

**THE EFFECT OF ACCESS TO IMPROVED WATER AND SANITATION ON  
HOUSEHOLD WELFARE: CASE STUDY EVIDENCE FROM UNHS 2023/2024**

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**UGANDA CHRISTIAN  
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## DECLARATION

I, NABAASA BRENDA, hereby declare that this dissertation with the title “The Effect of Access To Improved Water And Sanitation On Household Welfare: Evidence from the UNHS 2023/2024” is my original work and has not been presented for a degree or any other academic award in any University or Institution of learning.

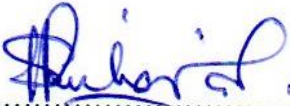
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## APPROVAL

This is to certify that the research report by NABAASA BRENDA, Registration Number M23B34/033, entitled "The Effect of Access To Improved Water And Sanitation On Household Welfare: Evidence from the UNHS 2023/2024", has been carried out under my supervision and is hereby approved for submission to the School of Business in partial fulfilment of the requirements for the award of the Bachelor of Science in Economics and Statistics degree of Uganda Christian University.

Signature: .....  ..... Date: ..... 22<sup>nd</sup> / May 2026. ....

DR. SEBAGALA RICHARD

## **DEDICATION**

The following report is dedicated to my beloved mother Mrs .Kanyesigye Edith due to her unrelenting love, sacrifices. To my parents Mr and Mrs Teira who have provided me with all the support, prayers, sacrifices, and encouragement without which I would not have reached my academic path. The fact that you always believe in me so much has motivated me to achieve the best. This is a success to my coursmates and friends because of the efforts I received, the support and encouragement you provided me in this process. I also dedicate this work to my supervisor, Dr. Richard Sebagala whose mentorship and advice has significantly helped me to grow academically and accomplish this study.

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## TABLE OF CONTENTS

|                                          |            |
|------------------------------------------|------------|
| <b>DECLARATION .....</b>                 | <b>I</b>   |
| <b>APPROVAL .....</b>                    | <b>II</b>  |
| <b>DEDICATION .....</b>                  | <b>III</b> |
| <b>ACKNOWLEDGEMENT .....</b>             | <b>IV</b>  |
| <b>TABLE OF CONTENTS .....</b>           | <b>V</b>   |
| <b>LIST OF TABLES.....</b>               | <b>IX</b>  |
| <b>LIST OF FIGURES.....</b>              | <b>X</b>   |
| <b>LIST OF ABBREVIATIONS .....</b>       | <b>XI</b>  |
| <b>ABSTRACT .....</b>                    | <b>XII</b> |
| <b>CHAPTER ONE .....</b>                 | <b>1</b>   |
| <b>INTRODUCTION.....</b>                 | <b>1</b>   |
| <b>1.0 INTRODUCTION .....</b>            | <b>1</b>   |
| <b>1.1 BACKGROUND OF THE STUDY. ....</b> | <b>1</b>   |
| <b>1.2. PROBLEM STATEMENT .....</b>      | <b>3</b>   |
| <b>1.3 GENERAL OBJECTIVE .....</b>       | <b>4</b>   |
| <b>1.4 SPECIFIC OBJECTIVES:.....</b>     | <b>4</b>   |
| <b>1.5. RESEARCH QUESTIONS .....</b>     | <b>4</b>   |
| <b>1.6. SCOPE OF THE STUDY .....</b>     | <b>5</b>   |
| <b>1.6.1 GEOGRAPHICAL SCOPE.....</b>     | <b>5</b>   |

|                                                                                                    |                  |
|----------------------------------------------------------------------------------------------------|------------------|
| 1.6.2. CONTENT SCOPE .....                                                                         | 5                |
| 1.7 CONCEPTUAL FRAMEWORK. ....                                                                     | 6                |
| 1.8 SIGNIFICANCE OF THE STUDY. ....                                                                | 7                |
| <b>CHAPTER TWO .....</b>                                                                           | <b>8</b>         |
| <b><u>LITERATURE REVIEW .....</u></b>                                                              | <b><u>8</u></b>  |
| 2.0 INTRODUCTION .....                                                                             | 8                |
| 2.1 THEORETICAL REVIEW .....                                                                       | 8                |
| 2.2 WORDS OF THE STUDY .....                                                                       | 9                |
| 2.2.1 HOUSEHOLD WELFARE STATUS.....                                                                | 9                |
| 2.2.2 IMPROVED DRINKING WATER .....                                                                | 10               |
| 2.2.3 IMPROVED SANITATION FACILITY .....                                                           | 11               |
| 2.3 EMPIRICAL REVIEW.....                                                                          | 12               |
| 2.3.1 THE EFFECT OF ACCESS TO IMPROVED DRINKING WATER SOURCES ON HOUSEHOLD WELFARE IN UGANDA ..... | 12               |
| 2.3.2 THE EFFECT OF ACCESS TO IMPROVED SANITATION FACILITIES ON HOUSEHOLD WELFARE IN UGANDA.....   | 14               |
| 2.3.4 WHAT IS THE EFFECT OF TIME SPENT COLLECTING WATER ON HOUSEHOLD WELFARE IN UGANDA? .....      | 18               |
| 2.4 SUMMARY OF THE LITERATURE REVIEW.....                                                          | 19               |
| <b><u>CHAPTER THREE .....</u></b>                                                                  | <b><u>21</u></b> |
| <b><u>RESEARCH METHODOLOGY .....</u></b>                                                           | <b><u>21</u></b> |
| 3.0 INTRODUCTION .....                                                                             | 21               |
| 3.1 RESEARCH DESIGN. ....                                                                          | 21               |
| 3.2 DATA SOURCE.....                                                                               | 21               |
| 3.3 STUDY POPULATION AND SAMPLE.....                                                               | 21               |
| 3.4 CONCEPTUAL FRAMEWORK AND VARIABLE OPERATIONALIZATION .....                                     | 22               |
| 3.5 DEPENDENT VARIABLES .....                                                                      | 23               |

|                                                                            |                  |
|----------------------------------------------------------------------------|------------------|
| <b>3.6 MODEL SPECIFICATION.....</b>                                        | <b>24</b>        |
| <b>3.7 ESTIMATION STRATEGY. ....</b>                                       | <b>25</b>        |
| <b>3.8 ESTIMATION PROCEDURES .....</b>                                     | <b>25</b>        |
| <b>3.8.1 TEST 1: MULTICOLLINEARITY.....</b>                                | <b>26</b>        |
| <b>3.8.2 TEST 2: COMPLEX SURVEY DESIGN ADJUSTMENTS.....</b>                | <b>26</b>        |
| <b>3.8.3 TEST 3: GOODNESS-OF-FIT AND SPECIFICATION: .....</b>              | <b>26</b>        |
| <b>3.9 VALIDITY AND RELIABILITY.....</b>                                   | <b>26</b>        |
| <b>3.10 ETHICAL CONSIDERATIONS .....</b>                                   | <b>27</b>        |
| <b>CHAPTER FOUR .....</b>                                                  | <b>28</b>        |
| <b><u>ANALYSIS, INTERPRETATION AND DISCUSSION OF FINDINGS.....</u></b>     | <b><u>28</u></b> |
| <b>4.0 INTRODUCTION .....</b>                                              | <b>28</b>        |
| <b>4.1 DESCRIPTIVE STATISTICS .....</b>                                    | <b>28</b>        |
| <b>4.2 SANITATION FACILITY TYPE BY WELFARE QUINTILE.....</b>               | <b>30</b>        |
| <b>4.3 MULTICOLLINEARITY DIAGNOSTICS.....</b>                              | <b>31</b>        |
| <b>4.4 MAIN ORDERED LOGIT RESULTS .....</b>                                | <b>32</b>        |
| <b>4.4.1 EFFECT OF IMPROVED DRINKING WATER ON WELFARE.....</b>             | <b>34</b>        |
| <b>4.4.2 EFFECT OF IMPROVED SANITATION ON WELFARE .....</b>                | <b>35</b>        |
| <b>4.4.3 THE IMPACT OF SHARED SANITATION ON WELFARE WAS EXAMINED. ....</b> | <b>35</b>        |
| <b>4.4.4 THE EFFECT OF TIME BURDEN ON WELFARE. ....</b>                    | <b>36</b>        |
| <b>4.4.5 CONTROL VARIABLES .....</b>                                       | <b>36</b>        |
| <b>4.5 PREDICTED PROBABILITY ANALYSIS.....</b>                             | <b>37</b>        |
| <b>4.6 SUBGROUP ANALYSIS.....</b>                                          | <b>37</b>        |
| <b>4.7 ROBUSTNESS CHECK .....</b>                                          | <b>39</b>        |
| <b>4.8 SUMMARY OF FINDINGS .....</b>                                       | <b>39</b>        |
| <b><u>CHAPTER FIVE .....</u></b>                                           | <b><u>40</u></b> |

|                                                                                                 |                  |
|-------------------------------------------------------------------------------------------------|------------------|
| <b><u>DISCUSSION, CONCLUSIONS AND RECOMMENDATIONS.....</u></b>                                  | <b><u>40</u></b> |
| <b>5.0 INTRODUCTION .....</b>                                                                   | <b>40</b>        |
| <b>5.1 DISCUSSION OF FINDINGS .....</b>                                                         | <b>40</b>        |
| <b>5.1.1 OBJECTIVE ONE: EFFECT OF IMPROVED DRINKING WATER ACCESS ON HOUSEHOLD WELFARE .....</b> | <b>40</b>        |
| <b>5.1.2 OBJECTIVE TWO. EFFECT OF IMPROVED SANITATION ON HOUSEHOLD WELFARE.....</b>             | <b>41</b>        |
| <b>5.1.3 OBJECTIVE THREE :EFFECT OF TIME SPENT COLLECTING WATER ON HOUSEHOLD WELFARE .....</b>  | <b>41</b>        |
| <b>5.1.4 OBJECTIVE FOUR: EFFECT OF SHARED SANITATION ON HOUSEHOLD WELFARE .....</b>             | <b>42</b>        |
| <b>5.2 CONCLUSIONS .....</b>                                                                    | <b>43</b>        |
| <b>5.3 RECOMMENDATIONS .....</b>                                                                | <b>44</b>        |
| <b>5.4 LIMITATIONS OF THE STUDY.....</b>                                                        | <b>45</b>        |
| <b>5.5 AREAS FOR FURTHER RESEARCH .....</b>                                                     | <b>46</b>        |
| <b><u>REFERENCES.....</u></b>                                                                   | <b><u>47</u></b> |

## LIST OF TABLES

**Table 4.1:** WASH Indicators and Selected Characteristics by Welfare Quintile

**Table 4.2:** Sanitation Facility Type by Welfare Quintile

**Table 4.3:** Variance Inflation Factors for Independent Variables

**Table 4.4:** Ordered Logit Estimates of the Effect of WASH Access on Household Welfare Quintile

**Table 4.5:** Ordered Logit Coefficients by Urban or Rural Subgroup

## **LIST OF FIGURES**

**Figure 1.1:** Conceptual Framework of the Study

**Figure 4.1:** Predicted Probabilities of Household Welfare Quintiles by Water Access Status

**Figure 4.2:** Predicted Probabilities of Household Welfare Quintiles by Time Burden Status

## **LIST OF ABBREVIATIONS**

|               |   |                                  |
|---------------|---|----------------------------------|
| <b>JMP</b>    | - | Joint Monitoring Programme       |
| <b>MLE</b>    | - | Maximum Likelihood Estimation    |
| <b>OLS</b>    | - | Ordinary Least Squares           |
| <b>PSU</b>    | - | Primary Sampling Unit            |
| <b>SDGs</b>   | - | Sustainable Development Goals    |
| <b>UBOS</b>   | - | Uganda Bureau of Statistics      |
| <b>UNHS</b>   | - | Uganda National Household Survey |
| <b>UNICEF</b> | - | United Nations Children’s Fund   |
| <b>VIP</b>    | - | Ventilated Improved Pit          |
| <b>WASH</b>   | - | Water, Sanitation and Hygiene    |
| <b>WHO</b>    | - | World Health Organization        |

## **ABSTRACT**

This study examined the association between access to improved water and sanitation and household welfare in Uganda using data from the Uganda National Household Survey (UNHS) 2023/2024. Specifically, the study analyzed the association between access to improved drinking water, improved sanitation facilities, shared sanitation facilities, and time spent collecting water and household welfare. Household welfare was measured using welfare quintiles derived from household consumption expenditure. The study employed a quantitative cross-sectional research design using secondary nationally representative data from 13,547 households. The effect of education level, region, place of residence, household size, and sex of the head of the household was controlled for in the estimation of an ordered logistic regression model. All sampling weights and design adjustments have been used to guarantee that estimates are nationally representative. The results showed that improved drinking water and improved sanitation facility availability had positive and significant relationships with household welfare. Households with improved drinking water and sanitation had higher odds of belonging to higher welfare quintiles compared to households without such access. Time spent collecting water for more than 30 minutes was negatively associated with household welfare, suggesting that long water collection times are linked to reduced opportunities for productive and income-generating activities. The findings for shared sanitation were mixed. In the full sample, shared sanitation was positively associated with household welfare, largely reflecting urban households living in formal shared residential settings with relatively better facilities. However, subgroup analysis revealed negative associations in some disadvantaged contexts, particularly where congestion and poor sanitation conditions were more prevalent. The study concludes that improved access to safe water and sanitation services is strongly associated with better household welfare outcomes in Uganda. However, since the study relied on cross-sectional survey data, the findings should be interpreted as associations rather than definitive causal relationships. The study recommends increased investment in rural water infrastructure, improved sanitation programs, and reduction of water collection time through expansion of nearby safe water sources. Policies should also focus on improving the quality, hygiene, and management of shared sanitation facilities, particularly in densely populated and low-income areas where congestion and poor sanitation conditions may reduce household welfare.

## **CHAPTER ONE**

### **INTRODUCTION**

#### **1.0 Introduction**

This study analyzed the association between access to improved water and sanitation and household welfare status in Uganda, using evidence from the Uganda National Household Survey (UNHS) 2023/2024. The need for improved water and sanitation is universally acknowledged as one of the factors that affect human welfare, affecting health, productivity, and living conditions. This chapter is a background of the study, problem statement, general objective, specific objective, research questions, scope, significance, and conceptual framework. The chapter sets out the rationale behind analyzing the role of access to improved water and sanitation services in Uganda in driving welfare inequalities within households.

#### **1.1 Background of the study.**

The availability of improved water and sanitation is acknowledged as an important factor in the socio-economic development and human welfare. Inadequate access to these basic services still remains a major drawback worldwide, especially in developing nations, where absence of infrastructure, high population growth rates and scarce resources hinder service provision. Improved drinking water sources and sanitation are key elements in protecting public health, mitigation public health risks and improving overall quality of life as stated by the WHO/UNICEF Joint Monitoring Program (JMP, 2017; 2023). They're basic human needs, but as well as that they're a big factor in economic productivity and social well-being.

There are several linked pathways between water, sanitation and household health and well-being. Having access to improved drinking water, is associated with reduced exposure to water borne diseases like cholera and dysentery, hence reducing morbidity and mortality rates (WHO, 2022). Improved health outcomes translate into reduced healthcare expenditures and increased labor productivity, both of which are essential components of household welfare (World Bank, 2022). In addition, access to nearby water sources significantly reduces the time burden associated with water collection. In many developing countries, particularly in rural areas, households especially women and children spend considerable time fetching water from distant sources, limiting participation in income-generating activities and education (UNICEF, 2023). Therefore, improved access to water supports not only health but also economic and social outcomes at the household level. Similarly, access to improved sanitation facilities plays a crucial role in promoting hygiene, environmental sustainability, and human dignity.

Poor sanitation is associated with environmental contamination, increased disease transmission, and adverse health outcomes, all of which negatively affect household welfare (World Health Organization, 2022). Safe disposal of human waste helps mitigate these risks, with improved sanitation facilities, like flush toilets and ventilated improved pit latrines, ensuring safe disposal. Furthermore, providing access to private sanitation improves safety, privacy and dignity, especially for women and girls, and has a positive impact on well-being (UNICEF & WHO, 2021).

Gaps in access to improved water and sanitation services are considerable in developing countries, and can be strongly influenced by structural issues including infrastructure, governance, and geography. Generally, urban areas will have more access to piped water and sewerage facilities and rural areas will have access to community-based or less reliable water and sewerage systems (UN-Habitat, 2020). Consequently, rural households are more likely to face difficulties in accessing improved services and, as a result, their welfare outcomes are poorer than in urban areas. The inequalities indicate the need to explore how access to water and sanitation translates into inequalities in household welfare. The situation of access to improved WASH facilities has changed over time in Uganda because of Government investments and changes in the sector. But big gaps do exist between regions and between urban and rural. While improved drinking water sources are used by a large proportion of household's reporting using the sources as improved from the Uganda Bureau of Statistics (UBOS, 2024), challenges of access, reliability, and distance remain. There are still a number of households that depend on sources that are distant from their place of residence which leads to delays in the collection process and thus to lower impact of access. Likewise, sanitation facilities are not equally available, with rural households less likely to have improved sanitation facilities (UBOS, 2024). These differences indicate that access to improved water and sanitation goes beyond just having access to it; it's also about convenient access, quality and sustainability. Households using improved services at, or near their household will be more likely to have positive welfare outcomes than those using distant or shared facilities (WaterAid, 2022). This underscores the need to take into account various aspects of access, such as time burden and exclusivity of use, when studying the link between water and health and household welfare. Access to improved water and sanitation services has implications beyond health and environment, and is important for household welfare. Household welfare, usually expressed as consumption expenditure, is a measure of the welfare of households which indicates their capacity to provide for basic necessities and achieve an adequate living standard.

Better access to water and sanitation can boost welfare, through lower health expenditures on waterborne diseases, more time to generate income and increase labour productivity. On the other hand, a household without access to WASH service could be exposed to increased medical costs, decreased

productivity, and time limitations that could have a negative impact on their consumption and welfare status. The above dynamics underscore the need to study water and sanitation as a fundamental service in addition to being an important driver of livelihoods and economic development at the household level. Moreover, provision of improved water and sanitation also has indirect economic pathways in relation to household welfare. Not only do fewer illnesses result in less lost working days and productivity, but time saved from improved water access can be used for productive or education activities (World Bank, 2022). Better sanitation will also minimize the environmental degradation and public health hazards, and lead to long-term welfare gains at both household and community levels (WHO, 2022).

Although the importance of water and sanitation in determining welfare outcomes is known, empirical evidence that directly links water and sanitation access to household welfare in Uganda is limited. It is quite common to see studies on access or on health outcomes without developing the analysis into the general welfare implications. This leaves a lack of knowledge on the relationship between the gains in access to water and sanitation and the actual gains in welfare.

## **1.2. Problem Statement**

Clean water and sanitation are integral to household welfare, which continues to be a main development policy issue, especially in many developing countries where access to basic services is still unevenly distributed. It is well recognised that accessing improved drinking water and sanitation is a critical component of the improvement of living standards, health and socio-economic development. Access to safe water and adequate sanitation remains problematic and continues to result in preventable diseases, lower productivity and higher household vulnerability, at global level (WHO, 2022; World Bank, 2022). There are great challenges in these efforts, particularly in Sub-Saharan Africa despite recent international ones under the Sustainable Development Goals (SDG) agenda. The Government and development partners have achieved significant results in Uganda in improving access to improved water sources and sanitation facilities.

The Uganda Bureau of Statistics (UBOS, 2024) indicates that there is a significant improvement in access to improved drinking water sources in the households. This reported access can however, often hide problems of access due to distance, reliability and quality of services. Numerous households, especially in the rural areas, still expend significant working hours fetching water from remote sources and others use common or unimproved sanitation service. These obstacles place a restriction on the effective use of water and sanitation facilities, and can diminish the link between water and sanitation services and household welfare outcomes.

In addition, the lack of access to improved water and sanitation has been linked to increased exposure to water borne diseases, high health care expenditures and loss of productive time (WHO, 2022). Collecting water at the same time also inflicts costs on development activities, such as income generating activities and education, especially for women and children, as stated by UNICEF (2023). Lack of hygiene conditions can also be linked to environmental contamination and health hazards, potentially compromising household health conditions (WHO & UNICEF, 2021). All of these factors point to a potential relationship between the access to limited and/or lacking water and sanitation services and lower household welfare. Existing research in Uganda largely has examined the level of needs met, infrastructure provision and health outcomes, but there is limited empirical evidence that directly examines the association between the coverage of improved drinking water and sanitation services and other household welfare outcomes. In particular, there is a lack of studies that have focused on the association of factors like proximity to water source, type of sanitation facility, and exclusivity of use to indicators of welfare like expenditure, productivity and welfare status overall. This leaves a knowledge deficit on whether or not there are measurable welfare effects of access to water and sanitation at the household level. As there are no empirical indicators available, designing targeted interventions aimed to improve welfare by investing in water and sanitation services becomes quite tricky without any empirical evidence that can confirm their effectiveness. Thus, this study aims to analyze the link between improvements in drinking water and sanitary conditions with household welfare in Uganda, based on the UNHS 2023/24. The study helps fill this void and offer information on the potential role water and sanitation interventions can play in contributing to households' welfare and in shaping policy for sustainable development.

### **1.3 General Objective**

The overall aim of the study is to investigate about the impacts of improved water and sanitation on household welfare in Uganda using UNHS 2023/2024 data.

### **1.4 Specific Objectives:**

- i. To analyze the impact of improved drinking water source on welfare of households in Uganda.
- ii. To assess the effect of access to improved sanitation facilities on household welfare in Uganda.
- iii. To analyze how time taken to collect water influences household welfare in Uganda
- iv. To evaluate whether sharing of sanitation facilities affects household welfare in Uganda.

### **1.5. Research Questions**

The following questions will guide the study to accomplish the above objectives.

- i. What is the effect of access to improved drinking water sources on household welfare in Uganda?
- ii. What is the effect of access to improved sanitation facilities on household welfare in Uganda?
- iii. What is the effect of time spent collecting water on household welfare in Uganda?
- iv. How does reliance on shared sanitation facilities affect household welfare in Uganda?

## **1.6. Scope of the Study**

### **1.6.1 Geographical scope**

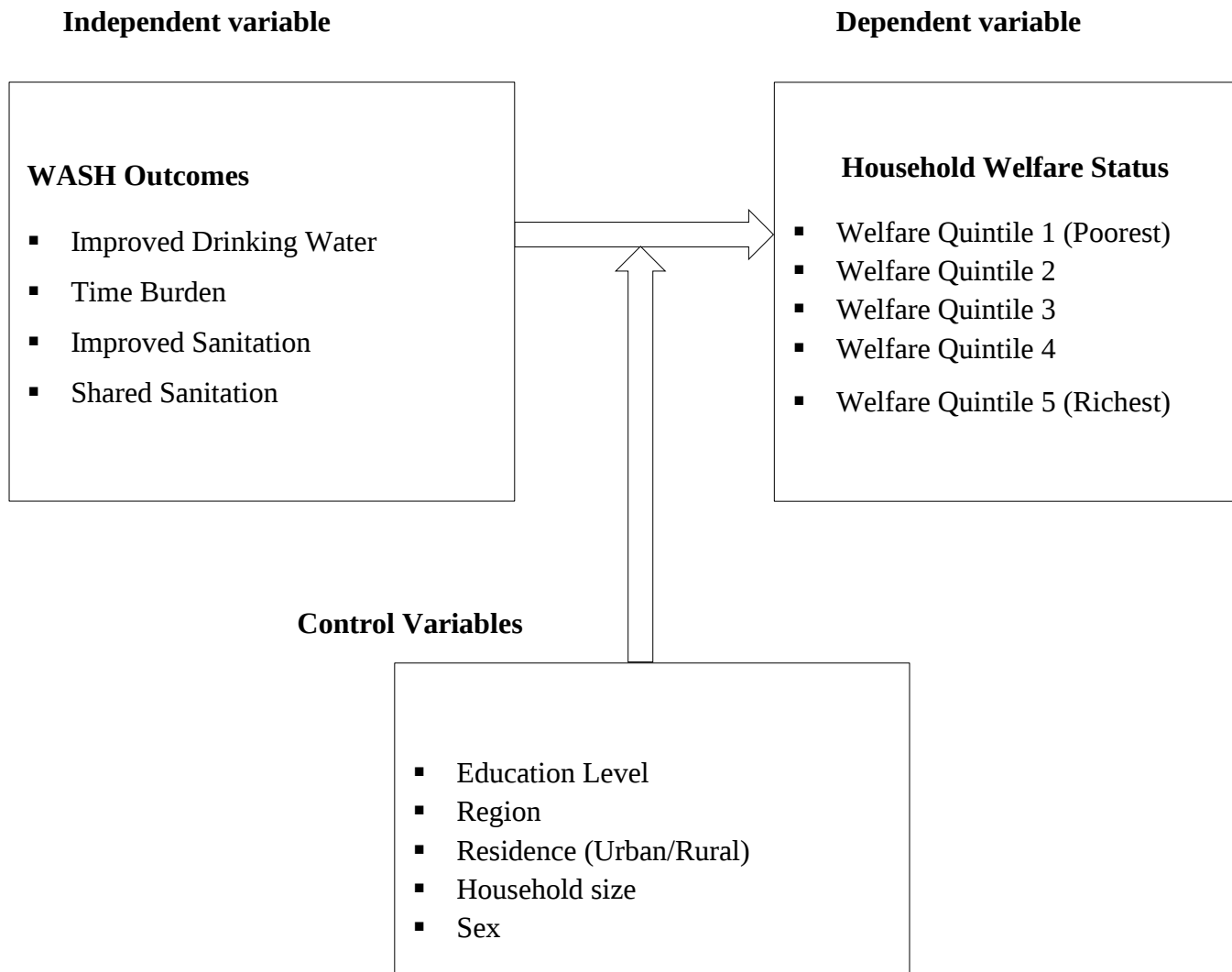
The study is conducted in Uganda, and uses nationally representative data from Uganda National Household Survey (UNHS) 2023/2024. The analysis is based on the entire country of Uganda, including both the rural and urban parts of the country, as well as all of the country's regions, including Eastern, Northern, Western and Central Uganda. The scope of the geographical data ensures that the results are not only representative of the country as a whole, but also of the various levels of access to improved water and sanitation services, and their impact on household welfare, in the different geographical areas of Uganda.

### **1.6.2. Content scope**

This paper explores the link between the use of improved water and sanitation and the welfare of the household in Uganda. In particular, it attends to the important WASH indicators such as improved drinking water sources, improved sanitation facilities, dependence on shared sanitation facilities, and time spent in collecting water. Household welfare is regarded as the dependent variable, and measured by such factors as the consumption expenditure and general living conditions. Selected household characteristics, such as education level of the household head, household size, region, and place of residence (urban or rural) are also considered in this study to guard against any unwanted biases in the estimated effects of the WASH variables on household welfare.

### 1.7 Conceptual Framework.

**Figure 1: Conceptual Framework**



Source: Adopted from Mwenyango (2022)

The conceptual framework in this study shows the connection between access and use of improved water and sanitation (WASH) services with household welfare in Uganda. The independent variables used in this study are improved drinking water sources, time burden for water collection, improved sanitation facilities and shared sanitation facilities, while the dependent variable is the household welfare status. Better access to improved sanitation and water is likely to take several paths in affecting household welfare. Access to better water sources saves households on water collection time and hence gives them time to engage in productive activity. Having access to improved sanitation facilities helps to improve people's health and hygiene, lower the incidence of disease and the costs of services, improving the well-being of the household. Alternatively, access to shared sanitation can have adverse impacts on welfare

as it can provide less privacy, health risks and reduce sanitation quality. This study also introduces control variables that may affect access to WASH services and household welfare outcomes such as the level of education of the household head, geographic region and place of residence (urban or rural). The analysis also controls for these variables, to ensure that the estimated impact of WASH indicators on the household's welfare is unbiased and represents the reality.

### **1.8 Significance of the study.**

The study makes a policy and academic contribution as it offers empirical evidence of the impact of access to improved water and sanitation on household welfare in Uganda. The findings can provide policies with insights that can inform the design and implementation of water and sanitation interventions as a means to improving the welfare of households. The findings can be used by institutions that have responsibility for water, sanitation, and public health to set priorities more effectively for the populations that are not served to minimize inequalities in coverage of needed services.

For development partners and practitioners, the study highlights the importance of investing in WASH infrastructure as a means of improving living standards, reducing time burdens, and enhancing productivity at the household level.

Academically, the study contributes to existing literature by shifting the focus from the commonly studied relationship where welfare determines access to WASH, to examining how access to WASH itself affects welfare outcomes. This provides a clearer understanding of the role of basic services in shaping socio-economic wellbeing.

Finally, the study provides a basis for further research on the interaction between infrastructure access and household welfare, particularly in developing country contexts

## **CHAPTER TWO**

### **LITERATURE REVIEW**

#### **2.0 Introduction**

This chapter reviews existing literature on the association between access to improved water and sanitation and household welfare. The purpose of this review is to establish the theoretical and empirical foundation of the study while identifying gaps that justify the current research using evidence from the Uganda National Household Survey (UNHS) 2023/2024.

#### **2.1 Theoretical review**

his study is guided primarily by the Household Production Theory, originally developed by Gary Becker. The theory creates a simple analytical framework to reason about the relationship between access to these improved water and sanitation services and better household welfare outcomes. According to the Household Production Theory, the household is a decision unit where various inputs like income, time, infrastructure, and public services are combined to generate the welfare outputs, such as health, productivity, and overall welfare of the household (Becker, 1965). In this context, WASH is considered as an important input in the household production function. Households which have more access to these services are more likely to have higher welfare relative to those with less or no access to these services.

The health production pathway is one of the pathways that this theory highlights. Improved drinking water is associated with reduced exposure to waterborne disease like diarrhoea, cholera and typhoid; and improved sanitation is associated with reduced environmental contamination and disease transmission. Better WASH conditions are associated with a reduction in morbidity and mortality, particularly of children, based on empirical evidence (WHO & UNICEF, 2021). Improved health is linked to higher workers' productivity, lower health care costs, and greater ability to engage in income-generating activities by household members – propping up welfare (World Bank, 2022). One more significant pathway is the allocation and also effectiveness of time. Households with no good sources of water can spend considerable time fetching water in many developing countries such as Uganda. Uganda Bureau of Statistics (UBOS, 2024) also indicated that rural household in Uganda are more likely to spend more than 30 mins of their trip fetching water. The Household Production Theory proposes that time is limited and that saving time to gather water could free up time for households to have them for productive purposes, in education or leisure. This reallocation supports the generation of income and human capital, which are key factors of household welfare.

Resource efficiency and cost savings are also emphasized in the theory. Households benefiting from improved water and sanitation experience reduced direct and indirect losses due to morbidity (illness), such as reduced health costs and lost work days. Households with unimproved sources, however, may have to spend more on health-related expenses and have to compromise on productivity that has a detrimental impact on their welfare status (UNDP, 2020). Better services can thus boost the productive use of the household's resources, leading to better "productivity" in the satisfaction of welfare outcomes. Theories from the Household Production Theory and the Human Capital Theory further support the theoretical underpinning of this study. According to the Human Capital Theory, health is one of the elements of human capital which has significant relationship with the productivity and income (Schultz, 1961; Becker, 1993). Better access to improved water and sanitation contributes to improved health and, therefore, greater ability to work, learn and earn income. This forms a vicious circle: Improving access to WASH services brings better health, which brings better welfare of the household. Although several explanations of the relationship between WASH and welfare exist, the Household Production Theory continues to be used as a key tool for analysis in this study. This is because all of the above household-level inputs are directly related to welfare outcomes, with relatively clear mechanisms of improvement in health, savings of time and productivity.

## **2.2 Words of the study**

### **2.2.1 Household welfare status**

Household welfare status indicates the overall economic and living situation of a household, which is an ability to satisfy basic needs including food, shelter, education, health care and access to basic services such as water and sanitation. It's multidimensional and more than just about income; about consumption, assets, and life in general. Welfare is usually computed based on household consumption expenditure, rather than income, in development economics, especially in developing nations where income flows are not regular, not formal, and hard to strictly measure (Deaton & Zaidi, 2002). The consumption is taken as measure of actual living standard and is more stable in time as compared to the GDP (Haughton & Khandker, 2009). Many scholars including Ravallion (2016) believe that one of the main ways to evaluate poverty and inequality is through the measurement of welfare, which can then be used as a basis for comparing households in various household welfare groups. For empirical studies, welfare levels are often divided into five quintiles or percentiles for analysis to examine welfare differences. This method enables researchers to show the difference in access to services between the poorest and richest sections of the population.

In this study, welfare status of households is measured through the use of the quintiles of households' welfare derived from the Uganda National Household Survey (UNHS 2023/2024). Households are categorized into five groups – poorest (Q1), poorer (Q2), middle (Q3), richer (Q4), and richest (Q5). This classification means that it is a nationally representative and standard measurement of welfare of a household, allowing comparisons to be made between them.

It is consistent from the existing literature that the welfare status of household is a significant factor that affects the provision of basic services to the household. Better-off households are able to afford improved water, sanitation facilities and other infrastructure because they have better access to these facilities and services (World Bank, 2019; UNICEF & WHO, 2021). On the other hand, the less affluent families are more likely to get communal or unimproved components, which have less reliability and health risks. Welfare inequalities in Uganda are tightly coupled with inequality in services, especially in rural and urban settings. Therefore, it is important to look at indicators of household welfare status to gain insights about inequalities in WASH (Water, Sanitation and Hygiene) outcomes.

### **2.2.2 Improved Drinking Water**

Improved drinking water means water sources that are designed and built to prevent contamination especially from faecal contamination that would make the water safe to drink. The WHO/UNICEF Joint Monitoring Programme (JMP) classifies water sources as improved if they were piped into dwellings, public standpipes, borehole, protected well, protected spring, rainwater collection systems; and as unimproved if obtained from unprotected wells, unprotected springs, unprotected surface water, or from sources not classified as above (WHO/UNICEF, 2021). A water source that is deemed “improved” will provide more access to improved drinking water sources than unimproved water sources, like unprotected wells, rivers, lakes and surface water. In this study, drinking water is considered improved if it meets the same classification criteria used in the UNHS 2023/2024 dataset to be consistent with nationally representative data. It must be noted, however, that “improved” use does not necessarily mean that water is safe to drink. Household surveys seldom involve direct water quality testing, so this does not necessarily ensure that better water sources are not contaminated when collected, transported, or stored in a house (Bain et al. 2014).

The need for better drinking water is well known. Improved access to drinking water resources is linked to lower rates of water borne diseases like diarrhea, cholera and typhoid, which are still significant public health problems in many developing countries (Prüss-Ustün et al., 2019). Besides, improved water access helps to improve nutrition, productivity and educational outcomes – especially for children. However, inequities in access to improved water sources remain. Wealthier households tend to have

potable water in their households, whereas weaker households rely on shared or distant sources of water (WHO/UNICEF, 2021; World Bank, 2020). The differences are also affected by regional and urban–rural differences in Uganda; such that in rural areas, householders have more difficulties in accessing reliable and access to improved drinking water sources. Moreover, restricted access also creates greater water collection challenges, especially for women and children. Thus it is important to investigate improved drinking water in relation to household welfare status to understand inequalities in access and their wider implications for household welfare.

### **2.2.3 Improved Sanitation Facility**

**Improved Sanitation Facility** Sanitation facilities that have been improved are those that are built to separate human waste from human contact in such a way that human diseases are not spread. The World Health Organization/UNICEF Joint Monitoring Program (JMP) defines improved sanitation facilities as flush or pour-flush toilets that are connected to sewerage systems, septic tanks or pit latrines, ventilated improved pit (VIP) latrines, and composting toilets (WHO/UNICEF, 2021). The function of these facilities is very important for public health and environmental hygiene. Improved sanitation is assessed in this study by the classification in the international standard UNHS 2023/2024.

The analysis is restricted to improvements in the availability of sanitation facilities by home either through private ownership or shared infrastructure. Even though they are said to be improved, there are, however, hygiene and accessibility issues with shared facilities. It has been highlighted in the literature that there is a close relationship between sanitation and health. Children in poverty are at higher risk of infectious diseases like diarrhoea, cholera and gastrointestinal infections due to poor sanitation, which is a significant factor in the transmission of these diseases (Prüss-Ustün et al., 2019).

The provision of improved sanitation also brings dignity, safety and better quality of life. Economic capacity, social norms and sanitation awareness have been shown to affect investment in sanitation by scholars like Jenkins and Curtis (2005). Private sanitation facilities are more common in richer households whereas the poorer households may use shared or unimproved sanitation facilities or open defecation because of financial constraints. Additionally, the World Bank (2020) has identified sanitation inequality as a constant problem in many developing countries such as Uganda. Improved sanitation varies widely by welfare group and by geographic location in Uganda. Generally, the infrastructure has better access in urban households than in rural households where the infrastructure development is limited. But also cultural practices and density of population shape the type and use of sanitation. Thus, the study of the different aspects of improved sanitation and its relation to household

welfare status gives valuable insights into inequality in basic service provision and is able to guide policy interventions towards ensuring universal access to sanitation.

## **2.3 Empirical review**

### **2.3.1 The effect of access to improved drinking water sources on household welfare in Uganda**

In Uganda, access to improved drinking water sources has significant impacts on household welfare. Household welfare is significantly affected by access to improved drinking water source in Uganda. Empirical studies universally show that improved access to drinking water has multiple interrelated impacts on household welfare. The relationship generally happens in the form of better health, less time limits and better productivity of the home. These mechanisms interact, affect the household's human and physical capital accumulation and hence its overall welfare level. The health channel is one of the most well-packaged routes, as holding-up drinking water has actually been linked to decreased exposure to water-borne disease. Census blocks that use unimproved water sources are at increased risk of purveying waterborne diseases, like diarrhea and cholera, which have consequences on health and well-being but also economic costs for healthcare consumption and lost labor time. Conversely, the utilization of improved sources of drinking water has a strong association with reduced incidence of disease suggesting healthier household members able to engage more effectively in economic activities. There is evidence from developing countries that accessible water is an effective predictor of lower child mortality and morbidity, thereby directly impacting the welfare of households (WHO & UNICEF, 2021). The findings of the national survey indicate that for Ugandans, access to improved water sources contributes significantly to the reduction of health related welfare inequalities, with households that rely on improved water sources reporting fewer incidences of illness. This indicates that better access to water is positively linked not just with improvements in the health status, but with savings of household resources which would otherwise be used to cover medical treatment.

A second critical aspect is the reduction of time spent collecting water. Women and children in many low-income countries, such as Uganda, have to invest large amounts of their time in collecting water from far away and uncertain sources. Having access to better drinking water supplies and particularly those available on site or in a short distance soon diminishes this burden of time. Empirical research found that the savings in water collection time can free up time for households to allocate to alternative activities such as income-generating opportunities, childcare and education, and other activities that contribute to their well-being (World Bank, 2022). The data shows that in Uganda households using improved water sources take less time to fetch water, thereby increasing their ability to participate in economic and social activities that boost welfare. Thus, the welfare benefits of time saved are great, not

only in the present but also in the future, when it will have been spent developing human capital. Improved drinking water is also correlated to household productivity and income generation, strengthening its correlation to welfare. Healthier people are more productive, and with fewer time constraints, households have the opportunity to diversify their economic activities. Better access to water has also been associated with greater labour supply and income, especially in rural areas, where water scarcity could be particularly constricting (World Bank, 2019). Households that have access to good water can engage in agricultural and non-agricultural activities with fewer disruptions due to illness or time lost, putting them in a better position in Uganda. This means that better access to water could prove to be a key enabling factor for economic progress, and have a direct impact on household welfare.

While these positive links are recognized, there are some limits to the association between better drinking water and household welfare. Labelled ‘improved’ water does not necessarily mean that water supplies are consistently available or that the quality of service received is satisfactory. Sometimes, households can benefit from better sources of water (borehole, public tap) but due to congestion/low flow, waiting times are still on the high side. Highlighting increasing evidence that shared improved water sources in densely-populated areas may cause great time costs, which diminish welfare gains (World Bank, 2022). This is because the welfare benefits of better water access are connected to the type of water source, but also its reliability, accessibility and functionality.

Additionally, water access differentials can constrain the impact of better water access on welfare. The improvement of water infrastructural facilities may not be even and distribution for urban and economically well off including with improved service coverage than for rural and low income areas (World Bank, 2019). Therefore, the effectiveness of the welfare may vary across households depending on their geographic area, resulting in different household outcomes. There are still inequalities in access to water in Uganda, both in terms of region and rural–urban, which hinder the delivery of welfare gains from improved water (UBOS, 2024). These differences show the need to take context into account when evaluating the link between access to water and welfare. Current research literature has much to offer about the health, time use and productivity impacts of improved drinking water, but this work falls short of providing a comprehensive analysis of how these impacts fit into a broader picture of household welfare. Much of the literature treats the outcomes of interest separately, leaving one to ponder the possible interactions among the factors that affect overall well-being. Furthermore, the use of nationally representative data to delve into these relationships is limited in Uganda, limiting the generalizability of results.

### **2.3.2 The effect of access to improved sanitation facilities on household welfare in Uganda**

Household welfare is largely determined by access to improved sanitation facilities, which manifest themselves through health benefits, cost-effectiveness and productivity. The relationship is not only correlational, but also a series of causal processes by which sanitation conditions affect the capacity of households to be healthy in the long-term and to build and sustain resources over time. Better sanitation is linked to reduced exposure to human waste, a primary contributor of environmental pollution and disease spread, and therefore, has direct impacts on health and indirect effects on economic outcomes. One of the key ways that sanitation impacts household welfare is through health improvements. Inadequate sanitation is tightly linked with the transmission of infectious diseases, and is especially important in the transmission of diarrheal diseases that disproportionately affect children and vulnerable populations. Households without access to improved sanitation facilities are more vulnerable to contaminated environment, and are likely to experience more disease and resulting healthcare expenses. Bolstered sanitation, on the other hand, brings about a considerable decrease in incidence of disease and in turn healthier members of the household and lower medical costs. There is robust evidence that sanitation benefits lead to reductions in child mortality and morbidity, thereby having also long-term effects on human capital formation and household welfare (WHO & UNICEF, 2021). Household sanitation facilities are linked to reduced welfare disparities that relate to disease burden, with improved sanitation facilities in Uganda being reported to have positive health consequences for households (UBOS, 2024). In addition to health, sanitation also has an impact on welfare through its ability to affect the financial and economic aspects of life. Poor sanitation related illnesses have both direct and indirect costs on the households. The direct costs are related to medical care and medications, and indirect costs include lost work days and productivity loss. Improved sanitation is also linked to reduced economic costs as it decreases the burden of diseases linked to poor sanitation, which enables families to invest in other social services that enhance welfare, including education, nutrition and other investments. Empirical evidence suggests that the improvement in sanitation is positively correlated to the increase in household consumption, which suggests a better economic status of the household (World Bank, 2022). In Ugandan context, improved sanitation conditions are associated with lower vulnerabilities to health shocks that contribute to a more stable household income leading to welfare improvement (UBOS, 2024). In addition, there are further links between sanitation and productivity and labour outcomes, which reinforces the connection of sanitation and welfare. Better health yields more people a greater ability to work in the labor market and to contribute to productive activities. A decrease in sickness means a decrease in lost work days and more efficiency, especially in families that rely on manual work. Moreover, better sanitation facilities contribute to better home environment which in turn

means that better child development and education is possible. Households with good sanitation conditions have been shown to have reduced incidences of recurrent illness, leading to better school attendance and learning outcomes and therefore to long-term benefits for child welfare (UN-Habitat, 2020). This illustrates the immediate and intergenerational impacts of sanitation on welfare. Better sanitation is associated to a set of welfare benefits, but the welfare benefits of better sanitation are reliant on the definition and implementation of sanitation, especially when considering shared sanitation.

By international definition, access to shared sanitation facilities can be considered improved and classified in terms of technology and even though they may not be treated as separate sanitation facilities, they may be considered improved because of accessibility, hygiene and maintenance concerns. Shared sanitation facilities might have their expected welfare benefit dampened due to the factors of overcrowding, suboptimal maintenance and lack of hygiene. Household exposure to contamination and privacy deprivation is known to have bad effects on well-being, even when the infrastructure is better than it is in households that use separate toilets. Evidence indicates that exposure to contamination and lack of privacy is worse in households using shared sanitation services (World Bank, 2019). This also establishes a key difference between having access to improved sanitation and the quality of it, leading to the importance of discussing it as a different outcome. Contextual and spatial conditions also have an impact on the link between sanitation and welfare. Lack of access to better sanitation services is varied both within and between geographic areas and rural and urban households.

The urban households have good infrastructure and service provision for improved sanitation where as the rural households are use of basic or unimproved sanitation facilities. There may also be infrastructure access barriers to improved sanitation for households with similar welfare levels in areas with less infrastructure (UBOS, 2024). This implies that the role of sanitation on welfare is embedded within a broader structural framework which includes structural conditions as well as household characteristics.

While there is considerable empirical evidence that links sanitation to welfare, there are certain constraints. The type of sanitation facilities is not always a good approximation of actual usage or the state of the sanitation service, both of which are important for the health benefit that can be achieved. An improved facility does not automatically mean that it is used consistently or hygiene is practised properly, for instance. Furthermore, some cultural and human behaviors can affect sanitation outcomes without access to sanitation infrastructure. These constraints suggest that the sanitation-welfare link is not simple and cannot be adequately expressed by only considering whether or not sanitation is being used. Better sanitation leads to better health and wellbeing outcomes, lower costs and more productivity. The size of these impacts is a function of the quality of facilities, level of sharing, and the presence of spatial inequalities, among other things. This study contributes to the literature through an in-depth

analysis of the effect of improved sanitation on household welfare in Uganda using nationally representative data, and takes these contextual factors into account.

There is a question of the impact of shared sanitation facilities on household welfare in Uganda in 2.3.3.

Flies and food waste, as well as health risks, are significant factors in the impact of shared sanitation facilities on household welfare; however, other factors, such as the effect on time and dignity and productivity, are also of importance. Shared facilities may meet a basic level of sanitation access in crowded and low-income communities, but may not come close to providing the benefit of private improved sanitation to a beneficiary. Consequently, households using shared sanitation services are likely to have poor living standards when compared to those with access to private sanitation.

One of the most important pathways by which shared sanitation impacts welfare is that of less health protection. Shared facilities – some might be technically described as “improved”, but their shared use frequently results in poor management, overcrowding and unhygienic conditions. These conditions make it more likely for exposure to pathogens to occur, reducing, if not negating, the health gains that are generally expected from better sanitation. Sharing of facilities puts households at higher risk of suffering diseases associated with sanitation because of the risk of contamination from more than one user as well as poor cleaning practices. This means increased health expenditures and more susceptibility to disease, thereby impacting household welfare (WHO & UNICEF 2021; World Bank 2019). Ubago data indicates that households using shared sanitation units are more likely to have worse sanitation and hygiene conditions, and are exposed to environmental health risk, than those with their own sanitation (UBOS, 2024).

Time and convenience costs are associated with shared sanitation and can lead to decreased welfare. Households have to share toilets with others at a distance or wait for them in use a transfer as this is not generally found in private facilities. This places a strain on time, especially in densely populated urban communities with several households relying on a small number of facilities. Access to sanitation takes time that otherwise could be spent generating income, caring for children and children's education, or other productive pursuits. Access to facilities is often not as easy for women and children to access, with longer travel times or waiting times, which can reduce their participation in other welfare-enhancing activities (UN-Habitat, 2020). Another important channel is the impact on dignity, safety and wellbeing brought about by shared sanitation. Shared facilities may lack privacy and security and that can make it more difficult for them to be used regularly, particularly by women and girls. Safety concerns, especially during night-time may drive households to practice open defecation or use less, further compromising sanitation outcomes. These have implications for psychological well-being and quality of life which are

part of household welfare. One of the important non monetary costs that distinguish shared versus private sanitation is the lack of privacy and control over sanitation facilities (World Bank, 2022).

The quality and upkeep of common facilities also account for their relatively small role in welfare, because they are often poorly maintained and of poor quality. Shared facilities are often poorly maintained, because no one is solely responsible for the upkeep, so the facility may deteriorate quickly and its use may be limited. In a majority of cases, there are no clear provisions for the responsibility of cleaning and repairing facilities and buildings, leaving them unhygienic. This could diminish the use of the facility and its ability to achieve improvement in sanitation outcomes, as access is not the same as improved sanitation outcomes. As such, even when households have the opportunity to have access to sanitation infrastructure, unexpected effects on health and welfare may not be observed. From a socio-economic point of view, shared sanitation is an indicator of existing resource limitations and inequalities. Households that are reliant on shared facilities are generally those who may be unable to afford having their own sanitation facilities owing to insufficient income or lack of space, especially in squatter settlements in cities. The link between shared sanitation and lower welfare levels therefore indicates it is a symptom as well as cause of lower welfare levels. Although it serves as a partial solution in contexts where provision of private sanitation is not possible, it doesn't resolve welfare inequalities as it achieves lower quality outcomes than private sanitation. Empirical evidence shows that there are significantly better welfare indicators for households with private improved sanitation facilities compared to those that share facilities even when controlling for income and other household characteristics (World Bank 2019; UBOS 2024).

But one should be aware that there are still some welfare gains to be gained with shared sanitation over unimproved sanitation or open defecation. Shared facilities can not only minimize environmental contamination relative to more basic facilities, but they can also help enhance overall sanitation conditions in settings where no alternatives are available. The amount of these benefits varies based on the number of users, management systems and maintenance practices. Fewer benefits is associated with poorly managed shared facilities with poorly defined user responsibilities compared to well-managed facilities with clear user responsibilities (UN-Habitat, 2020). Overall, the use of common facilities with sanitation is seen as correlated to lower household welfare, as a result of associated negative health impacts, time constraints, lack of privacy and substandard maintenance. Shared sanitation can be used as a short-term solution in resource poor areas, but can not fully provide the welfare benefits of private improved sanitation. This makes it an important variable in this study to analyze separately and give a better understanding of the impacts of access to various sanitation alternatives on the welfare of the household in Uganda.

### **2.3.4 What is the effect of time spent collecting water on household welfare in Uganda?**

Collecting water is an important and often overlooked factor contributing to household welfare, especially in developing countries such as Uganda, where many households continue to have no access to water in their homes. There are several interrelated pathways connecting the relationship between water collection time and the welfare, such as labor productivity, education, health and time allocation inside the household. First, too much time spent collecting water is linked to less time available for productive economic activities. Traditionally, water collection in most Ugandan households, particularly in rural areas, is done mainly by women and children. If considerable hours are spent daily on collecting water, this can impact involvement in other livelihood activities like farming, informal commercialization or wage employment.

This reduces the earning potential of household members, thereby impacting negatively the welfare of the household. Empirical evidence also indicates that the closer that households are located to improved water sources, the more productive their labour and the higher their income level is (World Bank, 2019). This implies that saving time spent collecting

water could expand the human labor force at the disposal of economic activities and boost welfare levels. Second, time commitment for water collection has ramifications for education, especially children. In many cases, children especially girls are responsible for assisting with water collection. There is a correlation between high school nonattendance and distance from water. Distance to water is often tied to late school attendance, absenteeism or even school dropout. This affects human capital development, which is one of the fundamental factors of long-term welfare. Research shows that it is related to better school attendance and education results when water collection time is reduced (UNICEF, 2021). But the magnitude of this benefit would rely on the ability of families to redirect saved time into education instead of other household activities. Third, the time need to collect water and their health, which affects their welfare, has indirect impacts. Traveling long distances to collect water can be physically exhausting and potentially hazardous, as people may be at risk of accidents or unsafe water sources along their path. Also, excess time can be spent by households obtaining water and reduce the amount of water used for hygiene, thus increasing the risk of water borne diseases. Lower productivity and rising health care costs due to poor health reduce household welfare. There is evidence that the availability of water systems can decrease the prevalence of waterborne diseases and have a positive impact on health (WHO, 2020). The welfare effect of saving time is not always obvious, however. A drawback is that if water collection time is reduced but not productively utilized, there is no guarantee of an increase in welfare. Perhaps, in certain settings, it is possible to incorporate time gains into other unpaid domestic activities, especially among women, thereby reducing potential welfare gains. In

addition, infrastructure issues like the reliability of water supply can decrease the impact of proximity enhancements. However, where water sources are located further away, they may be disconnected for some time, causing people to spend extra time waiting to get water or making multiple trips, thereby reducing the intended benefits of access to water (UNDP, 2020).

In addition, there is spatial and socio-economic inequity in terms of water availability and water-use that affect the time-welfare relationship. Poor infrastructure is a higher risk of increased water collection times for rural households and low-income households. This results in a differential distribution of welfare benefits, in that the time burden falls more heavily on disadvantaged families. The literature also indicates that having low income is strongly associated with experiencing poverty over time, thus perpetuating cycles of poverty (Sorenson et al., 2011). Water collection time is not just an issue of service delivery, however, it also has an element of equity and inclusive development. To summarise, labour invested in fetching water has a negative impact on people's wellbeing by impacting their level of education, their health and their labour productivity. This time burden can have a significant impact on welfare in that it can be used in alternative ways, including drinking water, cooking and washing food, and washing clothes. The link between the increased welfare and better access to water is dependent on the ways in which the saved time is used in the household, and on the reliability of water supply systems. Meeting these challenges will involve the development of additional water infrastructure but also maintenance of a regular water supply service and the development of an equitable water use distribution between regions.

Although there is a vast amount of literature that has studied water and sanitation, most studies do not consider broader aspects of how access to water and sanitation affects household welfare. Few studies have been conducted in Uganda that have applied nationally representative data to explore the relationship between improved water and sanitation provision and the welfare of households, such as through the effects on productivity, time savings, and health-care costs. This study, therefore, seeks to fill this gap by employing UNHS 2023/2024 data to explore the connection between enhancing water and sanitation access and household welfare in Uganda.

## **2.4 Summary of the Literature Review.**

The literature reviewed shows that access to improved water and sanitation is positively associated with household welfare through clear pathways including better health, reduced time burden, and increased productivity. Improved water sources are associated with lower risk of waterborne diseases and reduce medical costs, while improved sanitation facilities promote hygiene, dignity, and safer living environments, all of which contribute to improved well-being (WHO, 2020; World Bank,

2019). At the same time, reduced time spent collecting water may allow households to engage more in income generating and educational activities, further strengthening welfare outcomes. However, the literature also points out important limitations, such as unreliable water supply, poor sanitation infrastructure, and inequalities in access across regions and income groups, which can weaken these benefits (UNICEF, 2021)..

## **CHAPTER THREE**

### **RESEARCH METHODOLOGY**

#### **3.0 Introduction**

This chapter presents the research design, data sources, variables, and analytical procedures used to examine the association between access to improved water and sanitation on household welfare in Uganda. The data in the study is secondary, which was derived from the Uganda National Household Survey (UNHS) conducted in the year 2023/2024. The chapter explains the research design, the target population, the operationalization of the variables, the model specification, the estimation method, diagnostic tests, and ethical issues. Stata was used for data management and analysis.

#### **3.1 Research Design.**

The design of the study was quantitative of the cross sectional type and the data used were secondary data obtained from UNHS 2023/2024. This design can be used for studying the relationship between access to improved water and sanitation and household welfare at national level. Aows an estimation of relationships between WASH indicators and welfare outcomes whilst accounting for household socio-economic and geographical features. The study does not provide causal evidence as it is based on cross sectional data.

#### **3.2 Data Source**

Secondary household level microdata from the Uganda National Household Survey (UNHS) 2023/2024 carried out by the Uganda Bureau of Statistics (UBOS) was used in this study. The UNHS is a nationally representative survey which yields comprehensive and detailed data on household welfare, drinking water, sanitation facilities, education, place of residence, and consumption expenditure. The survey uses two-stage stratified sampling which encompasses all all regions of Uganda and both urban and rural communities. Weights for sampling are given to ensure that results are nationally representative. The study's unit of analysis is a household.

#### **3.3 Study Population and Sample**

The study population is all households that were interviewed during UNHS 2023/24. The data are for all households living in all regions of Uganda, both rural and urban. The survey collects detailed information on socio-economic conditions, water and sanitation coverage, and household welfare. The UNHS 2023/2024 data was a nationally representative household sample for all regions of Uganda. In this study, the analytical sample comprised households where the information on the key variables in the analysis is complete, that is, households with complete information on welfare quintile, access to

improved drinking water, sanitation facilities, shared sanitation, time spent collecting drinking water, education level, region, residence, household size, and sex of the household head. During data cleaning and preparation, observations that had missing, incomplete and inconsistent responses on any of these variables were excluded. The cleaned analytical sample used was 13,547 households following the removal of observation units with incomplete or inconsistent information on the key variables. This is the last estimation sample used for ordered logistic regression analysis. The cl. This cleaned sample was subsequently weighted to reflect national representativeness and valid statistical inferences by using the UNHS sampling weights.

### 3.4 Conceptual Framework and Variable Operationalization

The conceptual framework of this study shows the relationship between access to improved water and sanitation and household welfare in Uganda. Access to improved drinking water sources, improved sanitation facilities, use of shared facilities and time spent collecting water are considered as primary explanatory drivers. The outcome variable is Household welfare as measured by Welfare indicators based on Household consumption expenditure (UBOS, 2024). Improved water means no more waterborne diseases spread and improved sanitation means better hygiene and living conditions. Decreased water collection time allows more time to spend on productive and income generating activities. However, there may be a negative relationship between the shared sanitation and household welfare in places where there are high levels of congestion, inadequate hygiene, and no privacy. Some other factors included in the study are education level, region, urban or rural place of residence, size of the household and sex of the household head. The above are controlled for, such that the impact of WASH-related variables on household welfare is isolated. The operationalization of each variable is presented in Table 3.4, which includes the variable names from the UNHS, the construction/coding and the type of the variable. This is a clear and explicit measurement which provides for the reproducible analysis.

**Table 3.4: Operationalization of Key Variables**

| Concept           | Variable Label (UNHS) | Construction / Coding                                                       | Type      |
|-------------------|-----------------------|-----------------------------------------------------------------------------|-----------|
| Household Welfare | Welfare quintile      | Q1 = Poorest, Q2 = Poorer, Q3 = Middle, Q4 = Richer, Q5 = Richest (ordered) | Dependent |

|                     |                     |                                        |             |
|---------------------|---------------------|----------------------------------------|-------------|
| Improved water      | Water source        | 1 = Improved, 0 = Unimproved           | Independent |
| Improved sanitation | Toilet type         | 1 = Improved, 0 = Unimproved           | Independent |
| Shared sanitation   | Shared facility     | 1 = Shared, 0 = Not shared             | Independent |
| Time burden         | Time to fetch water | 1 = >30 minutes, 0 = ≤30 minutes       | Independent |
| Education           | Education level     | None / Primary / Secondary / Tertiary  | Control     |
| Region              | Region              | Central / Eastern / Northern / Western | Control     |
| Residence           | Urban/rural         | 1 = Urban<br>0 = Rural                 | Control     |
| Household size      | Number of members   | Continuous                             | Control     |
| Sex of head         | Gender              | 1 = Male, 0 = Female                   | Control     |

Source: Secondary data

### 3.5 Dependent Variables

The dependent variable in this study is household welfare, in terms of the Uganda National Household Survey (UNHS) 2023/2024 consumption expenditure based Welfare quintiles. Households are divided into five 'quintiles' in order of their level of consumption expenditure, the poorest being in 'Q1' and the richest in 'Q5'.

This ordered classification reflects increasing levels of household welfare and preserves important information on welfare distribution across households. Unlike binary classification, which collapses welfare into two categories, the use of quintiles allows for a more comprehensive analysis of how access to improved water and sanitation influences welfare outcomes across different levels of the population.

### 3.6 Model Specification

To examine the relationship between access to improved water and sanitation and household welfare, the study employs an ordered logistic regression model. This approach is appropriate because the dependent variable (household welfare) is ordinal in nature, consisting of five ranked categories (Q1–Q5). The ordered logit model assumes the existence of an unobserved latent variable  $Y_i$ , which represents the underlying level of household welfare. The observed welfare categories are determined by threshold values that partition this latent variable into ordered groups.

The model is specified as:

$$Y^*_i = \beta_0 + \beta_1(\text{Improved Water}_i) + \beta_2(\text{Improved Sanitation}_i) + \beta_3(\text{Shared Sanitation}_i) + \beta_4(\text{Time to Water}_i) + \beta_5(\text{Education}_i) + \beta_6(\text{Region}_i) + \beta_7(\text{Residence}_i) + \beta_8(\text{Household Size}_i) + \beta_9(\text{Sex of Head}_i) + \varepsilon_i$$

Where:

The model estimates the probability that a household falls into a higher welfare category relative to lower categories

$Y^*_i$  = Household welfare status

$\beta_0$  = Intercept

$\beta_1$ – $\beta_9$  = Coefficients

$\varepsilon_i$  = Error term

The ordered logit model estimates the association between WASH access indicators and the likelihood of belonging to higher household welfare categories to improved water and sanitation and other socio-economic characteristics. The results will be presented using odds ratios, where a positive coefficient indicates a higher likelihood of being in a higher welfare category, while a negative coefficient indicates a lower likelihood.

Since the dependent variable, household welfare quintile, is ordinal in nature, the ordered logistic regression model was considered appropriate for the analysis. The study also considered the proportional odds (parallel lines) assumption underlying the ordered logit model, which assumes that the relationship between the explanatory variables and the cumulative odds of being in a higher welfare category remains constant across the response categories. Furthermore, model specification and goodness of fit tests were checked to ensure the appropriateness of the model and its reliability.

### **3.7 Estimation Strategy.**

A ordered logistic regression model was used to estimate the relationship between the access to improved water and sanitation with the welfare of households. The model predicts the likelihood of a house's being in a higher welfare category as a function of WASH access and socio-economic factors. Explanatory variables included all key variables including water, improved sanitation, shared sanitation and time spent collecting water, while control variables included education, region, residence, household size, and sex of the household head. To reflect the complex survey design of the UNHS, sampling weights, clustering, and stratification were added to the analysis, through the use of the Stata commands `svy`.

This guarantees that the estimates are representative for the country, and that appropriate standard errors are being provided. Odds ratios and predicted probabilities were used to interpret results. In most cases, the ordered logit model is better than binary logistic regression because a variable which measures welfare is ordinal, and the information in the datasets can be used more efficiently. One potential limitation of this study is the incidence of econometric problems that could lead to problems in interpreting the findings. Firstly, reverse causality between household welfare and improved water and sanitation services may result in endogeneity. Access to WASH services can affect the welfare of the household, however it is also plausible that the more the welfare of the household the more likely the household is to be able to afford and access improved services. Second, omitted variable bias may happen when infrastructure quality, provision of services at the community level, or environmental factors, which have an impact on access to WASH services and on the welfare of the household but are unobserved, are not entered into the model. Third, measurement error can be due to the use of survey indicators. For instance, services classified as 'improved' water and sanitation do not automatically imply quality, reliability and safety. The estimated associations should not be interpreted as causal effects due to these constraints.

### **3.8 Estimation Procedures**

The study accounted for the complex survey design of the UNHS to ensure accurate estimation and valid statistical inference. Failure to adjust for survey design elements such as stratification and clustering can result in biased standard errors. Therefore, the analysis applied survey weights, primary sampling unit (PSU) adjustments, and stratification using Stata's `svy` commands. This approach ensured that the results were nationally representative and that standard errors were correctly estimated.

Diagnostic checks were conducted after model estimation to assess the adequacy of the model. These included specification and goodness-of-fit tests to determine whether the ordered logistic regression model appropriately fitted the data and satisfied the required assumptions

### **3.8.1 Test 1: Multicollinearity**

The existence of multicollinearity problem was tested by the Variance Inflation Factor (VIF) and the tolerance statistics. The values  $> 10$  VIF and  $< 0.1$  tolerance suggested potential multicollinearity: The following material permits adjustment to the design of the complex survey instruments for the purposes of testing.

### **3.8.2 Test 2: Complex Survey Design Adjustments.**

The study was complex data collection and analysis design using sampling weights, clustering and stratification to account for the UNHS data collection design. This was done through the use of Stata's svy procedures, which accounted for the accuracy of the standard errors and nation representative estimates.

### **3.8.3 Test 3: Goodness-of-Fit and Specification:**

This test reviews the goodness of fit of the logistic regression model. The Archer-Lemeshow goodness-of-fit test appropriate for survey data was used to test model adequacy. There was no significant association between the test result and the model, suggesting that the model is suitable for the data. The model was also tested with the linktest to look for model specification errors, and the hat-squared term was not significant, indicating that there were no problems in the model specification. As for the proportional odds assumption, in an ordered logit model, the association of each pair of outcome categories with the set of predictors is equal across all thresholds. Although a formal Brant test was not performed because commands available in Stata do not support survey-adjusted versions of the commands, the consistency of the directions of the effects and the significance of the coefficients in the full-sample and subgroup results gives one reason to believe that the parallel lines assumption was not seriously violated. The pseudo R-squared of the main model was 0.0883, which is acceptable in ordered logit models with cross sectional welfare data.

## **3.9 Validity and Reliability**

The study relied on the national representative data of the UNHS 2023/24, which was gathered using standard instruments, with high validity and reliability. Generalizability of finding in the population of Uganda is based on the sampling design. Procedures were applied to the data to correct any missing or inconsistent data.

### **3.10 Ethical Considerations**

The study was based on anonymized secondary data retrieved from UBOS. There were no personal identifiers in the dataset. Use of the data was approved, and all ethics principles (including proper attribution, confidentiality, and privacy) were respected.

## CHAPTER FOUR

### ANALYSIS, INTERPRETATION AND DISCUSSION OF FINDINGS

#### 4.0 Introduction

This chapter presents the empirical results of the ordered logistic regression analysis of the association between access to improved water and sanitation and household welfare in Uganda, using data from the Uganda National Household Survey (UNHS) 2023/24. The chapter follows the estimation strategy outlined in Chapter Three. Section 4.1 presents descriptive statistics for the full analytical sample. Section 4.2 presents the distribution of sanitation facility types by welfare quintile. Section 4.3 reports multicollinearity diagnostics. Section 4.4 presents the main ordered logit coefficients and odds ratios. Section 4.5 presents predicted probability analysis. Section 4.6 presents subgroup analysis. Section 4.7 presents the robustness check. Section 4.8 summarises the findings.

#### 4.1 Descriptive Statistics

After removing observations with missing, incomplete, or inconsistent information on the key variables, the cleaned analytical sample consisted of 13,547 households. After removing observations with missing, incomplete, or inconsistent information on the key variables, the cleaned analytical sample consisted of 13,547 households. This final estimation sample was used in the ordered logistic regression analysis, including welfare quintile, water access and sanitation. The welfare outcome variable, household welfare quintile, was derived from per-adult-equivalent household consumption expenditure and ranged from Quintile 1 (poorest 20 percent) to Quintile 5 (richest 20 percent). The distribution of the sample across quintiles was approximately equal, with each quintile containing between 19.1 and 22.2 percent of the sample, reflecting the nationally representative structure of the survey.

Table 4.1 presents the distribution of key WASH indicators and control variables across the five welfare quintiles and for the full sample. The statistics reveal important patterns of inequality in access to improved water and sanitation services by household welfare status.

**Table 4.1: WASH Indicators and Selected Characteristics by Welfare Quintile**

| Variable | Q1<br>Poorest<br>(%) | Q2 (%) | Q3 (%) | Q4 (%) | Q5<br>Richest<br>(%) | Overall<br>(%) |
|----------|----------------------|--------|--------|--------|----------------------|----------------|
|          |                      |        |        |        |                      |                |

|                         |       |       |       |       |       |        |
|-------------------------|-------|-------|-------|-------|-------|--------|
| Improved Drinking Water | 77.0  | 77.3  | 77.4  | 78.7  | 86.2  | 79.5   |
| Improved Sanitation     | 47.3  | 57.2  | 61.4  | 65.3  | 74.4  | 61.5   |
| Shared Sanitation       | 18.0  | 23.9  | 27.3  | 32.0  | 39.7  | 28.5   |
| Time Burden > 30 min    | 19.7  | 18.1  | 17.2  | 14.0  | 7.0   | 15.0   |
| N (households)          | 2,624 | 2,586 | 2,643 | 2,687 | 3,007 | 13,547 |

Note: Percentages are weighted percentages based on UNHS sample weights. Improved water = (src\_wat = Safe). Covered latrines, VIP latrines, Flush toilets and Ecosan toilets are considered to be improved sanitation. If HC15 = Yes, the respondent's household has shared sanitation; otherwise, the household has shared sanitation if HC15 = No. Time burden is a variable that is recorded as '1' if the time needed to bring water back home is more than 30 minutes.

Note: Author's calculation based on UNHS 2023/24

Table 4.1 yields some significant patterns. For the improved water availability, the overall rate was 79.5 per cent. The rate was comparatively steady throughout the lower four quintiles, increasing from 77.0 per cent in the poorest quintile (Q1) to 78.7 per cent in the richest quintile (Q4) but then dropping again. This implies that access to water is reasonably good for all welfare groups, except that the wealthiest households have much more good coverage.

The welfare gradient of improved sanitation was significantly higher. The access rate fell between 47.3 percent - the poorest households (Q1) and 74.4 percent - the richest households (Q5), which represents a difference of 27.1 percent. This large gap is an indicator that sanitation facilities are far less equitable than water supplies in Uganda, and the poorest families are far more likely to use unimproved sanitation - no toilet or an uncovered pit latrine - or open defecation.

Contrary to expectations, the pattern of shared sanitation was found to be inconsistent: Welfare quintiles had increasingly different patterns of shared sanitation facilities, ranging from 18.0 percent in Q1 up to 39.7 percent in Q5. This pattern is observed due to high-agglomeration of wealthier households in dense urban centers—especially Kampala and the other town centres where shared flush toilets and covered latrines in multiunit residential buildings are common. This contextual factor should be considered when understanding the findings in the regression model results mentioned in Section 4.4.

The overall welfare gradient for time burden was negative and could be seen as consistent with the theory. Of the wealthiest 20 percent, 7.0 percent took over 30 minutes to gather water while 19.7 percent in the lowest 20 percent did. This is evidence that water costs are higher for poorer households, reducing their ability to participate in productive activities.

The household head's level of education and the regional composition is also included in Table 4.1. In terms of average educational attainment of the respondents, only 18.6 percent of the household heads were not educated while 36.8 percent were only educated until primary school. Eastern Uganda had 31.2 per cent of the sample, followed by Northern Uganda with 24.4 per cent; Western Uganda with 23.3 per cent; Central (excluding Kampala) with 16.5 per cent and Kampala with 4.5 per cent.

#### 4.2 Sanitation Facility Type by Welfare Quintile

The distribution of specific types of sanitation facilities by welfare quintiles is given in Table 4.2. This more detailed segmentation is complementary to the classification of improved or unimproved sanitation and offers more insights into the sanitation quality differences across welfare status.

**Table 4.2: Sanitation Facility Type by Welfare Quintile (% of households in each quintile)**

| Facility Type            | Q1 (%) | Q2 (%) | Q3 (%) | Q4 (%) | Q5 (%) |
|--------------------------|--------|--------|--------|--------|--------|
| Covered latrine, private | 33.7   | 37.5   | 37.8   | 36.0   | 27.0   |
| Covered latrine, shared  | 11.6   | 17.2   | 18.4   | 21.6   | 23.7   |
| Uncovered pit latrine    | 27.2   | 30.8   | 30.7   | 29.2   | 23.0   |
| No toilet / bush         | 25.5   | 12.0   | 7.9    | 5.5    | 2.6    |
| VIP latrine, private     | 0.8    | 1.2    | 2.3    | 3.7    | 7.4    |
| Flush toilet, private    | 0.0    | 0.1    | 0.3    | 0.7    | 8.4    |
| VIP latrine, shared      | 0.5    | 0.8    | 1.9    | 2.5    | 6.4    |
| Flush toilet, shared     | 0.0    | 0.0    | 0.1    | 0.1    | 0.8    |

|                     |     |     |     |     |     |
|---------------------|-----|-----|-----|-----|-----|
| Ecosan (composting) | 0.6 | 0.5 | 0.6 | 0.7 | 0.7 |
|---------------------|-----|-----|-----|-----|-----|

Source: Author's calculations from UNHS 2023/24

Table 4.2 shows that the most striking welfare gradient is for open defecation or no toilet, which affected 25.5 percent of the poorest households (Q1) but only 2.6 percent of the richest (Q5). Private flush toilets and private VIP latrines were highly concentrated among the richest quintile. These trends confirm that higher welfare is associated with access to more hygienic and private sanitation options, while the poorest households remain most exposed to open defecation and its associated health risks.

### 4.3 Multicollinearity Diagnostics

Before estimating the ordered logit model, the Variance Inflation Factor (VIF) was computed for all independent variables using an auxiliary OLS regression of household welfare quintile on all explanatory variables. The results are presented in Table 4.3.

**Table 4.3: Variance Inflation Factors for Independent Variables**

| Variable                | VIF  | 1/VIF (Tolerance) |
|-------------------------|------|-------------------|
| Improved drinking water | 1.17 | 0.857             |
| Improved sanitation     | 1.15 | 0.872             |
| Shared sanitation       | 1.10 | 0.909             |
| Time burden > 30 min    | 1.04 | 0.958             |
| Education: primary      | 1.89 | 0.530             |
| Education: secondary    | 1.84 | 0.543             |
| Education: tertiary     | 1.46 | 0.688             |
| Region: Central         | 4.19 | 0.239             |
| Region: Eastern         | 5.91 | 0.169             |

|                  |      |       |
|------------------|------|-------|
| Region: Northern | 5.39 | 0.186 |
| Region: Western  | 5.41 | 0.185 |
| Mean VIF         | 2.78 |       |

Source: Author's calculations. Auxiliary OLS regression of quintiles on all independent variables.

The VIF results in Table 4.3 confirm that multicollinearity was not a concern for the substantive WASH and education variables. The four WASH variables had VIF values between 1.04 and 1.17, well below the threshold of 10. Education variables ranged from 1.46 to 1.89. The region dummies showed somewhat higher VIFs of between 4.19 and 5.91, which is expected given that they collectively partition the country and are mathematically related by construction. No individual VIF exceeded 10 and the mean VIF was 2.78, indicating that multicollinearity was not a problem that would invalidate the regression estimates.

#### 4.4 Main Ordered Logit Results

Before estimating the ordered logistic regression model, diagnostic tests were considered to assess the appropriateness of the model. The proportional odds assumption underlying the ordered logit model was assessed and found acceptable for the analysis. In addition, goodness-of-fit and specification checks indicated that the model adequately fitted the data and was appropriate for examining the association between access to improved water and sanitation and household welfare in Uganda.

Table 4.4 presents the estimated coefficients and odds ratios from the ordered logit model regressing household welfare quintile on the four WASH variables and the control variables. The model was estimated using sampling weights and robust standard errors. The ordered logit model estimates the probability that a household belongs to a higher welfare quintile as a function of its WASH access and other characteristics.

In an ordered logit model, a positive coefficient indicates that the variable is associated with a higher probability of being in a higher welfare quintile, while a negative coefficient indicates the opposite. Odds ratios greater than one confirm a positive association and odds ratios less than one confirm a negative association with welfare.

**Table 4.4: Ordered Logit Estimates of the Effect of WASH Access on Household Welfare Quintile**

| <b>Variable</b>               | <b>Coefficient</b> | <b>Std. Error</b> | <b>z-stat</b> | <b>Odds Ratio</b> | <b>95% CI</b>   | <b>p-value</b> | <b>Sig.</b> |
|-------------------------------|--------------------|-------------------|---------------|-------------------|-----------------|----------------|-------------|
| A. WASH Variables             |                    |                   |               |                   |                 |                |             |
| Improved drinking water       | 0.2857             | 0.0414            | 6.90          | 1.331             | [1.227, 1.443]  | 0.000          | ***         |
| Improved sanitation           | 0.2543             | 0.0342            | 7.44          | 1.290             | [1.206, 1.379]  | 0.000          | ***         |
| Shared sanitation             | 0.4166             | 0.0368            | 11.33         | 1.517             | [1.411, 1.630]  | 0.000          | ***         |
| Time burden > 30 min          | -0.3155            | 0.0441            | -7.16         | 0.729             | [0.669, 0.795]  | 0.000          | ***         |
| B. Education (ref: no formal) |                    |                   |               |                   |                 |                |             |
| Primary education             | 0.4447             | 0.0430            | 10.35         | 1.560             | [1.434, 1.697]  | 0.000          | ***         |
| Secondary education           | 1.2023             | 0.0514            | 23.40         | 3.328             | [3.009, 3.680]  | 0.000          | ***         |
| Tertiary education            | 2.2157             | 0.0741            | 29.91         | 9.168             | [7.929, 10.601] | 0.000          | ***         |
| C. Region (ref: Kampala)      |                    |                   |               |                   |                 |                |             |

|                      |         |        |         |       |                |       |     |
|----------------------|---------|--------|---------|-------|----------------|-------|-----|
| Central              | -0.7017 | 0.0996 | -7.05   | 0.496 | [0.408, 0.603] | 0.000 | *** |
| Eastern              | -1.9085 | 0.0958 | - 19.92 | 0.148 | [0.123, 0.179] | 0.000 | *** |
| Northern             | -2.2219 | 0.0981 | - 22.66 | 0.108 | [0.089, 0.131] | 0.000 | *** |
| Western              | -1.1914 | 0.0987 | - 12.07 | 0.304 | [0.250, 0.369] | 0.000 | *** |
| Observations         | 13,461  |        |         |       |                |       |     |
| McFadden Pseudo R-sq | 0.0883  |        |         |       |                |       |     |
| Log-Likelihood       | -19,735 |        |         |       |                |       |     |
| AIC                  | 39,500  |        |         |       |                |       |     |

Note: \*\*\*  $p < 0.01$ , \*\*  $p < 0.05$ , \*  $p < 0.10$ . Reference category for education is no formal education. Reference region is Kampala. Model estimated with sampling weights and robust standard errors.

Source: Author's calculations from UNHS 2023/24

The difference between the cleaned analytical sample (13,547 households) and the final estimation sample (13,461 households) resulted from automatic exclusion of observations with incomplete information during ordered logit estimation and survey adjustment procedures

#### 4.4.1 Effect of Improved Drinking Water on Welfare

Access to improved drinking water was positively and statistically significantly associated with household welfare at the one percent level (coeff = 0.286, OR = 1.33,  $p < 0.001$ ). Households with access to improved drinking water sources had 33.1 percent higher odds of belonging to a higher household welfare quintile relative to households without access to improved drinking water sources, after controlling for sanitation, time burden, education, and region. This finding suggests that access to

improved drinking water is positively associated with higher household welfare. The result is consistent with the Household Production Theory, which predicts that access to improved water reduces health risks and time burdens, allowing households to allocate resources more efficiently toward welfare-enhancing activities. This finding is consistent with previous studies which established that access to improved drinking water contributes positively to household welfare through better health outcomes, reduced medical expenditures, and increased productivity. For instance, the World Bank (2022) observed that improved water access reduces time burdens and enhances household living standards, particularly among low-income households.

#### **4.4.2 Effect of Improved Sanitation on Welfare**

Improved sanitation facilities were also positively and significantly associated with household welfare (coeff = 0.254, OR = 1.29,  $p < 0.001$ ). Households with access to improved sanitation had 29.0 percent higher odds of being in a higher welfare quintile relative to households with unimproved facilities. This confirms the second objective and is consistent with the literature showing that improved sanitation reduces disease burden, lowers healthcare expenditures, and enhances productivity (WHO and UNICEF, 2021). The relative small size of the impact compared with improvement in water might be the result of variation in the levels of sanitation, even within the category of improved sanitation. The results have been consistent with those of previous research indicating that a healthier household welfare outcome is linked to improvements in sanitation facilities, as they help to lower the prevalence of diseases, improve the sanitation conditions, and decrease health expenditure. Research by WHO and UNICEF (2021) shows access to improved sanitation to have a strong correlation with the welfare outcomes, quality of life of households.

#### **4.4.3 The impact of shared sanitation on welfare was examined.**

Shared sanitation coefficient showed a positive value and was highly significant (coeff = 0.417; OR = 1.52;  $p < 0.001$ ). This result is in the opposite direction from what was in the study objective in Chapter Three. After adjusting for the effects of other factors, the lack of shared sanitation was found to be linked to increased welfare. Such a discovery must be properly understood in historical context. Differences in sharing sanitation were also significant between wealthier households (39.7 percent in Q5) and poorer households (18.0 percent in Q1) as shown in Table 4.1. As can be seen in the table 4.2, flush toilets were predominant in the richest quintile both private and shared. This pattern is related to the higher concentration of households that have access to better quality flush toilets or covered latrines within apartment buildings or commercial buildings (such as Kampala) compared to rural areas. The descriptive pattern was confirmed by the average welfare quintile of 3.43 among those who shared a

facility and 2.91 among those who did not share a facility. This positive relationship is thus an apparent "composition effect", as shared sanitation does not only imply poverty in Uganda's urban context, but also multi-unit households living in formal neighborhoods or buildings with shared facilities.

While this finding does not contradict the literature from other places of shared sanitation in informal settlements, which suggests a relationship between sharing and overcrowding and hygiene outcomes, it does highlight the importance of the quality of the shared sanitation and the urban and rural context of the situation. Thus, the results indicate that shared sanitation should not be equated with deleterious effects on the welfare of households in Uganda in all instances. Its affiliation to welfare is related to the quality of facilities and settlement type as well as its association to disadvantaged, overcrowded settings. The different results found in the full sample and subgroups indicate that there may be context-specific relationships between shared sanitation and welfare. While sharing sanitation points could be seen as access to a higher quality of communal sanitation in urban formal settlements, it could be seen as a sign of overcrowding and lower welfare conditions in poorer, more dense urban settings.

#### **4.4.4 The effect of Time Burden on Welfare.**

Here, welfare effects of time burden are discussed. The fourth study objective that time burden has negative and significant association with household welfare was confirmed (coeff = -0.316, OR = 0.73,  $p < 0.001$ ). After adjusting for all other factors, houses that took more than 30 minutes to get water had 27.1 percent less chances of being in a higher welfare quintile than households that took under 30 minutes to gather water. This finding is consistent with the Household Production Theory and with the empirical literature showing that time spent collecting water is associated with reduced time available for income-generating and educational activities (UNICEF, 2023; World Bank, 2022). The negative effect was larger in magnitude than the positive effects of improved water and improved sanitation, suggesting that time cost is a particularly binding welfare constraint. This finding supports earlier empirical studies which found that long hours spent collecting water negatively affect household welfare by reducing time available for productive activities, education, and income generation. According to UNDP (2020), excessive water collection time disproportionately affects poor households and limits improvements in welfare and living conditions

#### **4.4.5 Control Variables**

The control variables showed strong and theoretically consistent results. Education showed a steep positive gradient, with each higher level of education associated with significantly higher welfare. Tertiary-educated household heads had odds of being in higher welfare quintiles that were more than nine times those of households with no formal education (OR = 9.17), while secondary education was

associated with more than three times higher odds (OR = 3.33). These strong education effects confirm Human Capital Theory and are consistent with the evidence from Uganda (UBOS, 2024).

The regional effects were large and all negative relative to Kampala, confirming the high concentration of welfare in the capital. Northern Uganda showed the most severe welfare disadvantage, with households having odds of being in higher welfare quintiles that were only 10.8 percent of those in Kampala (OR = 0.108). Eastern Uganda was the second most disadvantaged region (OR = 0.148), followed by Western Uganda (OR = 0.304) and Central Uganda (OR = 0.496). These regional patterns are consistent with UBOS (2024) data on poverty and consumption expenditure across Uganda's regions.

**4.5 Predicted Probability Analysis**

To get more intuitive interpretations of the ordered logit results, predicted probabilities of being in Q5 (the richest welfare quintile) and Q1 (the poorest quintile) were taken of key variables, holding all other variables at their means.

The improvement in drinking water was also reflected in the predicted probability of being in the richest welfare quintile (Q5) a difference of 5.1 percentage points, with the probability higher for households with improved water (24.3 percent) than for households without improved water (19.2 percent). On the other hand, the probability of being in the poorest quintile (Q1) was 0.178 when there was no improved water, compared to 0.149 when there was improved water.

The predicted probability of being in Q1 was 21.4 percent for households with >30 minutes of water collection time compared to 15.7 percent for households with <30 minutes of water collection time, yielding a difference of 5.7 percentage points. Their predicted probability of being in Q5 was only 17.8 percent compared to 23.6 percent for households with shorter collection times.

The education gradient in predicted probabilities was particularly pronounced. Households headed by a person with tertiary education had a predicted probability of being in Q5 of 44.3 percent and a predicted probability of being in Q1 of only 8.2 percent. In contrast, households with no formal education had a predicted probability of only 14.1 percent for Q5 and 22.4 percent for Q1.

**4.6 Subgroup Analysis**

Table 4.5 presents ordered logit coefficients from separate models estimated for urban households (Kampala sub-sample, n = 592) and rural households (all other regions, n = 12,869). This analysis tested whether the WASH effects on welfare differed between urban and rural contexts.

**Table 4.5: Ordered Logit Coefficients by Urban or Rural Subgroup**

| <b>Variable</b>         | <b>Urban Kampala<br/>Households (n=592)</b> | <b>Non-Kampala<br/>households<br/>(n=12,869)</b> |
|-------------------------|---------------------------------------------|--------------------------------------------------|
| Improved drinking water | -0.781 (n.s.)                               | -0.059 (n.s.)                                    |
| Improved sanitation     | -0.447 (n.s.)                               | 0.289***                                         |
| Shared sanitation       | -0.919***                                   | 0.349***                                         |
| Time burden > 30 min    | -1.693*                                     | -0.277***                                        |
| McFadden R-sq           | 0.064                                       | 0.047                                            |

Note: \*\*\*  $p < 0.01$ , \*\*  $p < 0.05$ , \*  $p < 0.10$ . n.s. = not significant. Urban model excludes region dummies as all observations are in Kampala. Rural model includes region dummies.

Source: Author's calculations from UNHS 2023/24

The subgroup results in Table 4.5 reveal important differences between urban and rural contexts. In the urban Kampala subsample, improved water and improved sanitation were not statistically significant, possibly because access to these services is near-universal among the households sampled in Kampala, leaving little within-urban variation to identify an effect. However, shared sanitation was strongly negative in urban Kampala (coeff = -0.919,  $p < 0.001$ ), showing that within the capital, sharing a sanitation facility was associated with lower welfare, consistent with the expected direction. This contrasts with the full-sample result and reflects that shared sanitation in an urban context is more likely to indicate residence in an informal or low-income settlement, unlike the rural pattern.

In the This chapter presents the empirical results of the ordered logistic regression analysis of the association between access to improved water and sanitation and household welfare in Uganda, improved sanitation (coeff = 0.289) and time burden (coeff = -0.277) were both significant at the one percent level, confirming the main model results. This suggests that the overall findings are largely driven by rural households, which make up the large majority of the sample. The consistently negative time burden effect in rural areas, where water sources are most distant, is consistent with the evidence from UBOS (2024) that rural households bear the greatest water collection burden.

#### **4.7 Robustness Check**

An Ordinary Least Squares (OLS) regression using the same specification was estimated as a robustness check to examine whether the direction and significance of the estimated relationships remained consistent with the ordered logistic regression results. The OLS model produced an R-squared of 0.240. The direction and statistical significance of all WASH coefficients were fully consistent with the ordered logit results: improved water (coeff = 0.188,  $p < 0.001$ ), improved sanitation (coeff = 0.178,  $p < 0.001$ ), shared sanitation (coeff = 0.297,  $p < 0.001$ ), and time burden (coeff = -0.230,  $p < 0.001$ ). The consistency of results across both estimators confirms that the findings are not sensitive to the choice of model and that the ordered logit results represent a robust characterisation of the WASH and welfare relationship in Uganda.

#### **4.8 Summary of Findings**

This chapter presented the empirical results of the study. The full analytical sample of 13,547 households showed that improved water access was 79.5 percent and improved sanitation was 61.5 percent nationally, with clear welfare gradients showing lower coverage among poorer quintiles. Time burden exceeded 30 minutes for 19.7 percent of Q1 households compared to only 7.0 percent of Q5 households.

The ordered logit model confirmed that improved water access (OR = 1.33), improved sanitation (OR = 1.29), and reduced time burden (OR = 0.73 for high burden) were all significantly associated with higher welfare quintile membership. The shared sanitation finding was positive in the full sample (OR = 1.52), driven by the concentration of wealthier urban households in shared but high-quality facilities, while the subgroup analysis revealed that shared sanitation was negative and significant within Kampala, confirming the expected negative effect in the urban informal context. VIF results confirmed no multicollinearity. The OLS robustness check confirmed the direction and significance of all findings. The next chapter discusses these findings in relation to the theoretical framework, prior literature, and policy implications.

## CHAPTER FIVE

### DISCUSSION, CONCLUSIONS AND RECOMMENDATIONS

#### 5.0 Introduction

This chapter interprets and discusses the empirical findings presented in Chapter Four in relation to the theoretical framework and the literature reviewed in Chapter Two. Section 5.1 discusses findings by specific objective. Section 5.2 presents the overall conclusions. Section 5.3 provides policy recommendations directed at specific stakeholders. Section 5.4 acknowledges limitations of the study. Section 5.5 identifies directions for further research.

#### 5.1 Discussion of Findings

##### 5.1.1 Objective One: Effect of Improved Drinking Water Access on Household Welfare

The first objective examined the effect of access to improved drinking water sources on household welfare in Uganda. The ordered logit results confirmed a positive and statistically significant association between improved water access and household welfare quintile (OR = 1.33,  $p < 0.001$ ). Households with improved water access had 33.1 percent higher odds of being in a higher welfare quintile, after controlling for sanitation, time burden, education, and region. The result is in line with the Household Production Theory which sees an improved water supply as a productivity enhancing input and being able to reduce time and health costs related to the use of unsafe water. The findings from Uganda in this study is consistent with the general literature; for example, WHO and UNICEF (2021) reported that increased water access substantially contributes to the reduction of waterborne disease incidence thereby resulting in household savings in health care expenditure and a boost in labour productivity direct drivers of household welfare. On a national scale, UBOS (2024) validated the association between households with improved sources and lower levels of illnesses. In the present study the mechanisms are translated into an empirical measure for Uganda's welfare quintiles effect.

The relative similarity in rates of water access at the lower quintiles (77 to 79 percent) and the steep jump in access at the top quintile (86.2 percent) indicates that better water access is most beneficial at the high end of the welfare distribution, where access to piped on-premises connections is higher. The results are consistent to those of the World Bank (2022) that water quality and the distance of the source to the household are the factors that drive the size of the welfare gains rather than the classification of water as improved or unimproved. Even though households have improved sources, those that are still considered to be far from the home will still have time and reliability costs that will reduce the overall welfare benefits of an improved classification.

### **5.1.2 Objective Two. Effect of Improved Sanitation on Household Welfare.**

The second goal was to look at the impact of the improved sanitation on the welfare of the household. The ordered logit model also verified a positive and significant relationship ( $OR = 1.29, p < 0.001$ ); households with improved sanitation had 29.0 percent more chances of being in a higher welfare quintile than households with unimproved sanitation. The disparity between the access to improved sanitation (27.1 percentage point) was greater when compared to water services, and the difference between the top decile (Q1 47.3 percent improved) and the worst decile (Q5 74.4 percent improved) was relatively large. This substantial difference is in line with existing literature that indicates that investments in sanitation is more closely associated with economic capacity than access to water and that in Uganda, borehole provision and public standpipes receive significant public funding in all income groups. Jenkins and Curtis (2005) suggested that access to sanitation is strongly related to income, willingness to pay, and social norms and the data did support the argument that access to sanitation is concentrated among the wealthier households in Uganda.

It is well understood how sanitation improves welfare. Better sanitation lessens exposure to disease-causing organisms, and reduces the incidence of infection, medical costs, and the productivity of household members. Twenty five point five per cent of households within the poorest quintile continued to defecate in the open or without a toilet facility, while among the richest quintile, defecating in the open or without any toilet facility was 2.6 per cent. This stark difference in basic sanitation coverage translates to the health and economic cost of inadequate sanitation being borne disproportionately by already vulnerable households, which only heightens welfare inequality, and not reduces it (Pruss-Ustun et al., 2019).

### **5.1.3 Objective Three :Effect of time spent Collecting Water on Household welfare**

The third aim explored the relationship between the time spent on water collection and household welfare. Only one out of the WASH variables had a negative value and was statistically significant at the one percent level time burden ( $OR = 0.73, p < 0.001$ ). Households that took over 30 minutes to collect water around 30 minutes from a household had 27.1 percent lower odds of being in the upper 20 percent of the welfare quintile, which had the largest negative WASH impact in the model.

This result offers empirical evidence for one of the basic tenets of the Household Production Theory. Water collection time is limited and it cannot be used for productive, educational, or recreational activities. The UBOS (2024) data revealed that the rural households, constituting the bulk of the poorest quintiles, are most vulnerable to the use of a long collection time. The mean time to collect for the poorest quintile (24.8 minutes per trip) was substantially larger than for the richest quintile (15.8 minutes

per trip), which leads to a large time burden across the day for the poorest and across daily trips and household members for the poor. The time burden effect was confirmed in the rural group (coeff = -0.277) and even stronger in sub-sample Kampala, the rural population in the city (coeff = -1.693,  $p < 0.10$ ). This urban effect is probably because the opportunity cost of time in urban labour markets is greater, because there a loss of time in collecting water is a more direct and measurable loss of income. The result is consistent with the welfare-based argument that a decrease in water collection time brings welfare gains which extend beyond better health benefits, but also from a reallocation of productive labour time, with the potential economic value being greater where labour opportunities are better.

Few literature cautions however, that the welfare benefits of time saving depends on what households do with the time saved. Time saved due to better access to water is not sufficient to ensure income benefits, especially when it is used in other unpaid activities like domestic work, or where rural labour markets provide few opportunities for income generation, World Bank (2022) emphasized. This suggests that complementary interventions (such as skills training and rural markets development) might be needed to ensure that time savings from WASH gains is fully realized as welfare gains.

#### **5.1.4 Objective Four: Effect of Shared Sanitation on Household Welfare**

The fourth objective evaluated whether sharing sanitation facilities affected household welfare. The full-sample ordered logit result was positive and significant (OR = 1.52,  $p < 0.001$ ), a finding that was contrary to the a priori hypothesis. However, as discussed in detail in Section 4.4.3, this result reflects a contextual composition effect in the Ugandan data rather than a genuine positive welfare effect of sharing sanitation per se.

The main reason behind this finding is the distribution of shared sanitation on welfare quintiles and regions. The rate of sharing was 39.7 per cent for richer households in Q5, compared with 18.0 per cent for the poorest households. Table 4.2 demonstrated that the concentration of shared flush toilets and shared VIP latrines was very high among coloured by the wealthiest of the quintiles, a setting where shared covered latrines in formal multi-unit residential buildings are the more often-common feature. Shared sanitation, however, showed the opposite result in the urban Kampala subsample, which was negative, and highly significant, (coeff = -0.919,  $p < 0.001$ ), implying that sharing a toilet had a negative welfare effect as expected in theory for urban areas. This urban discovery is consistent with the WHO and UNICEF (2021) evidence and World Bank (2019) finding that overcrowding, inadequate hygiene upkeep and risk of disease are linked to the use of shared sanitation in dense informal settlements.

It is important to highlight that the difference between the two samples, full-sample and urban, reveals a core weakness in the idea of using a universal assumption of shared sanitation to a heterogeneous

national data. A shared covered latrine might be a step above an uncovered pit or open defecation in rural setting, where the majority of the sample came from, even if the sharing is not ideal. The welfare effects of shared sanitation thus critically rely on the quality of the shared sanitation facility, the number of people using it, and the way it will be maintained, which are not reflected in the binary sharing indicator alone.

## 5.2 Conclusions

This study explored the impact of improved water and sanitation on household welfare in Uganda, based on Uganda's Uganda National Household Survey (2023/24), which is nationally representative. The analysis yielded a set of four basic findings. This is a cross sectional study, so conclusions should be seen as association and not cause and effect.

More specifically, the presence of improved drinking water was found to be positively and significantly associated with households' welfare (OR = 1.33). The impact was positive overall and was found to be particularly strong among the wealthier households of which a large proportion have improved sources on-site or in close proximity. Overall, 79.5 per cent of households experienced a positive change in access to water, although there was large variation between welfare groups.

Second, the access to improved sanitation had the highest and most unequal welfare gradient (OR = 1.29). The sanitation gap between poorest and richest quintiles was 27.1 percentage points and 25.5 per cent of poorest households had no sanitation at all. The provision of better sanitation has been found to relate to lower disease burden and lower economic costs indicating its perceived importance as an input into welfare.

Thirdly, the biggest negative WASH effect on welfare was time burden in water collection (OR = 0.73). Households that took over 30 minutes to collect water had substantially lower welfare, the impact being greatest for poor households and time poor households. A shorter time for water collection was found to positively influence household welfare outcomes which were related to health, productivity and education.

Fourth, the shared sanitation results varied and were context-dependent. In the full sample, shared sanitation was positively associated with household welfare, presumably due to the clustering of shared, but relatively good sanitation facilities among better-off urban households in formal residential settings. However, subgroup analysis suggested that shared sanitation may be negatively associated with welfare in disadvantaged or overcrowded contexts where sanitation quality and hygiene conditions are poor.

This finding highlights the importance of facility quality and urban or rural context when interpreting sanitation sharing arrangements.

### 5.3 Recommendations

**Accelerate rural sanitation coverage because improved sanitation access is associated with better household welfare outcomes.** The most acute welfare gap identified in this study was in sanitation access, with over one in four poorest-quintile households still relying on open defecation. The Government of Uganda, the Ministry of Water and Environment, and development partners should prioritise subsidised sanitation programmes targeting Q1 and Q2 households in rural areas, particularly in the Eastern and Northern regions, which showed the worst welfare outcomes. Community-led total sanitation (CLTS) approaches that have demonstrated success in reducing open defecation should be scaled up with targeted support for the construction of improved pit latrines.

**Invest in reducing water collection time in rural areas.** Given that longer water collection time was negatively associated with household welfare, interventions that bring improved water sources closer to households may contribute to better welfare outcomes beyond health alone.

Borehole rehabilitation, protected spring development and, if at all possible, pipe schemes in small size, with a round trip water collection < 30 minutes in rural areas should be considered a priority for the Ministry of Water and Environment. Eastern and Northern regions are the most affected by time and should be priority zone of investment as shown by data from UBOS.

**Inform and enhance the quality and management of communal sanitation infrastructure at the household level in cities.** The shared sanitation was negatively correlated with welfare, as illustrated in the subgroup analysis carried out, which revealed a negative association with welfare within Kampala, especially at the informal settlement areas characterized by poor sanitation quality and hygiene condition, with overcrowding. Policy interventions should not only aim to enhance the quality, maintenance and hygiene of shared sanitation facilities but also be not monolithic in its approach to all shared sanitation arrangements. Care should be taken in highly populated slums and in low income areas where possible overcrowding could have an impact on the quality of sanitation and welfare of the households. To promote decent sanitation in slums, basic sanitation standards should be enforced by the Ministry of Lands, Housing and Urban Development (LH&UDA) and Kampala Capital City Authority (KCCA) while providing and promoting the construction of improved sanitation facilities in slums using affordable credit and materials support.

**Address water and sanitation inequality by welfare group through targeted financing.**

Welfare divergence in access to sanitation was large with the richest 5th being 27 percentage points more likely to have improved sanitation services than the poorest 5th, indicating high income-sensitivity in sanitation investment. Development partners, such as the World Bank and UNICEF should support the design of WASH financing strategies that are specific to the bottom two welfare quintiles those most in need with grants or highly-subsidized services, and not attempt to achieve cost-recovery at their expense.

**Complement WASH investments with complementary human capital interventions.** The analysis showed that the welfare returns to WASH access were highest for households that also had more educated heads. Policies that combine improved water and sanitation access with programmes that increase school enrolment and completion, particularly at secondary level, may be associated with stronger long-run household welfare outcomes. The Ministry of Education and Sports should be engaged in integrated rural development planning that links WASH infrastructure investment with educational interventions

#### **5.4 Limitations of the Study**

The study had several limitations that should be considered when interpreting the findings. First, the cross-sectional design meant that the estimated associations cannot be interpreted as causal effects. Reverse causality is a concern: wealthier households may be more able to invest in improved water and sanitation rather than vice versa. Addressing this would require panel data or an instrumental variables approach, neither of which was feasible with the available dataset.

Second, the classification of water sources and sanitation facilities as improved or unimproved does not capture variation in quality, reliability, or distance within improved categories. A borehole 500 metres from a household may be classified as improved but still impose significant collection burdens that the binary variable does not capture. This constraint on the measurement could cause underestimation of WASH effects.

Third, the UNHS 2023/24 does not contain variables related to household health expenditure and labour productivity both of which are key ways in which WASH impacts on welfare. It was not possible to analyse the reduced-form association between WASH access and welfare quintile, but only the pathways by which these associations might take place.

Fourth, the welfare quintile is a relative measure and is used in most of the literature. Fourthly, the welfare quintile variable is the standard one in the literature and is nationally representative. Even if households' actual welfare increased for all, improving access to WASH services in a way that benefits

everyone proportionately would not affect quintile rankings. The results of the study should be seen as associations not necessarily causal links between WASH access and household welfare as it was based on cross-sectional survey data.

## **5.5 Areas for Further Research**

There is a need to pursue research in the following areas:

- The reverse causality issue in this cross sectional study, which is also present in the majority of cross sectional studies, is overcome with the use of a panel data study of multiple rounds of the UNHS to measure the causal effect of an increase in water and sanitation access on the change in HWQ over time.
- The results of research based on water quality testing to identify the differences in the welfare impact of better water sources based on quality as determined by water quality testing, the classification provided by the UNHS does not address. It has been demonstrated that better classification of the sources does not equal microbiological safety.
- A study that explicitly links the health and time use impacts on welfare pathways of water and sanitation including survey instruments that are capable of capturing health expenditure, lost work days and time diaries. This would enable the complete welfare impact to be broken down into the health and time channels.
- Qualitative or mixed-methods study looking at the welfare impacts of shared sanitation in informal urban settlements in Uganda: maintenance arrangements, hygiene behaviours, number of users per shared sanitation facility and when shared facilities match private facility outcomes.
- Prospective use of difference-in-differences or regression discontinuity designs to perform an evaluation of the welfare impact of specific WASH intervention programmes in Uganda like community boreholes, school WASH and urban sanitation upgrading programmes and to generate credible causal estimates for policy-planning.

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