BINDURA UNIVERSITY OF SCIENCE EDUCATION

DEPARTMENT OF ENVIRONMENTAL SCIENCE



***ESTIMATING PER CAPITA WATER USE IN UNMETERED HOUSEHOLDS IN MARONDERA TOWN, ZIMBABWE*.**

BY

CHIDEMBO LYVET N

(B220763B)

A RESEARCH PROJECT SUBMITTED IN PARTIAL FULFILLMENT OF THE REQUIREMENTS OF THE BACHELOR OF SCIENCE (HONS) DEGREE IN SAFETY, HEALTH AND ENVIRONMENTAL MANAGEMENT.

MAY 2026

DECLARATION

To be completed by the student

Student number: B220763B

Chidembo Lyvet N, declares that this project is my original work and has not been submitted before. The references to projects submitted previously were indicated in the project.

To be completed by the supervisor

This project has been checked for conformity with faculty guidelines. It is suitable for submission to the faculty.

Supervisor's signature  Date 26 August 2026

Chairperson's signature  Date 26 August 2026

DEDICATION

This research is dedicated to my parents Greddwel and Constance Chidembo, together with my brothers Walter and Onias.

ACKNOWLEDGEMENTS

I thank God for making this project a success. My acknowledgment goes to my supervisor for his guidance. A special thanks to my family and friends for their unwavering support and limitless encouragement.

ABSTRACT

Background: Access to safe and adequate water remains a critical public health concern in developing countries. In Marondera town, Zimbabwe, a significant proportion of households are unmetered, making it difficult to determine actual per capita water consumption. Without reliable water use data, effective urban water management, public health planning and equitable distribution of water resources cannot be achieved.

Objective: The study estimated per capita water use in unmetered households in Marondera town to support effective water resource management, public health protection and environmental sustainability.

Methods and Materials: A mixed-methods research design was adopted. A corrected semi-structured closed-ended questionnaire was administered to 107 unmetered households selected through stratified random sampling across all 12 wards of Marondera. Semi-structured interviews were conducted with purposively selected household members. Sample size was determined using Cochran's formula at a 95% confidence level and 10% margin of error. Quantitative data were analysed using descriptive statistics and frequency-weighted midpoint estimation. Qualitative data were analysed using Braun and Clarke's six-phase thematic analysis framework. Per capita water use was estimated using an activity-based proxy method, with present household size as the denominator and total household daily use as the primary estimation variable, cross-validated against activity-specific volume questions.

Key Findings: The majority of participants were female (58.9%) and most households received water only 1–2 days per week (70.1%). The overall frequency-weighted per capita water use estimate was 27.8 litres per capita per day (LPCD), above the WHO critical minimum of 20 LPCD

but below the WHO intermediate benchmark of 50 LPCD. Disaggregation by present household size revealed LPCD estimates ranging from 98.7 LPCD for households of 1–2 persons to 14.1 LPCD for households of 10 or more persons. Households of seven or more present members, comprising 15.9% of the sample, fell below the WHO 20 LPCD critical minimum. Drinking and cooking contributed the smallest per-activity estimate of 1.4 LPCD despite being the most health-critical activity. Waterborne illness was reported by 43.9% of households, rising to 83% in the largest household size group. Dissatisfaction with water services was high (62.6%) and 67.3% of respondents were willing to have a water meter installed.

Conclusion: Unmetered households in Marondera are not meeting adequate domestic water supply levels on average, with larger households experiencing the most severe per capita water deprivation and the highest rates of waterborne illness. Supply frequency and metering, accompanied by affordable tariff structures, are the most critical interventions needed to improve water adequacy and protect public health in unmetered zones of Marondera.

Key terms: per capita water use; unmetered households; LPCD; water scarcity; public health; Marondera; Zimbabwe

Table of contents

APPROVAL FORM ii

DEDICATION iii

ACKNOWLEDGEMENTS iv

ABSTRACT v

TABLE OF CONTENTS vi

LIST OF TABLES viii

LIST OF FIGURES ix

LIST OF ABBREVIATIONS x

CHAPTER 1: INTRODUCTION 1

1.1 Background to the Study 1

1.2 Problem Statement 2

1.3 Aim and Objectives 3

1.3.1 Research Aim 3

1.3.2 Objectives 3

1.4 Research Questions 3

1.5 Significance of the Study 4

1.6 Assumptions 4

1.7 Limitations 4

1.8 Delimitations 5

CHAPTER 2: LITERATURE REVIEW 6

2.1 Introduction 6

2.2 Per Capita Water Use and Unmetered Households 6

2.3 Water Use and Public Health 6

2.4 Methods of Estimating Water Use in Unmetered Households 7

2.5 Debates in Unmetered Household Studies 9

2.6 Gaps in Existing Literature 9

2.7 Theoretical Frameworks 9

2.7.1 Determinants of Household Water Consumption Framework 9

2.7.2 Statistical Regression Framework 10

2.8 Conclusion 10

CHAPTER 3: RESEARCH METHODOLOGY 11

3.1 Description of Study Area 11

3.2 Research Design 12

3.3 Research Instruments 12

3.3.1 Semi-Structured Closed-Ended Questionnaire 12

3.3.2 Semi-Structured Open-Ended Interviews 13

3.4 Systematic Review of Existing Relevant Frameworks 14

3.5 Development of the Conceptual Framework 15

3.6 Determination of Sample Size 16

3.7 Recruitment and Selection of Participants 16

3.8 Per Capita Water Use Estimation Procedure 17

3.9 Ethical Considerations 18

3.10 Data Collection 18

3.10.1 Semi-Structured Closed-Ended Questionnaire 18

3.10.2 Semi-Structured Open-Ended Interviews 19

3.11 Framework Development and Evaluation 19

3.12 Data Management 19

CHAPTER 4: RESULTS 21

4.1 Characteristics of Participants.....21

4.2 Household Water Access and Infrastructure.....22

4.3 Water Usage Behaviour and Volume Estimates.....23

4.4 Per Capita Water Use Estimates (LPCD) 24

4.5 Activity-Disaggregated LPCD Estimates 25

4.6 Knowledge, Perceptions and Attitudes Toward Water Conservation and Health .26

CHAPTER 5: DISCUSSION 28

5.1 Introduction.....28

5.2 Characteristics of Participants.....28

5.3 Household Water Access and Infrastructure.....29

5.4 Water Usage Behaviour and Volume Estimates.....29

5.5 Per Capita Water Use Estimates (LPCD) 30

5.6 Activity-Disaggregated LPCD Estimates 31

5.7 Knowledge, Perceptions and Attitudes Toward Water Conservation and Health .32

CHAPTER 6: CONCLUSION AND RECOMMENDATIONS.....33

6.1 Conclusion 33

6.2 Recommendations.....34

REFERENCES 35

APPENDICES 40

Appendix A: Research Schedule 40

Appendix B: Semi-Structured Closed-Ended Questionnaire.....41

Appendix C: Semi-Structured Open-Ended Interview Guide 45

LIST OF TABLES

Table 2.1 Methods for estimating per capita water use in unmetered households 8

Table 3.1 Boolean search strings and filters applied per database 15

Table 3.2 Ward-level sample allocation 17

Table 4.1 Summary demographic profile of participants (n = 107) 21

Table 4.2 Estimated LPCD by present household size (n = 107) 24

Table 4.3 Activity-disaggregated LPCD estimates at modal household size (5.5 persons)25

LIST OF FIGURES

Figure 3.1 Map of the location of Marondera town, Zimbabwe.....11

Figure 3.2 Conceptual framework development process.....16

Figure 3.3 Steps of thematic analysis (Braun and Clarke, 2006).....20

Figure 4.1 Estimated LPCD by present household size with WHO benchmark lines.....24

Figure 4.2 Activity-disaggregated LPCD contributions at modal household size.....25

Figure 4.3 Distribution of households by C7 total daily use category and LPCD estimate24

Figure 4.4 Waterborne illness reported by present household size 27

Figure 4.5Perceived effect of inadequate supply on health and waterborne illness prevalence 27

CHAPTER 1: INTRODUCTION

1.Introduction

1.1 Background to the study

Globally, about eleven million remain unmetered (Richard Wilson, 2024). Although water is a vital resource in daily life, households often remain unaware of their actual water consumption (GENAQ, 2025). In developing countries where the lack of monitoring data is scarce, accurately estimating the average daily specific water consumption is complex (Mounirou et al., 2023). Approximately, 2.2 billion people still lack access to safely managed water services (WHO/UNICEF 2023). Zimbabwe faces urban water scarcity with water supplies strained by socio-economic stressors (Brooke & Fenner, 2022). In Marondera residents are facing severe water shortage (Wisdom, 2024).

Unmetered households, which lack water meters to monitor actual consumption, face challenges related to inefficient water use (Ofwat, 2025; Parvatka, 2024). One of the key frameworks in water management is the direct link between measuring water consumption and achieving water savings (Eawater, 2024). Accurate estimates of domestic water usage are important in informing urban water management, including the design and operation of water distribution systems, the formulation of water handling policies and development of residential infrastructure design for efficient and sustainable water use (Khan et al, 2023; Meyer et al., 2021; Rondinel-Oviedo & Sarmiento-Pastor, 2020). Predicting water use consumption is important for water management (X.Meng & Lifeng Wu, 2021). Conscious water consumption reduces water usage and lowers carbon footprints (Parvatkar, 2024).

One of the recurring challenges in drinking water supply is the lack of data regarding the actual volumes of water consumed (Mounirou et al., 2023). Previous studies have highlighted the scarcity of usage data due to the absence of meters (Ahmed et al., 2025). Therefore, this study aims to address a significant by estimating the water usage to support water management.

1.2 Problem statement

A major challenge in estimating per capita water use in unmetered households is that it depends on perceived knowledge rather than the actual water consumption (Madias, Borusiak & Szymkowiak 2022). Historically, few household surveys have evaluated per capita water availability (Thomas et al., 2020), this study aims to fill the knowledge gap by presenting new data on per capita household water consumption. A central issue driving this study is the absence of current data on per capita household water consumption (Jacobs et al., 2022).

1.3 Aim and Objectives

1.3.1 Aim

To estimate per capita water use to support effective water resource management, public health protection and environmental sustainability.

1.3.2 Objectives

- **i.** To gather primary data regarding water consumption patterns from a representative sample of unmetered households in Marondera.
- **ii.** To calculate an estimate of per capita water use in unmetered households in Marondera.
- **iii.** To assess whether households are meeting the required water use amount for domestic purposes.
- **iv.** To develop a monitoring recommendation for unmetered zones

1.4 Research questions

i. What is the per capita water use in unmetered households in Marondera?

ii. How do the current levels of per capita water use in unmetered households affect public health and safety?

iii. How can the estimation of water per capita use improve the public health policies?

1.5 Significance of the study

Quantifying water use in unmetered households help identify areas at risk of inadequate water supply for basic hygiene and sanitation, thereby preventing disease outbreaks like cholera. The study offers the Marondera Town Council with per capita water consumption data that is important for implementing more effective water distribution systems.

1.6 Assumptions

- The selected unmetered households will represent the broader population in Marondera
- The participants will provide with honest and truthful answers
- No major changes like drought that can alter normal patterns of consumption

1.7 Limitations

- Use of indirect measurements methods
- Seasonal variations- study is conducted in rainy season which results might differ from dry season
- Reliance on reported data may cause bias
- The selected households might not perfectly represent all the unmetered households in Marondera

1.8 Delimitations

- The study only focuses on unmetered households in Marondera and not other municipalities
- The research targets unmetered households only not metered or commercial entities
- The study will rely on the provided data and not historical data

CHAPTER 2: LITERATURE REVIEW

2. Literature review

2.1 Introduction

This chapter reviews scholarly literature regarding per capita water use in unmetered households with research gaps, reviews the current study of existing knowledge and examine theories relevant to domestic water use estimation. Firstly, it defines key concepts related to per capita water use and unmetered households. It then analyzes the relationship between water access and public health and methods of estimating water consumption in the absence of a meter.

2.2 Per capita water use and unmetered households

Per capita consumption is a statistical measure of the average amount of resource used by each person (Mazzei, 2025), which regarding to water use is measured as liters per capita per day (Thomas et al., 2020). Water consumption in a household depends on a lot of factors, for example household size (GENAQ, 2025). The bill in unmetered households is not based on the actual water used (Ofwat, 2025).

2.3 Water use and public health

Households with water sources close to their homes and enough domestic water for daily activities have significantly better health than households with more distant water sources and less water (WHO, 2020). The quantity of water used for hygiene is crucial in diarrheal disease transmission, inadequate water for personal hygiene results in the spread of diarrheal diseases (Sultana et al., 2022).

According to the World Health Organization (WHO) people who use an average of 20 LCPD water for personal and food hygiene, laundry and bathing do not have enough water to meet basic hygiene needs, therefore they face high risk of water related problems. However, those who use 50 LCPD and 100 LCPD of water are at low risk for health concerns. During diseases outbreaks when demands for water are increased 20L/day is usually not enough (WHO, 2020). The estimation of per capita water use is important for ensuring adequate supply and the prevention of diseases.

2.4 The methods for estimating per capita water use in unmetered households

Table 2.1 summaries the methodological approaches that were used in studies to estimate per capita water consumption in households that are unmetered.

Method	Description	Main limitations	Reference
Water demand equivalent	estimates daily water consumption based on patterns of human habitation correlating to the number of bathrooms and bedrooms in a home	Relies on infrastructure instead of actual behavior	MauiRecovers (2025)

Water use diaries	Household members document their water-related activities and the volumes used for different daily activities and estimate per capita water use	Relies on self-reporting data which may be biased	Zozmann et al (2022)
GIS-Based approach	Building height and size were determined and spatially linked to water consumption data, the values were then used to estimate the number of residents living in each building providing a method to estimate per capita water consumption where detailed population register data was unavailable.	Limited by data availability	Stelz, Kudaya & Funch-Hanusch (2025)

Population and Benchmark approach	used parameters like usage, household size, geographic region and property value, a Microsoft Excel-based too was developed that provides benchmark for different conditions and LCD-tool	Benchmark consumption might not represent the actual water use in unmetered households	Jacobs et al (2022)
Production and Pump records	Used limited number of working water meters and pump operational data. estimating per capita use by dividing total volumes of water produced by the served population	Does not account for losses	Abbas, Kazam & Takizawa (2022)

2.5 Debates in the studies of unmetered household water use

While other researchers propose that households without a personal meter members use more water than what is socially optimal (Carrillo, Contreas & Scartascini 2024; Pooja Parvatkar 2024), others argue that consumer behavior is not changed by a meter (Richard Wilson, 2024).

Another notable debate is that while some studies suggest that per capita consumption of household members decrease with household size (Jacobs et al 2022), others imply that per person water use increase with household size (Jegnie, Fogarty & Iftekhar., 2023).

2.6 Gaps in existing literature

While there has been much research on household water availability and consumption in Zimbabwe (Gondo & Kolawole, 2022), few researchers have taken unmetered households into consideration. Another gap in the existing literature is that researchers focus on the determinants of water consumption but does not take seasonal variability into consideration and its effect on household consumption (Gondo et al., 2020; Khan et al., 2023).

2.7 Theoretical frameworks

2.7.1 Determinants of household water consumption framework

This framework is influenced by social, environmental, economic and political factors which determine how much water is used, it focuses the research to collect data that is critical in explaining the variation of per capita water estimates (Cominola et al., 2023). Existing literature shows that the determinants are age distribution, behavioral practices, income levels (Motho et al., 2022; Shree & Raj, 2020).

2.7.2 Statistical regression framework

This framework is used to estimate water variables using quantifiable variables like household size providing a tool to link observable characteristics of unmetered use guiding the selection of appropriate independent variables like household size and socio- economic indicators (Canquiil et al., 2026; Sabzchi-Dehkharghani et al., 2023)

Integrating the frameworks gives better results because the frameworks address different dimensions in the current study. The estimation of water consumption without a meter is complex and needs different frameworks

2.8 Conclusion

The literature review demonstrates that while research exists in water consumption, researches on per capita water consumption in unmetered households is limited, which the current study hopes to furnish. Existing studies highlight the health risks associated with low water per capita per day with WHO standards providing benchmarks for assessing adequacy. There are methods that exists for estimating water use without a meter.

CHAPTER 3: MATERIAL AND METHODS

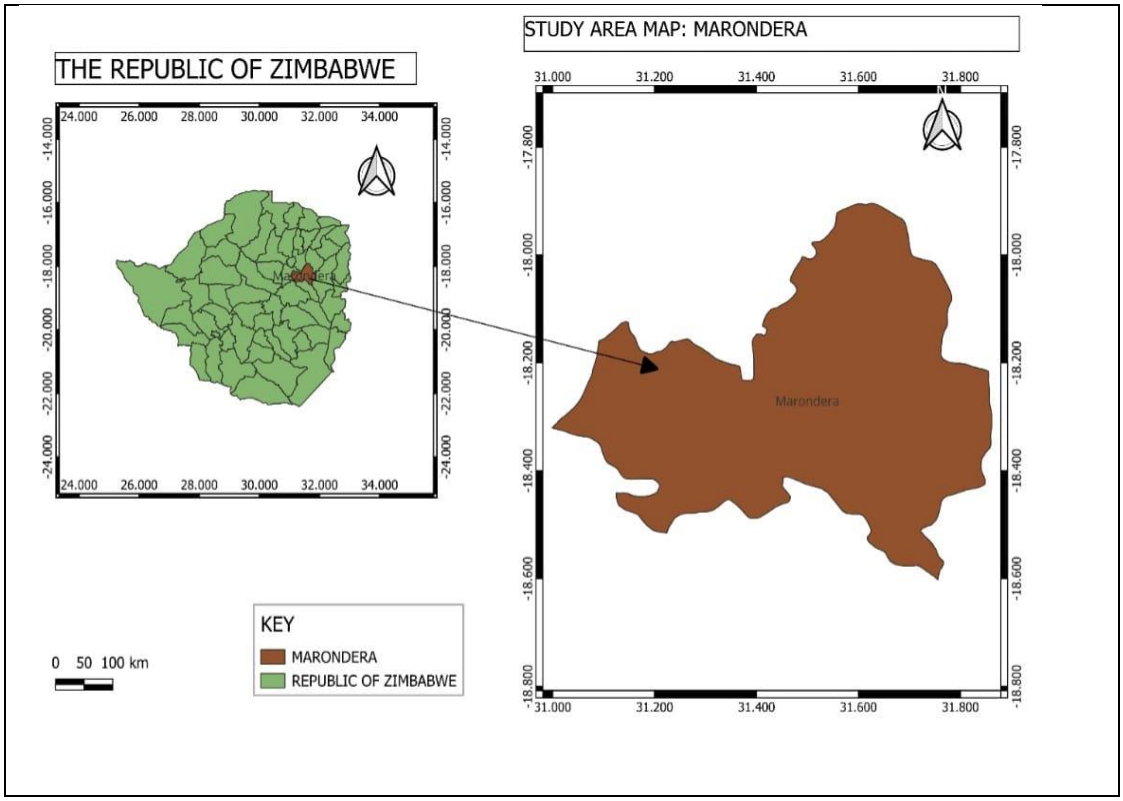
3. Material and methods

3.1 Description of the study area

The research was conducted in Marondera town, originally known as Marandellas which is located 72 km east of the capital city Harare along Harare-Mutare highway as the capital of Mashonaland East Province in Zimbabwe. It is situated on a highveld plateau at 5,538 ft. The population of Marondera is 66,203 according to the 2022 Zimbabwe Population and Housing Census.

It is governed by Marondera Municipality which is responsible for the local management of water and distribution of households. Marondera is moderate, subtropical highland characterized by warm, wet summers and cold dry winters.

Fig 3.1 Map of the location of Marondera town, Zimbabwe



3.2 Research design

This study adopted a mixed- methods research design of using quantitative and qualitative approaches to come up with better conclusions for the estimate per capita water use in unmetered households in Marondera (Tegan George, 2021). The mixed methods research resulted in richer insights and validation of data through triangulation (Josephine Oranga, 2025). Quantitative methods were used to provide with estimates of liters per capita per day (LPCD), the standard unit of measuring individual daily water consumption (Abbas et al., 20220), while qualitative methods were used to provide explanations for observed patterns of consumption (Savelli et al., 2023).

3.3 Research Instruments

3.3.1 Semi-structured closed-ended questionnaires

The survey instrument comprised closed-ended questions (Appendix B) that were designed to quantify usage volume using existing literature (Linden, 2024; Zozmann et al., 2022). The questionnaire was revised before being used for data collection. The questionnaire had 27 items which were divided into 4 sections. Section A had 4 items on demographic data like education level, occupation, household size, household members living in, age and gender, section B had 6 items which were on household water access and infrastructure characteristics like water source type, storage capacity, actual volume collected per delivery, tap functionality, supply hours and supply reliability patterns.

Section C had 11 items on water usage behavior covering water use daily activities and the frequency of those activities (laundry, bathing), volumes used per activity and coping strategies during water scarcity periods, section D had 5 items on knowledge, perceptions and attitude toward water conservation and effect on health for example the awareness of water conservation practices, health and hygiene practices, satisfaction with water services and willingness to have meters installed and reasons for reluctance for those who did not want. The piloting took approximately 30 minutes to complete for a participant.

The purpose of administering the questionnaire was to collect the quantity of water usage. It was considered the most appropriate tool due to its standardized response and data quantification (Nigel Lindemann, 2023). It has been used in similar studies (Khan at el., 2023; Shree & Raj, 2020). However, its main limitation is that since the water use were recorded via the participant's memory, it could be biased (Khan et al., 2023). This was addressed by pretesting before the main survey and adjustments were made based on reviewed responses to ensure quality (Njoku et al., 2022).

3.3.2 Semi-structured open-ended interviews

A semi-structured interviews guide (Appendix C) was developed from literature (Komildjanovna, 2024; George, 2023) to facilitate interviews focused on gathering qualitative data to provide with narratives and insights to the quantitative data. The interviewees were the household members in unmetered households who were purposively selected based on their direct involvement. The pilot interviews indicated that each one would last for about 45 minutes. It covered aspects such as household context, household water uses practices, awareness of water conservation, strategies of coping with unmetered supply and perceptions of water adequacy.

The research instrument has been used in similar studies (Motho et al., 2022; Simone at el., 2025). Its strength is that it helps to understand the reasons and values that influence people's perceptions about water use and activities (Motho et al., 2022). However, its main limitation is that it may result in responses that are not constructive (Curel, 2023). This was addressed by asking questions focusing on the central research problem (Shona McCombles, 2022).

3.4 systematic review of existing relevant frameworks

A systematic review of existing frameworks was conducted based on the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (Page et al., 2021). The procedure search for records & duplicates, abstract-level screening, full-text screening and final included studies & reports (Kelvin Kallmes, 2022). The procedure has the ability to provide clear and reliable conclusions, convey vast amounts of information, work to minimize the introduction of bias and provide the opportunity to critically evaluate and comprehensively pool the results of multiple comparable trials with the aim of increasing statistical power related to water use in unmetered settings (Sohrabi et al., 2021).

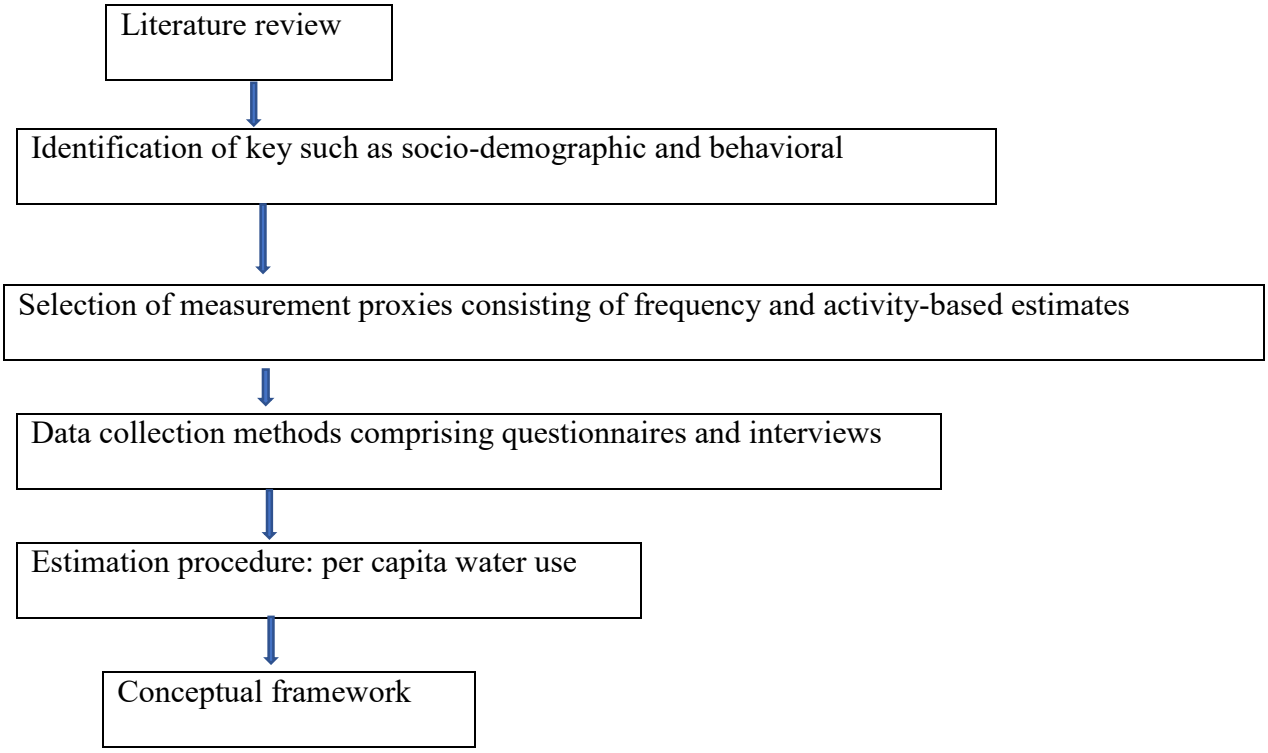
It was conducted using peer-reviewed and grey literature sources from various academic databases such as Scopus, Web of Science, Google Scholar, ScienceDirect and PubMed using the following Boolean search strings of combination of keywords applied across the databases: "water use" OR "water consumption" AND "unmetered households" OR "non-metered households". Filters applied restricted the review period to 2020- 2026, peer reviewed studies and English-language publications while excluding non-research articles and duplicate records.

Table 3.1 shows the search terms

Databases	**Boolean search string**	**Filters applied**
Scopus	(“water consumption” OR “water use”) AND (“per capita” OR “per household”) AND (“unmetered” OR “non-metered”) AND (“framework” OF “methodology”)	Year 2020-2026 English language publications Article Review
Web of Science	(“water consumption “OR ‘water use”) AND (“per capita OR “household”) AND (“non-metered” OR “unmetered”)	Year 2020-2026 English language Article Review Proceedings Paper
Google Scholar	“Water consumption” OR “water use” AND “per capita” OR “Household” AND “unmetered” OR “estimation” AND “framework” OR “methodology”	Year 2020 to 2026 English language Sorted by: Relevance
PubMed	((“water consumption” [Title/Abstract] OR “water use” [Title/Abstract]) AND (“per capita” [Title/ Abstract] OR “household” [Title/ Abstract]) AND (framework” [Title/ Abstract] OR “model” [Title/ Abstract]))	Year 2020-2026 English Language Journal, Article, Review
ScienceDirect	(“water consumption” OR “water use”) AND (“per capita” OR household”) AND (“unmetered” OR non-metered”) AND (“framework” OR ‘methodology”)	Year 2020-2026 English language Research articles Review articles

3.5 Development of the conceptual framework

The development of a conceptual framework to estimate per capita water use in unmetered households was done using the processes in fig (3.2).



The conceptual framework was developed using a systematic review of combining literature review, theoretical frameworks and considerations relevant to the case study. The key constructs were identified as the determinant, these included: socio-demographic and behavioral practices. Due to absence of meters, measurable proxies like activity-based estimates were used. Data collection methods included questionnaires and interviews. The framework was refined.

3.6 Determination of sample size

The quantitative sample size was calculated using Cochran's formula n= $\frac{Z^2p(1-p)}{e^2}$ with a 95% confidence level and a 10% margin of error because the population of unmetered households was not known. Non-responses were also taken into consideration in calculations.

$n=\frac{z^2(1-p)}{e^2}$ where n is the sample size, Z is the Z-score, p is the estimated proportion of the population and E is the margin of error.

$n=\frac{(1.96)^2.0.5(1-0.5)}{(0.10)^2}$ n=96.04 (therefore 96 households)

Adjustment for non-response=10%

$n=\frac{96}{1-0.10}$ $n=\frac{96}{0.90}$

n=106.67 (Therefore, the determined sample size is 107)

3.7 Recruitment and selection of participants

Stratified random sampling was utilized by distributing the sample size into 12 wards (strata). All the 12 wards were included to ensure geographical and socio-economic representation, since Marondera town has 12 wards. The exact number of unmetered households in each ward was not known so equal allocation approach was adopted, $n=\frac{107}{12}$ to give 8.9 therefore 11 wards were allocated 9 households and 8 households to the remaining ward. Table 3.3 shows the selection of participants. The inclusion criteria were household without a water meter and adult above 18 years that can be responsible for water management and the exclusion criteria were metered households.

Ward	Sample size (n)
Ward 1	9
Ward 2	9
Ward 3	9
Ward 4	9
Ward 5	9

Ward 6	9
Ward 7	9
Ward 8	9
Ward 9	9
Ward 10	9
Ward 11	9
Ward 12	8
Total	107

3.8 Per Capita Water Use Estimation Procedure

Due to the absence of water meters, per capita water use was estimated using activity-based proxy methods (Abbas et al (2022); Zozmann et al (2022). This formula applied to the closed-ended questionnaire data in section C. Activities included drinking and cooking, bathing, laundry, household cleaning, toilet flushing, and gardening. Volumes per activity were obtained from participants closed-ended responses in Section C of the questionnaire. Daily frequency was derived from reported weekly frequencies divided by seven. This approach was used in similar studies for indirect measurement for unmetered households (Mounirou et al., 2023; Jacobs et al., 2022).

Total Household Daily Water Use (L) = Σ (Activity volume × Frequency per day × Number of persons performing activity)

Per capita water use was then derived as:

LPCD = Total Household Daily Water Use (liters) / Household size

3.9 Ethical considerations

This study adhered to ethical guidelines (Mirza et al., 2023). These include ethics of respect, informed consent, confidentiality, anonymity, reporting back to participants, trustworthiness of research and issues of translation. In the case where a household declined to take part, another household was chosen (Njoku et al., 2022). The Bindura University of Science Education provided institutional approval via the Department of Environmental Science (Appendix B). Informed consent from all participants were obtained in writing (Appendix C).

3.10 Data collection

3.10.1 Semi-structured closed-ended questionnaire

A pre-tested semi-structured, self-administered questionnaire (27 items) was distributed to around 107 participants in Marondera in March 2026 after obtaining informed consent and reminded of their voluntary participation and the right to withdraw. Closed-ended questions in were used for numerical estimation of water consumption in liters per capita per day (LPCD). The researcher briefed the participants on the study. The questionnaire was written in simple clear English, which the participants reported of not having any difficulties in understanding.

3.10.2 Semi-structured open-ended interviews

A semi-structured interview conducted in May 2026 was used to collect the qualitative data after obtaining informed consent from the participants. Detailed notes were taken and recorded after getting the permission from the participant. They were conducted face-to-face with each lasting approximately 45 minutes. The interview was conducted in simple and clear English. The participants reported of not having difficulties in understanding the questions.

3.11 Framework development and evaluation

Data obtained from the questionnaires and interviews was used to develop the conceptual framework. Pilot testing was conducted following the design of preliminary framework to assess feasibility and effectiveness and adjustments were made before full-scale data collection. Following full data collection, the framework was evaluated through descriptive statistics, regression analysis and comparative benchmarking such as comparing estimated LPCD values with WHO recommended domestic water consumption. Feedback from the participants was obtained through surveys and the qualitative and quantitative data were used for the final evaluation.

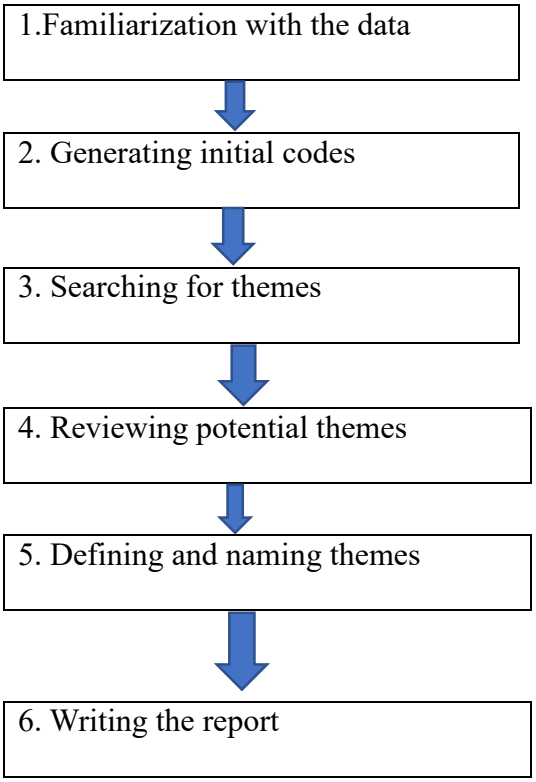
3.12 Data management

The data were checked for completeness and correctness (James Ajayi, 2024). Duplicates records were removed, corrected misspellings, removing irrelevant data points and removing questionnaires missing more than 10% of key variables (Unimrk, 2023). The data were coded in numbers and entered into Microsoft Excel. The overall household liters were calculated based on the processes of the available literature of unmetered households (Cominola et al., 2023).

Thematic analysis was used for analyzing qualitative data for identifying, analyzing and interpreting patterns of meaning within datasets (Ahmed et al., 2025). Braun and Clarke,s six-phase thematic analysis framework was used which includes familiarization with data, generating initial codes, searching for themes, defining and naming themes and writing the report. The raw data were familiarized through reading and rereading and recording initial ideas and possible patterns. Creating starting codes by going through the data to find meaningful features. Codes were grouped into broader patterns and themes using thematic maps. Candidate themes were checked on coherence within and distinction between themes. The essence of each theme was refined and described to how it relates to the study. Results were presented in the form of narration of data in

a meaningful way and connecting results with literature. The ultimate result of the data analysis was in LPCD per household.

Fig 3.4 shows the steps of Thematic Analysis



CHAPTER 4: RESULTS

4. Results

4.1 Characteristics of participants

Table 4.1 shows the results pertaining the demographic of the participants. Most of the participants were female (58.9%). Majority of the participants were in the 26–35 years age group (34.6%). The modal present household size was 5–6 members (35.5%). Secondary education was the modal attainment (63.6%). Most of the participants were employed full time (29.9%), but there was a slight difference with the unemployed (29.0%).

Table 4.1. Summary demographic profile of participants (n = 107)

Characteristic	Category	Frequency	Percentage **%**
Gender	Female	63	58.9
	Male	44	41.1
Age group (modal)	26–35 years	37	34.6
Present household size (modal)	5–6 members	38	35.5
Education (modal)	Secondary level	68	63.6
Employment (modal)	Employed full-time	32	29.9

4.2 Household Water Access and Infrastructure

Most households relied on municipal piped water (63.6%), with 24.3% using communal standpipes and 12.1% boreholes. Most of the participants reported to 70.1% receive supply only 1–2 days per week (70.1%), with the modal supply episode lasting 2–4 hours (45.8%). Storage capacity was most commonly 100–200 litres (37.4%) and actual volume collected per delivery was dominantly 100-200 litres (34.6%) and 26.2% collected less than 100 L. Functional taps were reported by 64.5% of households. Qualitative interviews showed that standpipe queuing and short supply windows further reduced collectible volumes, particularly for larger households at the end of distribution queues.

4.3 Water Usage Behavior and volume estimates

Drinking and cooking accounted for 5–10 Liters/household/day for 38.3% of the participants, while bathing used 10–30 L (43.9%). Toilet flushing was practiced by 64.5% of households, with 35.5% relying on pit latrines or Blair toilets. Most of the participants performed laundry 1–2 days per week (59.8%). The modal total household daily use was 81–160 L (36.4%), with 20.6% reporting less than 80 L/day. The most common coping strategies during scarcity were fetching from alternative sources (69.2%), reducing water-using activities (57.0%) and reusing water (49.5%). Interview data confirmed a universal prioritization of needs: drinking and cooking first, bathing reduced and laundry postponed to supply days

4.4 Per Capita Water Use Estimates (LPCD)

LPCD was estimated by dividing the frequency-weighted household daily use (148.1 L/day) by the present-household size midpoint. The overall weighted mean LPCD is 27.8 L/person/day above the WHO critical minimum of 20 LPCD but below the 50 LPCD intermediate benchmark.

Table 4.2 shows estimated LPCD by present household size — weighted mean = 148.1 L/day

Household size	Frequency	LPCD	95% Confidence level
1–2 persons	15	98.7	69.6–127.8
3–4 persons	36	42.3	34.3–50.3
5–6 persons (modal)	38	26.9	21.9–31.9
7–9 persons	12	18.5	12.4–24.6
10+ persons	6	14.1	7.5–20.7
Overall weighted mean	107	27.8	

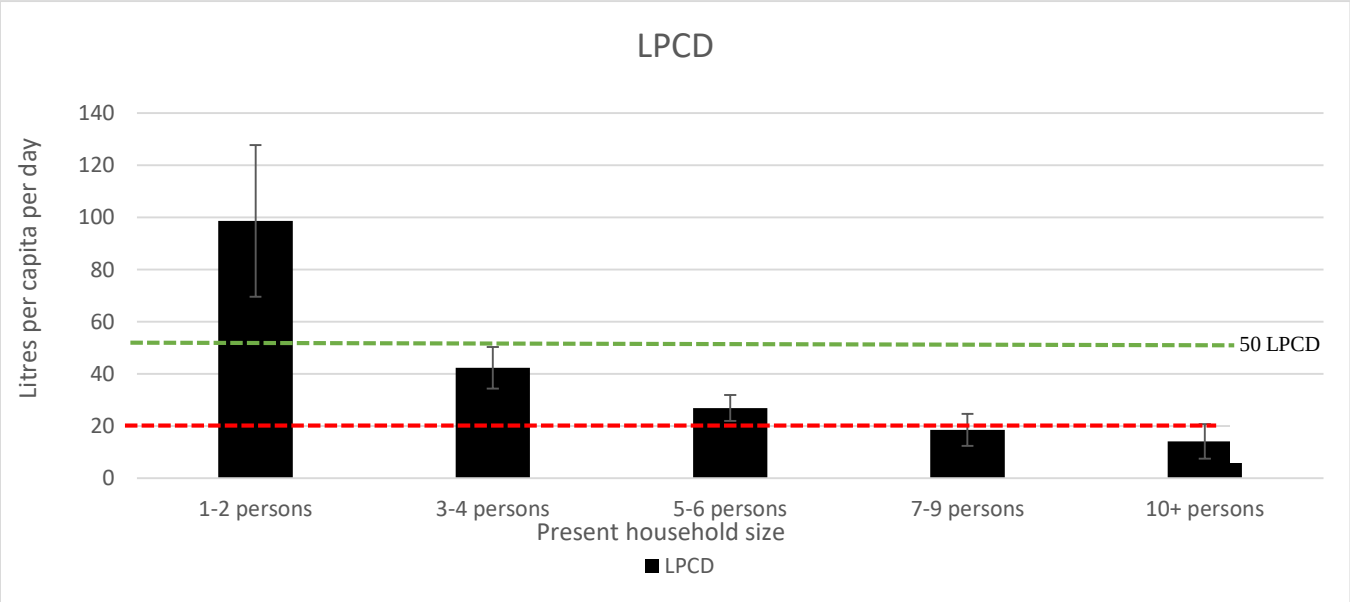


Figure 4.3 shows estimated LPCD by present household size. Error bars represent 95% confidence intervals. Dashed lines indicate WHO critical minimum (20 LPCD) and intermediate benchmark (50 LPCD). N= 107

4.5 Activity-Disaggregated LPCD Estimates

Table 4.3 shows the LPCD contribution of each domestic activity at the modal household size (midpoint = 5.5 persons). The activity sum of 12.3 LPCD is lower than the derived estimate of 26.9 LPCD. Drinking and cooking (1.4 LPCD) is the smallest per capita contributor despite being the most critical activity.

Table 4.3 shows Activity-disaggregated LPCD estimates modal household size (5.5 persons)

Activity	Household litres/day (modal)	LPCD
Drinking and cooking	7.5	1.4
Bathing	20.0	3.6
Toilet flushing	12.9	2.3
Laundry - daily contribution (C4×C4a÷7)	6.4	1.2
General cleaning	10.0	1.8
Gardening	11.1	2.0
Activity sum	67.8	12.3

4.6 Knowledge, Perceptions and Attitudes Toward Water Conservation and Health

Most participants were aware of at least one conservation practice: reusing water (61.7%), fixing leaking pipes (54.2%) and rainwater harvesting (43.0%). Critically, 54.2% reported that inadequate water supply significantly or severely affected their health, and 43.9% reported at least one waterborne illness in the household in the preceding 12 months. Dissatisfaction with water services

was dominant (62.6% dissatisfied or very dissatisfied), and 67.3% expressed willingness to have a meter installed, with those reluctant citing primarily concerns about increased bills (60.0% of the reluctant group).

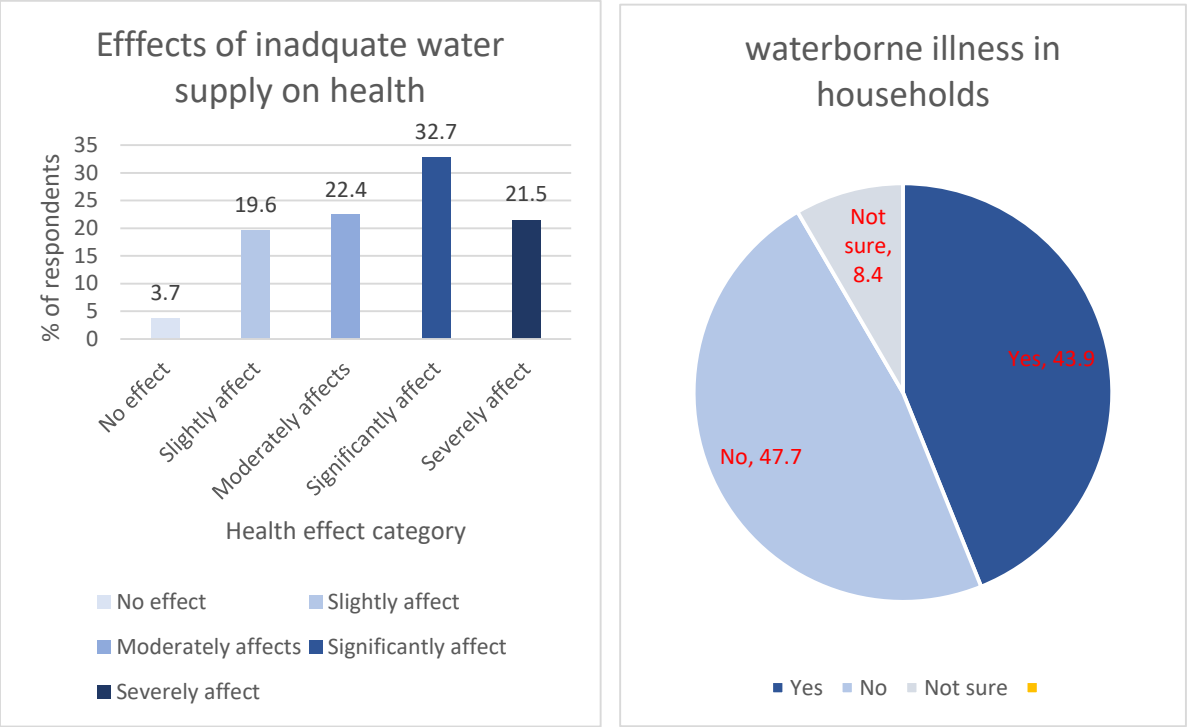


Figure 4.5 Left (4.5a) Perceived effect of inadequate supply on health and Hygiene, n=107. Right (4.5b): Reported waterborne illness prevalence in the household in the past 12 months (Yes/No/Not sure). Together these figures demonstrate the public health consequences of sub threshold LPCD in unmetered households of Marondera.

CHAPTER 5: DISCUSSION

5. Discussion

5.1 Introduction

This chapter presents a comprehensive discussion of the findings obtained in the study. The findings are interpreted and compared with existing literature and previous similar studies. The discussion is structured around: evaluating calculated Liters per Capita Day (LPCD), analyzing household water access, accessing public health and adequacy implications against World Health Organization (WHO) standards.

5.2 Characteristics of participants

The majority of the participants were female (58.9%), suggesting that women are more involved in household water management activities (Habib, Zainab & Sheeraz, 2025). The dominance of female participants in water-related surveys is consistent with findings from similar studies (Motho et al., 2022). The dominant age group was the 26-35 years (34.6%). This age group typically has the highest domestic water demands due to childcare responsibilities and daily household operations (Mazibuko, Mutanda & Ngcamu, 2026).

The results showed that the most dominant household size was 5-6 members and the LPCD decreased as compared to households with 3-4 people, this is also in agreement that the LPCD decreases when members increase since the supply is not according to the number of people in a household (Jacob et al., 2022). The educational profile showed most participants had obtained secondary level which might suggest adequate literacy levels to comprehend water-related information (Valenzuela-Morales et al., 2022).

5.3 Household water access and infrastructure

The results showed that 63.6% of unmetered households rely on municipal piped water as their primary source yet 70.1% receive supply only 1-2 days per week for a duration of about 2-4 hours. This might be due to the urban water delivery systems in Zimbabwe which are heavily constrained by operational inefficiencies and critical infrastructure (Brooke & Fenner, 2022) and that the pipes are unmetered so municipal billings lack volumetric foundation (Ofwat, 2025).

Majority of participants have a storage of 100-200 liters (37.4%) but they manage to fill less than 100 liters per delivery (26.2%) showing capacity does not equal availability (Jacobs et al., 2022). The interview showed short supply windows and communal standpipe queuing limiting the volume of water each household gets yet 35.5% of households without functional taps rely on communal standpipe indicating that shared water access points are associated with lower effective per capita consumption (Thomas et al., 2020).

5.4 Water usage behaviour and volume estimates

Drinking and cooking accounted for 5–10 litres per household per day for 38.3% of participants. The WHO minimum recommendation is approximately 3–5 litres per person per day for drinking and cooking alone (Howard et al., 2020). Interview findings confirmed that households prioritized drinking and cooking first, while bathing frequency and laundry activities were reduced during shortages. This is in agreement that households facing intermittent supply tend to minimize non-essential water-consuming activities (Savelli et al 2023). Bathing used 10–30 litres per household per day for 43.9% of participants. At the modal household size of 5.5 persons, this yields 3.6 LPCD for bathing, a level at which only the most basic personal hygiene is possible and full bathing for all members cannot be achieved daily (Howard et al., 2020

Toilet flushing was practiced by 64.5% of households, while 35.5% relied on pit latrines or blair toilets. The 10–30 litre per day modal category for toilet flushing, proportionally adjusted to the 64.5% of households that flush, yields 2.3 LPCD. Although it contributes only a small proportion of total daily household water use, it plays a crucial role in maintaining hygiene and preventing the transmission of diseases (WHO, 2020).

The daily laundry water contribution of 1.2 LPCD was derived from the product of session volume and weekly frequency divided by seven. This figure reflects the finding that 59.8% of households did laundry only 1–2 days per week, consistent with the behavioural adaptation to scarcity (Motho et al., 2022). Gardening contributed a proportionally adjusted 2.0 LPCD across the 31.8% of households that reported garden water use that could have been used for essential hygiene-related activities (Cominola et al., 2023).

5.5 Per capita water use estimates LPCD

The overall weighted mean per capita water use estimated in this study was 27.8 litres per capita per day (LPCD). This value is above the WHO critical minimum requirement of 20 LPCD required for basic survival and hygiene but remains below the recommended intermediate benchmark of 50 LPCD associated with low public health risk (WHO, 2020).These findings suggest that although the households may be meeting minimum survival water needs, many are still vulnerable to hygiene-related health risks due to insufficient water quantities for adequate sanitation and personal hygiene, this aligns with the view that households with water consumption below 50 LPCD often struggle to maintain optimal hygiene standards (Thomas et al., 2020).

Estimation by present household size revealed a clear inverse relationship between household size and LPCD. Households of 1–2 present persons (LPCD = 98.7; 95% Confidence level: 69.6–127.8).

This confirms that small households in Marondera are individually well supplied even under constrained total volumes, because the same fixed household water allocation is shared among fewer persons (Jacobs et al., 2022).

Households of 3–4 present persons (LPCD = 42.3; 95% CI: 34.3–50.3) fall just below the WHO 50 LPCD threshold. These households are at the borderline of basic hygiene adequacy, any reduction in supply like shorter supply episode or a failed delivery would push them below the critical minimum (Howard et al., 2020). The modal group of 5–6 present persons (LPCD = 26.9; 95% CI: 21.9–31.9), accounting for 35.5% of the sample, is unable to meet full domestic hygiene needs on a daily basis. This is in line with the findings of determinants of household water consumption framework of Cominola et al. (2023), which identifies household size as the primary structural driver of per capita deprivation under constrained supply.

Households of 7–9 present persons (LPCD = 18.5; 95% CI: 12.4–24.6) had a mean below the WHO 20 LPCD critical minimum. The lower confidence interval bound of 12.4 LPCD approaches the emergency threshold identified by Howard et al. (2020) as the level at which meeting basic survival water needs becomes difficult. Households of 10 or more present persons (LPCD = 14.1; 95% CI: 7.5–20.7) are the most severely deprived group in the sample, with a lower CI bound of 7.5 LPCD, a level consistent with emergency water supply conditions during humanitarian crises (WHO, 2020). These findings have direct public health implications for the 15.9% of the sample.

5.6 Activity-disaggregated LPCD estimate

The results showed that drinking and cooking contributed the smallest proportion of total LPCD (1.4 LPCD) despite being the most essential activities. This demonstrates the limited water quantities available for basic household needs. Insufficient water allocation to cooking and

personal hygiene may contribute to poor food hygiene and increased disease risks (WHO, 2020). Bathing and laundry activities contributed larger proportions of household water use (3.6 LPCD and 1.2 respectively) because these activities generally require larger water volumes. Similar findings were reported by Zozmann et al. (2022), who observed that bathing and laundry dominate domestic water use in unmetered households. The lower activity-disaggregated LPCD estimate compared to the derived household LPCD may indicate possible under-reporting of some activities or challenges in accurately recalling daily water use quantities. Self-reported water estimation methods have been associated with recall bias and estimation errors in previous studies (Khan et al., 2023).

5.7 Knowledge, perceptions and attitudes towards water conservation and health

The study revealed that most participants were aware of at least one water conservation practice, particularly water reuse (61.7%), repairing leaking pipes (54.2%) and rainwater harvesting (43.0%). This suggests that households recognize the importance of conserving limited water supplies and that awareness of water scarcity promotes household conservation behaviour (Cominola et al., 2023). Despite this awareness, many participants reported that inadequate water supply significantly affected household health and hygiene. The reported occurrence of waterborne illnesses within the preceding 12 months (43.9) may indicate that insufficient water availability compromises hygiene practices and sanitation conditions (Thomas et al, 2020).

The willingness by some participants to support installation of water meters (67.3%) may reflect recognition of the importance of monitoring consumption. Previous studies have shown that metering can improve water use efficiency and reduce unnecessary wastage (Carrillo, Contreras Scartascini, 2024). However, reported concerns regarding affordability and billing fairness may influence acceptance of metering systems in low-income households.

CHAPTER 6

CONCLUSION AND RECOMMENDATIONS

6.1 Conclusion

This study estimated per capita water use in unmetered households in Marondera town. The overall frequency-weighted per capita water use estimate for unmetered households in Marondera is 27.8 litres per capita per day (LPCD). Estimations by present household size revealed that households of 1–2 persons averaged 98.7 LPCD, households of 3–4 persons averaged 42.3 LPCD, the modal group of 5–6 persons averaged 26.9 LPCD, households of 7–9 persons averaged 18.5 LPCD and households of 10 or more persons averaged 14.1 LPCD. Activity-disaggregated estimates showed that drinking and cooking contributed only 1.4 LPCD at the modal household size, the smallest per-activity contribution despite being the most health-critical activity. Bathing contributed 3.6 LPCD, toilet flushing 2.3 LPCD, laundry 1.2 LPCD, cleaning 1.8 LPCD and gardening 2.0 LPCD. The total activity sum of 12.3 LPCD was lower than the primary estimate of 26.9 LPCD derived from the total household daily use question.

6.2 Recommendations

- Increasing water supply frequency to at least three to four days per week to ensure households receive adequate water for domestic and hygiene needs
- Introducing water metering and regular water-use monitoring in unmetered areas to support efficient water resource management

References

Abbas, M., Kazama. S., & Takaziwa, S (2022). Water Demand Estimation in Service Areas with Limited Numbers of Customer Meters- Case Study in Water and Sanitation Agency (WASA) Lahore, Pakistan. *Water,* 14(4),2197

Alharsha, I., Memon, F.A., Farmani, R., & Hussien, W.A. (2022). An investigation of domestic water consumption in Sirte, Libya. *Urban Water Journal,* 19(9), 922-944.

Ahmed, T., Ahmed, M., Sipira, H. (2025). Sustainable urban water management through the application of smart water meters in developing countries: example case study from Pakistan. *Sustain water resource management,* 11(32).

Ahmed, S.K., Mohammed, R.A., Nashwan, A.J., Ibrahim, R.H., Abdalla, A.Q., Ameen, B. M.M., Khdhir, R.M. (2025). Using thematic analysis in qualitative research.

Brooke, A., & Fenner, R. A. (2023). Improving urban water management and building water supply resilience in the city of Harare, Zimbabwe – a systems view. Civil Engineering and Environmental Systems, 40(4), 195–228.

Canquil, D., Martin, D.S., Inoquio-Renterria, I., & Leger, P. (2026). A systematic literature review on machine learning techniques for predicting household water consumption. *Water Resources Management,* 40(2).

Cominola, A., Preiss, L., Thyer, M., Maier, H.R., Prevos, P., Stewart, R.A., & Castelletti, A. (2023). The determinants of household water consumption: A review and assessment framework for research and practice. *Clean Water,* 6(1).

Eawater (2024). Transforming Urban Water Management in residential communities

GENAQ. (2025). *Water consumption in a household.*

George, T (2021). Mixed methods research definition, guide & examples.

Habib, N., Zainab, S. S., & Sheeraz, M. I. (2025). Women's role and challenges in household water conservation: A case of Rawalpindi City.

Howard, G., Bartram, J., Williams, A., Overbo, A., Fuente, D., & Jo-ANNE, G. (2020). Domestic water quantity, service level, and health. Word Health Organization.

Jacobs, H.E., Scheepers, H.M., & du Plessis,J. A (2022). Per capita water consumption for benchmarked South Africa service levels derived by means of reasoning. *Water SA,* 48(2), 130-141

Jegnie, A., Fogarty, J., & Iftekhar, S. (2023). Urban Residential Water Demand and Household Size : A Robust Meta-Regression Analysis

Kelvin Kallmes (2021). PRISMA Flow diagram: How publications flow through the updated PRISMA 2020 process chart.

Mazibuko, N. F., Mutanda, G. W., & Ngcamu, B. S. (2026). The knowledge of water conservation and strategies for addressing water shortage in the Fairview community in Kwa-Zulu-Natal, South Africa. Frontiers in Water, 8

Meyer, B.E., Jacobs, H.E., Ilemobade (2021). Classigying household water use into indoor and outdoor use from a rudimentary data set: a case study in Johannesburg, South Africa.

Motho, M., Kolawole, O.D., Motsholapheko, M.R., & Mogomotsi, P.K. (2022). Influence of household demographic and socio-economic factors on water demand in Ngamiland, Botswana. 48-59

Mourirou, L.A., Sawadogo, A., Yanogo, H., Yonaba, R., Zorom, M., Faye, M.D, Karambiri, H. (2023). Estimation of the Actual S pecific Consumption in Drinking Water Supply Systems in Burkina Faso (West Africa): Potential implications for infrastructure sizing. *Water*

Njoku, P.O., Durowoju, O.S., Uhunamure, S.E., & Makungo, R. (2022). Investigating the attitude of domestic water use in urban and rural households in South Africa. *Water,* 14(21), 3490.

Savelli, E., Mazzoleni, M., Di Baldassarre, G., & Cloke,H. (2023). Urban water crises driven by elites' unsustainable consumption. *Nature Sustainability*, 6, 929-940.

APPENDICES

Appendix A: Research schedule

The following log frame outlines the timeline for the study's phases and key activities (Gant chart)

Activities	M1	M2	M3	M4	M5
Proposal writing					
Literature review					
Ethical clearance application					
Instrument design					
Pilot testing					
Data collection					
Data cleaning					

Data analysis					
Report writing					
Review and revision (supervisor feedback)					
Thesis submission					

Appendix B: semi-structured closed-ended questionnaire

QUESTIONNAIRE ID……

BINDURA UNIVERSITY OF SCIENCE EDUCATION

DEPARTMENT OF ENVIRONMENTAL SCIENCE

Researcher: Chidembo Lyvet

Physical address: 3172 Unit D, Seke Chitungwiza

Email: lyvetchidembo07@gmail.com Cell:0786314485

Supervisor: Dr. A. Kanda: Department of Environmental Science, Bindura

Email: akanda@buse.ac.zw Cell:0773558130

Research title: *Estimating per capita water use in unmetered households in Marondera town, Zimbabwe.*

Introduction

My name is Lyvet Chidembo, a final fourth-year student at Bindura University of Science Education (Registration Number: B220763B), pursuing a Bachelor of Science (Hons) degree in Safety, Health and Environmental Management. In partial fulfilment of the degree requirements, l am undertaking a research project entitled: *Estimating per capita water use in unmetered households in Marondera town, Zimbabwe.* The findings of this study may contribute to public health and WASH programming, water demand management and policy and urban water planning. I invite you to voluntarily participate by providing some information on this matter.

Signature……This day ……. of month……..., 2026

Instruction to participant

Please put a cross (x) on the appropriate response

Section A: Demographic characteristics of participants

1. Gender: 1. Male **2.** Female

2. Age group: **1**. 18-25 years **2.** 26-35 years **3.** 36-45 years **4.** 46-55 years **5.** 56 years and above

3. Number of people in the household **1.** 1-2 people **2.** 3-4 people **3.** 5-6 people **4.** 7-9 people **5.** 10 people and above

3b. How many of these members are currently living in and consuming water **1.** 1-2 people **2.** 3-4 people **3.** 5-6 people **4.** 7-9 people **5.** 10 people and above

4. Highest education level completed **1.** No formal education **2.** Primary level **3.** Secondary level **4.** Tertiary/ College/ University

SECTION B: HOUSEHOLD WATER ACCESS AND INFRASTUCTURE

1.What is your primary source of household water? **1.** Municipal piped water **2.** Communal standpipe **3.** Borehole

2. Total household water storage **1.** Less than 100 liters **2.** 100-200 liters **3.** 201-500 liters **4.** 501-1000 liters **5.** More than 1000 liters

3. What is the actual volume of water you collect per delivery 1. Less than 100 liters 2. 100-200 liters 3. 201-500 liters 4. 501-1000 liters 5. More than 1000 liters

4. Is the household tap currently functional 1. Yes 2. No 3. Not applicable

5. What is the water supply pattern? **1**. Daily supply **2.** 1-2 days a week **3.** 3-6 days a week

6. On days when water is supplied, approximately how many hours is it available 1. Less than 2 hours 2. 2-4 hours 3. 5-8 hours 4. More than 8 hours

SECTION C: WATER USAGE BEHAVIOR AND VOLUME ESTIMATES

1. Approximately, how many liters does your household use per day for drinking and cooking 1. Less than 5 liters 2. 5-10 liters 3. 11-20 liters 4. More than 20 liters

2. Approximately, how many liters does your household use for bathing per day (all household members combined) 1. Less than 10 liters 2. 10-30 liters 3. 31-60 liters 4. More than 60 liters

5. Does your household use water for toilet flushing? 1. Yes 2. No (use pit latrines/ Blair)

5b. If yes, approximately how many liters does your household use per day for toilet flushing 1. Less than 10 liters 2. 10-30 liters 3. 31-60 liters 4. More than 60 liters

7. How many days a week does your household do laundry? 1. Everyday 2. 1-2 days a week 3. 3-6 days a week 4. Never

7b. How many liters do you use for laundry per session? 1. Less than 20 liters 2. 20-50 liters 3. 16-30 liters 4. More than 30 liters

8. Approximately, how many liters does your household use for general cleaning 1. Less than 5 liters 2. 5-15 liters 3. 16-30 liters 4. More than 100 liters

9. Does your household use water for gardening 1. Yes 2. No

9b. If yes, how many liters does your household use for gardening per day 1. Less than 80 liters 2. 81-160 liters 3. 161-240 liters 4. More than 240 liters

10. Average liters used for all household activities **1.** Less than 80 liters **2.** 81-160 liters **3.** 161-240 liters **4.** More than 240 liters

11. What are your coping strategies when water is scarce *(X all that apply)* 1. Fetching water from alternative sources 2. Reducing water using activities 3. Reusing water 4. No specific strategy

SECTION D: KNOWLEDGE, PERCEPTIONS AND ATTITUDES TOWARD WATER CONSERVATION

1.Which water conservation practices are you aware of? 1. Fixing leaking pipes 2. Reusing water 3. Rainwater harvesting 4. Not aware of any

2. How much effect does inadequate water supply affect your health and hygiene 1. No effect 2. Slightly affect 3. Moderately affect and cause illness 4. Significantly affect and cause illness 5. Severely affect health

3. Level of satisfaction with current water services 1. Satisfied 2. Very satisfied 3. Neutral 4. Dissatisfied 5. Very dissatisfied

4. Would you be willing to have a water meter at your home? 1. Yes 2. No 3. Not sure

4b. If No or Not sure, what is the main reason? 1. Concern about increased water bills 2. Do not believe it will improve water supply 3. Lack of information about metering

Appendix C: Semi-structured open -ended interview

Participant number…….

BINDURA UNIVERSITY OF SCIENCE EDUCATION



Tel. (263) 712 842 712-4

P.BAG 1020

Bindura,

Researcher: Chidembo Lyvet

Physical address: 3172 Unit D, Seke Chitungwiza

Email: lyvetchidembo07@gmail.com Cell:0786314485

Supervisor: Dr. A. Kanda: Department of Environmental Science, Bindura

Email: akanda@buse.ac.zw Cell:0772773560

Research title: *Estimating per capita water use in unmetered households in Marondera town, Zimbabwe.*

Objective: To gather contextual qualitative information of unmetered households in Marondera to compliment quantitative estimates.

Consent to audio recording

This recording will only be used for research purposes. Declining to be recorded does not result in any penalty. If you consent to audio recording please sign below

Signature …… This day …… of month …… 2026

Questions- (45 minutes)

1.Can you describe your household (the number of people who live here, are all members currently living here).

2. Are there other household sharing a water source with you?

3. What are sources of water for your household?

4. What type of sanitation facility do you use? (flush toilet, blair).

5. How reliable is your water supply?

6. Since the household is unmetered how do you track the volumes of water being used?

7. Can you describe the domestic activities that require water (laundry, cleaning, bathing).

8. Which activities require the most water and why?

9. How do you cope when water is scarce?

10. How has the lack of a water meter affected your water use?

11. Do you feel that the amount of water you receiving is adequate for all your needs?

Thank you for your time and sharing valuable information.