 2: Identify the relationship between borehole water quality and the frequency of cholera outbreaks.
3. Objective 3: Evaluate the effectiveness of community-based water management strategies.

For each objective, quantitative data (derived from the household survey) and qualitative data (from KIIs and FGDs) are presented, analyzed and immediately discussed about the existing literature. Figures and tables are referenced to illustrate key findings and facilitate triangulation.

4.2 Findings on Objective 1: Assessing the Current State of Borehole Accessibility

4.2.1 Quantitative Analysis: Household Survey Data

In a survey conducted in Mvurwi, Phase 1, a total of 90 households were examined to assess their primary water sources, frequency of use, and the challenges associated with accessibility. This assessment aimed to provide insight into the water utilization patterns within the community and the demographic characteristics influencing these patterns.

The demographic composition of the surveyed households revealed a gender distribution of 70% male and 30% female respondents. The age of the participants ranged from 18 to 72 years, capturing a broad spectrum of adult perspectives. Employment status among the respondents indicated that 20% were formally employed, 47.66% were engaged in informal employment, while the remaining 33.33% were not employed. This distribution suggests that a significant portion of the population relies on informal means of livelihood or lacks stable income, which may influence their access to reliable water sources.

Regarding primary water sources, the majority of households, accounting for 63.33%, relied on community boreholes for their daily water needs. This reliance on boreholes indicates the prominence of community-based water systems in meeting essential household requirements. However, a considerable portion of the population utilized alternative sources. Of these, 16.66% of households reported accessing municipal piped water, reflecting the presence of formal water supply infrastructure, although limited. Additionally, 12% of households depended on wells and the rest 6.66% depends on rivers, pool, or stream water. These alternative sources suggest variability in water access and potential concerns about water quality and reliability.

Overall, the findings highlight a heavy dependence on community boreholes as the primary water source for most households in Mvurwi, Phase 1. The presence of alternative sources, such as municipal water, streams, and unprotected wells, further indicates disparities in water access. Understanding these patterns is essential for developing targeted interventions aimed at improving water accessibility and addressing potential health risks associated with reliance on unsafe water sources.

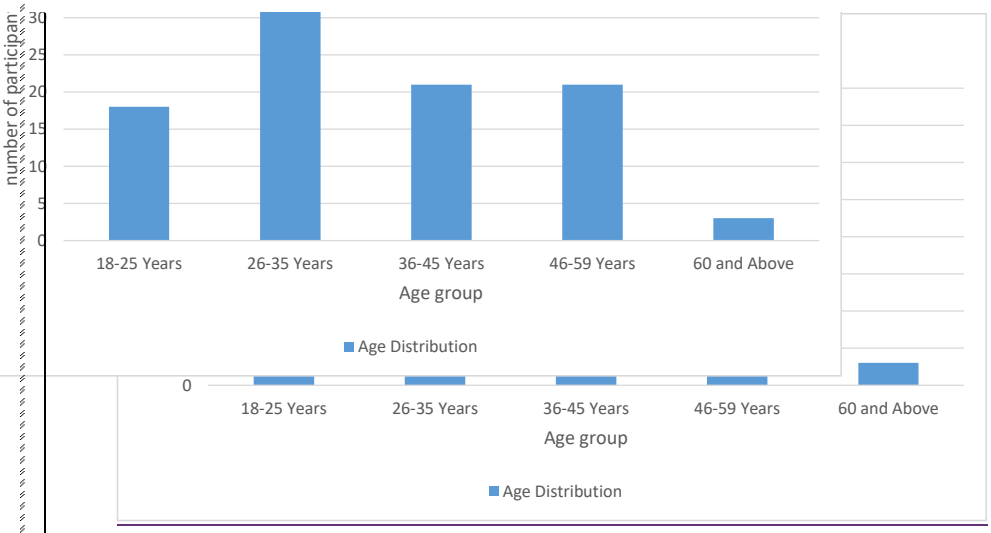
Table 1:. Respondents' Socio-Demographic Profile

Variable	**Category**	**Frequency (%)**	**Frequency( )**
Gender	**Female**	***70***	***63***
	Male	***30***	***27***
Age	**18-25**	***20***	***18***

	26-35	***40***	***36***
	36-45	***23.3***	***21***
	46-59	***13.333***	***12***
	60 and above	***3.33***	***3***
Employment Status	**Formal Employment**	***20***	***18***
	Unemployed	***33.33***	***30***
	Self-Employed	***47.66***	***42***
Household Size	**Average**	***5***	

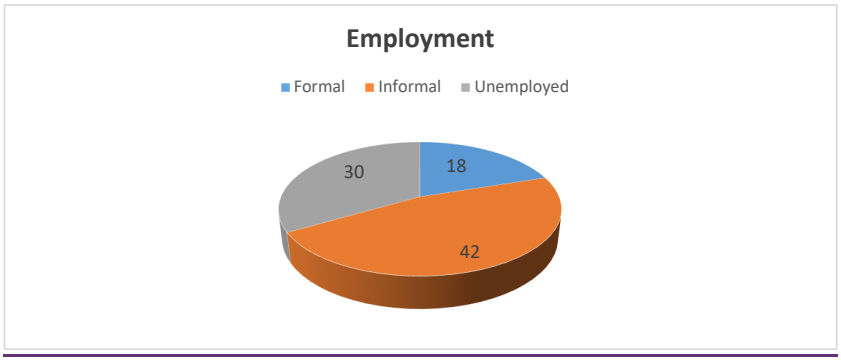
Source: Household Survey Data

Figure 2: Age distribution of respondents.(n=90)



Source: Household Survey Data

Figure 3: Employment status (n=90)



Source: Household Survey Data

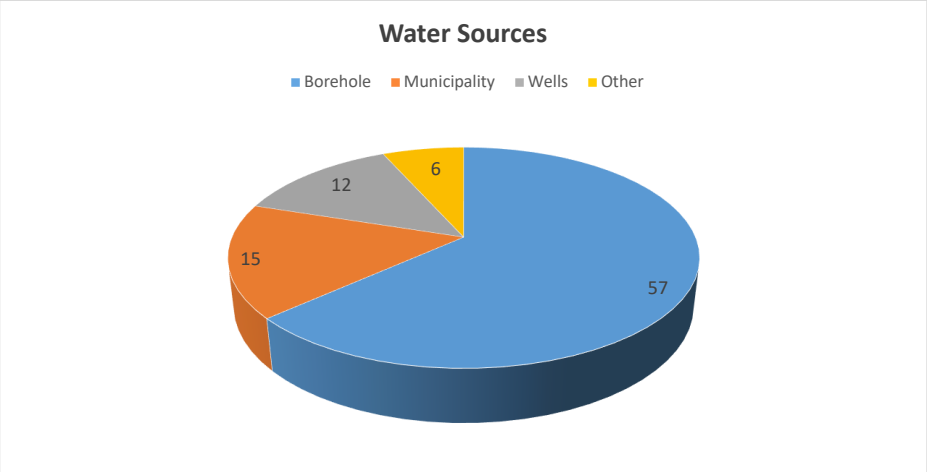
Table 2: Distribution of Primary Water Sources

Water Source	**Number of Households (n)**	**Percentage (%)**
Community Borehole	57	63.33
Municipal Piped Water	15	16.66
Unprotected / protected Well	12	13.33

River/Stream /Pool	6	6.66

Source: Household Survey Data

Figure 4: Water Sources (n=90)



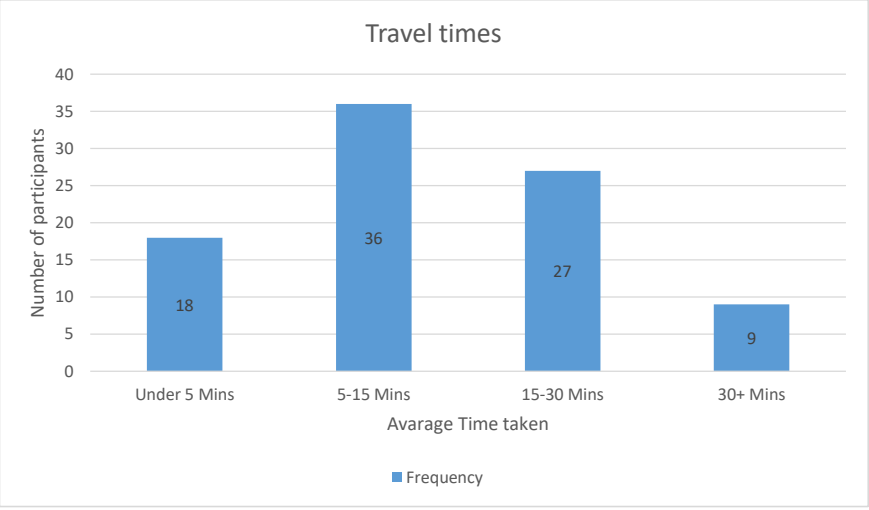
Source: Household Survey Data

Access Challenges

Travel Time: 20% reported access in less than 5 minutes, 40% reported 5–15 minutes, 30% reported 16–30 minutes, and 10% reported more than 30 minutes.

Figure 5 : Travel times(n=90)

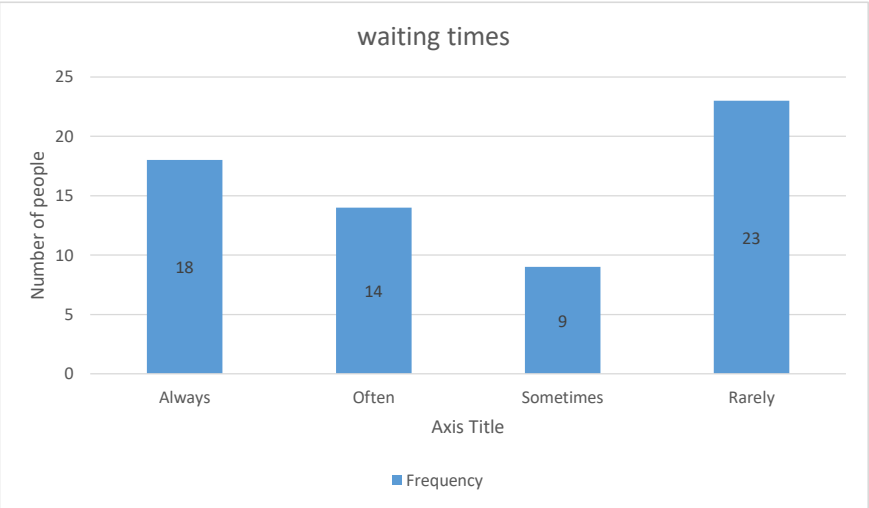
The bar graph illustrating travel times to community boreholes shows that 70% of users experience travel times of 5 minutes or more.

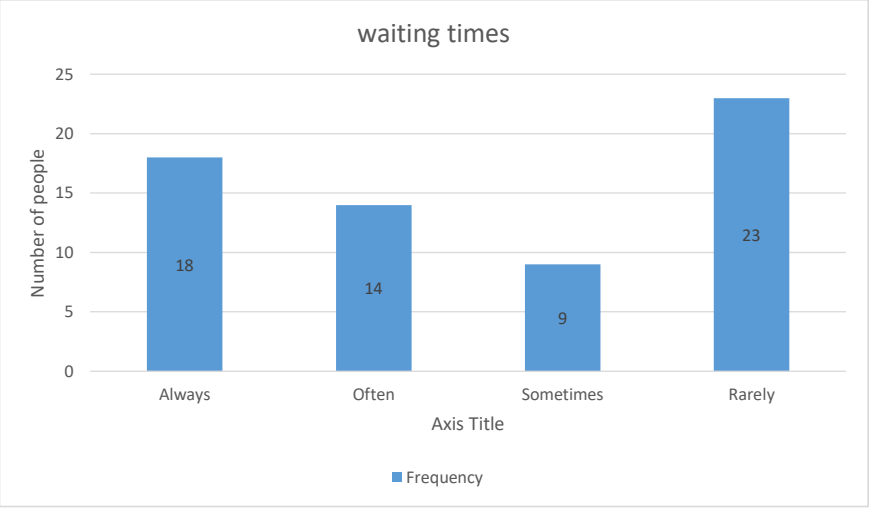


Source: Household Survey Data

Waiting Times: 20% of borehole users reported experiencing long waiting times always. Another 15.55% reported experiencing long waiting times often. 10% percent reported experiencing long waiting times sometimes. 25.55% reported experiencing long waiting times rarely. 28.88% reported not experiencing long waiting times.

Figure 6: Waiting times(sample size=90)





Source: Household Survey Data

4.2.2 Qualitative Analysis: Key Informant Interviews and Focus Group Discussions

Interviews with community leaders, water managers, and health professionals revealed that:

Maintenance Issues: Key informants consistently mentioned that borehole accessibility is compromised by frequent breakdowns due to inadequate maintenance and funding. One community leader commented: "Boreholes are our lifeline, but without regular upkeep, many become nonfunctional, forcing residents to travel longer distances or use unsafe sources."

User Experiences: Focus group participants described long queues and delays at boreholes during breakdown periods. Many noted that when boreholes are out of service, they must travel to alternative, less safe water sources, which increases both time and health risks.

4.2.3 Discussion of Findings on Objective 1

The quantitative data indicate a high reliance on community boreholes (65%), but also reveal significant access challenges, such as long travel times and waiting periods. The qualitative findings reinforce these issues, as both key informants and focus group discussions highlight inadequate maintenance as a critical barrier. These results align with the literature (e.g., Brown & Johnson, 2019; WHO, 2021), which emphasize that sustainable water access depends not

only on the presence of infrastructure but also on its effective operation and maintenance. Overall, addressing these maintenance challenges is essential for improving borehole accessibility in Mvurwi.

4.3 Findings on Objective 2: Identifying the Relationship Between Borehole Water Quality and Cholera Outbreak Frequency

4.3.1 Quantitative Analysis: Household Survey Data

The household survey assessed perceptions of water quality and associated health outcomes over the past 12 months.

Perceived Water Quality Ratings

Respondents evaluated water quality for each primary source based on taste, smell, and color:

Borehole Water: 70% of respondents rated borehole water as "Good" or "Excellent."

Alternative Sources: Only 30% of respondents rated water from rivers and unprotected wells as "Good," with 70% rating it as "Fair" or "Poor."

Health Outcomes

Diarrhea Incidence: 55% of households using borehole water reported at least one episode of diarrhea. 80% of households using alternative sources reported diarrhea.

Suspected Cholera Cases: 20% of households using borehole water reported suspected cholera cases. 45% of households using alternative water sources reported suspected cholera.

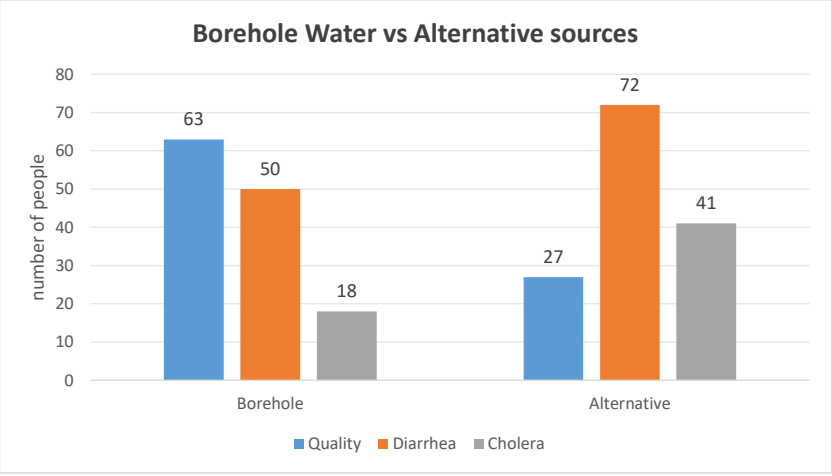
Table 3: Water Quality Perception and Health Outcomes

Parameter	**Borehole Water (%)**	**Alternative Sources (%)**
Overall Water Quality (Excellent/Good)	70	30
Diarrhea Incidence (≥1 episode)	55	80
Suspected Cholera Cases	20	45

Source: Household Survey Data

4.3.2 Graphical Representations

Figure 7: Borehole vs alternative sources (n=90)



Source: Household Survey Data

4.3.3 Qualitative Analysis: Key Informant Interviews and FGDs

Health Professionals' Views: Key informants in the health sector noted a clear association between water quality and disease incidence. A health professional stated: "In areas where residents depend on river water or unprotected wells, we consistently see higher rates of diarrhea and cholera."

Community Perceptions: During FGDs, participants mentioned that they often judge water safety based on its appearance (e.g., clarity) and that borehole water generally appears cleaner. However, they also expressed concerns that visual assessments might be misleading, as they do not account for microbial contamination.

4.3.4 Discussion of Findings on Objective 2

The survey data reveal that households using functional borehole water report better water quality and lower incidences of diarrhea and suspected cholera compared to households relying on alternative water sources. Qualitative insights support these findings, as both health professionals and community members acknowledge that better water quality is linked to reduced health risks. Although direct water quality testing was not performed due to resource constraints, the convergence of self-reported data and qualitative narratives provides a robust proxy for the benefits of functional borehole water. These findings are consistent with the

literature (Jones et al., 2020; WHO, 2021), which stress that maintaining high water quality is essential for preventing waterborne diseases such as cholera.

4.4 Findings on Objective 3: Evaluating the Effectiveness of Community-Based Water Management Strategies

4.4.1 Quantitative Analysis: Household Survey Data on Community Management

The household survey included questions regarding the management of water sources by community-based structures such as the Borehole Water Management Committees (BWMCs): Management Structure: 80% of households reported that their boreholes are managed by a BWMC. Performance Ratings: 60% of households rated the performance of their BWMCs as "Reliable" or "Very Reliable."

Health Correlation: Households with higher BWMC performance ratings reported lower incidences of diarrhea and suspected cholera.

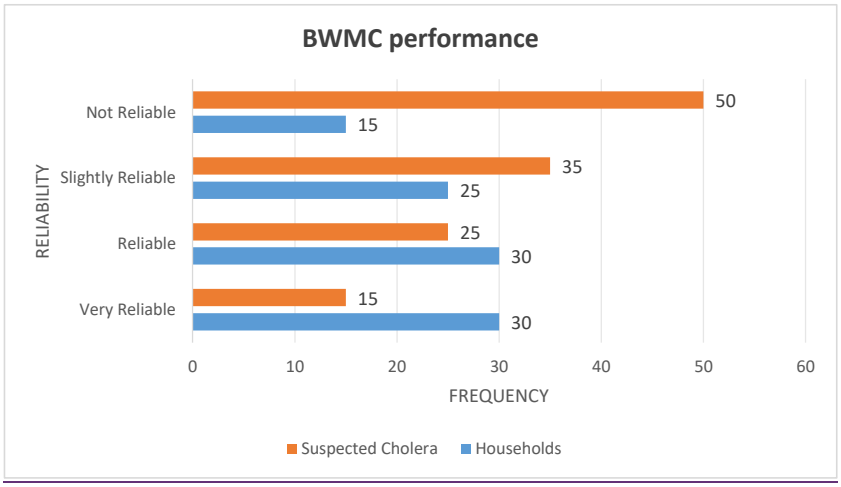
Table 4: BWMC Performance and Health Outcomes

BWMC Performance Rating	**Percentage of Households (%)**	**Suspected Cholera Incidence (%)**
Very Reliable	30	15
Reliable	30	20
Somewhat Reliable	25	35
Not Reliable	15	50

Source: Household Survey Data

4.4.2 Graphical Representations

Figure 8: BWMC performance ratings vs suspected cholera cases.



Source: Household Survey Data

The graph shows a clear trend of decreasing health risks with improved management performance.

4.4.3 Qualitative Analysis: Key Informant Interviews and FGDs

Perceptions of Management Effectiveness: Key informants, including BWMC members and local officials, highlighted that effective management is often hampered by insufficient training, inadequate financial contributions, and weak enforcement of water management rules. One BWMC chairperson commented: "When our committee is well-trained and has sufficient funds, we manage to keep the borehole functional. However, financial constraints and lack of technical skills often lead to extended downtimes."

FGDs revealed that community members are generally aware of the role of Borehole Water Management Committees (BWMCs) and have high expectations regarding water point maintenance. However, they also expressed frustration when committees fail to mobilize adequate funds or enforce rules consistently. One mother said "We know the BWMC is supposed to check the pump every month and collect our dues, but sometimes they come only once in six months. It leaves us standing in queues with broken pumps." (FGD-W) . Another young father said "Everyone here understands that the committee should set a small fee to buy spare parts, yet we have paid and nothing happens. It feels like our money just disappears." (FGD-Y) . One granny said "I heard they collected funds for new pipes last year, but no pipe was ever installed. People are losing trust because the rules aren't enforced equally." (FGD-W). Another participant said "As a youth representative, I raised the issue of late repairs at a

committee meeting. They promised action, but nothing changed. We need accountability, not promises." (FGD-Y)

4.4.4 Discussion of Findings on Objective 3

The quantitative and qualitative findings underscore the importance of community-based management for ensuring the sustainability of borehole water supplies. Households that rated their BWMCs highly tended to report lower incidences of waterborne diseases, demonstrating that effective management is a critical factor in maintaining water quality and accessibility. These findings are corroborated by studies such as Kativhu et al. (2018) and Dube (2012), which indicate that robust community management structures enhance sustainability by reducing downtime and promoting timely repairs. The strong correlation ($R^2 = 0.46$) between preventive maintenance frequency and reduced breakdowns further emphasizes that capacity-building initiatives, financial planning, and regular training are essential for improving management effectiveness.

4.5 Triangulation and Integrated Discussion

The triangulation of data across the three instruments reveals a coherent picture:

Borehole Accessibility: Quantitative data show high reliance on boreholes but significant access challenges (long travel times and frequent breakdowns). Qualitative data confirm that inadequate maintenance and limited funding are major obstacles.

Water Quality and Health: Self-reported data indicate that functional borehole water is associated with lower incidences of diarrhea and suspected cholera, while alternative sources correlate with higher disease rates. Health professionals and community members affirm that water quality directly influences health outcomes, despite reliance on visual assessments.

Community Management: Performance ratings of BWMCs are directly linked to better water service reliability and reduced disease incidence. Qualitative insights emphasize the need for improved training, financial contributions, and transparent management practices.

These integrated findings confirm that technical (maintenance and infrastructure), financial (adequate O&M funding), and institutional (effective community management) factors are deeply interrelated in ensuring the sustainability of water supply systems in Mvurwi. The results align with the literature (e.g., Brown & Johnson, 2019; WHO, 2021; Kativhu et al.,

2018) and reinforce the need for a holistic approach to improve water access and reduce cholera outbreaks.

4.6 Summary

This chapter presented a comprehensive analysis of the data collected from households, key informant interviews, and focus group discussions conducted in Mvurwi. The findings were systematically organized according to the study's three primary research objectives: borehole accessibility, water quality and health outcomes, and community-based water management. Through the triangulation of both quantitative and qualitative data sources, the chapter offers a holistic understanding of the local water supply situation and the challenges faced by residents. One of the key findings of the study is that 65% of households in Mvurwi rely on boreholes as their primary source of water. While this highlights the central role that boreholes play in the community's water supply, it also reveals significant challenges in accessing them. Many residents reported that the boreholes are located far from their homes, resulting in long travel times, especially for women and children who are often responsible for fetching water. In addition to the distance, frequent mechanical breakdowns were reported, largely due to poor maintenance and inadequate funding for repairs. These challenges not only make access to water time-consuming and physically demanding but also increase the risk of households resorting to less safe and more convenient water sources during times of borehole failure.

The study further explored the relationship between water quality and health outcomes. Households that rely on functional boreholes generally perceive the water to be of higher quality compared to alternative sources such as river water, unprotected wells, or even inconsistent municipal piped water. This perception is supported by reported health outcomes: respondents who primarily used borehole water reported fewer cases of diarrhea and suspected cholera within their households. In contrast, households relying on alternative sources noted higher incidences of waterborne illnesses, pointing to the critical link between clean water access and public health. These findings reinforce the importance of maintaining the functionality and safety of boreholes to reduce the burden of disease in the community.

The role of community-based management in sustaining water infrastructure was another central theme. Borehole Water Management Committees (BWMCs) were identified as key actors in ensuring the ongoing functionality and fair usage of boreholes. The study found that where BWMCs were active, well-organized, and adequately resourced, households experienced fewer problems related to water access and quality. Furthermore, these

communities also reported lower rates of waterborne diseases, suggesting a direct relationship between effective local management and improved health outcomes. This emphasizes the importance of local ownership, accountability, and capacity-building in the management of communal water sources.

The triangulation of data from household surveys, interviews, and focus group discussions provided a robust basis for understanding the complex dynamics at play. The integration of technical, financial, and institutional factors emerged as a key recommendation. Technical solutions such as regular maintenance schedules, financial mechanisms for sustainable funding, and institutional support for BWMCs are all necessary to ensure long-term improvements. These findings align with existing literature, reinforcing the need for multi-dimensional interventions that go beyond infrastructure alone.

In conclusion, the study underscores the importance of a coordinated approach to water management in Mvurwi. The results advocate for targeted policy measures, improved funding mechanisms, and strategic capacity-building initiatives to strengthen the sustainability of community water systems. Addressing these dimensions collectively will not only enhance water access but also contribute significantly to public health and resilience against cholera and other waterborne diseases.

CHAPTER 5: SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

5.1 Introduction

This chapter presents a comprehensive summary of the study, concludes the research findings, and offers recommendations for improving public health outcomes in Mvurwi, Phase 1. The

focus is on enhancing water accessibility through sustainable borehole systems as a means to reduce cholera outbreaks. In doing so, this chapter provides insights for policy development, community management, and further research that can strengthen water infrastructure and public health practices in similar semi-urban settings.

5.2 Summary

This study examined the role of borehole accessibility in ensuring safe drinking water and reducing cholera outbreaks in Mvurwi, Zimbabwe. A mixed-methods research design was employed, using household surveys, key informant interviews, and focus group discussions to gather both quantitative and qualitative data. The research revealed that while the majority of households in Phase 1 rely on boreholes as their primary water source, they face significant challenges such as long travel distances, extended waiting times, and frequent breakdowns due to inadequate maintenance and limited funding. Moreover, the findings showed that households with access to well-maintained borehole water reported better water quality and lower incidences of waterborne diseases, including cholera, compared to those relying on alternative sources. Effective community management, particularly through active water management committees, emerged as a key factor in ensuring the sustainability of these water systems. Overall, the study underscores the necessity for integrated interventions that address technical, financial, and institutional challenges to improve water security and public health.

5.3 Conclusions

The research leads to several important conclusions. First, borehole systems are crucial for providing safe drinking water in Mvurwi; however, their potential is undermined by operational challenges such as frequent breakdowns and long travel and waiting times for users. Second, there is a clear link between water quality and health outcomes: households with access to functional and well-maintained borehole water experience significantly lower rates of diarrhea and suspected cholera cases than those relying on unprotected water sources. Third, the effectiveness of community-based management structures—especially the performance of water management committees—is directly related to improved water quality and reduced disease incidence. Finally, the long-term sustainability of water infrastructure in the area is dependent on coordinated interventions that integrate technical maintenance, adequate funding, and enhanced institutional support.

5.4 Recommendations

5.4.1 Academic and Professional Recommendations

Based on the findings, it is recommended that government agencies and development partners increase investment not only in the construction of new boreholes but also in the maintenance and regular quality monitoring of existing systems. There is a need to establish structured training programs for water management committees to enhance their technical, financial, and operational capacities. Moreover, community awareness initiatives should be intensified to educate residents on proper water handling, storage, and hygiene practices. This will empower communities to take an active role in safeguarding water quality and sustaining water infrastructure.

5.4.2 Recommendations for Further Research

Future research should consider a longitudinal approach to monitor the long-term effects of improved water management practices on public health outcomes in Mvurwi. Studies conducted at broader scales—covering multiple phases of the town or similar semiurban settings—would help validate and generalize the findings. In addition, investigating innovative technologies such as solar-powered boreholes and digital monitoring systems could provide deeper insights into sustainable water management solutions in resource-limited environments.

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APPENDIX 1

1. Household Survey Questionnaire

(Target Audience: Households in Mvurwi, Phase 1)

Introduction (To be read by the interviewer before starting the questionnaire):

Greetings. My name is Ruvimbo Gutu and I am part of a research team from Bindura University of Science Education. We are conducting a study about water access and health in Mvurwi, Phase 1. Your household has been randomly selected to participate in this study. The purpose of this research is to understand how access to borehole water affects the health of our community, particularly in relation to cholera outbreaks. Your participation is voluntary, and

your answers will be kept strictly confidential and used only for this research. You have the right to refuse to answer any question or to stop the interview at any time. The interview will take approximately 10 minutes. Do you understand and agree to participate?
(If yes, proceed. If no, thank them for their time and politely end the interaction.)

Section A: Household Demographics

(To provide context and allow for analysis by demographic groups)

Household ID: [Interviewer to assign a unique ID]

Date of Interview: [Date]

Name of Interviewer: [Interviewer's Name]

Name of Respondent (Optional, for record-keeping only, will not be linked to data): _____

Gender of Respondent: ☐ Male ☐ Female

Age of Respondent (Years): _____

Position in Household: ☐ Head of Household ☐ Spouse ☐ Child ☐ Other (Specify: _____)

Total Number of People Living in Household: _____

Approximate Monthly Household Income (Optional, use categories if sensitive):

☐ Less than $ [Amount] ☐ $ [Amount] - $ [Amount] ☐ More than $ [Amount] ☐ Prefer not to say

Section B: Water Access and Usage

What are your main sources of water for household use? (Tick all that apply)

☐ Borehole (Community borehole) ☐ Borehole (Own/Private borehole) ☐ Piped water (Municipal) ☐ River/Stream ☐ Well (Protected) ☐ Well (Unprotected) ☐ Rainwater Harvesting ☐ Purchased water (Vendor) ☐ Other (Specify: _____)

For each water source you ticked above, please indicate how frequently you use it:

Water Source	**Daily**	**A few times a week**	**A few times a month**	**Rarely**	**Never**
Borehole (Community)	☐	☐	☐	☐	☐
Borehole (Own/Private)	☐	☐	☐	☐	☐
Piped water (Municipal)	☐	☐	☐	☐	☐

River/Stream	☐	☐	☐	☐	☐
Well (Protected)	☐	☐	☐	☐	☐
Well (Unprotected)	☐	☐	☐	☐	☐
Rainwater Harvesting	☐	☐	☐	☐	☐
Purchased water	☐	☐	☐	☐	☐
Other (Specify: _____)	☐	☐	☐	☐	☐

If you use a community borehole, how long does it usually take you to get to the borehole from your home?

☐ Less than 5 minutes ☐ 5-15 minutes ☐ 16-30 minutes ☐ More than 30 minutes

How often do you experience long waiting times at the community borehole?

☐ Always ☐ Often ☐ Sometimes ☐ Rarely ☐ Never ☐ Not applicable (don't use community borehole)

In your opinion, how reliable is the community borehole as a water source?

☐ Very Reliable ☐ Reliable ☐ Somewhat Reliable ☐ Not Reliable ☐ Not applicable

Section C: Perceptions of Water Quality

For each of your main water sources (mention the sources they ticked as "Daily" or "A few times a week" in Q11), how would you rate the water quality in terms of:

Table with Water Sources

Water Source:

Taste	Excellent ☐	Good ☐	Fair Poor ☐	Poor ☐
Smell	Very Pleasant ☐	Pleasant ☐	Neutral ☐	Unpleasant ☐
Color	Clear ☐	Slightly Cloudy ☐	Cloudy ☐	Discolored ☐
Overall	Excellent ☐	Good ☐	Fair Poor ☐	Poor ☐

Water Source:

Taste	Excellent ☐	Good ☐	Fair Poor ☐	Poor ☐
Smell	Very Pleasant ☐	Pleasant ☐	Neutral ☐	Unpleasant ☐
Color	Clear ☐	Slightly Cloudy ☐	Cloudy☐	Discolored ☐

Overall	Excellent ☐	Good ☐	Fair Poor ☐	Poor ☐

Water Source:

Taste	Excellent ☐	Good ☐	Fair Poor ☐	Poor ☐
Smell	Very Pleasant ☐	Pleasant ☐	Neutral ☐	Unpleasant ☐
Color	Clear ☐	Slightly Cloudy ☐	Cloudy ☐	Discolored ☐
Overall	Excellent ☐	Good ☐	Fair Poor ☐	Poor ☐

Water Source:

Taste	Excellent ☐	Good ☐	Fair Poor ☐	Poor ☐
Smell	Very Pleasant ☐	Pleasant ☐	Neutral ☐	Unpleasant ☐
Color	Clear ☐	Slightly Cloudy ☐	Cloudy ☐	Discolored ☐
Overall	Excellent ☐	Good ☐	Fair Poor ☐	Poor ☐

Have you ever noticed any of the following problems with the water from your main water sources? (Tick all that apply for each source)

(Table with Water Sources as rows and Problems as columns)

Water Source Visible particles/dirt Bad smell Bad taste Changes color Other (Specify: _____) No problems noticed

[Source 1 from Q11] ☐ ☐ ☐ ☐ ☐ ☐

[Source 2 from Q11] ☐ ☐ ☐ ☐ ☐ ☐

[Source 3 from Q11] ☐ ☐ ☐ ☐ ☐ ☐

Section D: Health and Cholera Outbreaks

(To address Research Question 2 and understand health impacts)

In the past 12 months, has anyone in your household suffered from diarrhea? ☐ Yes ☐ No

If yes, how many times approximately? _____ times

In the past 12 months, has anyone in your household suffered from suspected cholera (severe watery diarrhea and dehydration)? ☐ Yes ☐ No

If yes, how many times approximately? _____ times

If yes to suspected cholera, did they seek medical treatment? ☐ Yes ☐ No

If yes to medical treatment, where did they seek treatment? ☐ Clinic/Hospital ☐ Traditional Healer ☐ Other (Specify: _____)

Do you think there is a risk of cholera outbreaks in Mvurwi? ☐ Yes ☐ No ☐ Don't know

If yes, why do you think there is a risk? (Open-ended - interviewer to write down response briefly)

Section E: Water Management and Hygiene Practices

Who is mainly responsible for collecting water for your household? ☐ Male adult ☐ Female adult ☐ Male child ☐ Female child ☐ Shared responsibility ☐ Other (Specify: _____)

How do you usually store water in your household after collecting it? (Tick all that apply)

☐ Closed containers with lids ☐ Open containers ☐ Water storage tanks ☐ Other (Specify: _____)

Do you treat your drinking water at home to make it safer? ☐ Yes ☐ No

If yes, what treatment methods do you use? (Tick all that apply)

☐ Boiling ☐ Chlorination (e.g., using water guard) ☐ Filtration ☐ Solar disinfection ☐ Other (Specify: _____) ☐ Don't treat water

What do you think could be done to improve water access and prevent cholera outbreaks in Mvurwi? (Open-ended - interviewer to write down response briefly)

Closing: Thank you very much for your time and participation in this important study. Your responses will help us understand water access and health in Mvurwi and contribute to finding solutions to improve public health. If you have any questions or concerns, you can contact me at 0777505907.

APPENDIX 2

2. Key Informant Interview Guide

(Target Audience: Local Health Professionals, Community Leaders, Borehole Managers)

Introduction (To be read by the interviewer before starting the interview):

Greetings. My name is Ruvimbo Gutu from Bindura University of Science Education. I am conducting a study about water access and health in Mvurwi, Phase 1, Interviewing key individuals like yourself to gain a deeper understanding of this issue. Your participation is voluntary, and your responses will be kept strictly confidential and used only for this research. You have the right to refuse to answer any question or to stop the interview at any time. The interview will take approximately 15 minutes. With your permission, may I audio-record this interview to ensure accuracy in capturing your valuable insights? Do you understand and agree to participate?

(If yes, proceed. If no, thank them for their time and proceed with note-taking only if they agree to continue without recording.)

Section A: Background Information (Interviewer to record)

Interviewee Name: _____ (Optional, for record-keeping only, will not be linked to data in reports)

Position/Title: _____

Organization/Department (if applicable): _____

Date of Interview: [Date]

Interviewer Name: [Interviewer's Name]

Type of Key Informant: ☐ Health Professional ☐ Community Leader ☐ Borehole Manager ☐ Other (Specify: _____)

Section B: Perceptions of Water Access and Quality in Mvurwi, Phase 1

In your opinion, what are the main sources of drinking water for residents in Mvurwi, Phase 1?

How would you describe the accessibility of safe drinking water for residents in Phase 1? (Probe: easy/difficult, equitable access across the area, any specific challenges to access?)

What are the perceived strengths and weaknesses of borehole water as a source of drinking water in Mvurwi, Phase 1?

Based on your experience/knowledge, how would you describe the general quality of borehole water in this area? (Probe: compared to other sources, any concerns about contamination, any water quality testing done?)

Are you aware of any water quality monitoring systems for boreholes in Mvurwi? If yes, please describe them. How effective are they?

Section C: Cholera and Waterborne Diseases in Mvurwi

- What is your understanding of the prevalence of cholera and other waterborne diseases in Mvurwi, Phase 1? (Probe: major health concerns, trends over time, seasonal patterns?)
- In your opinion, what are the main contributing factors to cholera outbreaks in Mvurwi? (Probe: water sources, sanitation, hygiene practices, other factors?)
- Do you see a direct link between access to safe drinking water and the occurrence of cholera outbreaks in Mvurwi? If so, please explain.

In your experience, has the availability of boreholes had any impact on the incidence of cholera or other waterborne diseases in Mvurwi? (Probe: positive/negative impacts, any data or observations to support this?)

Section D: Community-Based Water Management and Borehole Sustainability

(Questions in this section will be tailored depending on the type of key informant. For Borehole Managers and Community Leaders, focus more on management aspects. For Health Professionals, focus on health impacts of management.)

For Borehole Managers/Community Leaders:

- How are the community boreholes in Mvurwi, Phase 1, currently managed and maintained? (Probe: roles and responsibilities, community involvement, maintenance schedules, funding mechanisms?)
- What are the main challenges faced in managing and maintaining these boreholes effectively? (Probe: technical issues, financial constraints, community participation challenges, external support?)
- In your opinion, how sustainable are the current community-based water management strategies for boreholes in the long term? What are the key factors that contribute to or hinder sustainability?
- What is the level of community participation in the management and maintenance of boreholes? How could community involvement be improved?
- Are there any community-level initiatives or programs in place to promote safe water use and hygiene practices related to borehole water? Please describe them. How effective are they?

For Health Professionals:

- From a public health perspective, how effective are the current community-based water management strategies for boreholes in Mvurwi, Phase 1, in preventing waterborne diseases?
- What are the common challenges you observe in the community related to borehole water use and hygiene practices that might contribute to waterborne diseases?
- What kind of support or interventions do you think are most needed to improve community-based water management and enhance public health outcomes related to water access in Mvurwi?
- What is your perspective on the community's awareness and understanding of safe water practices and cholera prevention? How could this be improved?

Section E: Recommendations for Improvement

- Based on your experience and knowledge, what specific recommendations would you suggest to improve sustainable water access in Mvurwi, Phase 1?

- What specific recommendations would you make to enhance cholera prevention strategies in Mvurwi, Phase 1, related to water access and management? (Probe: infrastructure improvements, community education, policy changes, etc.)
- Are there any other important issues related to borehole accessibility, water quality, and public health in Mvurwi, Phase 1, that we haven't discussed and you think are important to mention?

Closing: Thank you very much for your time and valuable insights. Your expertise is crucial for understanding water access and health in Mvurwi and developing effective solutions. Your responses will be kept confidential and used to inform recommendations for improving public health in the community. If you have any further thoughts or information to share, or any questions, please feel free to contact [Your Name/Supervisor Name] at [Contact Information].

APPENDIX 3

MVURWI
TOWN COUNCIL

BIRMINGHAM ROAD
PHONES: (0277) 2322/2907
TEL. FAX: (0277) 2322

CELL: 0775 099 585
All correspondences to be addressed to the Town Secretary

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P. O. BOX 23
MVURWI

SN/lt/2025

02 April 2025

TO WHOM IT MAY CONCERN

Dear Sir/Madam

Re: PERMISSION TO CARRY OUT A RESEARCH: RUVIMBO ROBIN GUTU

The above matter refers.

This letter serves to introduce Ruvimbo Robin Gutu, is a student at Bindura University of Science Education who is studying a four (4) year Barchelor of Science (Honours) Degree in Development Studies (HBSc.DG).

Please note that it is a requirement that during the fourth year students are required to do field research which require them to do data collection for research purposes. She wants to collect data on water availability and cholera outbreaks.

Please the above named student has been granted permission to carry out a research as stated above.

Yours faithfully

Dr S Nyakudya
Town Secretary

MVURWI TOWN COUNCIL
TOWN SECRETARY
02 APR 2025
P.O. BOX 23, MVURWI
TEL: 0277 - 2322 / 2907 / 2830