RURAL SANITATION PREFERENCES AND HOUSEHOLD DECISIONS: A MIXED-METHODS CASE STUDY IN WOLAITA, ETHIOPIA

by

DAYNA M. HANSBERGER

A THESIS

Presented to the Department of International Studies
and the Graduate School of the University of Oregon
in partial fulfillment of the requirements
for the degree of
Master of Arts

September 2020

THESIS APPROVAL PAGE

Student: Dayna M. Hansberger

Title: Rural Sanitation Preferences and Household Decisions: A Mixed-Methods Case Study in Wolaita, Ethiopia

This thesis has been accepted and approved in partial fulfillment of the requirements for the Master of Arts degree in the Department of International Studies by:

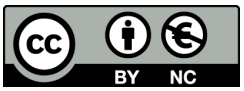
Lesley Jo Weaver	Chairperson
Melissa Graboyes	Member
Kory Russel	Member

and

Kate Mondloch	Interim Vice Provost and Dean of the Graduate School

Original approval signatures are on file with the University of Oregon Graduate School.

Degree awarded September 2020



THESIS ABSTRACT

Dayna M. Hansberger

Master of Arts

Department of International Studies

September 2020

Title: Rural Sanitation Preferences and Household Decisions: A Mixed-Methods Case Study in Wolaita, Ethiopia

Rural Ethiopian families bear the responsibility to invest in their own sanitation, resulting in large disparities in latrine quality. This study analyzes considerations for household latrine purchases, desirable latrine characteristics, and satisfaction among households with unimproved and improved latrines. The mixed-methods study included observations, key informant interviews, household interviews, household surveys, and health worker focus groups.

Key findings include a model of shared and distinct sanitation motivations and barriers at two household decision points – the decision to build an unimproved latrine and the decision to purchase a basic improved latrine. Households with improved latrines experienced high levels of satisfaction, compared to households using an unimproved latrine. A human-centered design approach to the improved latrine was integral to the product desirability, effective sales process, and customer satisfaction. Study results are intended to better understand sanitation influences and facilitate practical and incremental improvement in household sanitation facilities.

CURRICULUM VITAE

NAME OF AUTHOR: Dayna M. Hansberger

GRADUATE AND UNDERGRADUATE SCHOOLS ATTENDED:

University of Oregon, Eugene
George Washington University, Washington, District of Columbia
American University, Washington, District of Columbia

DEGREES AWARDED:

Master of Arts, International Studies, 2020, University of Oregon
Master of Public Health, 2018, George Washington University
Bachelor of Arts, International Studies, 2014, American University
Bachelor of Arts, Economics, 2014, American University

PROFESSIONAL EXPERIENCE:

Graduate Assistant, Division of Global Engagement, University of Oregon, Eugene, 2018-2020

WASH Evaluation Intern, iDE Ethiopia, Addis Ababa, 2019

GHPOD Training Event Specialist, Social Impact, Washington, District of Columbia, 2015-2017

GHPOD Program Assistant, Social Impact, Washington, District of Columbia, 2014-2015

Research Assistant, Eniware, LLC, Washington, District of Columbia, 2014

Strategic Impact Team Intern, InterAction, Washington, District of Columbia, 2013

Development Intern, Woodrow Wilson International Center for Scholars, Washington, District of Columbia, 2012

Peace Corps Response Program Support Assistant, United States Peace Corps, Washington, District of Columbia, 2011-2012

GRANTS, AWARDS, AND HONORS:

Graduate Assistant Fellowship, Department of International Studies and Division of Global Engagement, 2018 to 2020

George and Conni Slape Fellowship, Internship, University of Oregon Department of International Studies, 2020

George and Conni Slape Fellowship, Thesis Research, University of Oregon Department of International Studies, 2019

Special Opportunities Travel and Research Award, University of Oregon Graduate School, 2019

Thurber Award, University of Oregon Department of International Studies, 2019

ACKNOWLEDGMENTS

Thank you to my committee of Dr. Weaver, Dr. Graboyes, and Dr. Russel for their invaluable guidance and support. Their questions, suggestions, and expertise pushed me to expand my thinking and fundamentally improved the direction and writing of the thesis. In particular, Dr. Weaver provided counsel on methodology, data analysis, and chapter organization. Dr. Graboyes developed my awareness of medical anthropology, historical considerations, and disease perceptions. Dr. Russel expanded the breadth and depth of sanitation research to inform my study, as well as the data collection instruments.

I owe an enormous debt of gratitude to the entire iDE Ethiopia team for their feedback and collaboration throughout the planning and data collection. Special thanks to Alemayehu, Andrea, Olani, Okelo, and Seble who were instrumental to the data collection and applicability of this thesis. Thank you to the 53 households and stakeholders who opened their homes and took the time to talk to a curious student about their latrines. I am so humbled and thankful for their willingness to share experiences, knowledge, and goals for sanitation.

Finally, thank you to my support network and the MA cohort for their continued encouragement through the creation of this work. Thank you to Whit, whose unwavering support and feedback on countless chapter drafts made completing this degree possible.

This research was supported by the George and Conni Slape Fellowship, the Graduate School Special Opportunities Travel and Research Award, and the Department of International Studies Thurber Award.

TABLE OF CONTENTS

Chapter Page

I. INTRODUCTION 1

1.1 Thematic Area 2

1.2 Study Scope 5

1.3 Significance 7

1.4 Chapter Structure 7

II. BACKGROUND 9

2.1 Importance of WASH and Sanitation 12

2.2 Sanitation in Ethiopia 15

2.3 Human-Centered Design 18

Human-Centered Design for Water, Sanitation, and Hygiene 19

III. RESEARCH DESIGN 22

3.1 Study Setting 22

3.2 Research Design Framework 24

3.3 Methodology 26

Observation and Key Informant Interviews 27

Household Interviews 29

Focus Group Discussions 30

Household Survey 31

Spatial Data 33

3.4 Data Analysis 33

IV. INTRODUCTING THE STUDY SAMPLE 35

Chapter Page

4.1 Wolaita Zone and Damot Pulasa District 35
4.2 Key Informant Characteristics 38
4.3 Household Interview and Survey Demographics 38
4.4 Household Sanitation Service Levels 41
4.5 Household Sanitation Decision-Makers 42
V. HUMAN-CENTERED DESIGN FOR IMPROVED SANITATION 45
5.1 Slab Design Process 45
Slab Design in Practice 47
5.2 Sanitation Business Model Design Process 51
Sanitation Business Model in Practice 52
VI. HOUSEHOLDS, SANITATION, AND DECISION POINTS 56
6.1 Factors Influencing Sanitation Decisions 57
6.2 Motivating Factors for Unimproved and Improved Sanitation 60
Household Health Concerns 60
Household Sanitation Knowledge 62
Household Appearance and Cleanliness 65
Sanitation Market Actors 66
Societal Pressure 67
6.3 Motivating Factors for Improved Sanitation 68
Adoption of Innovative Technology 68
Slab Durability and Longevity 70
Pride and Social Standing 71

Chapter Page

6.4 Barrier Factors for Unimproved and Improved Sanitation 72
Financial Burden and Affordability 73
Time and Labor 76
Lack of Awareness 77
6.5 Factor Importance 78
Factors for Unimproved Sanitation 80
Factors for Improved Sanitation 82
VII. HOUSEHOLD LATRINE PERCEPTIONS AND EXPERIENCE 84
7.1 Household Latrine Feedback 84
Measures of Latrine Satisfaction and Functionality 85
Latrine Dissatisfaction 89
7.2 Social Diffusion 91
7.3 Latrine Use 92
Handwashing Facilities 93
Vent Pipe and Drop-Hole Cover 96
7.4 Demonstrated Investment in Sanitation 97
VIII. CONCLUSION 101
8.1 Research Findings 101
Sanitation Decision-Making 101
Latrine Use 102
Latrine Satisfaction 103
Latrine Design 104

Chapter Page

8.2 Limitations 105

8.3 Implications for WASH and Sanitation 107

APPENDICES 111

A. KEY INFORMANT SEMI-STRUCTURED INTERVIEW GUIDE 111

B. HOUSEHOLD SEMI-STRUCTURED INTERVIEW GUIDE (ADOPTER AND NON-ADOPTER) 112

C. FOCUS GROUP GUIDING QUESTIONS 114

D. SURVEY QUESTIONNAIRE 115

REFERENCES CITED 126

LIST OF FIGURES

Figure Page

1. Sanitation service ladder (adapted from WHO & UNICEF Joint Monitoring Programme) 3

2. Ethiopia sanitation service levels (2017 data from WHO & UNICEF Joint Monitoring Programme) 4

3. Sanitation service ladder (adapted from the WHO & UNICEF Joint Monitoring Programme) 10

4. Examples of unimproved and basic improved latrines at study site 11

5. Ethiopia sanitation service levels, 2000-2017 (data from WHO & UNICEF, 2017) 17

6. Ethiopia administrative levels, with study villages highlighted in inset 23

7. An exploratory design of the mixed methods study of latrine purchase and adoption (adapted from Creswell, 2015) 25

8. Main street in Galcha Suke (L) and household in Zamine Wulisho (R) 32

9. Presence of household latrine (Federal Democratic Republic of Ethiopia, 2007 census data) 36

10. Data collection locations in Damot Pulasa 37

11. Categorized sanitation facility of interviewed and surveyed households 42

12. Potential latrine slab designs: circular slab (left); rectangular slab (center); split rectangular slab (right) 48

13. iDE Ethiopia slab design features (photo courtesy of iDE Ethiopia) 49

14. Latrine slab design components: brochure (left); slab with standing participant (center); slab leaning against tree (right). The black vent pipe starter can be seen in the center and right images. 51

15. Awareness of iDE latrine slab among surveyed and interviewed households (frequency) 53

16. Movement along the sanitation ladder (sequential or non-sequential) 57

17. Sequential decision points along the sanitation ladder 58

Figure Page

18. Model for sanitation motivations and barriers at each investment decision point 59

19. Motivating factors for unimproved and improved sanitation.....60

20. Additional motivating factors for improved sanitation 68

21. Barrier factors for household sanitation decisions 73

22. Model for sanitation motivations and barriers at each investment decision point 80

23. Factors for household investment in unimproved sanitation.....81

24. Factors for household investment in improved sanitation.....82

25. Household latrines without signs of use: Zamine Wulisho interview, Zamine Wulisho interview, Galcha Suke survey (L to R) 93

26. Bereket's household latrine is unimproved.....98

LIST OF TABLES

Table Page

1. Sanitation levels for Ethiopian population (WHO & UNICEF, 2019) 18
2. Ethiopia administrative levels and corresponding study location 22
3. Research questions and associated data sources 24
4. Key informant interview locations and categorizations 28
5. Household interview locations and categorizations 30
6. General key informant demographics (n=13).....38
7. General household interview demographics (n=40).....39
8. Wealth and WASH indicators among households (n=40) 40
9. Sanitation decision-makers within households 43
10. Average costs of major latrine expenses and average total latrine cost 74
11. Household degrees of satisfaction with current sanitation facility.....86
12. Handwashing Station Claim vs. Observation.....95

CHAPTER I

INTRODUCTION

Understanding how, when, and why families decide to make initial and continued sanitation investments is vital for local, national, and global entities working to improve sanitation worldwide. People's decisions to invest in improving their household sanitation facilities have far-reaching impacts on individual, family, and community well-being. In Ethiopia, 85% of the population do not have access to improved sanitation for managing human waste (JMP, 2019). Without universal access to a safe latrine or toilet in every home, families bear the responsibility to invest in their own sanitation. In Ethiopia's rural Wolaita Zone, families frequently make decisions about upgrading their existing latrine infrastructure, installing a new latrine, repairing a broken roof for the latrine structure, or recommending their new latrine to a neighbor. For these households, sanitation investments, like other purchases, involves considerations of affordability, features, and product preference or availability. Sanitation decisions like replacing, upgrading, or installing a latrine involve a multitude of factors, including individual preferences, cost, materials, and the number of options for sale, and various accessories outside the toilet itself. Unlike other purchases however, sanitation decisions incorporate government policies, health effects, and psychosocial factors such as social status.

In this study, I analyze considerations for household latrine purchases, desirable latrine characteristics, and whether households are satisfied with their latrine investments. My research findings contribute to the growing body of knowledge around rural sanitation decisions, effective sanitation programs, and methods to meet customer demands for safe, clean, and functional latrines.

1.1 Thematic Area

Water, Sanitation, and Hygiene (WASH) is a grouping of related services. This acronym emerged in the early 2000s and is attributed to the Water Supply and Sanitation Collaborative Council (WSSCC) 2001 communications campaign, although work promoting these three areas had been ongoing long before the umbrella term was coined. Within the WASH acronym, the term sanitation refers to the method of disposal for human excreta – that is, the management of human fecal matter. Using the World Health Organization (WHO) and United Nations Children's Fund (UNICEF) Joint Monitoring Programme for Water Supply, Sanitation and Hygiene (JMP) model, sanitation facilities are placed on a ladder, where each progression toward "safely managed sanitation" is an advancement up the rungs of the ladder (WHO & UNICEF, 2017). The WHO/UNICEF JMP is the custodian of United Nations' Sustainable Development Goals (SDGs) on water, sanitation, and hygiene, and as such is a leading source for sanitation data monitoring and comparison. For the purpose of this study, it is most important to understand the distinctions between three of the five sanitation categories included in the JMP ladder. Open defecation is at the bottom of the ladder, and does not include any method to dispose of feces without human contact. Unimproved sanitation, the next rung up the ladder, disposes of feces in a facility, but there is still potential for human contact with excreta. Basic improved sanitation is two rungs above unimproved sanitation, and includes hygienic separation of fecal matter from human contact. These three categories of sanitation – open defecation, unimproved, and basic improved – are the most relevant to understanding this research (see Figure 1).

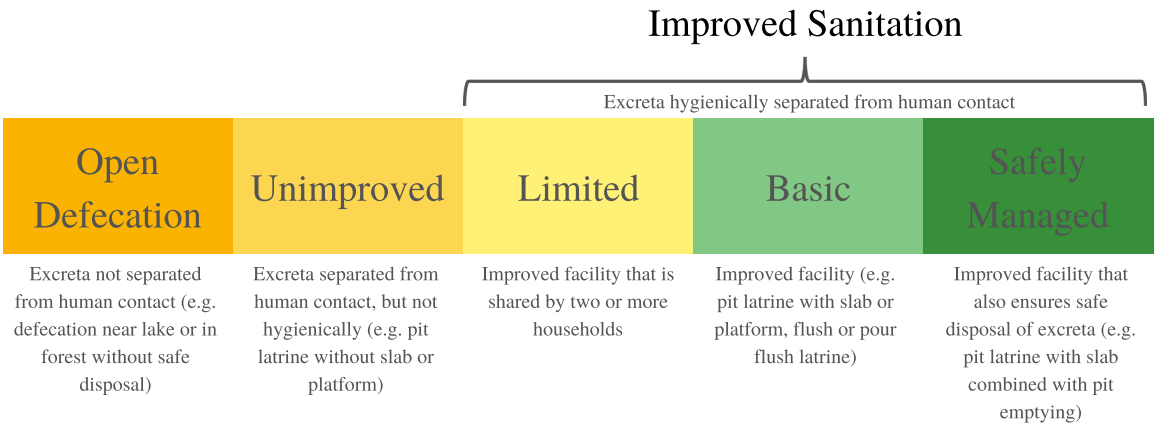


Figure 1. Sanitation service ladder (adapted from WHO & UNICEF Joint Monitoring Programme)

The lack of basic sanitation (i.e. use of open defecation, unimproved, or limited facilities) is linked to negative health outcomes and pathogen exposure (e.g. diarrheal disease, intestinal worms). Without basic sanitation, individuals may also lack privacy and safety (especially for women and girls due to social norms around menstruation and women's greater risk of gender-based violence). Due to these undesirable health, social, and safety outcomes, increasing access to basic sanitation is a priority for most governments and is included in the Sustainable Development Goals. Specifically, sanitation is a critical component of Goal 6: "Ensure availability and sustainable management of water and sanitation for all", and specifically target 6.2, achieving access to sanitation and hygiene for all, while ending open defecation (Transforming our world, UNGA, 2015). Since the early 2000s, Ethiopia has made great strides in reducing open defecation, with a 57% reduction in the proportion of the population practicing open defecation between 2000 and 2017 (WHO & UNICEF, 2019). Despite these improvements in households moving away from open defecation, Ethiopia ranks 22nd globally for the proportion of the population practicing open defecation (WHO &

UNICEF, 2019). Additionally, Ethiopia maintains the lowest rate of improved sanitation in the world (WHO & UNICEF, 2019). Using the most recent JMP data from 2017 depicted in Figure 2, 22% of Ethiopians continue to practice open defecation (WHO & UNICEF, 2019).

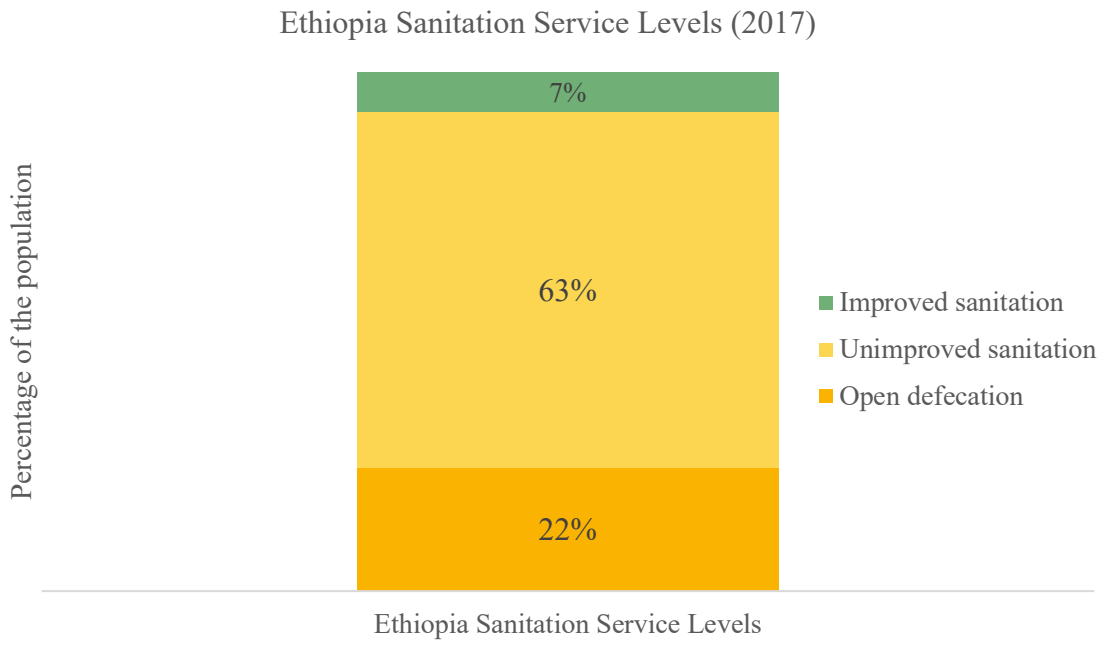


Figure 2. Ethiopia sanitation service levels (2017 data from WHO & UNICEF Joint Monitoring Programme)

In this context of significant population-level challenges to sanitation, I decided to focus my research on progressions up the sanitation ladder: from open defecation, to unimproved sanitation, to basic sanitation. Because movement along this ladder occurs at the household level and depends on significant personal investment from Ethiopian families, I wanted to explore how households made those decisions – including their preferences for sanitation facilities as well as motivations or barriers for investing in an unimproved or improved latrine. My hope was that researching the decision-making process would provide insight into opportunities for programs aimed to improve sanitation to support households' progression along the sanitation ladder.

Human-Centered Design (HCD) is an additional element in this research. HCD, sometimes referred to as "design thinking," is a problem-solving approach popularized by IDEO (IDEO.org, 2015). The HCD approach is person-centric, iterative, and holistic. The intent of incorporating HCD is to produce products, processes, and programs that are tailored to the needs of customers, recipients, or other relevant users. HCD has become more popular in the field of international development, with USAID, the Bill & Melinda Gates Foundation, non-governmental organizations (NGOs), and design firms leveraging HCD to address puzzles of global health and other challenges. However, the approach is still relatively new to the sanitation field. I wanted to incorporate an examination of the HCD-grounded latrine design process to consider how HCD can work within the field of sanitation and establish if the latrine design was a key factor that influenced sanitation decisions at the household level.

1.2 Study Scope

Following the United Nations resolution and reaffirmation of the human right to sanitation, my research frames sanitation as a human right (The human rights to safe drinking water and sanitation, UNGA, 2015). As households gain access to resources and community norms shift away from open defecation, I sought to understand the factors that influence latrine investment, satisfaction, and perceptions. I considered four research questions for household sanitation decisions, experiences, and values:

1. What factors affect a household's sanitation decisions?

2. What variation in sanitation behaviors exists within and across households?

3. To what degree are households satisfied with their sanitation facility?

4. How is the Human-Centered Design approach integrated into sanitation programs?

This case study was located across two villages in Ethiopia's Southern Nations, Nationalities, and People's Region (SNNPR), and included a partnership with iDE, a global development organization. iDE was originally founded as International Development Enterprises in 1982. The organization is a non-profit funded primarily through public and private foundation grants (iDE, 2019). iDE has a small headquarters office in Denver, Colorado, with larger offices in 14 countries. The organization employs HCD to foreground local solutions and facilitate a market-based approach to poverty alleviation in agriculture, WASH, and finance. In this partnership for my research, iDE provided context and feedback on my questionnaires, and served as the linkage to the Wolaita community for interviews, surveys, and focus groups. In turn, my findings and recommendations were shared with iDE to help inform future programs and guide prioritization within the sanitation sector. iDE did not manage the direction of my research or edit my research questions. I did not share the raw data with iDE, no attributable participant information was saved, and pseudonyms were used to protect the identity of research participants.

My research employed a mixed methods and multi-phase approach to blend household narratives and perceptions of other stakeholders in the sanitation landscape with quantitative data about latrine adoption. Data included observations, key informant interviews, household interviews, household surveys, and health worker focus groups. Through the use of this methodology, the study delivered a more holistic approach to understanding household latrine decisions, usage, and satisfaction.

1.3 Significance

This study's mixed-methods design contributes to the growing body of work foregrounding sanitation values, preferences, and decision-making at the individual and household level as key priorities for WASH research and intervention. The latrine decision-making model derived from this research (which is presented in Chapter VI) can similarly add to the field by identifying key motivations and barriers for household decisions at stages of sanitation investment. This is a novel approach to the established sanitation ladder, and provides greater context and nuance for the implied movement along the static JMP ladder.

Despite the documented impact of inadequate WASH on the global burden of disease, and studies illustrating the large-scale impact of improved WASH on population health, WASH studies and funding are still underrepresented in the broader field of global health (Bartram & Cairncross, 2010; Prüss-Ustün et al., 2019; WHO & UNICEF, 2019). Results of this case study will contribute to the valuable sanitation research already completed, continue to fill the gap in current literature on HCD for sanitation, and assist in addressing the relative lack of strategic prioritization of sanitation in the field of global health. It is my intent that this research inspires and informs further study on rural sanitation choices and values, particularly in Ethiopia. Additionally, findings of this research can be used as a springboard for iDE to identify priorities for further research and incorporation of HCD.

1.4 Chapter Structure

Chapter II presents the background on WASH, sanitation, and HCD subject areas. This chapter details the terminology, classifications, and impact of the WASH and

sanitation field. Included in this background is the history of sanitation in Ethiopia. Chapter III outlines the research design and methodology. This includes the study setting and site selection, research design framework, methodology, and data analysis. Chapter IV introduces the study sample. This chapter provides greater detail on demographics of the study location, as well as demographics of key informant, household interview, and survey participants.

Chapter V builds upon the HCD background in Chapter II and includes a robust exploration of HCD as a method and the HCD practice for the research hosting organization iDE Ethiopia (based on observations, interviews, and organizational documents), which produced the latrine slab and sales process that was studied in this thesis research. Chapter VI discusses household choices for personal sanitation, including choice of sanitation facility and degree of investment in sanitation. This chapter is structured around two distinct decision points that emerged in my research – investment in unimproved sanitation and improved sanitation – and proposes key motivations and barriers that promote or constrain household sanitation advancement. Chapter VI primarily relates to the first research question, and also incorporates some aspects of the fourth research question on HCD in sanitation. Chapter VII further examines WASH habits (e.g. latrine use) and sanitation feedback among households. This chapter includes analysis of variation in latrine use within and across households (responding to the second research question), the degree of sanitation satisfaction (research question three), as well as some aspects of the HCD research question. Chapter VIII provides summary remarks for each research question, a discussion of limitations, implications for WASH and sanitation, and recommendations for future research.

CHAPTER II

BACKGROUND

Sanitation is the method of separating human waste from human contact. This is a broad term, and many types of sanitation and fecal management exist. Sanitation is often discussed in the company of drinking water and hygiene – other public health priorities – within the term WASH. These three areas are frequently grouped together to reflect their interrelatedness in access, policies for improvement, and outcomes. The WASH consortium of water, sanitation, and hygiene is a relatively recent focus within global health, as the term itself gained wider use after 2001. The history of WASH and the importance of water, sanitation, and hygiene for global health are further discussed in section 2.1.

The Joint Monitoring Programme established a ladder of service classifications which defines levels of sanitation, as well as similar ladders for drinking water and hygiene classifications (WHO & UNICEF, 2017). Although the term "toilet" is sometimes conflated with "sanitation", toilet refers only to certain facilities (predominantly basic improved sanitation or safely managed improved sanitation), while the term sanitation encompasses all methods for disposal of human excreta (feces and urine). Methods for disposal of human excreta include wet sanitation (e.g. flush or pour-flush facilities connected to sewers or pit latrines) and dry sanitation (e.g. dry slab pit latrines, composting toilets). These definitions are widely utilized within global health, and form the basis for determining the household sanitation levels in this study (see Figure 3). While the seemingly precise boxes in the sanitation ladder visualization may remove opportunities for nuance, there are many types of sanitation facilities used

globally, with large variance within and between countries. With this consideration, the service ladder classification remains helpful to categorize facilities and understand trends in sanitation at national, regional, or global levels.

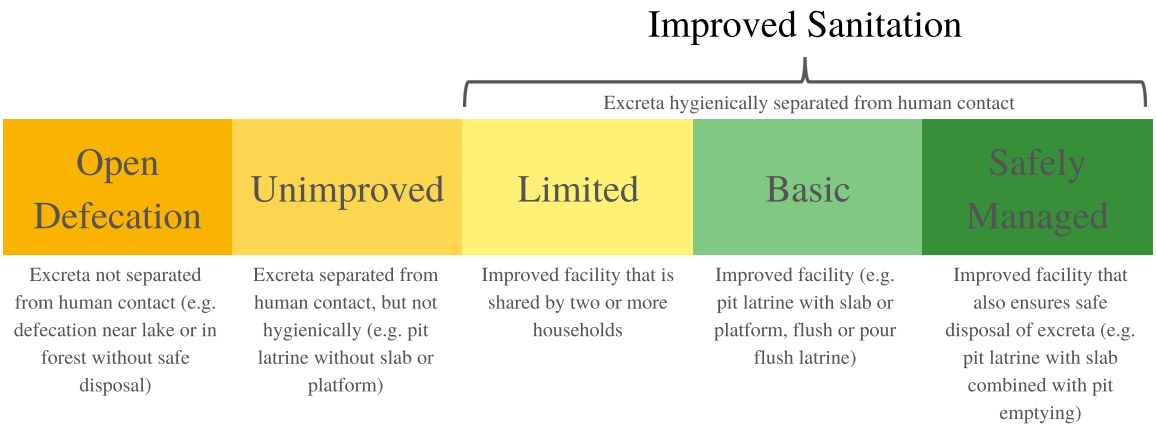


Figure 3. Sanitation service ladder (adapted from the WHO & UNICEF Joint Monitoring Programme)

At the bottom of the sanitation service ladder is open defecation, the disposal of fecal matter in open spaces or with other solid waste (e.g. fields, bushes, bodies of water). Unimproved sanitation service does separate excreta from human contact, but does not involve hygienic separation (e.g. pit latrine without slab or platform, bucket latrine, hanging latrine). Improved sanitation refers to facilities designed to hygienically separate excreta from human contact. There are three sub-categories of improved sanitation. Limited improved sanitation is the use of improved sanitation facilities that are shared between households. Basic improved sanitation is an improved facility that is not shared with other households (e.g. composting toilets, pit latrines with slabs, flush/pour flush facility leading to sewer system, septic tank, or pit). At the top of the ladder is safely managed improved sanitation, an improved facility that is not shared with other households and which includes safe disposal for excreta either on- or off-site. Figure 4

demonstrates unimproved and basic sanitation in the context of Wolaita Zone, Ethiopia. In this setting, unimproved sanitation consisted of pit latrines without slabs and improved basic sanitation consisted of pit latrines with concrete slabs.

Figure 4. Examples of unimproved and basic improved latrines at study site

2.1 Importance of WASH and Sanitation

The areas that comprise WASH – water, sanitation, and hygiene – are by no means novel, nor have they always been promoted for the furtherance of global health and disease prevention. The practice of separating human waste and sewage has long been observed, as far back in history as the early Bronze Age (Mitchell, 2016). Evidence of water and sanitation systems have been found in ancient civilizations, including Mesopotamia (some of the first inhabitants to manage the challenge of urban water access and waste disposal), the Roman Empire (well known for construction of aqueducts and public lavatories), and Minoan and ancient Greece (who developed architectural and hydraulic drainage systems) (Mitchell, 2016). In the 19th century, the rise of germ theory as a dominant global health practice increased focus on the fecal-oral route of disease and the preventative measures of sanitation, clean water, and hand hygiene (Mitchell, 2016). International monitoring of drinking water and sanitation was first instigated by the WHO (then the League of Nations Health Organization) in the early 1930s (Bartram et al., 2014). At present, the WHO continues to monitor WASH in alignment with global targets such as the SDGs (WHO & UNICEF, 2017). After the acronym's rise in usage following the 2001 WSSCC highlight, WASH began to be listed as a clustered area of theory and practice for global health NGOs, researchers, and organizations. Today, key actors in the global WASH field include national aid organizations (e.g. USAID, DFID), the United Nations, major funders like the Gates Foundation, and hundreds of national and international organizations broadly focused on global development and health.

As of 2017, approximately two billion people worldwide lack access to at least a basic improved sanitation facility or safely managed sanitation (WHO & UNICEF,

2019). These two billion individuals lacking access to a basic sanitation facility or higher on the sanitation ladder are comprised of 627 million people using limited services, 701 million using unimproved facilities, and 673 million utilizing open defecation (WHO & UNICEF, 2019). The number of people without adequate WASH practices (at least basic sanitation) is especially elevated in low-income countries, primarily in the SDG regions of sub-Saharan Africa, Eastern and South-Eastern Asia, and Central and Southern Asia. Although achieving SDG 6 – universal sanitation by 2030 – seems unlikely and would require doubling of the current average 1% sanitation increase per year, there are many examples of positive strides in global sanitation. The proportion of the world's population without access to basic sanitation service was nearly halved (decreased from 44% to 27%) from 2000 to 2017, and all regions except Oceania saw an increase in basic sanitation or greater (WHO & UNICEF, 2019). In sub-Saharan Africa, the population with basic sanitation service doubled between 2000 and 2017 from 149 million to 314 million (WHO & UNICEF, 2019).

Despite improvements in decreasing open defecation and increasing access to basic sanitation, the two billion people without improved sanitation and resulting burden of morbidity and mortality represent a serious public health issue. Scholars and health-focused organizations have undertaken different assessments for the global burden of disease from inadequate WASH prior to 2019. These studies produced a variety of estimates but a shared conclusion that inadequate WASH is related to adverse health outcomes, including diarrheal disease, soil-transmitted helminth infection (hookworm, roundworm, whipworm), and malnutrition (Cumming & Cairncross, 2016; GBD 2017 Risk Factor Collaborator, 2018; Prüss-Ustün et al., 2014). A recent comprehensive

analysis estimated 829,000 deaths and 49.8 million Disability Adjusted Life Years (DALYs) were attributable to WASH-related diarrheal disease (Prüss-Ustün et al., 2019). Conversely, increased access to and utilization of WASH resources has been affiliated with improved health outcomes, including moderate or mixed improvement for diarrhea morbidity (Cumming et al., 2019; Fewtrell et al., 2005; Gelaye et al., 2014; Wolf et al., 2018), and lower risk of helminthiasis transmission (Ziegelbauer et al., 2012). Conclusive statements about the impact of improved global WASH or sanitation facilities on health require further comprehensive studies and more reliable data. The potential positive health impacts of improved sanitation merit the continued study and advancement of sanitation worldwide.

At the national level, more than half of all deaths in Ethiopia are due to communicable, maternal, neonatal, and nutritional diseases (IHME, 2017). Within this category, respiratory infections and tuberculosis, maternal and neonatal disorders, and enteric disorders (e.g. diarrheal diseases) were the leading causes of death (IHME, 2017). Communicable, maternal, neonatal, and nutritional diseases comprised nearly 90% of deaths for children under the age of five, with enteric infections, respiratory infections and tuberculosis, and neonatal disorders (e.g. preterm birth, sepsis) as the leading causes (IHME, 2017). In Ethiopia's Wolaita Zone, intestinal helminth infection prevalence was approximately 72% among schoolchildren (Alemayehu et al., 2017). Comorbid intestinal parasitic infections and trachoma account for the second-greatest cause of outpatient morbidity in Ethiopia (Alemu et al., 2011). One recent study found that over 30% of Ethiopian schoolchildren were infected with at least one species of intestinal parasite (Gelaw et al., 2013). This far exceeds the WHO threshold (1% prevalence of medium and

high intensity infections) to classify soil transmitted helminths as a public health problem (Montresor, 2012).

2.2 Sanitation in Ethiopia

Although WASH does not receive as much public attention as other global health topics, moderate funding, national prioritization, and global health research are being extended to this area and the associated maladies. Actors in the sanitation field include individual households, community-based organizations, health workers, governments, NGOs, researchers, and multilateral organizations. In the early 2000s, all levels of sanitation actors began to increase their focus on WASH improvement in Ethiopia. The Government of Ethiopia's Health Extension Program (HEP), launched in 2003, trained a cadre of Health Extension Workers (HEWs) to implement prevention, outreach, and curative health care at the village level (Bilal et al., 2011; Wang et al., 2016). One HEP area of care, "Hygiene and Environmental Sanitation," is specifically focused on improving sanitation in communities. The structure of the HEP is designed to facilitate community health advancements and to reach all households. Under the HEP, two female HEWs are assigned to each village. Each HEW pairing supervises six Health Development Army (HDA) women. The HDA volunteers further mobilize a total of 30 household communities to make progress in the health program areas. In another sanitation-related government initiative, the Government of Ethiopia implemented Community-Led Total Sanitation (CLTS) strategies for sanitation improvement in 2010. CLTS leverages strong emotions such as shame and disgust to "trigger" individuals to cease open defecation. However, this practice initially focused on changing attitudes about the open defecation behavior and did not include resources or solutions. The

subsequent movement away from open defecation and related lack of alternate sanitation solutions led to an increase in "DIY" unimproved latrines as an alternative to open defecation (e.g. pit latrines, hanging latrines). These unimproved latrines, while an alternative to open defecation, include neither hygienic separation of excreta from human contact nor mechanisms for safe fecal waste disposal.

In 2013, the Government of Ethiopia implemented the One WASH National Programme (OWNP). This program is ongoing with OWNP Phase II and is intended to facilitate national water and sanitation coverage by the end of 2020, but is expected to continue beyond the year 2020 (Wilson et al., 2018). The OWNP encouraged international development organizations to generate demand for sanitation technologies, and included opportunities for partnership with the Government of Ethiopia (National WaSH Steering Committee, 2018). Specifically, the Government of Ethiopia released the National Sanitation Marketing Guideline to address the "post-triggering" phase of CLTS and continue progress in sanitation beyond the "DIY" latrines (Federal Democratic Republic of Ethiopia, Ministry of Health, 2013). The global development organization iDE had been working in Ethiopia since 2007 on non-sanitation projects, and began implementing sanitation projects in 2013 upon release of the OWNP. Ethiopia's most recently reported WASH budget (fiscal year 2018) was USD 112 million, but the country received USD 556 million in water and sanitation aid commitments to augment the relatively low national WASH budget (WHO, 2019). With opened opportunities for sanitation partnerships in the country, the Ethiopian Ministry of Health also implemented a policy prohibiting the use of subsidies for sanitation technology. This meant that

development actors cannot provide free or discounted sanitation products to households (concrete latrine slabs or otherwise).

Between 2000 and 2017, Ethiopia made enormous strides in moving from open defecation to unimproved sanitation (see Figure 5). Nationally, open defecation decreased from 53 million to 23 million people, and unimproved sanitation increased from nine million to 66 million people (WHO & UNICEF, 2019). However, over 23 million people (22% of the Ethiopian population) still practice open defecation (WHO & UNICEF, 2019).

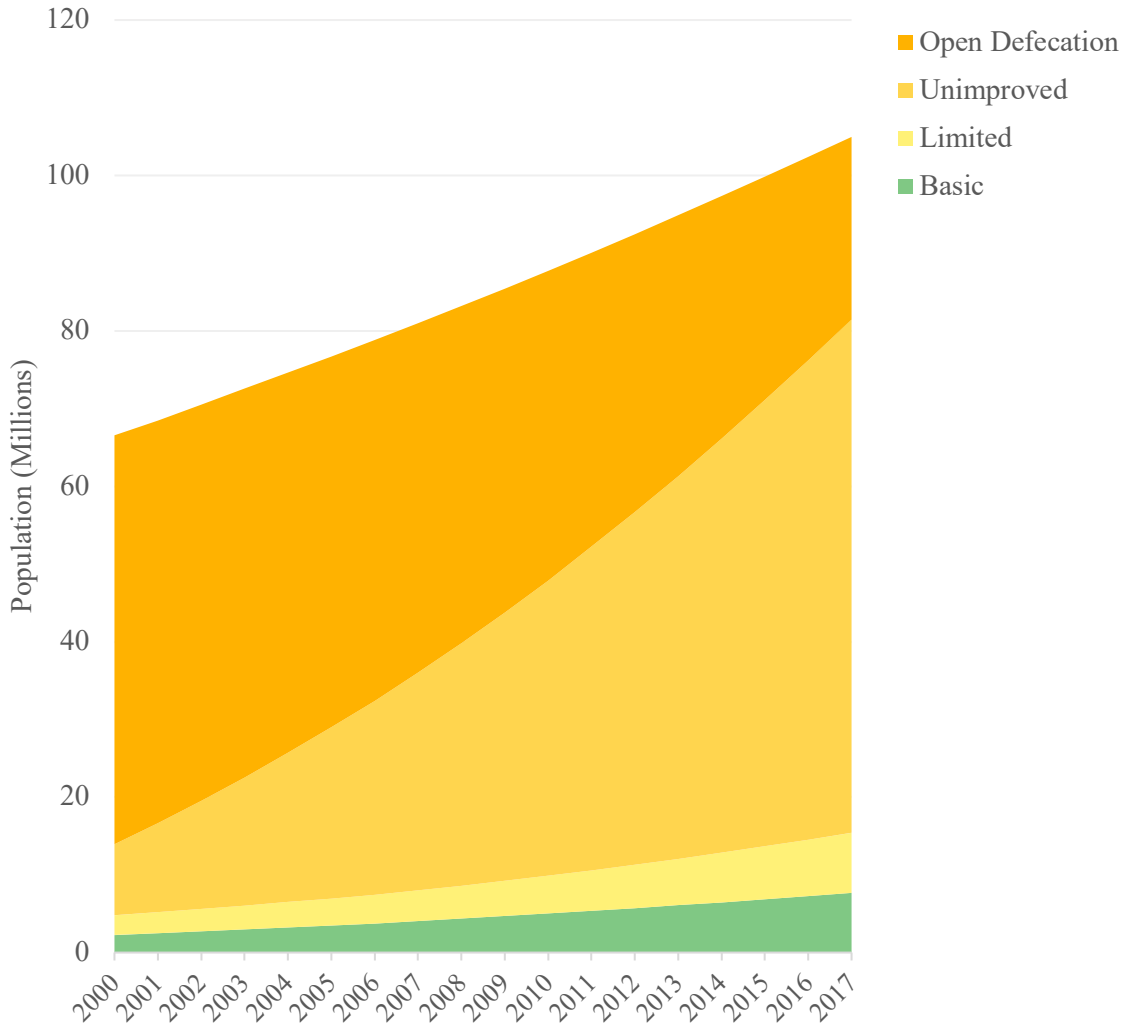


Figure 5. Ethiopia sanitation service levels, 2000-2017 (data from WHO & UNICEF, 2017)

As of 2017, upwards of 66 million people (63% of the national population) use unimproved sanitation facilities and just over seven million people (7%) utilize basic improved sanitation (see Table 1). In the study region, SNNPR, 11.6% of households use improved sanitation (8.5% basic sanitation and 3.1% limited sanitation). The majority of households (70.5%) use unimproved sanitation, while 17.9% use open defecation (WHO & UNICEF, 2016).

Table 1. Sanitation levels for Ethiopian population (WHO & UNICEF, 2016; 2019)

	Open Defecation (% of population)	Unimproved Sanitation (% of population)	Limited Sanitation (% of population)	Basic Sanitation (% of population)
National (2017 data)	22.4%	63%	7.4%	7.3%
SNNPR (2016 data)	17.9%	70.5%	3.1%	8.5%

2.3 Human-Centered Design

Human-Centered Design (HCD) is a method to understand consumer wants and needs, resulting in an iterative design process that produces innovative solutions. iDE grounds all WASH programs and grants in the HCD approach, and is a leader among global development organizations using HCD. This approach is consequently integrated into the latrine slab product itself and the sanitation market (connections between customers, manufactures, sales agents, and other actors involved with latrine slabs) for this research. HCD was originally borne out of the product design field as a process to create products that meet the requirements and desires of the end-users (Brown & Wyatt, 2010).

Today, HCD is a transdisciplinary approach, integrating fields including architecture, psychology, anthropology, and business management. Key principles of HCD for application in global health include: active and informed involvement of users to increase product applicability, sustainability, and ownership; an iterative design process to develop the product with stakeholder and user feedback; and multidisciplinary design teams to ensure input from a variety of perspectives and backgrounds. The HCD process is cyclical and iterative, and is "best thought of as a system of overlapping spaces rather than a sequence of orderly steps" (Brown & Wyatt, 2010, p. 33). These three spaces – inspiration, ideation, and implementation – comprise the core of HCD work. The HCD approach aims to engage the local population to ensure that products align with community needs and desires. While the concept of HCD is not new, its application to global health topics is relatively recent. Previous interventions utilizing HCD in health have shown successful implementation and preliminary impact results, such as technology for health education and chronic disease management (Bazzano et al., 2017).

Human-Centered Design for Water, Sanitation, and Hygiene

HCD can be utilized to combat misplaced or poorly designed WASH interventions, such as a latrine block constructed without community consultation that resulted in disuse. For iDE sanitation programs, HCD is intended to produce a latrine that households want to purchase and use, which will in theory increase adoption and thus contribute to reducing the negative health outcomes associated with a lack of adequate sanitation facility. Potential areas of a latrine that HCD could influence include the location and slope of latrine footholds or the materials and shape for the latrine slab. In addition to sanitation facility design, HCD can also be applied to sanitation marketing –

the process of designing, framing, and selling sanitation facilities to consumers. Similar to other health marketing areas, sanitation marketing borrows from traditional marketing theory by commoditizing the "product" as the sanitation infrastructure. In this case, the sanitation marketing product sold is a concrete slab for a latrine. Areas for HCD to inform the sanitation market design could include latrine price, method of sale, or advertisements.

Currently, there is a dearth of academic research exploring HCD's application to sanitation specifically. Of the 25 HCD-related studies identified through my literature review, only a handful specifically applied HCD to a sanitation program in a low- or middle-income country context, and none were situated in Ethiopia. Sommer (2010) highlighted an intervention among Tanzanian primary and secondary schools that utilized participatory design principles of HCD to involve girls in the design of WASH resources for menstrual hygiene management (MHM) at their schools. When girls were included in idea generation and critical design stages for school-based latrine, handwashing, and water needs to ensure adequate MHM capabilities, they generated effective and sustainable solutions. The resulting design included moving the location of an incinerator to reduce perceived embarrassment walking across the schoolyard with menstrual hygiene products (Sommer, 2010). HCD principles were also integrated into a CLTS program in Malawi (Cole et al., 2014). Through the use of a participatory design process, product users (the community members) sought to answer the question: Can we create a toilet that matches what the majority of villagers want, need, and can afford using local materials? Village teams identified key design features for sanitation infrastructure and marketing, including: integrating builders with village health workers and community

members to increase shared understanding of sanitation technology capabilities for the local context; use of location-appropriate materials for latrines; and identifying alternative sanitation technologies appropriate for the specific village context (Cole et al., 2014).

CHAPTER III

RESEARCH DESIGN

3.1 Study Setting

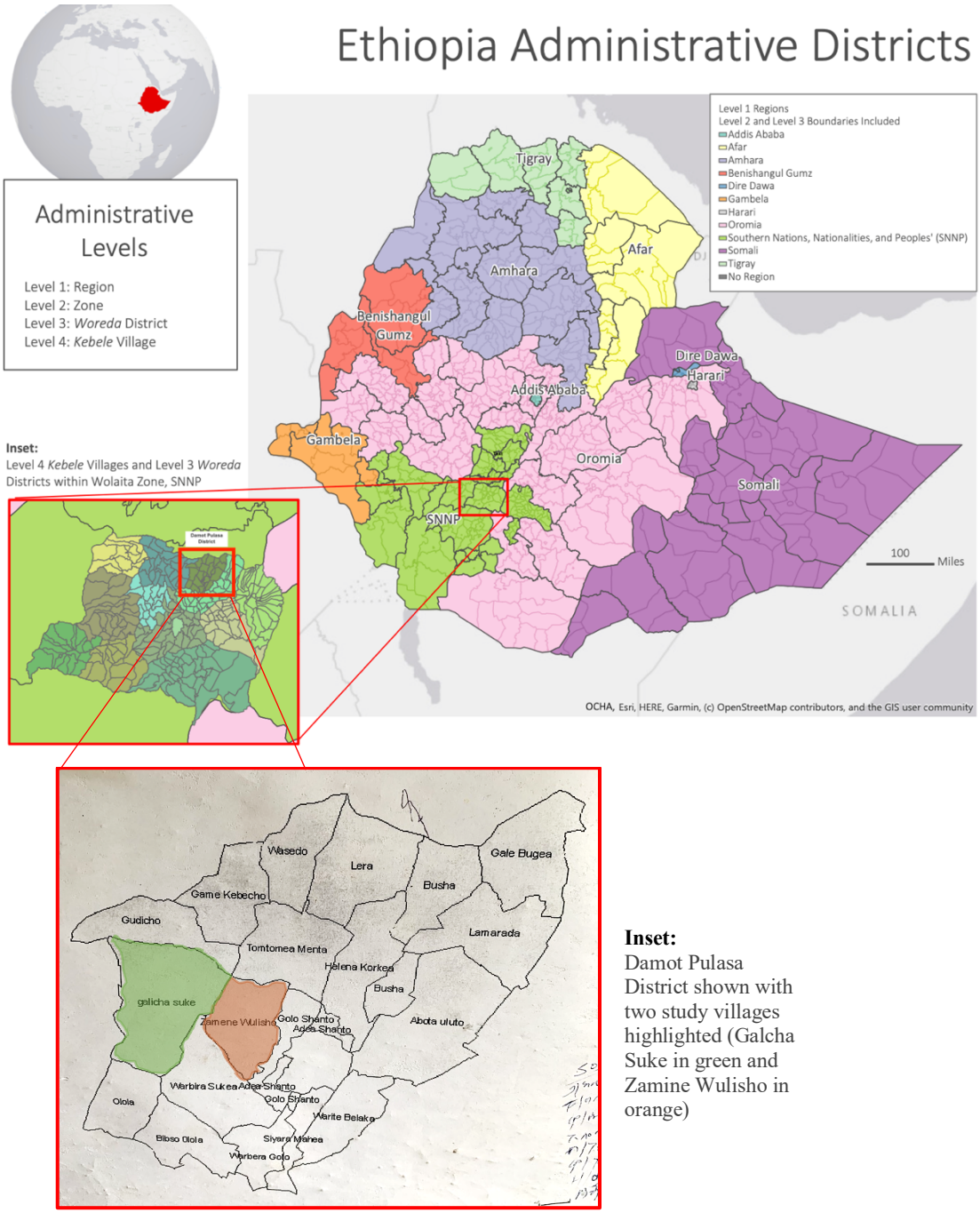
I chose Ethiopia as the study setting due to the country's high rate of open defecation and low rate of improved sanitation facilities. Ethiopia is divided into four administrative levels: region, zone, *woreda* (district), and *kebele* (village). Wolaita Zone is one of 14 zones within the Southern Nations, Nationalities, and Peoples' Region, located in the southwest of the country bordering Kenya and South Sudan (see Table 2 for the administrative levels). In Wolaita Zone's rural region of SNNPR, only 7% of the population have access to basic improved sanitation facilities (WHO & UNICEF, 2016). Given the particularly low rate of improved sanitation in this area, and my knowledge of the emerging sanitation market, Wolaita Zone was a suitable location for this research.

Table 2. Ethiopia administrative levels and corresponding study location

Administrative Level	Study Location
1. Region	Southern Nations, Nationalities, and Peoples' Region (SNNPR)
2. Zone	Wolaita Zone
3. District (*woreda)*	Damot Pulasa District
4. Villages (*kebeles)*	Galcha Suke and Zamine Wulisho Villages

Wolaita Zone is further divided into 15 districts and hundreds of villages. After solidifying Wolaita Zone as the area of study, I chose two neighboring villages within the Damot Pulasa District: Galcha Suke and Zamine Wulisho. Damot Pulasa District is not entirely open defecation free (ODF). This designation is given to a community by the Government of Ethiopia when there are no households practicing open defecation. Galcha Suke village has been certified as ODF by the Ethiopian Ministry of Health, while neighboring Zamine Wulisho has not been certified as ODF. The two villages were

selected to include ODF and non- ODF villages, and latrine slabs were sold in both villages. iDE sanitation programs were operational in the district and the location was logistically feasible with the iDE field office in Damot Pulasa's capital of Sodo. See Figure 6 for a map situating the two villages within Ethiopia.



Inset: Damot Pulasa District shown with two study villages highlighted (Galcha Suke in green and Zamine Wulisho in orange)

Figure 6. Ethiopia administrative levels, with study villages highlighted in inset

3.2 Research Design Framework

This study used a mixed methods and multi-phase approach in order to combine household narratives and sanitation stakeholder experiences with quantitative latrine adoption data. Given the complexity of human behaviors around sanitation practices and beliefs, qualitative or quantitative data alone would not be sufficient to understand this topic. The mixed methods approach leveraged the depth of qualitative interviews and the breadth of a quantitative survey for a more comprehensive view of sanitation perspectives. Each research question required specific data types, and together, the qualitative and quantitative data provide a more holistic understanding of household latrine choices, use, and satisfaction (see Table 3).

Table 3. Research questions and associated data sources

Research Question	Question 1: What factors affect a household's choice of latrine?	Question 2: What variation in household use exists across household members?	Question 3: To what degree are households satisfied with their latrine?	Question 4: How is the HCD approach integrated into sanitation programs?
Associated Data Sources	• Key informants • Household Interviews • Focus Group • Survey	• Household Interviews • Focus Group • Survey	• Key Informants • Household Interviews • Survey	• Key informants • Household Interviews

I chose the exploratory sequential design for mixed methods research, as it allowed me to first explore the topics and the population through qualitative interview data, before designing and implementing a quantitative survey based on the results of the qualitative analysis (Creswell, 2015). Phase One of this design employed qualitative methods of observations, focus groups, and key informant and household interviews to

explore the question of latrine behavior. Based on my qualitative findings, I created a household survey instrument in Phase Two, then deployed the quantitative instrument in Phase Three of the exploratory sequential design. See Figure 7 for the exploratory design framework.

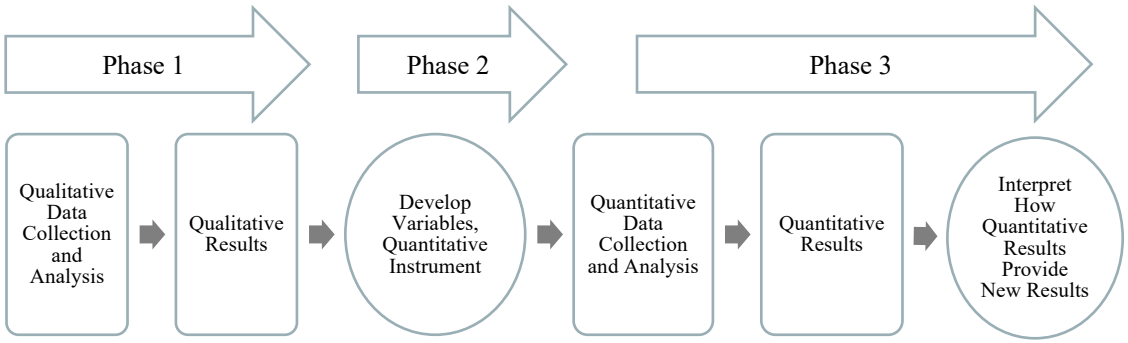


Figure 7. An exploratory design of the mixed methods study of latrine purchase and adoption (adapted from Creswell, 2015)

I primarily used grounded theory to guide my methodology (Birk and Mills, 2015). In keeping with grounded theory's inductive approach, I developed my interview questions from repetitive themes or disagreement in concepts that emerged out of interviews with individuals. Beginning with my observations, through the initial interview and each subsequent interview, and continuing into the focus group discussions, I created memos to document my perceptions, decisions, and adjustments to interview topics or hypotheses. In addition to grounded theory, the study employs Eisenhardt's "no theory first" design, wherein relationships between variables and constructs are not assumed, and are explored through the study (Eisenhardt, 1989). My study also draws on the Diffusion of Innovation Theory, "The process by which an innovation is communicated through certain channels over time among the members of a social system" (Rogers, 1995, p. 5). These theoretical concepts were applied to the

adoption of HCD latrines in the Wolaita Zone in examining their perceived relative advantage, compatibility, complexity, and observability.

I drew from established sanitation research to inform my latrine-related questions and observations, and which later informed my sanitation decision-making model presented in Chapter VI. Observational indicators for latrines (e.g. worn trail to the latrine, drop-hole cover present, walls and roof) were influenced by Montgomery et al.'s (2010) elements used to define latrine quality. Household questions around sanitation satisfaction, constraints, and motivations were informed by studies of sanitation preference, intention, and choices in sub-Saharan Africa (Diallo et al., 2007; Jenkins & Curtis, 2005; Jenkins & Scott, 2007). Additional considerations of individual, household, community, and societal levels of sanitation influence drew from the Integrated Behavioral Model for Water, Sanitation and Hygiene (IBM-WASH) and it's applicability to rural sanitation access and use in Ethiopia (Aiemjoy et al., 2017; Alemu et al., 2017; Dreibelbis et al., 2013).

3.3 Methodology

To address my research questions, I conducted mixed methods field research for ten weeks in Addis Ababa and Damot Pulasa, Ethiopia. I partnered with the global development organization iDE, Ethiopia Country Office (iDE Ethiopia) to identify and collect these data. This partnership was instrumental to my research in several ways. First, iDE Ethiopia provided valuable contextual insights into the WASH field and the wording of questions for the target population. Second, the staff in Damot Pulasa served as gatekeepers and arbiters to the community, which allowed me to find and communicate with participants. In addition to Ethiopia's primary working language of

Amharic, the Wolaita people in Wolaita Zone speak Wolaitigna (sometimes spelled Wolaytta or Wolaytegna). While my key informant interviews were occasionally conducted in English, the majority of interviews, focus groups, and surveys were conducted in Wolaitigna and intermittently Amharic through translation. Prior to beginning data collection, I received written approval from the University of Oregon Institutional Review Board, and written approval from iDE Ethiopia to access organizational reports on latrine sales. Additionally, I received verbal approval from the head of Damot Pulasa District to conduct my research in two villages within the district. All participants gave oral approval prior to the interview or survey administration, and all confirmed approval afterwards.

Observation and Key Informant Interviews

Prior to beginning interviews, and throughout my time in Ethiopia, I conducted informal participant observation as an iDE intern and researcher. I observed interactions between parties within the sanitation market (e.g. customers, manufacturers, health workers), the presence and condition of public latrines, and options for installing latrines (building materials, transportation options, physical space for construction). These observations were recorded as field notes in the form of jottings, observation notes, and photographs. I typed up my field notes each night, which then became part of the qualitative data that were later coded and analyzed.

I conducted key informant interviews to gather information from a broad group of stakeholders (iDE staff, sales agents, slab manufacturers, government health workers). These conversations with interlocuters helped me to better analyze the impact of HCD on the entire sanitation map, rather than only the latrine consumer or end user (see Table 4).

Table 4. Key informant interview locations and categorizations

	Galcha Suke	Zamine Wulisho	Addis Ababa & Damot Pulasa
iDE Field Office Staff	0	0	5
Slab manufacturer	1	1	0
Sales agent	2	2	0
HEW	1	1	0
TOTAL:	4 key informants	4 key informants	5 key informants

The 13 key informants were chosen based on their roles and locations. I conducted five interviews with iDE Ethiopia staff, one in the main Addis Ababa office and four in the Damot Pulasa field office. I interviewed the WASH specialist for iDE Ethiopia in Addis Ababa, two iDE staff in the Damot Pulasa field office, and two field facilitators in Damot Pulasa to gain insight into organizational strategy, HCD, and the sanitation landscape. Additionally, I interviewed key members of the sanitation market in both Zamine Wulisho and Galcha Suke. In each study village, I interviewed the slab manufacturer, two of the latrine slab sales agents, and one of the HEWs. My inclusion criteria were that the participant was over the age of 18 and currently worked in the aforementioned role. My only exclusion criteria for key informants were if the participant was under the age of 18 or if they declined both to let me audio record the interview and take notes during the interview.

I asked key informants about their roles in latrine manufacturing, marketing, sales, and promotion and their level of satisfaction with the product (latrine) and process (sanitation marketing). These interviews were audio recorded and transcribed in English. Interviews with iDE Ethiopia staff were conducted in English, while interviews with slab manufacturers, HEWs, and sales agents were conducted in Wolaitigna with English translation from the iDE interpreter. Additionally, I took jottings during each interview

and wrote personal notes each evening following the interview(s) of the day. See Appendix A for the key informant semi-structured interview guide.

Household Interviews

I interviewed households from two groups: 1) households that had purchased an improved latrine with a slab (termed as improved latrine adopters); and 2) households that had not purchased an improved latrine. This latter group could have potentially included two subgroups: a) households that use an unimproved latrine; and b) households that practice open defecation (termed as non-adopters). Although I maintained that non-adopters could be any household without an improved latrine, it happened that all non-adopters used an unimproved latrine consisting of a pit latrine without a slab. I purposively sampled the adopter and non-adopter interview participants so that the two groups were evenly divided across the two villages. iDE records of latrine sales were used to identify latrine adopters and non-adopters were identified through the knowledge of iDE field facilitators, sales agents, and manufacturers.

My inclusion criteria for latrine adopters were that the interview participant was over the age of 18 and the household purchased a slab latrine. Inclusion criteria for non-adopters were that the interview participant was over the age of 18 and the household had not installed an improved latrine. The exclusion criteria for both groups were if the participant was under the age of 18 or if they declined both to let me audio record the interview and take notes during the interview. I interviewed 20 households in total (see Table 5). I interviewed five adopter households and five non-adopter households in Galcha Suke and likewise in Zamine Wulisho. In the interviews, I asked adopter and non-

adopter households about the latrine choice process, latrine investments, attitudes and beliefs around latrines, and satisfaction with their current sanitation facility.

Table 5. Household interview locations and categorizations

	Galcha Suke	Zamine Wulisho
iDE Latrine Adopter	5	5
Non-Adopters	5	5
TOTAL:	10 households	10 households

Household interviews were conducted in Wolaitigna with simultaneous English translation. I asked each interview question to the participant in English, then the interpreter translated the question into Wolaitigna. The participant responded in Wolaitigna, which was translated back into English. All interviews were audio recorded and transcribed in English. Similar to the key informant interviews, I took jottings during household interviews and wrote nightly notes for each household. In keeping with my grounded theory approach, interview questions evolved throughout the qualitative data collection phase. See Appendix B for the resulting household adopter and non-adopter semi-structured interview guide.

Focus Groups Discussions

Initially, I planned to conduct four focus groups with sales agents and households to further discuss the latrine purchasing process and decision-making. However, I felt that I had reached saturation on household perspectives from the interviews. Additionally, it was proving logistically unattainable to gather more sales agents away from their homes and work to participate in my focus group. Instead, I conducted two focus groups with Health Extension Workers (HEWs) and Health Development Army (HDA) members. I had previously known of the HDA in Ethiopia, a volunteer network of women who are

supervised by HEWs and promote health within their community of approximately 30 households. From the key informant interviews, I learned that the HDA was an important component of sanitation promotion and information, so I wanted to solicit feedback and knowledge from this group. In Galcha Suke, the focus group included six HDA volunteers and two HEWs. In Zamine Wulisho, the focus group included six HDA volunteers and one HEW.

Focus group participants were recruited with the inclusion criteria that they were over the age of 18 and that they currently worked as a member of the HDA or as a HEW. Exclusion criteria were that the participant was under the age of 18 or was not willing to participate in the focus group. For each focus group, I asked the women broad questions about the state of sanitation in their household area, leaving the conversation open for other health-related topics. Like the interviews, the focus group discussions were conducted in Wolaitigna with English translation. I audio recorded and transcribed each discussion in English. Additionally, I wrote jottings during the focus groups and created note files following the focus group discussions. Each focus group lasted approximately one hour. I facilitated the focus group, after introductions made by the village HEW(s). See Appendix C for the focus group guiding questions.

Household Survey

Following the qualitative data collection, I created and implemented a household survey. This instrument was created to collect information on household latrine choices, use, and satisfaction. I randomly selected households by sampling every third household working my way through the village. I chose the starting location in the center of the village, randomly selected a direction, and proceeded down the road in that direction (see

Figure 8). If a household was unavailable, I proceeded to the next household along the path until I found an available participant. I did not administer the survey to households previously interviewed and moved to the next household along the path if a previously interviewed household was selected randomly for the survey. Through random sampling, I hoped to capture both adopter and non-adopter households.

Figure 8. Main street in Galcha Suke (L) and household in Zamine Wulisho (R)

Inclusion criteria were that the survey respondent was over the age of 18. Exclusion criteria were if the respondent was under the age of 18, if anyone in the household had previously participated in the interviews or focus groups, or if the respondent was unwilling to respond to the survey questions. I originally intended to survey 30 total households (15 in each of the villages). However, the rainy season caused flooding on many roads, which made certain routes impassable and increased the travel time through villages. I surveyed as many households possible in the time I had. In each village, I surveyed 10 households for a total of 20 surveys. They survey was administered using the EpiCollect mobile application, which allowed for offline data collection. See Appendix D for the survey questionnaire.

Spatial Data

I collected GPS location data from all household interviews, surveys, and observations to pair these spatial data with iDE's existing data on latrine purchases. The GPS data was collected in the EpiCollect mobile application, tied to each household or key informant ID number. I attempted to locate existing GPS data on all latrine sales in my study area, but it was not possible to collect this information during my limited time in Wolaita, as it would have involved photocopying each sales agents' receipts and translating the handwritten location into spatial data. Due to this constraint, I utilized the spatial data to visualize participant proximity in Chapter IV but do not further analyze these data. All spatial data are masked to protect participants' anonymity, so that the GPS points do not identify a specific house, but rather an area within 50 meters (164 feet) of the household.

3.4 Data Analysis

I first transcribed interviews and focus group discussions from the audio recording into English. I uploaded the interview transcriptions, focus group transcriptions, observational notes, and other researcher notes into Dedoose, a cloud-based qualitative analysis program. In Dedoose, I created and applied codes to the text. In keeping with the grounded theory approach to qualitative data, I created *in-vivo* codes (revolving around particular terms of phrases that people used in interviews) as I analyzed the data, and wrote memos to document my thought process and emerging themes in the open coding process. Throughout the coding process, I used the principle of constant comparison to ascertain any emergent codes that had not been retroactively applied to earlier interviews and to compare across interview and focus group data to

create or modify codes. I included descriptive and analytic codes for my qualitative data and created and maintained a codebook. I conducted a word-based analysis by counting keywords and phrases (e.g. “safety,” “price,” “neighbor,” “disease transmission”).

For my quantitative data of 20 surveys, I generated frequencies and descriptive statistics and compared the survey instrument results to the qualitative data. I created graphical representations for frequencies of keywords, themes, and codes within my data, disaggregated by demographic variables. I compared these frequencies between the iDE adopter and non-adopter household interview groups, key informants, and household survey respondents.

CHAPTER IV

INTRODUCING THE STUDY SAMPLE

4.1 Wolaita Zone and Damot Pulasa District

Wolaita Zone, in Ethiopia's Southern Nations, Nationalities, and Peoples Region, is comprised of 15 districts. All household participants, and all but five key informant interviews resided in two of the 23 villages within the Damot Pulasa District. Damot Pulasa is almost entirely rural, with 22 rural villages and one non-rural village. As of the most recent Ethiopian census, the population of Wolaita Zone was 1,902,227 and Damot Pulasa was the fifth most populated region, with a population of 132,266 (Federal Democratic Republic of Ethiopia, Central Statistical Agency, 2007). Household demographics for Damot Pulasa are not publicly available, so Wolaita Zone demographics are utilized as a substitution, as well as SNNPR demographics when zonal data is not available.

Nearly 90% of Wolaita households and 95% of Damot Pulasa households are classified as rural (Federal Democratic Republic of Ethiopia, Central Statistical Agency, 2007). Sixty-three percent of Wolaita Zone households have a household latrine, 61% of which are pit latrines, 1.3% are VIP latrines, and 0.7% are flush latrines (Federal Democratic Republic of Ethiopia, Central Statistical Agency, 2007). The remaining 37% of Wolaita households do not have any type of latrine. Safe water is accessible for 59% of households. Ethiopia has shifted from collecting data on household income to only collecting data on household expenditures due to income variability and lack of accuracy in income data for agricultural households (Federal Democratic Republic of Ethiopia, Central Statistical Agency, 2018). Wolaita Zone's average annual household

expenditures are ETB 10,122, the equivalent of approximately 326.5 U.S. Dollars (Federal Democratic Republic of Ethiopia, Central Statistical Agency, 2018). Compared to the national average, Wolaita Zone households have much lower annual household expenditures (the national average is ETB 44,390, USD1,432) and are more rural (Federal Democratic Republic of Ethiopia, Central Statistical Agency, 2007). Wolaita Zone has greater coverage of household latrines compared to the national average of 33% (Federal Democratic Republic of Ethiopia, Central Statistical Agency, 2007). See Figure 9 for census-derived sanitation coverage.

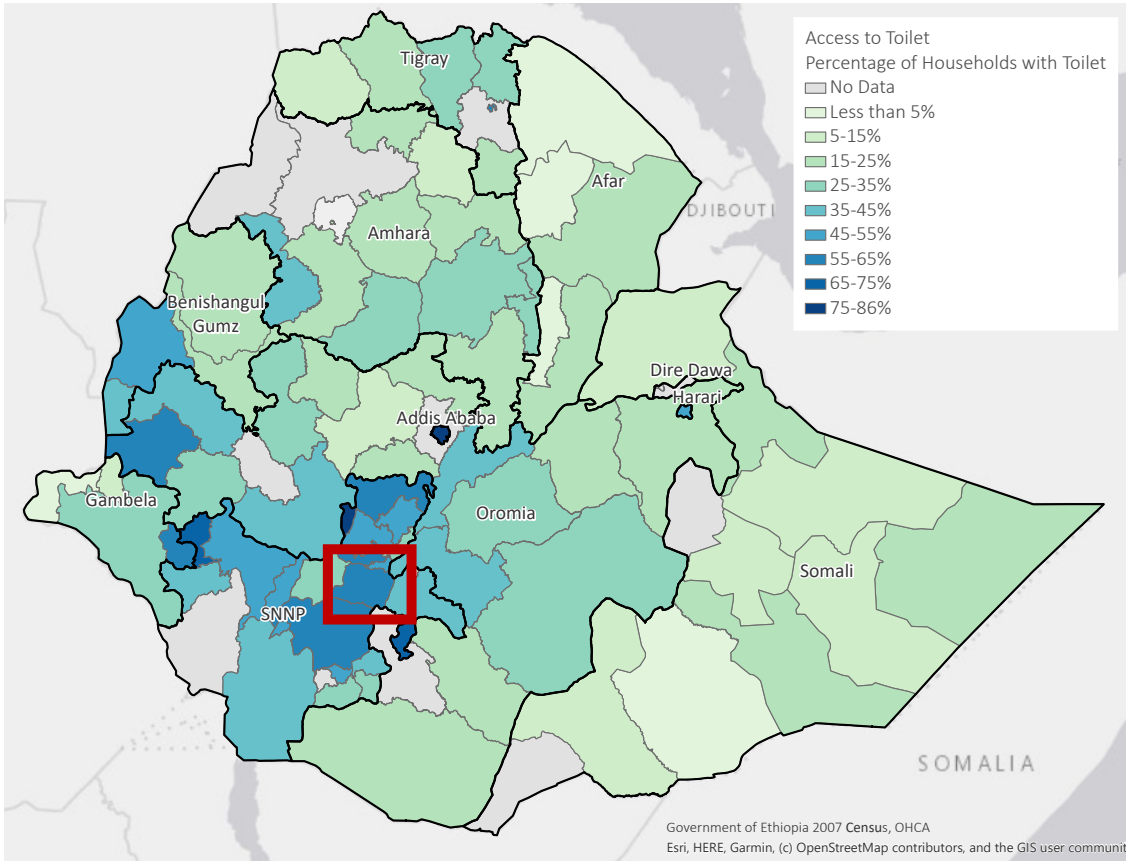


Figure 9. Presence of household latrine (Federal Democratic Republic of Ethiopia, 2007 census data). Wolaita Zone is highlighted.

Although Wolaita Zone has approximately double the national average of sanitation coverage, the census does not differentiate by improved and unimproved

latrines, only by pit latrine, VIP latrine, or flush latrine. Sixty-one percent of Wolaita Zone's 63% sanitation coverage is comprised of pit latrines, but the census does not specify whether those latrines are improved, only whether there is a latrine present. As discussed in section 2.2, it is reasonable to assume that the majority of pit latrines in Wolaita Zone are unimproved.

The key informant interview, household interview, and household surveys took place throughout Wolaita Zone's Damot Pulasa District. Spatial data (GPS coordinates) were collected for each interview and survey location, so as to track the geographic distance between households. Figure 10 below displays the key informant interviews, household interviews, and surveys within Damot Pulasa. Excluded from this map are the two key informant interviews in Sodo town and the key informant interview in Addis Ababa.

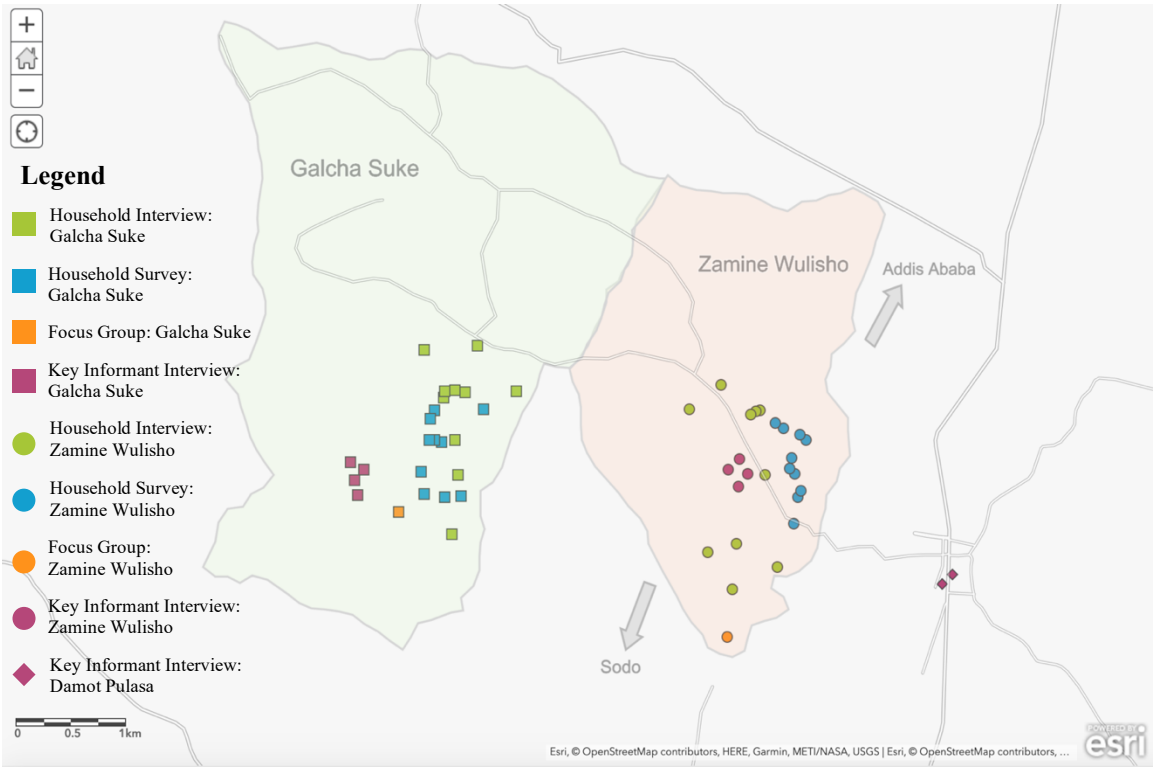


Figure 10. Data collection locations in Damot Pulasa

4.2 Key Informant Characteristics

Thirteen key informant interviews took place. One key informant was located at the central iDE Ethiopia office in Addis Ababa. Four participants were located in Wolaita Zone, two in the iDE field office in Sodo, and two at the Damot Pulasa office. The remaining eight key informant participants were evenly divided between the two villages – Zamine Wulisho and Galcha Suke. Key informant characteristics are included in Table 6 below.

Table 6. General key informant demographics (n=13)

Key Informant Characteristics (n=13)	
Respondent sex (%)	
Female	61.5%
Male	38.5%
Respondent occupation (%)	
iDE Program Staff	38.5%
Sales Agent	30.7%
Manufacturer	15.4%
Health Extension Worker	15.4%
Respondent location (%)	
Addis Ababa	7.7%
Sodo/ Damot Pulasa	30.7%
Zamine Wulisho	30.7%
Galcha Suke	30.7%

4.3 Household Interview and Survey Demographics

In total, 20 household interviews and 20 household surveys were conducted in Wolaita Zone. Both the household interviews and surveys were evenly divided between Zamine Wulisho and Galcha Suke. The mean participant household size was seven people, and mean number of children was slightly greater than four children. Female-headed households comprised 20% of households. The mean age of the household head

was 43 years, and 80% of all household heads were married. 32.5% of household heads had completed partial primary education, 12.5% had completed primary education, and 25% had completed more than primary education. The most common occupation among household heads was farmer (82.5%), followed by merchant (7.5%). Table 7 contains general household characteristics from interviews and surveys.

Table 7. General household interview demographics (n=40)

	Household Interview	Household Survey	Household (Combined)	Household Range (Combined)
Household size (mean, ± SD)	6.9 ± 2.5	7.3 ± 2.0	7.1 ± 2.2	2 – 11
Female-headed household (%)	60%	15%	20%	
Household head marital status (%)				
Married	75%	85%	80%	
Widowed	15%	15%	15%	
Never married or unknown	10%	0%	5%	
Household head age, years (mean, ± SD)	38.4 ± 14.0	49.7 ± 15.3	45.3 ± 15.8	20 – 80
Number of children (mean, ± SD)	4.4 ± 2.8	4.2 ± 2.5	4.3 ± 2.6	0 – 8
Household head occupation (%)				
Farmer	70%	90%	82.5%	
Merchant	15%	5%	7.5%	
Other	15%	5%	10%	
Household head education (%)				
No education	25%	35%	30%	
Partial primary school	35%	30%	32.5%	
Completed primary school	5%	15%	12.5%	
Partial secondary school	20%	20%	17.5%	
Completed secondary school	0%	0%	0%	
College education	15%	0%	7.5%	

The mean total land holdings for households was half a hectare (approximately one acre). Mean total livestock holdings was 2.5 livestock (including cattle, oxen, and sheep). Twenty percent of households owned some form of vehicle (motorcycle, bicycle, donkey cart, horse cart). In the WASH area, 30% of households owned a pit latrine with a

concrete slab (either iDE's round slab or a previously available rectangular slab from another organization). The remaining 70% of households owned an unimproved pit latrine, without a slab. When asked whether the household had a handwashing station at the latrine or elsewhere in the home, 70% of households responded yes (64% of unimproved latrine households and 83% of slab latrine households). All but two households were asked about their water access, and all had access to some form of water utility, whether handpump (22.5%) or public water point (72.5%). The cost of installing a latrine varied greatly among households, with some incurring no capital or labor expenses (household members dug the pit and constructed the latrine themselves with existing materials) and other households spending upwards of ETB 1,000 (USD 32). Expenses were substantially higher among households with slab latrines. Households with an improved latrine invested an average of ETB 1,011 (USD 32.50) compared to an average of ETB 279 (USD 9) for the unimproved latrine. See Table 8 for wealth and WASH-related indicators for interviewed and surveyed households.

Table 8. Wealth and WASH indicators among households (n=40)

	Household Interview	Household Survey	Household (Combined)	Household Range (Combined)
Agricultural assets (mean, ± SD)				
Land owned, hectares	0.5 ± 0.3	0.5 ± 0.3	0.5 ± 0.3	0.1 – 1.5
Number of livestock	2.1 ± 1.6	2.9 ± 1.4	2.5 ± 1.6	0 – 7
Other household assets				
Motorcycle	10%	5%	7.5%	
Bicycle	5%	0%	2.5%	
Cart	5%	15%	10%	
Mobile phone	–	40%	–	
Metal roof	–	90%	–	

Table 9. (continued).	Household Interview	Household Survey	Household (Combined)	Household Range (Combined)
WASH assets				
Improved latrine	50%	10%	30%	
Unimproved latrine	50%	90%	70%	
Handwashing station	65%	75%	70%	
Water source: handpump	37%	10%	22.5%	
Water source: water point	63%	85%	72.5%	
Time to reach water (min)	–	8.75	–	
Additional water treatment	–	15%	–	
Cost of latrine, ETB (mean ± SD)	728.15 ± 654	268.40 ± 302	498.28 ± 554	0 – 2,015
Improved latrine	1,132.30 ± 599	810.00 ± 573	1,011.08 ± 635	0 – 2,015
Unimproved latrine	324.00 ± 424	239.89 ± 283	278.50 ± 334	0 – 1,200

4.4 Household Sanitation Service Levels

Interviewed households were purposively selected for their sanitation facility, and surveyed households were randomly selected. Twenty-eight interview and survey households had invested in unimproved sanitation (a pit latrine without a slab), and 12 households used basic improved sanitation (a pit latrine with a concrete slab). See Figure 11 for visual representation of household position on the sanitation ladder.

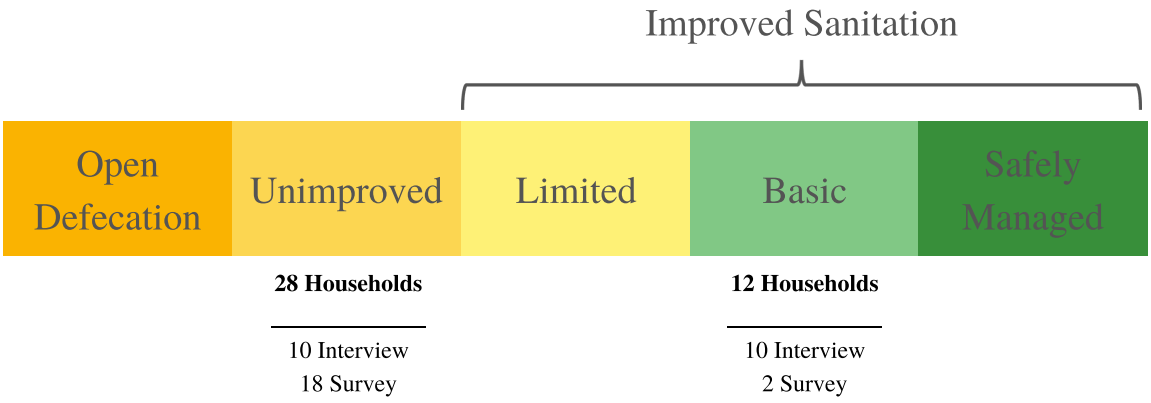


Figure 11. Categorized sanitation facility of interviewed and surveyed households

All of the 28 interview and survey households using an unimproved latrine at the time of this research used open defecation before they installed their unimproved latrine. The majority of these households had shifted from open defecation to unimproved sanitation between three to eight years ago (up to 30 years for one participant). Three of the 28 households had utilized open defecation more recently before they installed their current unimproved latrine within the last six months. The 12 households using basic sanitation had all utilized unimproved sanitation prior to installing a slab for their pit latrine. The 11 households that purchased the iDE slab installed it between one month and three years ago. The sole household with a non-iDE slab latrine had received a free rectangular slab from an unknown NGO 10 years ago.

4.5 Household Sanitation Decision-Makers

It is pertinent to briefly share the demographic breakdown of household decision-makers in the study population. Throughout subsequent chapters, the decision-maker is the individual or individuals within a household responsibly for sanitation-related decisions. Within the two study villages, decision-making within the household largely fell to the head of household, both for everyday purchases and for sanitation investments.

Thirty-two household heads of the 40 total households were married, while eight were widowed or of unknown marital status. For the majority of married household heads, the male household head made sanitation decisions, with some sanitation decisions made by the husband and wife together. All non-married household heads were female. Most sanitation decisions for these households were made by the female household head herself, with some made by an adult child. See Table 9 for decision-makers.

Table 10. Sanitation decision-makers within households

	Sanitation decision-maker			
	Husband and wife	Household head (male)	Household head (female)	Adult child of household head
Married household head(s) (n=32)	31%	69%	-	-
Non-married household head (n=8)	-	-	63%	37%

Surveyed households were also asked about general household purchases in addition to sanitation purchases. Seventeen of 20 surveyed households had married heads of household and three had a non-married household head. For five of the surveyed households, the decision-making responsibilities for sanitation and general purchases rested with a different person. These five households all had married heads of household, and stated that general household purchases are decided jointly by the husband and wife, while sanitation decisions were made by the male household head alone. This indicates a slight shift in how some households make decisions about general purchases (e.g. food) and sanitation (e.g. latrines) where sanitation investment may be more frequently decided by the male household head, even if other purchases are jointly decided. The difference in decision-making responsibility may be due to respondent bias. Three of the five respondents who noted a difference in responsibility for household purchases and

sanitation purchases were male household heads. These men may have wanted to claim sole responsibility for the sanitation decision, since it was apparent that the survey focused on sanitation. However, the sample size of for the difference in decision-making (three male household heads respondents and two female respondents non-household heads) is not large enough to determine concrete reasons for the difference.

The study participants in Wolaita Zone live in an almost entirely rural area of Ethiopia. Although slightly more than half of households in the community have some form of sanitation facility, very few have an improved latrine. The majority of study households' income is derived from smallholder farming. This is the primary occupation in Wolaita Zone, attributable to the availability of land, job opportunities, and lower levels of educational attainment. Consequently, household expenditures for Wolaita Zone are low, and households must carefully consider spending money outside of food, agricultural supplies, and other household essentials. The average study household was comprised of seven people – a married couple with four children. Some households included extended kinship networks of siblings, cousins, or grandparents. All households were willing to discuss their latrine and passionate about the sanitation considerations and challenges at the household and community level.

CHAPTER V

HUMAN-CENTERED DESIGN FOR IMPROVED SANITATION

The section that follows relays my observations and interview findings on the HCD process for the iDE latrine slabs. This background is specific to my research setting, demonstrates how HCD is implemented for this particular product, and contextualizes subsequent results sections. The latrine design process and design choices provide valuable context for household latrine decisions and satisfaction. This retrospective approach to the HCD structure for the previously designed iDE latrine slab and sales process is an opportunity to examine whether HCD resulted in a latrine that is more closely attuned to household desires and preferences or provides greater satisfaction. This chapter first reviews the HCD process for the latrine slab design and the iterative feedback process to incorporate customer preferences in section 5.1. In section 5.2 I review the HCD approach as applied to the sanitation business model, starting from customer discovery to launching the slabs for sale in Ethiopia.

5.1 Slab Design Process

This narrative of the slab design process is compiled from key informant interviews, primarily with the iDE WASH Expert, Ifaa. Ifaa was working with iDE when the latrine programs began, and was involved in the HCD process for the sanitation marketplace and slab itself. The initial phase of HCD, termed the "deep dive", lasted nine months and spanned four regions of Ethiopia (Oromia, Tigray, Amhara, and SNNPR) and eight districts (two districts per region). The iDE deep dive aligned with the first phase of HCD – inspiration – where designers go out into the world and identify the "problem or opportunity that motivates people to search for solutions" (Brown & Wyatt, 2010, p. 33).

In this time, iDE formed a group of "experts with different background and experiences – we had engineers, sanitation people, market development, and business people on the team" (Ifaa). The team conducted observations and household interviews across the eight districts to better understand the end user perspectives of sanitation. To learn from the enabling environment, the team spoke with government departments and other involved parties in the sanitation and hygiene market. According to Ifaa, "The government is very intense here so it's really important and helpful to understand the policy environment and how people are doing business […] it's also important to align our initiative with the country's policies and strategies." This sector-specific deep dive alone took two months.

After listening to end users and other relevant parties, the team came back together to synthesize the narratives in a storytelling session. This represented the ideation space of HCD – "A process of synthesis in which [the team] distills what they say and heard into insights that can lead to solutions or opportunities for change" (Brown & Wyatt, 2010, p. 34). Based on the stories, the team created design principles and began to prototype products and business models. This was the implementation space of the HCD process, where "The best ideas generated during ideation are turned into a concrete, fully conceived action plan. At the core of the implementation process is prototyping, turning ideas into actual products and services that are then tested, iterated, and refined" (Brown & Wyatt, 2010, p. 35). The initial prototypes of slabs and business models were tested in communities through three rounds of testing. The feedback was generated through focus groups and one-on-one household discussions, where a household could test the slab without installing it. Ifaa described this process where households were "observing the product, touching it, lifting it, squat[ting] on it, and they are explaining

their feelings about it – what do they love most, what do they hate." In each round, the team would solicit feedback from community members, then use that feedback and their own technical expertise to iterate the designs and bring the next round of prototype back to the community.

Slab Design in Practice

The prototypes tested different materials for the slab, including wood, metal, and concrete. The team found that end users "like concrete the most. People love something heavy because they think it is strong" (Ifaa). The feedback on concrete material was integral to the slab design, because latrine slabs are frequently molded in plastic to reduce weight and cost for households. According to Ifaa, there was another organization beginning to sell plastic products in Ethiopia, and they were not selling very many. He stated that plastic products make sense from a product design perspective, but households are not interested: "Even me as an engineer, if I wasn't part of the HCD process, I would have recommended plastic! It is easy for transportation, sometimes easier for the manufacturer, you only need molds and you can manufacturer thousands in a day, but I wouldn't think as an engineer that this may not work when it comes down to the community." He continued, "It's the understanding, listening to the community [that] I think helped us in our program in general […] this HCD process, I feel like it added a lot of value to our work."

The deep dive also included iterations of the latrine shape (see Figure 12). Through the HCD process, the iDE team tested multiple shapes, and discovered differences in shape preference through the regions. The circular slab was most popular overall in Amhara, SNNPR, and Oromia regions, but a rectangular slab was most popular

in Tigray. In Tigray, the soil formation is rockier, and Ifaa noted that it is more difficult for households to dig a circular pit, so a rectangular slab is more easily incorporated with rectangular pits. In the other three regions (Amhara, SNNPR, and Oromia), soil is more conducive to digging circular pits. In this topography, circular pits have the additional advantage of more evenly distributing force from the earth surrounding the open pit, leaving the pit more stable and less prone to collapse than a rectangular pit. In SNNPR, the circular slab was selected by the vast majority of community members. Accordingly, in SNNPR's Wolaita Zone, iDE offers the circular slab as the product. However, manufacturers are also able to make a rectangular slab, as it can be done without the circular mold by nailing together wood in a rectangular shape. Sales agents do not present this rectangular option to households at first, but keep it as a secondary resort if a household does not want to purchase the slab based on its circular shape. As Ifaa said, "Sometimes people want a reason for objection […] so if you come to them with a circular slab, they say 'I'm looking for a rectangular one' […] We don't want the shape to be a point of objection, so the sales agent can offer a different shape."

Figure 12. Potential latrine slab designs: circular slab (left); rectangular slab (center); split rectangular slab (right)

In addition to the construction materials, size, and shape, the HCD process informed the basic features of the slab (see Figure 13). Although there are options for sitting slabs globally, all slabs in Ethiopia are squatting, in keeping with cultural preferences. The slab's drop-hole is a keyhole shape, designed to be small enough so that users (especially children) do not fear falling, but large enough to capture urine and feces. The slab is sold with a concrete cover for the drop-hole, which is a keyhole shape slightly larger than the keyhole in the slab. The cover has a long metal handle (approximately 18 inches) for a user to cover and uncover the drop-hole without touching the cover itself. Two footholds on either side of the drop-hole are raised in the back to act as a guide for how to correctly position in a squat relative to the drop-hole. They allow the user to avoid contact with the surface of the slab and are rougher in texture than the surface of the slab to help prevent slipping.

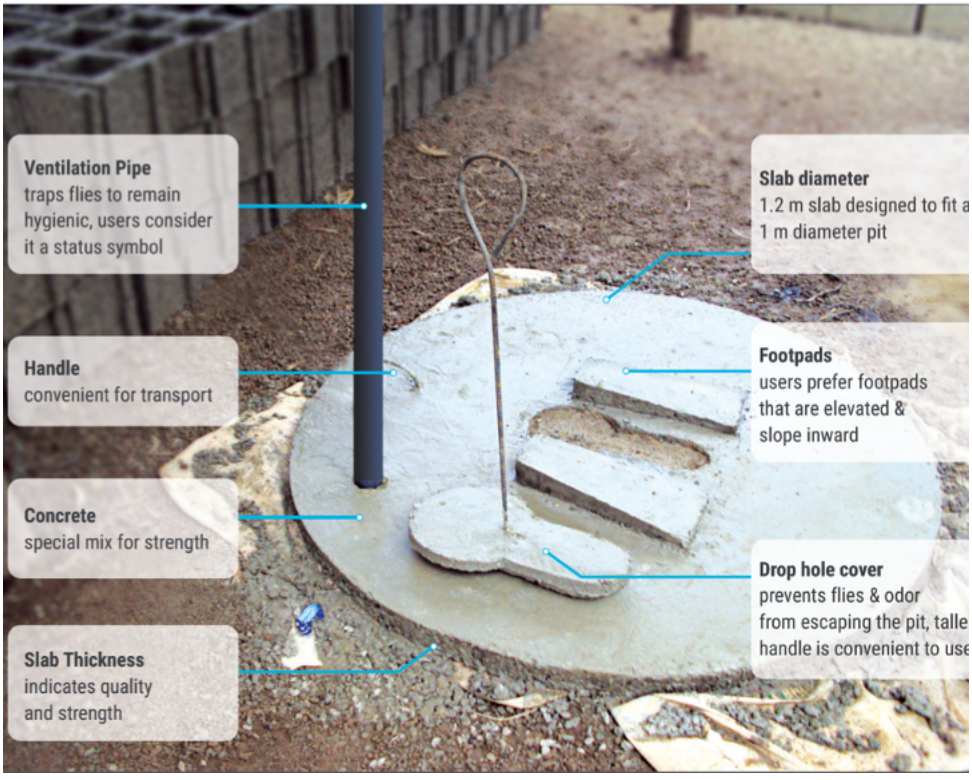


Figure 13. iDE Ethiopia slab design features (photo courtesy of iDE Ethiopia)

As previously discussed, the slab's weight and shape were acceptable to households. However, the substantial weight of a concrete slab is difficult for one person to move. The circular shape allows the customer or manufacturer to roll the slab on its edge for transport or delivery. The slab's reusability is a desirable feature, as a household can move the slab from a pit that has been filled to a newly dug pit. Once the slab is installed on the lip of the latrine pit, a household will need to lift it off the previous pit in order to reuse it in the empty pit. Due to the weight, and the seal formed around the edge of the pit by the slab, this could prove difficult. Consequently, a metal handle was included in the slab design to make this process easier. Households can then use the handle to lift the slab off the pit, before rolling the slab to the new location.

In the initial design, the iDE slab included an extended ventilation pipe made of polyvinyl chloride plastic pipe (PVC) that ran from the slab through the roof or rear wall of the latrine. Through the HCD process, the iDE team learned that this vent pipe is a highly desirable feature of the latrine slab, perceived by households to reduce the smell. In the design process, the iDE team determined that it was more important to package the drop-hole cover with the slab sale, both for safety and to reduce the opportunity for flies to reach the fecal sludge in the latrine pit. Flies are a common carrier of diseases and serve as a vector for fecal particulates to reach humans (WHO, 1997). Ideally, the vent pipe would be part of a ventilated improved pit latrine (VIP latrine), another type of improved latrine. However, earning this designation also requires a completely dark latrine interior, so that if flies do gain access, they leave the latrine pit towards the light at the top of the vent pipe. Given the realities of Ethiopian rural latrines, VIP latrines are not achievable at this time. Without the rest of the VIP components, the vent pipes are

essentially cosmetic, but still desirable for households. In order to still meet the demand for vent pipe, but reduce the overall cost of the latrine, iDE included a short vent pipe starter (approximately five inches long) embedded in the slab (see Figure 14). Households are still able to purchase PVC pipe at the markets, and can extend the vent pipe themselves if they so choose.

Figure 14. Latrine slab design components: brochure (left); slab with standing participant (center); slab leaning against tree (right). The black vent pipe starter can be seen in the center and right images.

5.2 Sanitation Business Model Design Process

After the listening and prototyping phase, the team finalized the product and conducted a month-long sales test across four of the eight HCD districts (one of the two districts in each region). The sales test allowed the team to refine the business model by iterating different promotion, delivery, and payment methods. As part of the earlier listening process, the team observed how people conducted their day-to-day purchasing – where they went, how they paid, if delivery was involved. In the sales test, the team trialed different locations (large market, at the manufacturer, small markets) and payment

methods. From the deep dive, the team learned that frequently a customer would pay in installments for larger products (e.g. table, chair, bed) at the time an order was placed, before the product was created. In these situations, customers would pay a deposit when they made the order, and paid the remaining balance upon delivery, “This gives them confidence and they don’t feel like they are losing their money because they are only paying a small amount, and the manufacturer also feels okay about it because even if households cancel [the order], they already deposited a certain amount so he will not lose any money” (Ifaa). Based on this finding, the iDE team included multiple payment options in the business model so that households could pay the full slab price in cash, or they could pay in installments. The sales test also included finalizing the manufacturers for latrine slabs. The iDE team found that it was most effective to hire slab manufacturers who have some concrete experience, or who were masons previously and could easily translate that training to manufacturing the slabs.

Sanitation Business Model in Practice

The multi-venue promotional strategy for latrine slab sales appears to be effective in raising awareness and soliciting customers. Households noted that they had heard about the slab and purchased the slab from a variety of sources. For slab promotion, households primarily became aware of the slab product from the manufacturer (e.g. seeing slabs curing outside or manufacturer self-promotion), the sales agent (door-to-door visits), the market (stall selling slabs as well as megaphone promotion), *kebele* leadership, from an existing slab (neighbor or family member, church), or from signage (billboards, flyers). See Figure 15 for awareness frequency among households.

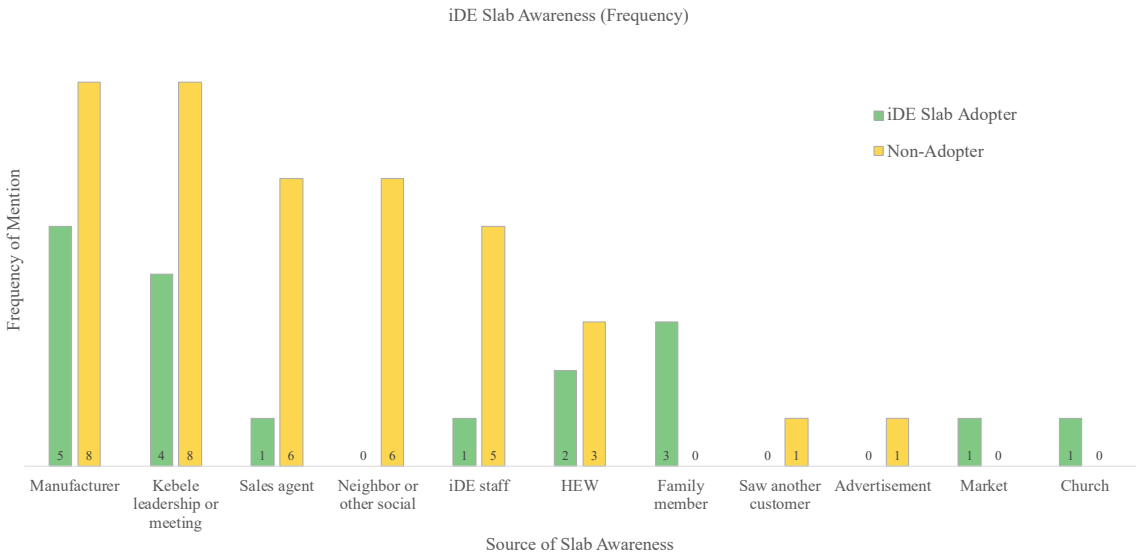


Figure 15. Awareness of iDE latrine slab among surveyed and interviewed households (frequency)

Manufacturers' locations are usually central to the *kebele*, so the slabs are visible for people in transit. Similarly, seeing slabs in churches or in the public marketplace is an effective method to build product awareness through household's regular movement and activities. The most frequent cited method(s) of awareness for customers was the slab manufacturer, a *kebele* meeting or leader, or a family member. Across surveyed and interviewed households, all but two households had heard about the slab (one surveyed and one interviewed household had not heard of the slab prior to my questions). For those households that had not purchased the slab but had heard of it, the most frequent method(s) of awareness were the slab manufacturer, *kebele* meeting or leader, sales agent, or a neighbor or friend.

Households made their slab purchase through a sales agent or directly from the manufacturer. Most slab adopters made the purchase through the sales agent, although two customers paid the manufacturer directly. When a customer orders a slab, they can

either pay the full amount up front, or pay a deposit of ETB 200 (USD 6.5) at the outset and the remaining cost upon completion. The official purchase process is for a customer to make the order through the sales agent. The sales agent collects the order and the money from the customer, and creates a receipt with the customer's personal information. The sales agent keeps one receipt, returns one carbon copy to the customer, and submits the money and a second carbon copy receipt to the manufacturer to begin the order.

Manufacturers are given extensive training and instruction for creating the concrete slab. After collecting the money from the sales agent (either an initial deposit for the full payment), the manufacturer purchases construction materials – sand, cement, rebar, and PVC. After beginning production, the slab sits for a 21-day curing period, at which point the customer collects the slab and pays the remaining fee (if applicable). After collecting the slab, a customer usually utilizes a rented donkey cart to carry the slab most of the distance to their home, combined with rolling the slab. Customers receive instructions from the manufacturer on how to dig the pit and install the latrine slab. iDE field facilitators, sales agents, and HEWs also assist with installation questions. Depending on customer preference, a household may dig the pit in advance of collecting their slab, or collect the slab first, then begin to excavate the pit. The customer installs the slab on top of a one-meter diameter pit (approximately three feet). The pit should have a 20-centimeter (approximately eight-inch) lip, onto which the slab is set. Because the slab is one meter and 20 centimeters in diameter, the lip helps the slab to sit above the pit, and reduces the possibility of pit collapse. Households can then cover the edge of the pit with additional cement or mud to further seal the slab onto the pit.

The most commonly discussed component of the sanitation marketplace was the cost of the slab. Key informants at all levels of the sanitation marketplace frequently mentioned the increased cost of the slab over time. At the start of the project, the slab cost ETB 300 (USD 10) but it has risen above ETB 450 (USD 14.5), and as high as ETB 490 (USD 16) in some places. This increased cost is attributed to a rise in the price of raw materials, primarily the cement as well as rebar used to reinforce the concrete slab. In the last three years, the cost of these materials has risen more than 100%. Selassie, a field facilitator, stated that a slab costs an average of ETB 370 (USD 12) to produce, and is sold for ETB 470 (USD 15). The ETB 100 (USD 3) profit is shared between the sales agent (ETB 30, USD 1 commission) and the manufacturer (ETB 70, USD 2). In the midst of these price increases, the iDE project identified the need for alternative financing, and has begun to implement linkages between slab customers and local microfinance institutions. This allows households that would otherwise be unable to afford the slab access to credit for sanitation investment. The microfinance loan amount is usually ETB 1,000 (USD 32), which could support the cost of the latrine slab, corrugated iron sheeting (CIS) roof, labor to dig the pit, and other beginning costs for a new latrine. The microfinance linkage is intended primarily to address the seasonal income of agricultural workers. From the HCD process, iDE learned that community members are unwilling to borrow money from family or friends. Borrowing from individual lenders in many cases includes a high interest rate (as high as 100%) and rapid repayment within a year. With the sanitation microfinance linkages, interest rates range between 10-15%. According to the sales agents in both *kebele*s, approximately half of all slab customers access the microfinance credit for the slab, and the remaining households pay in cash.

CHAPTER VI

HOUSEHOLDS, SANITATION, AND DECISION POINTS

People's decisions to invest in improving their household sanitation facilities have far-reaching impacts on individual, family, and community well-being. Improved sanitation can generate health, pride, cost-savings, and happiness at all levels in a community. Because improved sanitation is not ubiquitous in Ethiopia, families must consider sanitation investment amidst a bevy of other financial needs, including food, agricultural supplies, or medical expenses. If a smallholder farmer in Wolaita Zone makes the decision to spend a significant portion of her annual income in a new latrine, it represents a conscious choice to invest in sanitation. This chapter focuses on the reasons behind sanitation decisions – the motivators encouraging households to make investments and the barriers preventing them. The phrase "sanitation decision" is used here to refer to any number of household-level choices around personal sanitation. A household's location on the sanitation ladder (ranging from open defecation to safely managed sanitation) is dependent on choices around investment, product, and utilization. This study includes all of these types of sanitation decisions in the context of a household's decision to invest in and use a particular level of sanitation facility.

As illustrated in Figure 16, decisions along the sanitation ladder are not always linear. Rather than moving from open defecation, to unimproved, to limited, to basic, then to safely managed sanitation, a household could jump from open defecation to basic improved sanitation, or from limited sanitation to safely managed sanitation. Households could also move backward on the sanitation ladder, for example if a latrine breaks or otherwise becomes unusable. Although these two decision points are not exclusively

chronological, all households in the study population invested in unimproved sanitation before investing in basic improved sanitation.

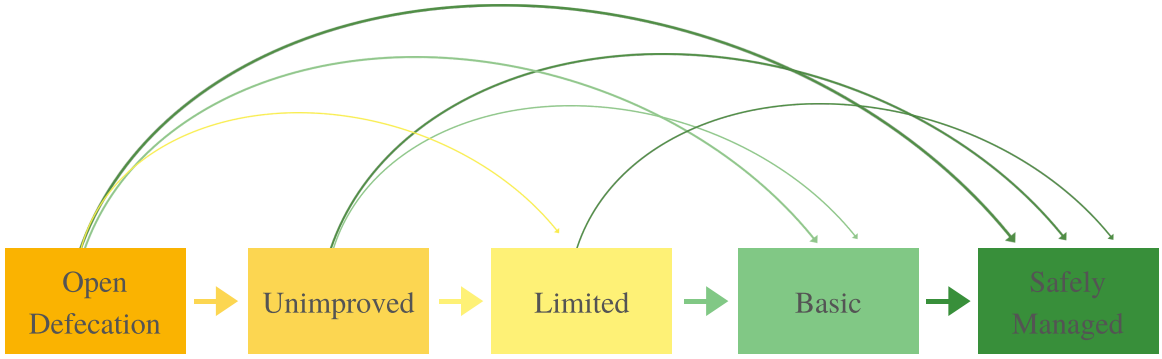


Figure 16. Movement along the sanitation ladder (sequential or non-sequential)

6.1 Factors Influencing Sanitation Decisions

The data from Wolaita Zone point to two key decision points, on which I will focus the remainder of this chapter –a household investing in unimproved sanitation, and a household investing in basic improved sanitation (see Figure 17). I frame sanitation motivators and barriers around these two decision points sequentially – first, households moving from open defecation to invest in unimproved sanitation (e.g. pit latrine without slab), and second, households moving from unimproved sanitation to invest in improved sanitation (e.g. pit latrine with slab). If a household were to invest directly in improved sanitation from open defecation, the motivators and barriers for this decision point would most likely include a combination of general factors discussed below and specific factors for investments in unimproved and improved sanitation.

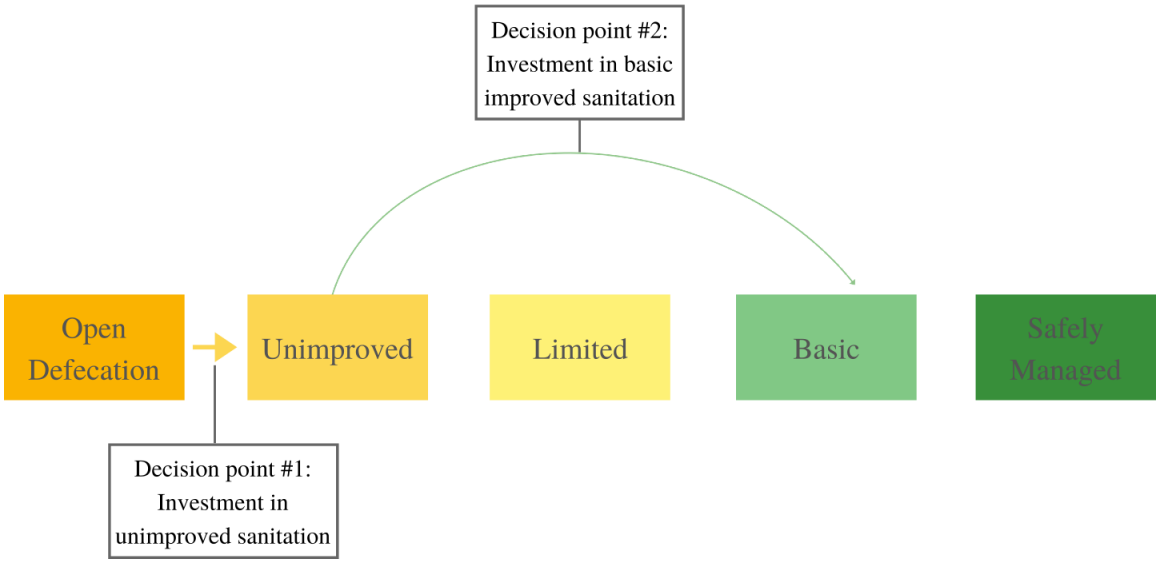


Figure 17. Sequential decision points along the sanitation ladder

Several common motivators and barriers emerged for each of the two key decision points for sanitation investment. Motivators are factors that drive, enable, or otherwise encourage a household to make a sanitation decision to move up the rungs of the sanitation ladder. Barriers are factors that hinder, discourage, or otherwise inhibit a household from a sanitation decision that could move them up the sanitation ladder. In my research, I identified eight key motivators and three important barriers that influence household sanitation decisions at both decision points. Five of the motivators and all three of the barriers apply to both decision points: 1) the decision to change from open defecation to unimproved sanitation; and 2) the decision to change from unimproved to basic improved sanitation. The remaining three motivators are specifically applicable to the further investment in improved sanitation (a latrine slab) at the second decision point. Figure 18 illustrates the motivations and barriers at each of the two decision points. Although each factor is discussed separately, most are interrelated in some way, either in their perception or due to overarching trends. For example, the household knowledge

motivator overlaps with the sanitation market and government policy motivators, and stands in contrast to the lack of awareness barrier.

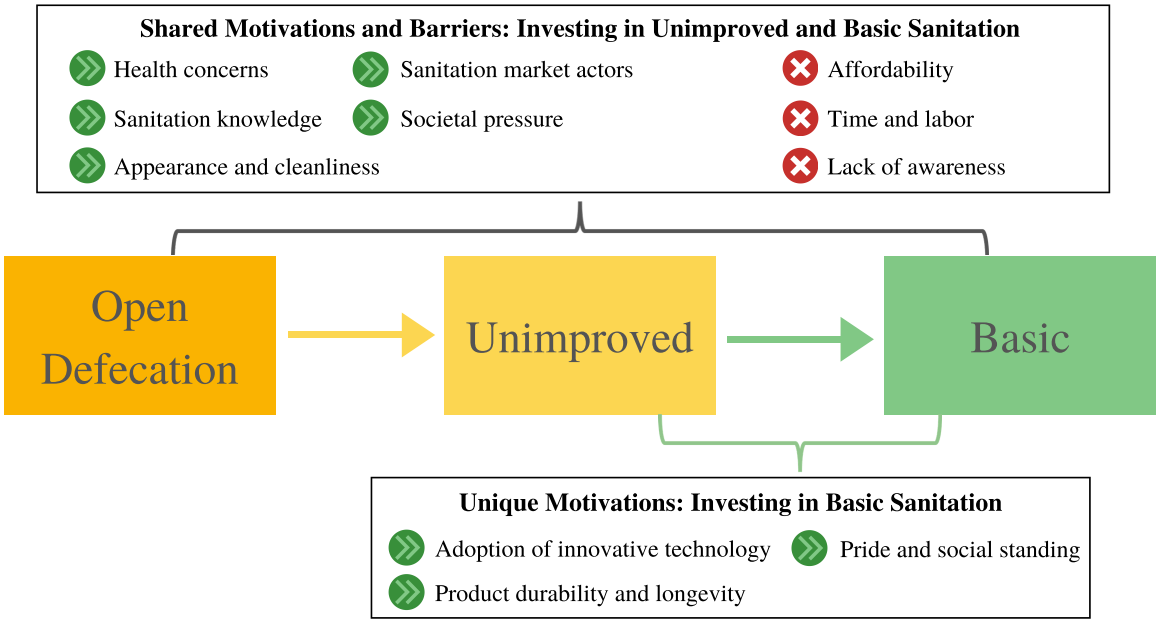


Figure 18. Model for sanitation motivations and barriers at each investment decision point

The remaining sections in this chapter will first review the five general motivators in section 6.2 – household health concerns, household sanitation knowledge, household appearance and cleanliness, sanitation market actors, and societal pressure. Section 6.3 will analyze the three motivators specific to households deciding to invest in improved sanitation – adoption of innovative technology, slab durability and longevity, and pride and social standing. Section 6.4 follows the discussion of household motivators to present findings on the general barriers – affordability, time and labor, and lack of awareness. Lastly, section 6.5 will analyze the relative importance of the motivators and barriers at each sanitation decision point. These eight motivators and three barriers emerged through the semi-structured interviews with households and household surveys. These sections

primarily use data from the 40 study households, with the addition of some relevant responses from key informants and focus group discussions.

6.2 Motivating Factors for Unimproved and Improved Sanitation

I identified five motivators that pushed study households to invest in unimproved or improved sanitation (see Figure 19). The most frequently cited motivator was health concerns, followed by sanitation knowledge, although both of these motivators were more common among households investing in unimproved sanitation. Appearance and cleanliness were mentioned equally frequently by unimproved and improved sanitation adopters. The influence of the sanitation market and societal pressure were significant motivators as well, although mentioned less frequently by households.

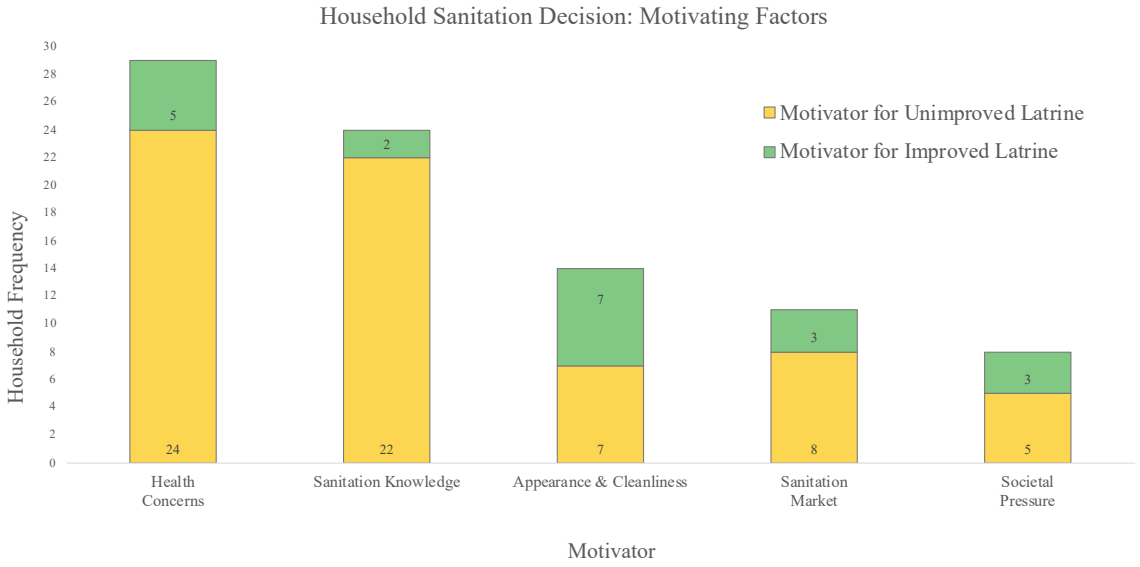


Figure 19. Motivating factors for unimproved and improved sanitation

Household Health Concerns

Improved health and decreased disease transmission were the most frequently mentioned factors for households choosing to invest in sanitation. Although five of the 12 households with improved sanitation mentioned health as a motivator, this factor was

particularly impactful for households investing in unimproved sanitation. Nearly every household with an unimproved latrine (24 of 28) mentioned health as a motivation for sanitation investment. Zeleke, a 55-year old farmer with an unimproved latrine, said "The health extension workers advised us to use the latrine. We heard about advertising of sanitation, and using the improved latrine to avoid transmission of different disease types. That's why we decided to build the current latrine." Households most frequently mentioned health motivations of diarrheal disease and general disease transmission as key reasons they chose to construct their current latrine. Zahra, a young farmer, discussed her family's reasons to invest in unimproved sanitation, "If you don't have a latrine and you defecate outside, there are flies and they sit on the feces and then they are on the children's mouths, everywhere. There is the disease transmission from flies. To avoid these issues, the traditional latrines are important."

Zahra and most other respondents did not specify the disease transmitted, or the health benefits from sanitation. Some, like Aster, a widowed farmer, spoke about specific diseases prevention from sanitation, "We started to build our latrine to avoid the transmission of different diseases, for example diarrhea." The lack of disease and health specificity may be due to translation from Wolaitigna language to English. Because I worked with an interpreter for simultaneous Wolaitigna-English translation during interviews, some Wolaitigna specificity in words may not have had an exact translation to English, or may have been condensed in translation. Given the prevalence of sanitation-related diseases in Wolaita discussed in Chapter II section 2.1, I approximate that motivations of "health" or "preventing disease transmission" include diarrheal disease, intestinal parasites, and child malnutrition. However, as demonstrated by Langwick's

(2007) experiences with *degedege* and malaria misunderstandings due to translation between Swahili and English, and Giles-Vernick, Traoré and Sirima's (2011) discussion of explanations for "cold fever" illness mistranslation of malaria, these approximate translations may omit or distort nuance in disease etiology and perceptions. In Konso District, an area within the Southern Nations, Nationalities, and Peoples' Region but southwest from Wolaita Zone, illness interpretation and disease causation beliefs are similarly varied and reflect complex differences and interactions between local and biomedical health systems (Workneh et al., 2018).

My discussions with key informants further cemented the importance of health messaging for households. The core messages HEWs and others in the sanitation market convey to households center on the health risks from open defecation and the importance of sanitation to eliminate those risks, because they are effective. Fantaye, a HEW, noted that "The health part is the most powerful message, about the transmission of disease with unimproved latrine. When we start to talk like this, immediately [households] are listening." This motivator is slightly varied for households deciding to invest in unimproved or improved sanitation. For households investing in unimproved sanitation, the health messaging is centered around the negative health outcomes of open defecation, and the benefits of safer excreta disposal. For households investing in improved sanitation, health messages are framed around the increased health protection from a slab – namely reducing flies and further reducing disease transmission.

Household Sanitation Knowledge

Participant households (both interviewed and surveyed) demonstrated high levels of knowledge around sanitation and hygiene behaviors and benefits. This knowledge was

not necessarily linked to health benefits of sanitation and hygiene, but rather centered around the essential nature of WASH and the fundamental importance of sanitation. Data from households revealed that families valued eliminating open defecation. Slightly more than half of surveyed households mentioned the avoidance of open defecation or the essential quality of a latrine, unprompted, as their reason to install a latrine. Zahra, an interviewee with an unimproved latrine, recalled why her household installed their current latrine: "The health extension workers and the *kebele* chairmen, they taught us about the utilization of latrines, the importance of latrines. We heard from them, then we started to dig the pit […] We heard about the latrine importance and that's why we started to dig." Households that mentioned this motivator may have separately discussed the health benefits of sanitation, but the discussion of sanitation knowledge and the importance of latrines is more accurately associated with the human right to sanitation and the inherently critical nature of latrine ownership. Household knowledge in part stems from the household's sanitation value and desire to own a latrine (whether unimproved or improved), and is further increased by communications from government HEWs and HDAs as well as iDE staff.

The Government of Ethiopia's One WASH National Programme (OWNP) includes national access to improved human excreta removal as a key component (National WaSH Steering Committee, 2018). The program's onset in 2013 consolidated WASH messaging, data collection, and reporting and increased national focus on WASH and sanitation coverage. An initial push from the OWNP was to eliminate open defecation in *kebeles*. This resulted in a widespread communication campaign to spread messaging about the dangers of open defecation. Government approval and emphasis was

placed on individuals and *kebeles* achieving open defecation-free status. Much of the sanitation information that households remembered during interviews and surveys was aligned with this focus – open defecation should be avoided, and sanitation facilities (at any level) were the goal. While the government messaging focused on eliminating open defecation, initial campaigns did not include a dual focus on improved sanitation. Rather, the emphasis on open defecation-free pushed many households to construct a latrine using materials on hand, resulting in a plethora of traditional "DIY" latrines to replace open defecation. These unimproved latrines were called "traditional latrines" by respondents. The term "traditional" refers to the materials for latrine construction, most commonly wooden poles or plastered mud to cover the pit in lieu of a slab.

In addition to repeated mention of eliminating open defecation and the importance of sanitation among all households, surveyed households expressed high levels of hygiene knowledge. All 20 surveyed households identified at least three of the four critical handwashing times (after defecation or cleaning a child, before contact with food, after working outside, after working with animals), as defined by the WHO (World Health Organization, 2014). This high level of sanitation and hygiene knowledge at the household level implies that health worker communications are permeating communities, and that a lack of general sanitation knowledge is not preventing households making latrine investments. It is important to restate that all interview and survey households used unimproved or basic latrines. Although I attempted to interview household that used open defecation, I did not purposively select non-adopter households, and by happenstance all non-adopter households used unimproved latrines. Therefore, the high level of household sanitation knowledge may be confounded by the obvious information

the households received in building their respective latrines. Similarly, households with improved latrines may have existing high levels of knowledge which prompted them to further invest in the higher standard of latrine facility.

Household Appearance and Cleanliness

Households in the two villages were kept clean, and household members sweeping the home or the packed dirt in front of the doorway was a common sight while walking through a *kebele*. Many households planted herbs and small potted plants at the front of the house and near the path to the latrine. Planting herbs can also be attributed to the emphasis on cleanliness and eliminating "bad smells" from the latrine area. Households with and without the latrine slab frequently cited increased cleanliness and better smelling defecation area as reasons to invest in their latrine. While unimproved traditional latrines can be cleaned, the improved latrine's concrete slab increases the ease of cleaning. Aster, a 60-year old widow, detailed the process for cleaning her latrine:

> The traditional latrine, in the current situation, we can clean it depending on the material. It is covered by plastic sheets so we can clean it easily. But my plan for the future (because the one we have now smells) is that I want to plant good smelling herbs around the latrine because I don't want the bad smell in the latrine area. I have plans to plant spices to cover the smell. But for cleaning, my system is that I cover by different materials, then I remove them and I can clean.

In contrast to the unimproved latrine, the slab can be washed and swept without damaging or weakening the structure. Taddese, a slab customer, remembered, "Previously, the traditional latrine we had, we couldn't wash it easily. But now, this is easy to wash and clean. It's easy, that's why I decided to purchase this slab." With the traditional latrine, water weakens the wooden poles and can erode the mud covering the pit, so households typically will sweep the latrine without washing, or change out materials (plastic sheets or *enset* leaves) on the floor of the latrine.

Sanitation Market Actors

The growing sanitation market in the region is an important method for delivering sanitation information and resources that serve to motivate households. In Damot Pulasa, the integrated market for latrine slabs consists of iDE field facilitators, iDE sales agents, iDE slab manufactures, iDE office staff, HEWs, and HDA members. These individuals are exceptionally competent in their work, and are dedicated to the health of their communities. They contribute to the vast majority of health and sanitation messaging received by households and community members that drives interest in sanitation improvement. The repeat contact of households with sanitation market actors serves as continued nudges for sanitation investment. Households might interact with HEWs when they visit the *kebele* clinic for other health events or issues, and would receive information and prompting about sanitation investment. Similarly, iDE staff promoting the slab latrine shared information at the market and going house to house. Additional members in the sanitation market include *kebele* chairs and local government leaders, as well as religious leaders. These leaders frequently promote sanitation improvement at town meetings and religious services, and can be seen in the sanitation market as secondary promoters who work with the aforementioned key informants.

More than half (70%) the members of the sanitation market in this study articulated a sense of pride in their community and their job, unprompted. Genet, a sales agent, said she was "interested in this activity first, then I became employed […] the community's life changed starting from the production in the *kebele*. Now, everybody has an improved latrine and utilization of a proper latrine. Before, latrines filled up and collapsed everywhere, and open defecation was a problem." The commitment and

creativity of the sanitation market actors in furthering sanitation within their communities is critical to facilitate the communications and messaging that motivate households.

Societal Pressure

Societal pressures act as a motivator for unimproved and improved latrine investment. As previously discussed, *kebele* leadership are involved in promoting improved sanitation. Key informants mentioned chairmen in both *kebele*s exerting pressures on households to invest in sanitation (both those without latrines, and those using unimproved latrines). Similarly, in Zamine Wulisho, which has not yet reached the open defecation-free status, men's groups will tactically socially distance themselves from participants using open defecation, as a social pressure mechanism to encourage sanitation practices (e.g. installing an unimproved latrine and ceasing open defecation). As I learned from conversations with HDA focus groups, this tactic is not intended to create pariahs, but rather to embed sanitation as a social norm and put pressure on male household heads to prioritize sanitation. Taddese, a 40-year old merchant and businessman, explained the influence of social norms on his decision to purchase the slab: "Now everybody is coming to improvement. At the town area, most households decided to use this improved latrine everywhere. So why wouldn't we decide this also?" In both *kebeles*, households and key informants were proud of the strides their communities were making in improving sanitation. This sense of community engagement and group effort extends to the public latrines found along roads. These latrines are communally constructed and cared for, and are open for community members and visitors to use.

6.3 Motivating Factors for Improved Sanitation

In addition to the general motivations discussed above, three new motivators emerged from my data that are specific to households investing in improved sanitation (see Figure 20). Adoption of innovative technology and slab durability and longevity were the two most powerful motivators pushing households to invest in improved sanitation. Additionally, pride and social standing encouraged households to move up the rungs of the sanitation ladder.

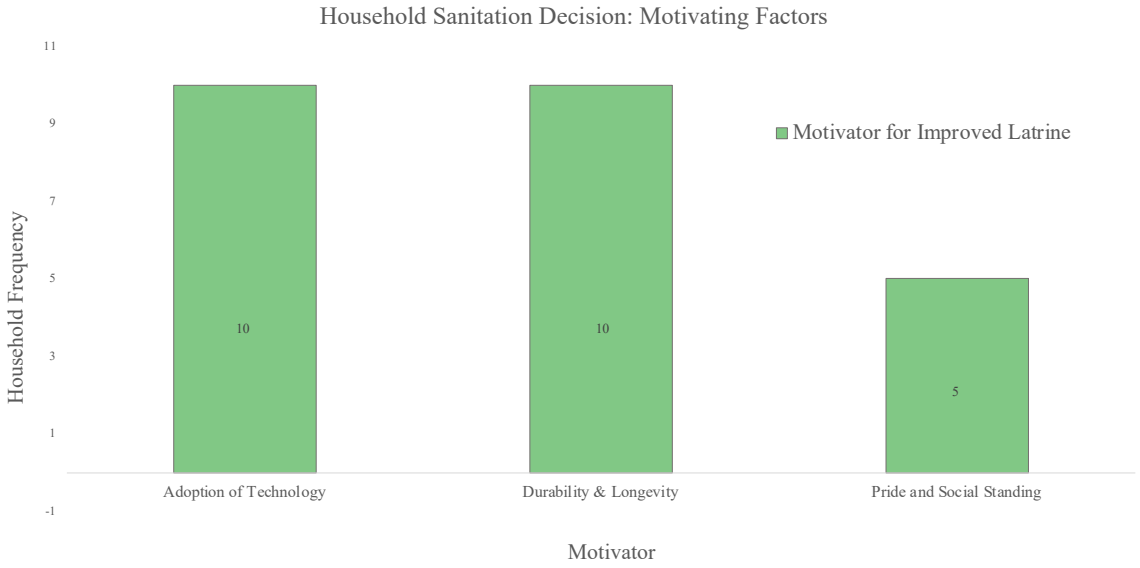


Figure 20. Additional motivating factors for improved sanitation

Adoption of Innovative Technology

Of the 12 households with an improved latrine, 10 specifically mentioned that the desire to adopt new and modern technology motivated them to invest in the slab. Yared, a household head who had purchased the slab, relayed to his community: "The [slab] technology is now new, please purchase now. We don't know the future, so people should purchase right now because it might not be available in the future." Households frequently used the terms "modern" and "technology" in reference to the slab, indicating

the people view “modern” goods as desirable and perceive purchasing the iDE slab as a way to partake in that modernity. This view also stands in contrast to the “traditional” label for unimproved latrine materials, where the slabs are a method of modernization. Meseret, a 60-year old farmer with an improved latrine, described her latrine, “The technology is preferable and we accepted the new technology. That’s why I decided to purchase the slab, because it is better than the previous latrine […] this is the best modern one!” This equivalency between the slab and newness, technological innovation, and modernity feed household’s desire to make advancements in their products and adopt the technology.

All but two households indicated they had heard about the iDE slab, regardless of whether or not they had purchased it. Households that had heard about the slab included 19 of the 20 households identified through iDE records as well as 19 of the 20 randomly selected survey households. One interviewed household with an unimproved latrine had not heard about the iDE slab, neither had one surveyed household with an unimproved latrine. To check that the 26 households with unimproved latrines did in fact remember the latrine, I asked what they recalled of this improved latrine. The most frequent response focused on specific design features of the latrine. These features included the ventilation pipe, the cover for the hole, the circular shape, the sturdy construction, ease of use and cleaning, and the association of the slab with innovative technology. These components serve practical purposes. For example, the round shape allows adopters to transport the slab by rolling, and also fits neatly atop a circular pit. The newness of these features also lends an appearance of desirable technological advancement to the slab, which motivates early adopters to have the most innovative technology in their home. Six

of the nine interviewed households that currently used an unimproved latrine and who had heard about the slab stated they intended to purchase the slab in the future. Two of the six said they were motivated by the adoption of innovative technology to make a plan for slab investment.

Slab Durability and Longevity

The slab is manufactured with concrete, so it is exceptionally heavy and durable. The slabs are intended to last for at least seven years, and there have been no reports of the slab breaking or collapsing. As evidence of the slab's longevity, concrete rectangular slabs provided by an NGO 10 years ago are still in use in *kebeles*. Because of this durability, when a household's latrine pit is full, the slab can be picked up and moved from the original location to a newly dug pit, and reused. This feature was frequently cited by health workers and adopters as a way to offset the cost of a slab. With most unimproved latrines, wooden poles span the top of the pit. These poles need to be replaced each time a new pit is dug, because they become weak and bowed, as well as dirty. Depending on the depth of the pit and the width of the poles, a household would need to purchase new poles approximately every three years or sooner. Hailu, a slab adopter, recalls: "Before, I had two latrines. Two pits that collapsed. I was always hearing about the slab and I was interested to get the slab.. […] 10 or 15 years ago, government workers were promoting a slab, but it was a rectangular shaped slab. Some households got that slab 10 or 15 years ago, and they are still using that slab now!" These long-term cost-savings and reusability of the slab are a desirable feature for slab purchasers.

Additionally, many adopter households referenced the slab's weight as symbolic of its strength and durability. As Ifaa, an iDE employee, recalled from the HCD process,

"We found that people like concrete the most. People love something heavy because they think it is strong." Households that had experienced previous collapses with wooden poles or had concerns about children's safety were especially motivated by the slab's weight and stability. Mekonnen, a farmer who had purchased the slab one month prior, remembered: "Always, when we purchased the poles to cover the traditional latrine, there was not a long duration. But with the slab, there is a long duration. Also, it's safe to use for the children. The duration is very attractive, […] it is reusable, it does not collapse." For Mekonnen and other households, the dual motivations of the slab's durability and longevity serve as guarantees of safety, stability, reusability, and cost-savings. Similar to the innovative technology motivator, of the six interviewed households that had heard of the slab and indicated an intent to purchase in the future, two mentioned the durability and longevity motivator. For these households, the slab's strong construction, safety, and reusability provided a key motivation for their future plan to invest in improved sanitation.

Pride and Social Standing

In the Wolaita Zone, households are exquisitely decorated, and great care is taken with colorful painting, designs, and upkeep for a home. A home's decoration and appearance convey a sense of pride, and are associated with a household's identity and status. In keeping with this, improved latrines are bundled into the home's influence on social standing and pride. Meseret, a widowed farmer and head of her household, stated, "I feel proud, because I improved the latrine. I have confidence to show any guests my latrine." This sentiment was expressed by other households with the slab as well, where the improved latrine stoked pride and indicated their social standing. One household

purchased the latrine slab after guests visited the home, and remarked that the current unimproved latrine was not appropriate for the head of household's high status in the community. Hailu, the head of household, subsequently purchased the slab to improve the latrine as befit his social standing. Households with an improved latrine also gained social standing by advising and commenting to other households about their sanitation facility. For example, Taddese, a businessman and merchant, said, "I gave [other households] advice, even some neighbors have installed [the slab] on the household level." While quotes like "We have called our neighbors to come and visit our latrine" from Tesfaye, a teacher, could indicate a sense of moral or social superiority, I believe this sentiment is more closely aligned with slab households assuming a position of leadership and guidance for neighbors without slabs.

Of the six interviewed households without the latrine slab who indicated their desire to purchase the slab in the future, one mentioned the connection to status and pride as the motivation for the future purchase. Households that had already installed the latrine slab mentioned future aspirational improvements to further increase the prestige of their latrine. These future projects included increasing the size of the latrine structure, installing a second latrine with slab for children or elderly household members, installing a shower stall adjacent to the latrine, or planting "pleasant smelling herbs" near to the latrine.

6.4 Barrier Factors for Unimproved and Improved Sanitation

Three general barriers emerged from this research (see Figure 21). These barriers apply to households at either decision point, but certain barriers may be more applicable to a particular decision point (e.g. cost is a more pressing barrier for improved sanitation

investment). This section presents the three key barriers for household sanitation investment – financial burden and affordability, time and labor, and lack of awareness.

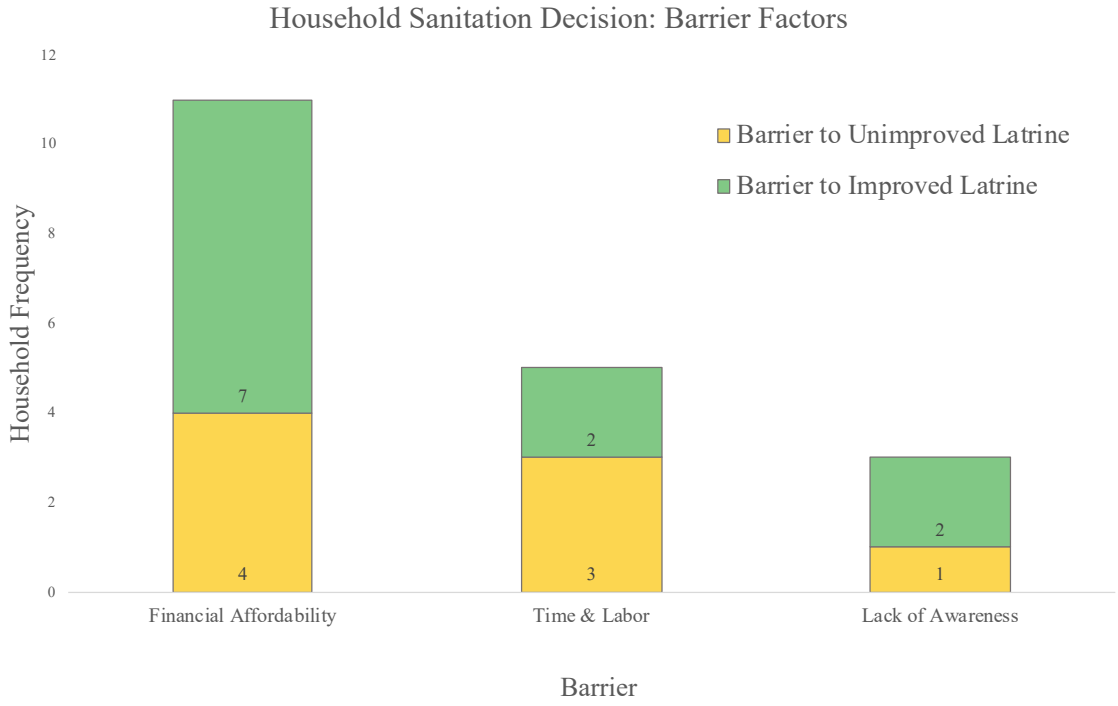


Figure 21. Barrier factors for household sanitation decisions

Financial Burden and Affordability

Cost is the most important barrier for all levels of sanitation investment. Even with any number of motivators, households are unable to invest in something for which they lack financial capacity. An unimproved latrine cost ETB 279 (USD 9) on average, and a basic improved latrine with slab cost ETB 1,011 (USD 32.5) on average. As part of the latrine investment, a household may need to purchase CIS as roofing, plastic sheeting or other material to cover walls or doorway, a day laborer to dig a pit or construct the latrine structure, wooden poles to cover the pit, or a slab to cover the pit. The three most expensive items are the CIS, labor, and the latrine slab (see Table 10). Although the cost for sanitation varied across study households, for most *kebele* households, even the

average cost of ETB 279 (USD 9) to build an unimproved latrine is a substantial expenditure. Given that average annual household expenditures in Wolaita Zone are ETB 10,122 (USD 326.5) per household, the average cost of an unimproved latrine amounts to 2.8% of a household's annual budget and the average cost of an improved latrine makes up 10% of an average Wolaita Zone household's expenses (Federal Democratic Republic of Ethiopia, Central Statistical Agency, 2018).

Table 11. Average costs of major latrine expenses and average total latrine cost

Item	Cost (ETB)	Cost (USD)
Corrugated iron sheeting	400	13
Day laborer	320	10
Latrine slab (2018)	380	12
Latrine slab (2019)	460	15
Average total cost of unimproved latrine	279	9
Average total cost of improved latrine	1,011	32.5

Because the latrine slab is a substantial additional cost for any household, cost is a greater barrier for households potentially making the shift to improved latrine. Zahra, a farmer with a traditional latrine, reiterated "The limitation of the money is the main challenge for us. We have seen [the slab] at our neighbors. We want to purchase it, but we have the limitation of money." For the 10 interviewed households without an improved latrine, seven (70%) stated that the lack of money was the barrier to purchasing a slab and achieving improved latrine status. For households with unimproved sanitation, four of the 10 households (40%) indicated that cost had initially been a barrier for installing their traditional latrine, but they had overcome that barrier or installed a "DIY" latrine at no cost.

The vast majority of household income in Wolaita Zone comes from smallholder farming. Approximately 83% of study households earned their income from the head of

household farming. Seasonal agricultural work results in uncertain financial futures, as well as many competing expenses when income arrives. During key informant interviews, sanitation market actors also identified affordability as the main barrier for households that would otherwise invest in an improved latrine. Tamrat, an iDE field facilitator, explained the additional influence of the agricultural cycle:

> The challenge is that in the rural area, farmers depend on agriculture, and agriculture is a seasonal activity. During production season they buy products [like seeds] so there is a shortage of money to buy the slab. In cropping season every interested farmer is ready to use this latrine but in the cropping season they don't have enough money to buy the slab [because they are waiting to sell their crops].

The seasonal income and objectively high upfront cost of the slab combine to render the improved latrine unaffordable to many households without savings, loans, or increased income.

An additional complication is the increasing cost of the concrete slab, due to raised prices for raw materials (namely cement and rebar). Although iDE is actively exploring alternative materials to reduce the cost without reducing the slab's durability, many key informants expressed that potential customers do not understand why the slab price has increased. This impediment was also raised in both HDA focus groups. Said one HDA:

> We promote the slab well in the community, but the community is complaining. They raise the issue of financial issues and limitations. Some people say, 'please reduce the cost of the slab'. But we try to promote and clarify about the material cost and about the slab [increases in price]. But still there are questions from the community. We try to promote the microfinance linkage, but some in the community are fearful of the loans. So, we try to promote and push the community still.

As expanded on in Chapter V section 5.2, the microfinance linkage mentioned by this HDA is a recent initiative, where households can take out a microfinance loan through

one of several partner organizations, and use it to purchase the slab and other materials for constructing an improved latrine. However, perceptions of the loans and severity of punishment for lack of payment left most households with a negative opinion of the loan process. The cement slab comprises approximately half of an average Wolaita household's monthly expenses, and with the 10-15% interest rate for microfinance loans, this remains a substantial expenditure.

Given the aforementioned strong motivations of health, sanitation knowledge, societal pressure, and appearance, households with limited income prioritize building a traditional latrine. However, the expenses for roofing and other materials are still substantial. Therefore, many households that build an unimproved latrine only invest the essentials at first (pit, wooden poles and/or mud covering for the pit, basic structure around the latrine). This allows the household to achieve individual open defecation-free status, while conserving money. Progressive sanitation improvements were a common theme among all households, including those who had purchased the slab. Essential components (the latrine pit and traditional or slab covering) were completed first, followed by secondary aspects such as walls and roof, then additional customizations such as wooden door, improved roof or walls, secondary structures or other features.

Time and Labor

In addition to cost, building a latrine requires significant time and mental investment from a household. Usually, this takes the form of physical labor from the household members to dig the pit, construct the latrine, or both. In cases where a household member is not able to physically assist with latrine construction, a day laborer will be paid to dig the pit and potentially construct the latrine walls or roof as well. Even

if a household has a day laborer or community assistant to construct the latrine, they still invest time to finish the latrine and shift their practice to the new sanitation facility. Mimi, the adult daughter of the household head, stated that her mother "heard about [the slab] and wants to purchase it in the future. But we have been busy. I think she might have talked with the sales agent and plans to give an order soon." In this case, and for other households that have an interest to purchase the slab in the future, the time and labor to place the order and plan the slab installation served as a barrier to investment. Similarly, three of the 10 households with unimproved sanitation mentioned that the time and labor to install their traditional latrine inhibited their investment in unimproved sanitation at first. Especially for "DIY" or no cost latrines, households must invest significant time and sweat to dig the pit and construct the traditional latrine.

Lack of Awareness

Because all the interviewed and surveyed households had some sanitation facility, it is difficult to determine the extent of unawareness or resistance to sanitation in the community. Key informant interviews primarily focused on financial barriers to sanitation, but several sales agents and HEWs mentioned needing to increase the scope of outreach to families currently using open defecation who had not been reached by sanitation messaging or who were reluctant to "accept" these messages. This may be related to the capacity of sales agents in a *kebele* – at the time of research, there were only three sales agents and one manufacturer per village. Although Damot Pulasa census information is not publicly available, I was told by HEWs that Galcha Suke had a population of 7,720 and Zamine Wulisho's population was 6,328. Given this size, it may be difficult for these staff to completely reach all households to raise awareness across

the entire *kebele*. Yohanna, a sales agent, described barriers to slab promotion, such as the "awareness problem, like they don't immediately accept the improved latrine. Some [people] immediately understand, but these kinds of barriers can be called awareness." One interviewed household specifically mentioned the lack of awareness as an initial barrier to moving from open defecation to their current traditional latrine. As mentioned previously, two of the households had not heard of the iDE slab during the interview and survey. For these households, the lack of awareness for the produce served as a barrier. Without knowledge of the product, investment in improved sanitation through the iDE slab is not possible.

6.5 Factor Importance

In discussing these factors, the logical concluding step is to determine which of the motivators and barriers are the most important at each decision point. If the goal of the Government of Ethiopia and global health actors is to achieve universal improved sanitation, then the goal is to nudge households up the rungs of the sanitation ladder. Although the end-goal is for all households to arrive at improved sanitation, the incremental progression up the rungs of the sanitation ladder is still progress – and, judging from the results of this study, these are necessary intermediate steps for most households. Based on interviews and survey results, households incrementally improve their sanitation facility when they are financially able to do so. All survey households were asked about their current latrine in relation to their previous sanitation method, and all respondents stated the current latrine was better. The smaller movement on the sanitation ladder (from open defecation to unimproved sanitation, and from unimproved sanitation to basic improved sanitation) may not always be viewed as sanitation progress

in official reporting, but is indicative of household investment and validation of sanitation improvement.

I focused on analyzing two decision points along this progression from open defecation to improved sanitation facilities: the decision for a household to install an unimproved latrine after using open defecation, and the decision to use an improved latrine after using an unimproved latrine. To that end, the above insights for Damot Pulasa *kebele*s can be extrapolated for these two intermediate steps in the *kebele*s. In general, health was the most effective sanitation motivator for upward movement on the sanitation ladder. As discussed in section 6.1, both households and sanitation promoters identified health as the primary factor that led a household to invest in a sanitation facility, but this factor was stronger for households investing in unimproved sanitation. Overall, cost was the most powerful barrier preventing a household from sanitation investment. Given limited finances and seasonal income, the cost associated with sanitation investment is a large hurdle to overcome.

Sanitation market actors can use the general motivators and barriers and the additional motivators for investment in improved sanitation identified through this research to inform promotional strategies and address barriers. The model created from my research (see Figure 22) visualizes these factors that advance or restrict household's desire and ability to invest in a latrine.

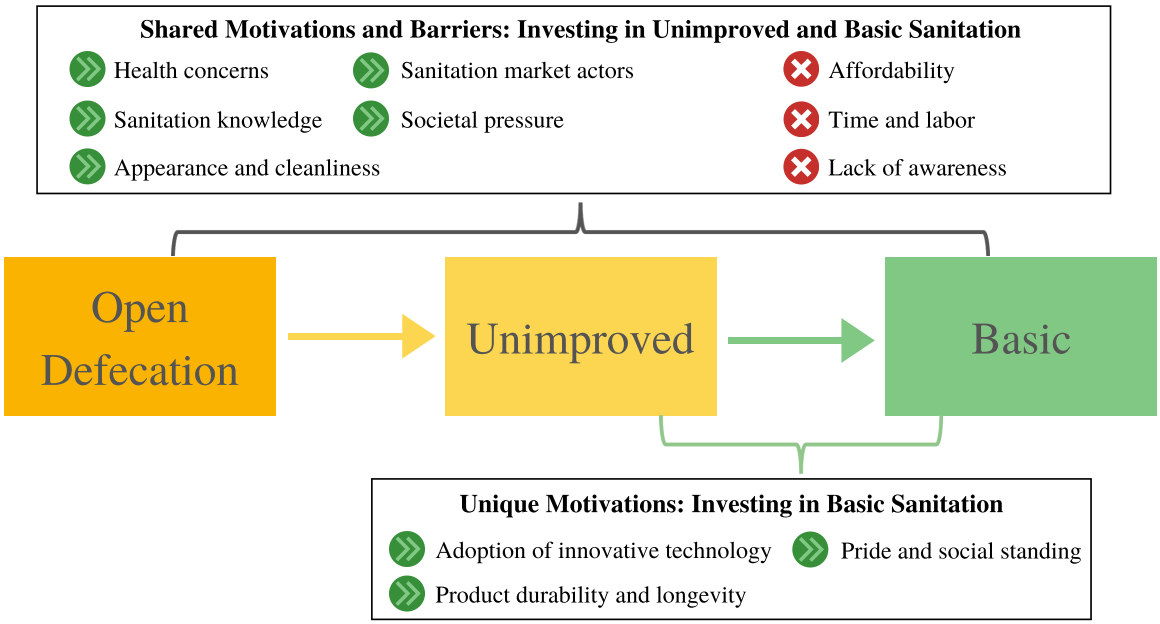


Figure 22. Model for sanitation motivations and barriers at each investment decision point

Factors for Unimproved Sanitation

For households moving from open defecation to unimproved sanitation, health is the most compelling motivator, closely followed by (and related to) sanitation knowledge. The largest barrier for household investment in unimproved sanitation is estimated to be a lack of awareness. See Figure 23 for the frequencies of each factor that motivated or barred household investment in unimproved sanitation.

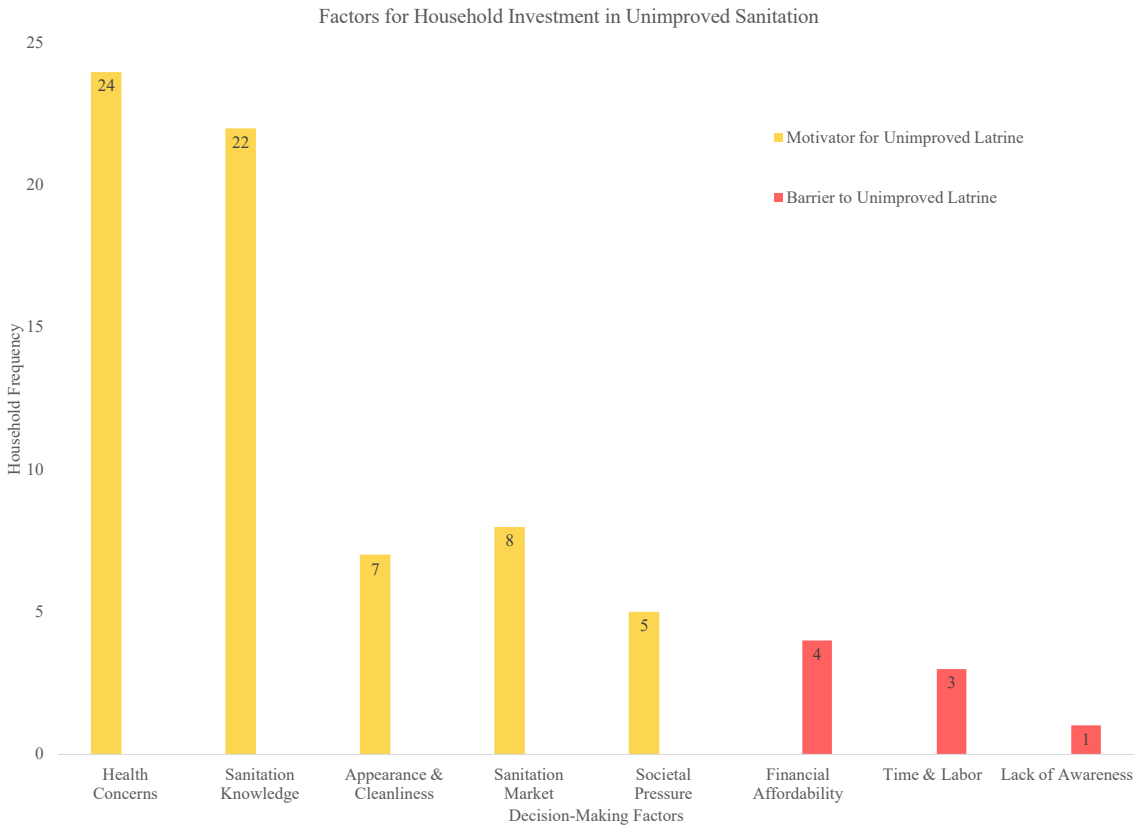


Figure 23. Factors for household investment in unimproved sanitation

Due to the strong messaging from the Government of Ethiopia and at the *kebele* level, avoiding open defecation is perceived as paramount by households. The negative health outcomes associated with open defecation (e.g. diarrheal disease, parasites, infant illness) are frequently publicized and internalized by households. Therefore, building an unimproved latrine is identified as a necessity for households, both to improve their health and to adhere to the sanitation messaging and government priorities. Because the sample population did not ultimately include any households currently practicing open defecation, it is difficult to conclude the most important barrier that may keep those households from investing in unimproved sanitation. Health workers and others promoting sanitation in the *kebele*s identified lack of knowledge or awareness as the obstacle to unimproved sanitation. As so many households constructed "DIY" latrines

which incurred limited or no cost, finances are likely not as important a barrier to unimproved sanitation.

Factors for Improved Sanitation

The slab itself (and associated features) was the most compelling motivator for households moving from unimproved sanitation to improved sanitation, as it was perceived as new and modern technology. As may be expected, cost is the largest barrier for households deciding to invest in improved sanitation. See Figure 24 for frequency of factors that influenced household investment in improved sanitation.

Figure 24. Factors for household investment in improved sanitation

If avoiding open defecation and the associated unimproved latrine is seen as a necessity for households, the improved latrine slab is seen as a commodity. Because households have received such strong messaging around open defecation and the health risks associated with the practice, they also perceived unimproved latrines as resolving most of the health issues. Health messaging is still an important motivator for the latrine slab, as the washable slab, drop-hole cover, and concrete structure do add health benefits.

However, health is not the most urgent issue in the minds of households with an unimproved latrine. Rather, households are motivated by the novel slab features themselves, including the concrete construction, vent pipe, durability, and reusability that are not available with an unimproved latrine. The same slab features that families see as desirable were included based on the HCD process. The durable material, vent pipe, and circular shape were all created from the participatory design process. Although the concrete slab provides cost savings in the long run (both through its reusability and potential healthcare cost savings), it does amount to half a household's average monthly expenses. Put simply, to warrant the significant upfront cost of a latrine slab, a household wants to feel that they receive further benefits, in addition to improved health.

Despite the substantial cost barriers to improved sanitation, the latrine slab is a desirable product for households that can be affordable with saving, longer-term payments, or microfinance loans. The improved latrine slab meets the practical sanitation needs of reducing human contact with fecal matter and is a durable product. In addition, the HCD approach to the slab's creation contributed to making the product itself and the purchase process closely aligned with customer aspirations (social standing, household improvements) and able to address challenges with unimproved sanitation (smell, ease of cleaning, frequent replacement of wooden poles). With broader advertisement and awareness of the improved slab latrine, and further development of creative financing solutions, the slab product can become a more attractive and reasonable purchase, leading to widespread installation at the household level.

CHAPTER VII

HOUSEHOLD LATRINE PERCEPTIONS AND EXPERIENCE

Once a household decides to invest in unimproved or improved sanitation, it is equally vital to consider customers' feedback. Through an exploration of household latrine experiences, I found areas of satisfaction with the latrine product, challenges to improve upon, and seemingly innocuous design features that made all the difference in latrine functionality. Increased understanding of sanitation satisfaction can help ensure continued household investment in sanitation over time, and determine new ways to support households. If universal improved sanitation is the objective within the Sustainable Development Goals and national priorities, latrine perceptions and experience are critical to increasing and sustaining sanitation adoption. A family who invested in improved sanitation needs to be fully satisfied with their latrine so that they use it consistently. A family who has an unimproved latrine needs to be dissatisfied with their current sanitation (and confident that an improved latrine will solve their existing challenges) in order to move up the sanitation ladder to improved sanitation. The results presented below provide a holistic view of the household experience with latrines and degree of satisfaction. The results I describe in this chapter derive primarily from household interviews and surveys.

7.1 Household Latrine Feedback

As Hailu reflected on his slab latrine, he reported his household's level of satisfaction as: "very, very satisfied! We are happy. You can see the latrine. When you enter, we can even sit in front of the latrine and drink coffee. It is clean, no one can smell a bad smell." Meseret purchased her latrine slab in the past year, and reported high levels

of satisfaction, even comparing the cleanliness to that of a bed: "It doesn't even seem like a latrine! It's like a bed. Everybody can come and sleep, it's so clean and attractive. What can I say – I don't have words to explain!" Hailu and Meseret's enthusiasm was matched by many other slab customers. I was surprised by how effusively people praised their latrine. People were pleased to discuss their latrine, offer comments on the portions that are most satisfactory for them, and spread the word about their latrine to neighbors. Household readiness to provide feedback on their latrine is further evidence of the amount of thought and mental investment in the sanitation facility.

Overall, household latrine satisfaction differed by *kebele* and latrine category. In Galcha Suke, 14 of the 20 households reported positive levels of satisfaction, while in Zamine Wulisho, nine of the 20 households reported satisfaction with their latrine. Among the 12 households with slab latrines, 11 (92%) reported satisfaction, where the only non-satisfied household had received the free rectangular slab years ago. The 28 households with an unimproved latrine reported mixed levels of satisfaction, with 43% satisfied, 39% dissatisfied, and 18% ambivalent (e.g. the latrine functions, but isn't feasible long term). See Table 11 for full household satisfaction data.

Measures of Latrine Satisfaction and Functionality

Due to the nature of the latrine's primary function, cleaning the latrine is an important and regular chore for most households. Depending on the type of latrine, people swept, washed, or changed the floor covering of their latrine. The concrete surface of the improved slab latrine makes washing and cleaning a much simpler job. Taddese stated that the slab latrine's ease of cleaning was an important factor influencing his satisfaction: "Previously, the traditional latrine we had, we couldn't wash it easily.

Table 12. Household degrees of satisfaction with current sanitation facility

Theme	Improved	Unimproved	Total
Satisfied with latrine	Satisfied: 11 (92%) Dissatisfied: 0 Neutral: 1 (8%) *n=12*	Satisfied: 12 (43%) Dissatisfied: 11 (39%) Neutral: 5 (18%) *n=28*	Satisfied: 23 (57.5%) Dissatisfied: 11 (27.5%) Neutral: 6 (15%) *n=40*
Meets household needs	Yes: 2 (100%) No: 0 *n=2*	Yes: 12 (67%) No: 6 (33%) *n=18*	Yes: 14 (70%) No: 6 (30%) *n=20*
Problems with latrine	Yes: 0 No: 11 (100%) *n=11*	Yes: 4 (17%) No: 19 (83%) *n=23*	Yes: 4 (12%) No: 30 (88%) *n=34*
Easy to clean	Yes: 10 (100%) No: 0 *n=10*	Yes: 16 (73%) No: 6 (27%) *n=22*	Yes: 26 (81%) No: 6 (19%) *n=32*
Comfortable for all	Yes: 9 (100%) No: 0 *n=9*	Yes: 17 (71%) No: 7 (29%) *n=24*	Yes: 26 (79%) No: 7 (21%) *n=33*
Safety	Yes: 9 (100%) No: 0 *n=9*	Yes: 17 (74%) No: 6 (26%) *n=23*	Yes: 26 (81%) No: 6 (19%) *n=32*
Privacy	Yes: 9 (100%) No: 0 *n=9*	Yes: 17 (74%) No: 6 (26%) *n=23*	Yes: 26 (81%) No: 6 (19%) *n=32*
Pride in latrine	Yes: 6 (100%) No: 0 *n=6*	Yes: 10 (56%) No: 8 (44%) *n=18*	Yes: 16 (67%) No: 8 (33%) *n=24*
Improved health because of latrine	Yes: 2 (100%) No: 0 *n=2*	Yes: 17 (94%) No: 1 (6%) *n=18*	Yes: 19 (95%) No: 1 (5%) *n=20*
Recommend latrine to others	Yes: 7 (100%) No: 0 *n=7*	Yes: 2 (100%) No: 0 *n=2*	Yes: 9 (100%) No: 0 *n=9*

But now, this [slab latrine] is easy to wash and clean. It's easy technology, that's why I decided to purchase this slab." Most households with an unimproved latrine also stated it was easy to clean the traditional latrine. For example, Mimi, an unimproved latrine user said, "Yes, it is easy to clean. There is mud plaster that we can clean." The six

respondents whose latrine was not easy to clean were all dissatisfied with their latrine overall.

A latrine should be comfortable for household members to use, or they may prefer to use a different sanitation facility (that may be further down the rungs of the sanitation ladder). Eskinder, a shop owner, stated that her slab latrine is: "comfortable for everybody. There are different customers who are disabled persons, and it is easy for them to use." For Eskinder, her latrine is part of her business. She allows her customers to use the latrine, and it is important to her that all customers are able to comfortably use the facility while they are eating or drinking in her shop or visiting with her family. The respondents who did not feel their latrine was comfortable for everyone to use were primarily dissatisfied (and a few neutral) in their overall latrine satisfaction. Respondents with the improved latrine all stated their facility was comfortable for everyone to use.

As previously discussed in section 6.3, the resulting pride and social standing from sanitation investment is an important motivator for improved latrines. An improved latrine lends an immediate elevation in social standing, given the community focus on improved sanitation. The resulting pride in this accomplishment is borne out in the customer feedback. All of the households with a slab latrine felt proud of their facility. Yared shared his pride in his slab latrine: "I am proud, because any guest who comes to my home, I have confidence to show them my latrine. It's acceptable for everyone so I am not afraid [to show it to someone]." The question about users' pride in latrines assisted in gauging attachment and attitudes toward the latrine. Any households that were not proud of their latrine had unimproved latrines and were dissatisfied or neutral in their overall levels of satisfaction.

Safety and privacy are key features of a functional latrine facility. Especially given with risks for personal safety associated with open defecation or shared latrine blocks, it is imperative for a person to feel safe when they use their household latrine daily. However, the structure and location of a latrine is not technically a component of the sanitation ladder, which is more focused on the disposal of human excreta. The latrine slab does not automatically guarantee safety and privacy, as that is an additional investment for a family to construct walls, roof, and door for their latrine. Although most households did not have full walls or a solid door, the latrine location was almost always set back behind or to the side of the house, surrounded by vegetation. The secluded location, coupled with strategic wall covering and plastic sheets, may have provided enough privacy for most respondents. Endale, a 30-year old farmer with an unimproved latrine stated, "Yes, I feel private because [the latrine] is covered. There is no door but there is the plastic sheet so there is privacy for me." Mekonnen, a father of two, emphasized the slab's safety for his children, saying: "I'm comfortable with the design, because we can dig the pit with the size of the slab. […] Without any additional materials we can cover the pit. The children will not be afraid to use it. It is safe and it will not collapse. Also, it is easy to clean and wash. This design meets our needs." Most participants responded similarly to Endale and Mekonnen, and indicated they had both safety and privacy. All slab-owning households responded affirmatively to safety and privacy questions. The households that did not have safety and privacy at their latrine were dissatisfied with their facility overall.

Surveyed households were asked additional questions about whether the latrine meets their household's needs and whether they believed the latrine had improved their

household's health. The question on household needs was included as a secondary question to validate the "satisfaction" question. More households felt the latrine met their needs (70%) than were satisfied with the latrine (45%). This is likely due to the lower standard associated with a latrine meeting one's needs (i.e. does the latrine function enough to serve its purpose) compared with a latrine providing satisfaction. All but one surveyed household felt that their latrine had improved their household's health. These data are aligned with the community perceptions that building a traditional latrine or a latrine with a slab would both be helpful for preventing diarrheal disease and sanitation-associated illness.

Latrine Dissatisfaction

Dissatisfaction with latrines was primarily centered around their functionality. Households were dissatisfied with their latrine when it needed maintenance, when it was uncomfortable, or when it did not look attractive. Sisay, a male household head with an unimproved latrine, expressed his current dissatisfaction and criteria for latrine satisfaction: "Currently, there is no door for my latrine. Also, it needs some cover and maintenance for drainage and things like that. If I cover everything and I make it improved, it will make me satisfied." Adanech similarly expressed the structural problems with her unimproved latrine: "It needs some maintenance, like to cover the top with CIS. And it needs to have strong poles. It's not attractive now. In rainy season, the rain enters through the latrine so it doesn't satisfy us currently. […] The latrine fell down in the wind. So then, my [youngest] son here supported us by trying to maintain it."

Across the sanitation indicators, households with improved latrines expressed more positive feedback than households with unimproved latrines. All areas of negative

feedback listed in Table 11 above came from households with unimproved latrines like Sisay and Adanech. Namely, negative feedback comprised the following responses: household dissatisfied with latrine; latrine does not meet household needs; any problems with latrine; latrine is not easy to clean; latrine is not comfortable; users do not have safety or privacy; household does not have pride in latrine; or household health was not improved by latrine.

There are several potential reasons why levels of negative feedback and dissatisfaction for improved latrines was nearly nonexistent. First, respondent bias may have contributed to more positive responses around the circular slab. Although I made sure to delineate my role as a student researcher who was not employed by iDE, my affiliation with the organization was clear both from the team's introductions and the field facilitator known by most of the community. It is possible that that respondents sought to tell the interviewer (me) what they believed was the desirable response (in this case, favorable feedback about the iDE slab). While I do believe this could have shifted some responses, I do not think it skewed all responses, or negated entire questions. I visited all the household latrines, and did not see discrepancies with satisfaction (e.g. respondent stated there were no problems, but the latrine was falling down or otherwise needed maintenance).

Second, the circular slab lends itself to positive feedback. The basic improved latrine is not an incredibly complex structure. The circular slab, if installed correctly, is able to cover the hole completely with a durable surface. This reduces the possibility for a user to fall into the pit, increases the ease of cleaning, and the circular shape maintains pit stability. It is very difficult to break the slab, so it is understandable that there were few

complaints about the pit or the slab after installation. Third, there are few alternatives to the circular slab in the study area with which to compare the levels of satisfaction. At the time of the study, there were some rectangular slabs given to households many years ago (as previously mentioned), and some other organizations selling slabs in other areas. In the two study *kebele*s, there was no comparable product being sold other than the iDE circular slab. If there was an alternative slab product for households to use or consider, they may be less satisfied with the iDE slab. However, this possibility cannot be known without comparison products in the area. Lastly, household investment in the latrine structure was correlated with higher levels of satisfaction. Overall, respondents with the iDE slab had invested more money in their latrine structure, which was correlated with more positive responses. The majority of dissatisfied respondents mentioned structural factors as the cause of their dissatisfaction. If slab owners were more likely to invest in their latrine structure, they would be less likely to experience the maintenance issues associated with dissatisfied households.

7.2 Social Diffusion

Both households with slabs and those without slabs responded passionately when asked if they would recommend their latrine to others. Hailu, the owner of an improved latrine, stated: “If I had the financial capacity, I would purchase [the slabs] myself and distribute to the community! I know the result and I know the benefit of this slab. Before, two pits collapsed for me. But now, this is a great technology for me. If I could, I would give them to everybody. This is how much I am satisfied with the slab.” Similarly, Sebhat, the owner of an unimproved latrine, stated: “I recommend to the community to dig the pits and dispose of feces in the pit, and to use the latrine. Even if they can’t

purchase the materials, if they don't have the capacity, just to use a traditional latrine like mine." Word of mouth, and the social diffusion of latrines was further reinforced by the number of respondents who had heard about the iDE circular slab through neighbors, family, friends, church, or other social events. These responses are in keeping with the themes of social pressure motivating households to invest in a traditional or improved latrine.

7.3 Latrine Use

Another consideration for household latrine feedback is whether or not everyone who lives in the household actually uses the latrine. If someone does not use the latrine, that behavior could indicate a lack of functionality or consideration for a particular group of people. However, all household respondents stated that every adult household member used the latrine in the day and at night, including women and elderly household members. Children either used the latrine themselves, or their feces were collected and discarded into the latrine. In general, children under the age of two did not use the latrine themselves. Respondents stated that these young children either used diapers or defecated into a small plastic children's training toilet, both of which would then be emptied into the latrine pit. Two households had a separate latrine for children. In both cases, the family had built a second latrine, and kept the old latrine for children to use. The children's latrines had a smaller pit, and were closer to the home so that children would not be afraid to use the latrine and it was easy for them to quickly find the latrine.

Following interviews and surveys, I asked participants if I could see their latrine. I took photos of the interviewed household latrines, as well as several of the surveyed households. I took careful notes on the latrine, including visible handwashing facility,

structure surrounding the latrine, well-trod path to the latrine, any signs of use or disuse. Among surveyed and interviewed household latrines, all but four showed evidence of use (two interviewed households and two surveyed households). These four households all had an unimproved latrine, and had indicated that everyone in the household used that latrine. Both interviewed households without apparent latrine use were located in Zamine Wulisho, while the two surveyed household latrines were located in both Zamine Wulisho and Galcha Suke. Of the two interviewed respondents whose latrines did not show signs of recent use, one household was in the process of changing to a slab (see Figure 25, left). Among the surveyed households without signs of latrine use, both stated they were in the process of replacing their current latrine.

Figure 25. Household latrines without signs of use: Zamine Wulisho interview, Zamine Wulisho interview, Galcha Suke survey (L to R)

Handwashing Facilities

Because hygiene is part of the WASH grouping, and is related to sanitation practices, I also asked about and observed handwashing. From my observations in Damot Pulasa, handwashing is frequent before eating and after working with livestock or in the field. At restaurants and cafes, the restaurant proprietor or server would first bring a small

pitcher of water (and sometimes soap) to the table, along with a bucket to catch the water. They poured the water so that customers could wash their hands before eating, and repeated the process after the meal. When I was at households, if a farmer was being interviewed and had been working in the morning, he or she would wash their hands before the start of the interview. One participant had been planting, and was embarrassed to take a photo with his hands visibly dirty and covered in soil, until I told him the photo would be cropped at the shoulders and his hands would not be seen. These experiences further indicated to me that handwashing (at least with water, if not soap as well) was a routine behavior for the community.

To see if these observations were borne out in practice, I asked households about their handwashing facilities and took observation notes at household latrines on water containers, hand cleaning materials (soap or ash), or a handwashing area (see Table 12). Nine of the 20 interviewed households (45%) stated they had a handwashing station at the latrine, four households (20%) had a facility somewhere in the home, six households (30%) previously had a handwashing station, and one household (5%) did not have a handwashing station. Upon observation, eight of the nine households that claimed to have handwashing supplies at the latrine were validated. Some differences emerged between the two villages. All five interviewed households in Galcha Suke with improved latrines also had a handwashing station at their latrine. In Zamine Wulisho, two of the five households with improved latrines had maintained handwashing supplies at the latrine.

Table 13. Handwashing station claim vs. observation

Handwashing Location Claimed and Observed		Claimed at latrine and observed *concordant*	Claimed at latrine, but did not observe *discordant*	Claimed elsewhere (no observation conducted)	Did not claim and did not observe *concordant*	Did not claim station, but observed *discordant*
Galcha Suke Interview	Improved	5	-	0	0	-
	Unimproved	0	1	2	2	-
Zamine Wulisho Interview	Improved	2	-	1	2	-
	Unimproved	1	-	1	3	-
Galcha Suke Survey	Improved	1	0	0	0	-
	Unimproved	2	-	2	5	1
Zamine Wulisho Survey	Improved	0	0	1	0	-
	Unimproved	0	0	9	0	-
TOTAL:		11	1	16	12	1

Three of the 20 surveyed households (15%) indicated the presence of a handwashing station at the latrine, 12 (60%) stated they had a handwashing station at another location in the household, and the remaining five households (25%) responded they previously had a handwashing station but not at the present time. Although handwashing supplies were visible at three households, only one of the three households that initially claimed to have a handwashing station at the latrine had visible handwashing supplies present. Similar to the village-level differences for interviewed households, all three surveyed households with visible handwashing supplies at the latrine were located in Galcha Suke. The one surveyed household with the iDE improved latrine (slab purchased but not yet installed) indicated the presence of a handwashing station at the

latrine, but supplies were not readily visible upon observation. The other household with a slab (rectangular slab from previous government intervention) indicated a handwashing station elsewhere.

Vent Pipe and Drop-Hole Cover

As previously discussed, the vent pipe and drop-hole cover were both desirable features of the slab latrine. My observation of installed latrines, however, did not find that any household had extended the vent pipe for their use. Although the cost to extend the vent pipe is minimal, it remains an additional cost for households. Without the ability to create a true VIP latrine, the vent pipe is primarily aesthetic. Additionally, there appears to be less instruction to households on how or why they may wish to extend the vent pipe. In one interview, the respondent asked my translator how he could purchase additional PVC to extend the vent pipe. Aside from this instance, participants seemed satisfied with the short vent pipe, and perceived it as reducing smells. In addition to the lack of vent pipe utilization, not all installed slabs had the drop-hole cover in use. Among the 10 interviewed households and one surveyed household with the iDE circular slab, all five slab adopters in Galcha Suke employed their drop-hole cover. None of the slab adopters in Zamine Wulisho had the slab cover in use or visible near the latrine. For the 28 interviewed and surveyed households with unimproved latrines, only three employed a drop-hole cover. One household in Galcha Suke used a ceramic pot, one household in Zamine Wulisho used a plastic bucket lid, and a second household in Zamine Wulisho used *enset* leaves. Because this trend was not noticed until the data analysis stage, no further questions were asked to participants about why they had not extended their vent pipe, or why they employed or did not employ the drop-hole cover.

For both latrine and handwashing behaviors, respondent bias may account for an individual overstating their WASH behaviors. It was apparent that my research revolved around sanitation, and as discussed in Chapter VI, households have received extensive information on the importance of sanitation. These factors may have led to households inflating their sanitation and hygiene behaviors in order to respond in a way they thought I wanted to hear, or that maintained their social standing, or avoided embarrassment. In general, I found households to be very comfortable in discussing their sanitation preferences and behaviors. However, I understand that my positionality as a white academic and lack of Wolaitigna fluency could have masked discomfort or embarrassment from participants who were in fact practicing open defecation or who did not practice frequent handwashing.

7.4 Demonstrated Investment in Sanitation

In general, households took care of their latrines, and demonstrated this form of attention and investment through monetary spending as well as evident neatness and cleaning of the latrine structure itself. Latrines were not painted like the main houses in Wolaita Zone, but many households had planted pleasant smelling plants or fragrant herbs near the latrine to reduce smell and beautify the surroundings. Maintenance and cleanliness of the improved latrines was, in general, more significant than for unimproved latrines. However, many unimproved latrines also showed distinct care and supervision, demonstrating buy-in on the part of the household. For example, Bereket's household in Zamine Wulisho spent no money on the latrine, as her husband dug the pit and they built the latrine themselves. The latrine's walls are made of some wooden poles filled in with dried stalks and plastic sheets. The door is a reused tablecloth. Inside the latrine, the pit is

covered completely with packed dirt and a plastic lid covering the drop-hole, underneath which are wooden support poles and the pit itself. Just outside the latrine is a water bottle with water, and a small stool with soap as a handwashing station. Bereket's latrine is technically unimproved, but it is carefully maintained. See Figure 26 for a photo of Bereket's household latrine.

Figure 26. Bereket's household latrine is unimproved

Nearly all households' primary source of capital came from smallholder farmers, and households had a low and seasonal income. Given the competing economic priorities of a household with few financial resources, spending money on a latrine signifies a high degree of emotional and future involvement in order to get a profit on the investment. One way to gauge monetary investment in a latrine is the cost to install the latrine itself. The average cost of a latrine was ETB 498 (USD 16), inclusive of paid labor and

materials. When divided by latrine category, average cost for an improved latrine was ETB 1,011 (USD 32.5) and average cost for an unimproved latrine was ETB 279 (USD 9). Adjusting for the average cost of ETB 460 (USD 15) for a latrine slab, households with improved latrines spent an average of ETB 617 (USD 20) on their latrines without the slab, approximately ETB 100 (USD 3) more than those households with unimproved latrines. Households in Galcha Suke invested more money in their latrine, on average, than households in Zamine Wulisho. The average latrine expenses in Galcha Suke was ETB 642 (USD 21) per household, while the average expense in Zamine Wulisho was ETB 354 (USD 11.5) per household. Additionally, households in Galcha Suke were more likely to invest in more expensive latrine materials, namely CIS (average cost of ETB 390, USD 12.50). Fifteen of the 20 Galcha Suke households purchased CIS, compared to two of the 20 Zamine Wulisho households.

Another form of investment is planning for future projects and continued latrine utilization. Taddese, a slab customer, stated succinctly, “Yes, I am satisfied with my latrine. That’s why I put additional modifications and cost into my latrine.” Every household was able to articulate changes they wanted to make to their latrine over time. Aster, a 60-year old widow with an unimproved latrine, shared that: “For the future, I have a big plan to increase the size of the latrine. To make it larger. Also, to install the door and dig a deep pit when I purchase the slab. And I plan to plant the spices around my latrine area to be clean, and to use the improved latrine.” This concept of iterative changes reflects earlier discussion of financial constraints, with households spending smaller amounts over a longer period of time to make additions to their latrines. Among households without a latrine slab, 24 of 28 stated they intended to purchase a slab in the

next year. Aside from purchasing a slab, the most commonly cited future latrine investments for households were to expand the latrine (make larger, add a second latrine stall, add a shower stall, increase depth of pit), improve the roof and walls (purchase CIS for roof, plaster walls), install a door, or make aesthetic improvements (plants). The interest in latrine investment and continuous improvement indicates the recognized importance of sanitation in the community. Not only are households making a significant initial investment in their latrines (both improved and unimproved), but they are making plans and goals for further monetary, labor, and time investments in the future.

CHAPTER VIII

CONCLUSION

8.1 Research Findings

This study explored factors influencing latrine choices at the household level. The goal was to explore what elements impacted household latrine adoption and utilization across two villages in Wolaita Zone, Ethiopia. This research employed a mixed methods approach to consider four related research questions: 1) What factors affect a household's choice of sanitation? 2) What variation in household sanitation utilization exists across household members? 3) To what degree are households satisfied with their sanitation facility? and 4) How is the Human-Centered Design approach integrated into sanitation programs?

Sanitation Decision-Making

As discussed in Chapter VI, numerous motivators and barriers affect a household's sanitation decisions. I identified two significant decision points for participant households: households moving from open defecation to invest in unimproved sanitation, and households moving from unimproved sanitation to invest in improved sanitation. In general, sanitation investments at all levels shared several key factors. Shared motivators included government messaging, societal pressure, and various health benefits while the primary shared barrier was cost. Outside these general factors, households that had recently navigated each decision point identified the most influential factors for their sanitation investment. Households that decided to invest in an unimproved latrine (after previously using open defecation) cited health benefits as the most relevant motivator, and lack of awareness as the most relevant barrier to their

current latrine. The households that adopted an improved slab latrine (after previously using an unimproved latrine) cited durability and slab design as the most relevant motivators and affordability as the most relevant barrier.

Latrine Use

All study participants reported high levels of latrine usage across all members of the household. There was no variation by age, sex, or time of day. For infants or young children who could not use the latrine themselves, households transferred their fecal matter into the latrine. Visual confirmation of latrine usage was present in all but four households. These four households reported exclusive use of their latrine, but there was no visible evidence of recent use. This is likely due to these latrines needing essential repairs and additional construction to make them desirable for use. For example, one latrine had only three narrow wooden poles to stand on atop a deep pit filled with fecal sludge. Another latrine did not have any privacy structure around it, leaving the user exposed to neighbors or other household members.

In addition to latrine use, I also asked households about their handwashing facilities. Thirty percent of households affirmed the presence of handwashing resources (i.e. water and soap or ash) at the latrine site, 40% said they had household handwashing resources elsewhere in the home, and 30% stated they did not have a handwashing station. The majority (83%) of the households that claimed a handwashing station at the latrine site were confirmed by sight with the latrine visit. Based on observations and participant responses, handwashing knowledge and prevalence in these communities is high. However, most observed handwashing stations did not have soap or ash present, so the handwashing may only involve water.

Latrine Satisfaction

All 11 households with the circular slab latrine reported they were satisfied with their latrine, and one household with a rectangular slab was neither satisfied nor dissatisfied. The 28 households using an unimproved latrine reported mixed levels of satisfaction, with 43% satisfied, 39% dissatisfied, and 18% neutral. Additional areas of latrine feedback – safety, privacy, ease of cleaning, pride, comfort – echoed the satisfaction trends, where households with a circular slab reported positive feedback, and households with unimproved latrines reported a mix of positive and negative feedback. One key takeaway from these responses is the high degree of satisfaction and positive experiences from households that purchased the circular latrine slab. These data suggest that if a household is able to afford the slab latrine, there are not additional barriers or negative experiences after purchasing. Additionally, the responses of households with unimproved latrines imply that this group of households may find their current latrine to be sufficient for practical purposes (a place to defecate) and it meets the government push to avoid open defecation. However, these households are not completely satisfied with their latrine, and are open to different facilities, if not actively planning for latrine improvements.

Households were asked about their current and future investment as an additional indicator of attachment to the current latrine. All households had ideas and plans for future monetary and time investments in their latrines. Frequently discussed sanitation project ideas included expanding the latrine itself to increase the size or add a second stall, improve the structure of the roof or walls, install a concrete slab (for households with an unimproved latrine), and make aesthetic improvements like planting herbs.

Latrine Design

Design is a key factor for the slab latrine sales process, desirability, and customer satisfaction. For households with an improved latrine, the design features served as an important motivator for purchase, and contributed to high levels of satisfaction after installation. For households with an unimproved latrine, slab design features stood out as incentives to further invest in their sanitation facility and plan to upgrade to an improved latrine. The most frequently discussed design features in both of the aforementioned areas were strength of the concrete, long-lasting and reusable, ease of washing and cleaning, vent pipe, and included drop-hole cover. Households described these features as modern and new technology. The enthusiasm and interest in the specific features of the slab shows that the improved latrine design provides additional benefits to users beyond the practical component of the unimproved latrine (for instance, social or psychological benefits). The slab's cost is a considerable investment for the average household in Damot Pulasa, and the non-health benefits of the slab latrine significantly increase a household's willingness to make the purchase. Additionally, the slab's round shape, ease of purchase and installation, and social desirability contributed to customer interest and satisfaction. The features of the slab itself, the design of the purchase and installation process, and the slab's multi-faceted promotional avenues are a direct result of the HCD process. The desirability of these features and satisfaction for customers indicates that the HCD process was effective in creating a latrine slab and sanitation market that is aligned with community needs and preferences.

Although design features of the slab latrine are desirable to customers, adherence to certain features in reality did not always match the level of enthusiasm in theory. The

vent pipe feature of the slab was mentioned by the vast majority of households as an attractive feature or an aspect of the slab they had remembered from advertising. However, no adopter households took the additional step to extend the vent pipe for use in their improved latrine. The drop-hole cover was similarly mentioned frequently as a component of the latrine slab. However, none of the slab adopters in Zamine Wulisho had a slab cover upon observation. These differences in perception and reality could bolster the theme of the slab as a modern household feature, where households desire the slab for its association, but see the vent pipe as aesthetic rather than something that needs further investment to install.

8.2 Limitations

As discussed throughout, three important limitations should be considered for this work. First, we cannot assume generalizability of findings to all villages in the district, all iDE programs, or all sanitation in Ethiopia. Second, the study was limited by considerations around language, including linguistic and cultural adaptation of questions, gist translation, and simultaneous translation in semi-structured interviews. Lastly, readers should consider the influence of response bias generated from my positionality as a white American affiliated with iDE on the results presented here.

First, the question of generalizability. My sample included 40 interview and survey households from each of the two villages. Based on this size, results are not widely generalizable. I do not believe this invalidates findings, but rather places my research within the broader context of sanitation at all administrative levels in Ethiopia, setting the stage for further research in these areas and providing avenues of incorporation for iDE.

Regarding language limitations, the simultaneous translation and semi-structured interviews meant that the interpreter did not have a script, and instead worked with me to convey the questions to respondents live during interviews. In my limited knowledge of Wolaitigna language, certain words include multiple meanings (for example, satisfaction and pride both used the same word in Wolaitigna, *ufayta*). Linguistic particularities may mean that adaptation of questions from English to Wolaitigna and local context, as well as interpretation of answers from Wolaitigna to English produced gist translations. Both areas may have resulted in loss of nuance or distinction between similar answers.

Finally, potential areas for response biases include acquiescence and social desirability. I introduced myself to all research participants as a graduate student interested in WASH, and although I made it clear I did not work for iDE, my interpreter and the accompanying field facilitator both introduced themselves as working with iDE. This obvious presence of the organization, as well as the clear focus of my questions on slab latrines (only offered by iDE at that time), may have contributed to acquiescence bias, where participants respond with what they believed I (or iDE) wanted to hear. Moreover, due to the widespread public education campaign around eliminating open defecation and fostering improved sanitation, participants may have responded in socially desirable ways. Namely, participants may have shifted responses away from open defecation behaviors or unimproved latrines in favor of improved sanitation or the plan to purchase an improved latrine. Additionally, my positionality as a white researcher in Ethiopia meant I was not only immediately recognized, but also automatically given a degree of power and status that I neither deserved nor requested. I attempted to mitigate the potential response biases with clear introductions and clarifications that there was no

reward or penalization for responses, and avoided question wording that promoted or shamed WASH behaviors or facilities.

8.3 Implications for WASH and Sanitation

Although the sanitation ladder contains evenly spaced categories, my research demonstrates that the progression along this ladder is not always linear, and decision-making factors significantly differ between the "rungs" of the ladder. I identified key factors for households investing in unimproved and basic improved sanitation facilities. Study participants fell into two categories: households with an unimproved latrine and households with an improved basic latrine. Each category aligned with a significant sanitation decision point that a household had experienced – the decision to invest in the unimproved or improved latrine. The most compelling motivators and most impactful barriers differed depending on which of these decision points the household was facing. All study participants expressed interest in sanitation and its integral nature for a healthy household. Barring financial barriers, study participants were invested in bettering their household latrine, whether through incremental upgrades or by moving up a rung of the sanitation ladder. By tailoring sanitation communication to households at different rungs of the sanitation ladder and different decision points, sanitation promoters can better equip households to make sanitation decisions for the health and happiness of their families. A household that currently uses an unimproved latrine will be more powerfully influenced by different factors than a family currently practicing open defecation. Sales agents and other sanitation promoters already change their strategies depending on how a household responds as a product of their training and inherent sales skill. However, these results can help the sanitation field create a more systematic approach to sanitation

communication and promotion and validate existing strategies. Sales agents, Health Extension Workers, slab manufacturers, or iDE staff can be better equipped to meet a household at their appropriate decision point by focusing on the key motivators and barriers at that stage. For example, if a sales agent approached a household that currently practiced open defecation, the sales agent would focus primarily on the health contrasts between open defecation and an improved latrine, and offer options to reduce the immediate cost of a concrete slab (including a discussion on long-term cost savings). For a household with an existing unimproved latrine, a sales agent could focus on the specific features of the slab, such as the sturdy construction, washable surface, and smell-reducing cover.

Government-affiliated sanitation promoters like Health Extension Workers or Health Development Army volunteers are dually focused on eliminating open defecation and increasing the number of households using improved sanitation. The incremental progression along the sanitation ladder is particularly applicable to these stakeholders. In these cases, sanitation promoters can use my decision-making results to target certain advertising or health communications to different audiences. For example, continued multi-venue promotion to increase sanitation knowledge and emphasizing health concerns would be the best fit for a family practicing open defecation and who would not be reasonably expected to purchase a latrine slab. Later, this family could be re-visited to promote the latrine slab's additional benefits over their improved latrine.

Sanitation promoters at both decision points can leverage my findings on household satisfaction and latrine feedback to augment their own experiences with the community. Household challenges with their current latrine serve as avenues for latrine

upgrade, or opportunities for future improvements in the slab product. If a family is dissatisfied with their unimproved latrine, and laments how frequently the wooden poles rot and bow when they put weight on them, this is an opportunity to promote the strength and longevity of the improved latrine slab. Similarly, the lack of vent pipe extensions for improved latrines denotes an opportunity to better communicate about the necessary second step to extend the vent pipe, or to reimagine the slab design. Household feedback also demonstrates the areas in which unimproved and improved latrine users are most satisfied. These findings can confirm slab design features that are appropriate, or identify unimproved latrine features that can be maintained or further improved.

The Human-Centered Design approach was instrumental in creation of the latrine slab and sanitation market. The linkages between the slab components decided upon using HCD and the desirable and satisfactory components from customer perspectives supports the use of HCD in sanitation planning. Successful HCD results in a product and process that is representative of customer needs, wants, and lifestyle. My findings serve as an endorsement of the HCD approach to sanitation product and market creation. Vital components of the improved latrine may not have been included without HCD. These key aspects include: the multi-venue promotion strategy for slab sales, the concrete material, and the circular shape with a keyhole. HCD helped produce these characteristics and their effectiveness was borne out in methods of customer awareness and purchases, feature desirability, and customer satisfaction. HCD is an iterative process, and although small adaptations have been made at the local level, the last systematic HCD-led analysis and movement was in 2013. Given the financial barriers to latrine slab ownership and the rapidly changing sanitation field, another series of HCD-based slab development could

help iDE better understand current perceptions and wider customer preferences and trends to further increase slab ownership and access.

Given the limitations of generalizability, further research is necessary to extrapolate these findings to a broader population or to wider sanitation program implementation. Future research could explore further sanitation behaviors such as drop-hole covering or vent pipe use, as well as linkages with other WASH behaviors like handwashing and water treatment. Additionally, future studies incorporating HCD could dive deeper into customer journeys and sanitation affordability. Lastly, spatial analysis could be helpful to visualize patterns of sanitation facility and determine proximity factors for latrine investment.

APPENDIX A

KEY INFORMANT SEMI-STRUCTURED INTERVIEW GUIDE

Role

1. What is your occupation? What is your role in the latrine sales process?
2. Can you describe how you came to be in this role? What drove you to this position?
3. How long have you been in this role?

Perceptions of Latrine Sales

4. How do you perceive the sales process for toilets?
    - ⇒ What do you think is working best?
    - ⇒ What would you change?
    - ⇒ Prompt about price/economic feasibility, technical feasibility, user desirability
5. Who are the customers? Who are the users?
6. What do you think I need to know about the toilet sales process?

Perceptions of Local Communities

7. In your experience with this village population, do households use their toilets?
8. What do you perceive as barriers to household toilet use?
9. What do you perceive as the driving motivators for toilet adoption?

Design

10. Can you explain the toilet design process to me?
11. Could you tell me about human-centered design?
12. What is your opinion of the current toilet concrete slab design? What about other components of the service (sales, delivery, etc.)

Concluding

13. Who else should I talk to?
14. Can you confirm that you are still comfortable with me keeping the recording of this interview so that I can remember what we talked about?
15. Could I get your contact information for any follow-up questions?

APPENDIX B

HOUSEHOLD SEMI-STRUCTURED INTERVIEW GUIDE (ADOPTER AND NON-ADOPTER)

Demographics

1. What is your age?
2. What is your current occupation?
3. What is your marital status?
4. Who is the head of household?
5. Are there any other household members?
   - ⇒ Sex and ages of other household members
6. Do you own land? How much?
7. Do you own livestock?
8. Do you own any vehicles (car or motorcycle or bicycle or donkey/ox cart)
9. How many years of education have you completed?

Sanitation Facility

10. Where do you usually relieve yourself?
    - ⇒ If latrine, ask for specifics about latrine (pit, pit w/slab, VIP, etc.)
11. Does everyone in your household use [insert response from Q #10]?
    - ⇒ Why are there differences in who uses this place?
    - ⇒ Do you share this facility with other households? How many?
    - ⇒ Do women and men use the same place?
    - ⇒ What about at night?
    - ⇒ What about children?
12. If pit latrine, what do you do when the pit is full?
    - ⇒ Have you experienced challenges like flooding or pit collapse?
13. What is your household's main source of drinking water?
14. Do you have a handwashing facility?
    - ⇒ When do you wash your hands?

Decision and Purchase Process

15. Where did you relieve yourself before your current sanitation facility?
16. Who made the sanitation purchase/upgrade decisions for your household?
17. Why did you choose your sanitation facility?
    - ⇒ What are your most important considerations when deciding about a toilet facility?
18. Please tell me about installing your current sanitation facility.
    - ⇒ If applicable, do you remember when you bought the latrine slab?
    - ⇒ If applicable, do you remember how you heard about the latrine slab?
19. What was the process to install the sanitation facility?
    - ⇒ If applicable, where did you go? Who did you buy it from? What was the collection and installation process like?
20. What was the cost? How did you pay for your sanitation facility?

⇒ Have you heard of microfinance for latrines? What do you think about it?

21. Have you heard about the iDE improved latrine slab? If yes:
    ⇒ How did you hear about it?
    ⇒ Tell me about your decision not to purchase the iDE improved slab?

Satisfaction

22. Are you satisfied with your sanitation facility?
    ⇒ Do you like how it looks?
    ⇒ Are you satisfied with the process to purchase supplies and install it?
    ⇒ Is it easy to clean?
    ⇒ Does it function?
23. Do you feel safe using it at all hours?
24. Do you have privacy?
25. Is it easy to use for elders and children? People with disabilities?
26. What would you improve about your sanitation facility?
27. Do you feel your sanitation facility meets your household's needs?
    ⇒ Would you recommend it to a friend or family member?
28. Are you planning to make any changes to your sanitation facility?
    ⇒ What are the most important updates?
29. Has your sanitation facility been unusable or needed repairs since you installed it? Have you had any problems?
30. Can I see your sanitation facility?

Concluding

31. Can you confirm you are still comfortable with me keeping the recording of this interview so that I can remember what we talked about?

APPENDIX C

FOCUS GROUP GUIDING QUESTIONS

Role

1. How long have you been a member of the Health Development Army?
2. What are your responsibilities as HDAs?

Sanitation in the Community

1. For the groups of households you work with, where do most people defecate?
   ⇒ Do most people have a slab, or a traditional latrine?
2. How long has the slab been available in this kebele?
3. Why do you think someone decides to purchase a slab?
4. If someone does not decide to purchase a slab, what do you think are the barriers for them?
5. Have you heard any feedback from people who have purchased the slab?
   ⇒ Any ways to make the slab more desirable?
6. In a household, does everybody use the same latrine?
   ⇒ What about water and handwashing in the kebele? Are there any challenges?
7. Do people talk about their latrines with friends, family, or neighbors? Is there discussion about latrines?
8. Can you tell me about the open defecation-free certification? What is that process? Is this kebele ODF?

Concluding

9. Is there anything else you want to discuss or share with me?
10. Can you confirm you are still comfortable with me keeping the recording of this conversation so that I can remember what we talked about?

APPENDIX D

SURVEY QUESTIONNAIRE

SECTION 1. Survey Information			
1.1	Woreda	Damot Pulasa	
1.1	Kebele	1. Zamine Wulisho 2. Galcha Suke	
1.3	Household ID		
1.4	Date	_____ August, 2019	

SECTION 2. Demographic Information			
2.1	Is the respondent the head of household?	0. No 1. Yes (*proceed to 2.5)*	
2.2	Sex of respondent	1. Male 2. Female	
2.3	Age of respondent		
2.4	Relationship to head of household (HoH)	1. Spouse of HoH 2. Parent of HoH 3. Child of HoH 4. Sibling of HoH 5. Other: _____	
2.5	Sex of head of household	1. Male 2. Female	
2.6	Age of head of household		
2.7	Occupation of head of household	1. Agriculture/Farmer 2. Non-agricultural income generation 3. Unemployed 4. Retired 5. Other: _____	
2.8	Marital Status of head of household	1. Single/never married 2. Married 3. Divorced/widowed 4. Non-monogamous	
2.9	Highest level of education completed by head of household		
2.10	Other household members (number of adults, number of children. Age of youngest child)		

2.11	Who else is present and listening **Observe only*	0. Only respondent 1. Spouse 2. Child(ren) 3. Adults of same sex 4. Adults of opposite sex	
2.12	Household metal roof **Observe only*	0. No 1. Yes	
2.13	Hectares of land owned	0. No land 1. Land (and hectares)	
2.14	Livestock owned (list)		
2.15	Vehicles owned (list)		
2.16	Mobile phone owned	0. No 1. Yes	

SECTION 3. General Sanitation Information			
3.1	Where do you go to relieve yourself?	1. Household latrine 2. Public/shared latrine 3. Outside near home *(proceed to 3.4)* 4. Outside not near home *(proceed to 3.4)* 5. Other: _____ *(proceed to 3.4)*	
3.2	What kind of latrine?	1. Pit with slab 2. Pit without slab 3. Pour flush/flush 4. Composting 5. Bucket	
3.3	Does anyone else use this facility who doesn't live in your household?	0. No 1. Customers 2. Guests 3. Other household	
3.4	How frequently do you use this space to defecate? *Read answers*	0. Never 1. Sometimes/occasionally 2. Usually/mostly 3. Always	
3.5	Does everyone in your household use this space?	0. No 1. Yes	
3.6	How frequently do elders use this space to defecate? *Read answers*	0. Never 1. Sometimes/occasionally 2. Usually/mostly	

		3. Always	
3.7	How frequently do non-elder adults use this space to defecate? *Read answers*	0. Never 1. Sometimes/occasionally 2. Usually/mostly 3. Always	
3.8	How frequently do other women use this space to defecate? *Read answers*	0. Never 1. Sometimes/occasionally 2. Usually/mostly 3. Always	
3.9	How frequently do male children use this space to defecate? *Read answers*	0. Never 1. Sometimes/occasionally 2. Usually/mostly 3. Always	
3.10	How frequently do female children use this space to defecate? *Read answers*	0. Never 1. Sometimes/occasionally 2. Usually/mostly 3. Always	
3.11	Do you have children too young to use the latrine? What is done with their feces?	0. All children use latrine 1. Feces put into latrine 2. Feces put into drain or ditch 3. Feces buried 4. Feces put in garbage 5. Feces left in open 6. Other: _____ 99. Does not know	
3.12	Before your current place to defecate, where did you relieve yourself?	1. Household latrine 2. Public/shared latrine 3. Outside near home 4. Outside not near home 5. Other: _____	
3.13	What is the household's main source of drinking water?	1. Handpump 2. Borehole 3. Public waterpoint 4. Bottled water 5. Protected well 6. Unprotected well 7. Piped water 8. Other protected source 9. Other unprotected source	

3.14	How many minutes does it take to go to the water source, get water, and return?		
3.15	Do you treat the water in any way?	0. No *(proceed to 3.16)* 1. Yes 99. Does not know *(proceed to 3.16)*	
3.16	What do you do to the water?	1. Boil 2. Add chlorine/bleach 3. Strain it 4. Water filter 5. Solar disinfection 6. Let it stand and settle 7. Other: _____	
3.17	Do you have a handwashing station? Where?	0. No handwashing station 1. Yes, at latrine 2. Yes, in household 3. Previously, but not currently	
3.18	When do you wash your hands?	0. Never wash 1. Before eating 2. After defecation 3. Before feeding child 4. After cleaning child 5. Before cooking 6. Before breastfeeding 7. After eating 8. After caring for livestock or working	
3.19	In the last week, how many times did a child under 5 have diarrhea	0. Never 1. 1-2 times 2. 3-4 times 3. 5-7 times 4. 8+ times 99. No children under 5 in household	
3.20	Who makes decisions about general purchases for your household?	1. Head of household (self) 2. Head of household (other) 3. Joint decision 4. Other: _____	
3.21	Who makes decisions about latrine purchases for your household?	1. Head of household (self) 2. Head of household (other)	

		3. Joint decision 4. Other: _____	

Household Latrine -> Section 4
Any other response -> Section 5

SECTION 4. If response to #3.1 is "Household Latrine"			
4.1	When did you purchase/install this latrine?	1. In the last 3 months 2. In the last 6 months 3. In the last year 4. 1+ years ago 5. 2+ years ago 6. 3+ years ago 7. 4+ years ago 8. 5+ years ago 99. Does not remember	
4.2	How did you pay for the latrine?	1. Cash 2. Microfinance loan *(proceed to 4.5)* 3. Other loan 4. Given money 5. No cost	
4.3	Have you heard of the latrine microfinance loan?	0. No *(proceed to 4.5)* 1. Yes 99. Does not remember *(proceed to 4.5)*	
4.4	Would you use a microfinance loan for a latrine in the future?	0. No 1. Yes	
4.5	What did you buy to construct the latrine?	0. No purchases 1. Slab 2. Cement 3. Corrugated Iron Sheet 4. Wood poles 5. Labor 6. Transportation 7. Other: _____	
4.6	What was the total cost for installation? (ETB)		
4.7	Can you use the latrine at night?	0. No 1. Yes	

4.8	Do you feel safe when you use the latrine?	0. No 1. Yes	
4.9	Do you have privacy when you use the latrine?	0. No 1. Yes	
4.10	Have you had any problems with your latrine in the last year?	0. No problems 1. Pit collapse 2. Structural problem 3. Slab problem 4. Pit overflow 5. Other: _____	
4.11	What do you plan to do when the pit is full?	0. Latrine does not have pit 1. Dig new pit and move something to new latrine 2. Dig new pit and build new latrine 3. Empty pit (self) 4. Empty pit (paid labor) 5. Unsure 6. Stop using latrine	
4.12	How many pits/latrines did you have before this one?		
4.13	Do you plan to make any changes to your latrine in the next year?	0. No *(proceed to 4.17)* 1. Yes 2. Yes, but not in the next year	
4.14	What changes do you plan to make?	1. Buy slab 2. Improve/build walls 3. Improve/build roof 4. Improve/build door 5. Install new latrine (replacement) 6. Install new latrine (additional) 7. Shower stall 8. Other: _____	
4.15	Do you plan to install PVC to extend the vent pipe? *If iDE slab or intent*	0. No 1. Yes	
4.16	Would you be interested in buying PVC from the slab manufacturer? *See above*	0. No 1. Yes	
4.17	What are characteristics of a good latrine?	1. Improve health 2. Easy to clean 3. Strong/does not collapse	

		4. Lasts long time 5. Nearby 6. Accessible 7. Privacy 8. Safety 9. Gives pride/prestige 10. Structural components (vent pipe. Slab, roof) 11. Other : _____	
4.18	Why did you decide to build a household latrine?	1. Health (general) 2. Health (disease transmission specific) 3. Safety 4. Privacy 5. Cleanliness 6. Prestige/social standing 7. Long-lasting 8. Peer/community pressure 9. Other: _____	
4.19	To what extent are you satisfied with your current latrine? *Read answers*	1. Very dissatisfied 2. Dissatisfied 3. Neither satisfied nor dissatisfied 4. Satisfied 5. Very satisfied	
4.20	Does this latrine meet your household's needs?	0. No 1. Yes	
4.21	Is the design of this latrine better or worse than previous latrines you have owned? *Read answers*	0. Same 1. Worse 2. Better	
4.22	Do you believe the latrine has improved your health or your household's health?	0. No 1. Yes	
4.23	Is the latrine easy to clean?	0. No 1. Yes	
4.24	Are you proud of your latrine?	0. No 1. Yes	
4.25	Is this latrine comfortable to use for everyone?	0. No 1. Yes	
4.26	Does your latrine use an iDE slab?	0. No *(proceed to 4.33)*	

		1. Yes	
4.27	Have you heard about the iDE slab?	0. No *(proceed to 4.36)* 1. Yes	
4.28	How did you hear about the slab?	1. Neighbor 2. Sales agent 3. Health Extension Worker 4. Health Development Army 5. Family 6. Friend 7. Manufacturer 8. iDE staff 9. PSC public works 10. Market 11. Kebele meeting 12. Poster/print ad 13. Other: _____	
4.29	What do you remember hearing about the slab?	1. Privacy 2. Easy to clean 3. Long-lasting 4. Strong/durable 5. Improve health 6. Economic 7. Other: _____	
4.30	Can I see your latrine?	0. No *(Proceed to end)* 1. Yes	
4.31	Latrine observations **Observe only*	1. Water container inside latrine 2. Water container outside latrine 3. Soap/ash/hand cleaning 4. Slab present 5. Cleaned floor 6. Covering for drop-hole 7. Metal roof 8. Wood roof 9. Other roof materials 10. Door or complete covering 11. Walls not able to see through 12. Walls but with see-through 13. Vent pipe 14. Path is well-trod 15. No roof	

		16. No walls 17. Cleaning supplies for latrine visible 18. Cobwebs 19. Location to side of house 20. Location behind house 21. Location in front of house	

*END of household latrine questions

SECTION 5. If response to #3.1 is not "Household Latrine"			
5.1	How many minutes does it take you to go to this facility and return?		✎
5.2	Can you use the facility at night?	0. No 1. Yes	
5.3	Do you feel safe when you use the facility?	0. No 1. Yes	
5.4	Do you have privacy when you use the facility?	0. No 1. Yes	
5.5	To what extent are you satisfied with this facility? *Read answers*	1. Very dissatisfied 2. Dissatisfied 3. Neither satisfied nor dissatisfied 4. Satisfied 5. Very satisfied	
5.6	We know there are many reasons why a household does not install a latrine. Why did you decide not to install a household latrine?	1. Expense 2. Not high priority 3. Satisfied with current option 4. Gender 5. Preference not to use latrine 6. Other: _____	
5.7	Do you plan to install a household latrine in the next year?	0. No *(Proceed to 5.12)* 1. Yes	
5.8	Why do you plan to install a latrine?	1. Health (general) 2. Health (disease transmission specific) 3. Safety 4. Privacy 5. Cleanliness 6. Prestige/social standing 7. Long-lasting 8. Peer/community pressure	

		9. Other: _____	
5.9	How will you pay for the latrine?	1. Cash 2. Microfinance loan *(proceed to 5.12)* 3. Other loan 4. Given money	
5.10	Have you heard about microfinance for latrines?	0. No *(proceed to 5.12)* 1. Yes 99. Does not remember *(proceed to 5.12)*	
5.11	Would you use a microfinance loan in the future?	0. No 1. Yes	
5.12	What are characteristics of a good latrine?	1. Improve health 2. Easy to clean 3. Strong/does not collapse 4. Lasts long time 5. Nearby 6. Accessible 7. Privacy 8. Safety 9. Gives pride/prestige 10. Other: _____	
5.13	Have you heard about the iDE slab?	0. No *(proceed to end)* 1. Yes	
5.14	How did you hear about the iDE slab?	1. Neighbor 2. Sales agent 3. Health Extension Worker 4. Health Development Army 5. Family 6. Friend 7. Manufacturer 8. iDE staff 9. PSC public works 10. Market 11. Kebele meeting 12. Poster/print ad 13. Other: _____	
5.15	What do you remember hearing about the slab?	1. Privacy 2. Easy to clean 3. Long-lasting	

		4. Strong/durable 5. Improve health 6. Economic 7. Other: _____	

*END of non-latrine household questions

REFERENCES CITED

Aiemjoy, K., Stoller, N. E., Gebresillasie, S., Shiferaw, A., Tadesse, Z., Sewent, T., Ayele, B., Chanyalew, M., Aragie, S., Callahan, K., Stewart, A., Emerson, P. M., Lietman, T. M., Keenan, J. D., & Oldenburg, C. E. (2016). Is using a latrine "a strange thing to do"? A mixed-methods study of sanitation preference and behaviors in rural Ethiopia. *The American Journal of Tropical Medicine and Hygiene, 96*(1), 65-73. doi:10.4269/ajtmh.16-0541

Alemu, A., Atnafu, A., Addis, Z., Shiferaw, Y., Teklu, T., Mathewos, B., Birhan, W., Gebretsadik, S., & Gelaw, B. (2011). Soil transmitted helminths and schistosoma mansoni infections among school children in Zarima town, northwest Ethiopia. *BMC Infectious Diseases, 11*(1). doi:10.1186/1471-2334-11-189

Alemu, F., Kumie, A., Medhin, G., Gebre, T., & Godfrey, P. (2017). A socio-ecological analysis of barriers to the adoption, sustainability and consistent use of sanitation facilities in rural Ethiopia. *BMC Public Health, 17*(1). doi:10.1186/s12889-017-4717-6

Bartram, J., & Cairncross, S. (2010). Hygiene, sanitation, and water: Forgotten foundations of health. *PLoS Medicine, 7*(11). doi:10.1371/journal.pmed.1000367

Bartram, J., Brocklehurst, C., Fisher, M., Luyendijk, R., Hossain, R., Wardlaw, T., & Gordon, B. (2014). Global monitoring of water supply and sanitation: History, methods and future challenges. *International Journal of Environmental Research and Public Health, 11*(8), 8137-8165. doi:10.3390/ijerph110808137

Bazzano, A. N., Martin, J., Hicks, E., Faughnan, M., & Murphy, L. (2017). Human-centred design in global health: A scoping review of applications and contexts. *PLoS One, 12*(11). doi:10.1371/journal.pone.0186744

Bilal, N. K., Herbst, C. H., Zhao, F., Soucat, A., & Lemiere, C. (2011). Health Extension Workers in Ethiopia: Improved access and coverage for the rural poor. In *Yes Africa Can: Success Stories from a Dynamic Continent* (pp. 433-443). Washington, DC: World Bank.

Birks, M., & Mills, J. (2015). *Grounded theory: A practical guide* (Second edition). SAGE.

Brown, T., & Wyatt, J. (2010). Design thinking for social innovation. *Development Outreach, 12*(1). doi:10.1596/1020-797X_12_1_29

Cole, B., Pinfold, J., Ho, G., & Anda, M. (2013). Exploring the methodology of participatory design to create appropriate sanitation technologies in rural Malawi. *Journal of Water, Sanitation and Hygiene for Development, 4*(1), 51-61. doi:10.2166/washdev.2013.166

Creswell, J. W. (2015). *A concise introduction to mixed methods research*. SAGE.

Cumming, O., & Cairncross, S. (2016). Can water, sanitation and hygiene help eliminate stunting? Current evidence and policy implications. *Maternal & Child Nutrition, 12*, 91-105. doi:10.1111/mcn.12258

Cumming, O., Arnold, B. F., Ban, R., Clasen, T., Mills, J. E., Freeman, M. C., Gordon, B., Guiteras, R., Howard, G., Hunter, P. R., Johnston, R. B., Pickering, A. J., Prendergast, A. J., Prüss-Ustün, A., Willem Rosenboom, J., Spears, D., Sundberg, S., Wolf, J., Null, C., . . . Colford, J. M. (2019). The implications of three major new trials for the effect of water, sanitation and hygiene on childhood diarrhea and stunting: A consensus statement. *BMC Medicine, 17*(1). doi:10.1186/s12916-019-1410-x

Diallo, M. O., Hopkins, D. R., Kane, M. S., Niandou, S., Amadou, A., Kadri, B., Amza, A., Emerson, P. M., & Zingeser, J. A. (2007). Household latrine use, maintenance and acceptability in rural Zinder, Niger. *International Journal of Environmental Health Research, 17*(6), 443-452. doi:10.1080/09603120701633529

Dreibelbis, R., Winch, P. J., Leontsini, E., Hulland, K. R., Ram, P. K., Unicomb, L., & Luby, S. P. (2013). The Integrated Behavioural Model for Water, Sanitation, and Hygiene: A systematic review of behavioural models and a framework for designing and evaluating behaviour change interventions in infrastructure-restricted settings. *BMC Public Health, 13*(1). doi:10.1186/1471-2458-13-1015

Eisenhardt, K. (1989). Building theories from case study research. *Academy of Management Review, 14*(4). doi:10.5465/amr.1989.4308385

Federal Democratic Republic of Ethiopia, Central Statistical Agency. (2007). *2007 population and housing census of Ethiopia*. Retrieved from http://www.csa.gov.et/

Federal Democratic Republic of Ethiopia, Central Statistical Agency. (2018). *The 2015/2016 Ethiopian Household Consumption-Expenditure (HCE) survey statistical report*. Retrieved from http://www.csa.gov.et/ehioinfo-internal?download=854:hce-2016-statistical-report-country-level

Federal Democratic Republic of Ethiopia, Ministry of Health. (2013). *National sanitation marketing guideline*. Retrieved from https://www.cmpethiopia.org/media/national_sanitation_marketing_guideline_20132

Fewtrell, L., Kaufmann, R. B., Kay, D., Enanoria, W., Haller, L., & Colford, J. M. (2005). Water, sanitation, and hygiene interventions to reduce diarrhoea in less developed countries: A systematic review and meta-analysis. *The Lancet Infectious Diseases, 5*(1), 42-52. doi:10.1016/s1473-3099(04)01253-8

GBD 2017 Risk Factor Collaborators (2018). Global, regional, and national comparative risk assessment of 84 behavioural, environmental and occupational, and metabolic risks or clusters of risks for 195 countries and territories, 1990-2017: a systematic analysis for the Global Burden of Disease Study 2017. *Lancet (London, England)*, *392*(10159), 1923–1994. https://doi.org/10.1016/S0140-6736(18)32225-6

Gelaw, A., Anagaw, B., Nigussie, B., Silesh, B., Yirga, A., Alem, M., Endris, M., & Gelaw, B. (2013). Prevalence of intestinal parasitic infections and risk factors among schoolchildren at the University of Gondar Community School, Northwest Ethiopia: A cross-sectional study. *BMC Public Health, 13*(1). doi:10.1186/1471-2458-13-304

Gelaye, B., Kumie, A., Aboset, N., Berhane, Y., & Williams, M. A. (2013). School-based intervention: Evaluating the role of water, latrines and hygiene education on trachoma and intestinal parasitic infections in Ethiopia. *Journal of Water, Sanitation and Hygiene for Development, 4*(1), 120-130. doi:10.2166/washdev.2013.060

Giles-Vernick, T., Traoré, A., & Sirima, S. B. (2011). Malaria, environmental change, and a historical epidemiology of childhood 'cold fevers': Popular interpretations from southwestern Burkina Faso. *Health & Place, 17*(3), 836-842. doi:10.1016/j.healthplace.2011.03.007

iDE. (2019). *2018 annual report* (Rep.). Retrieved from https://www.ideglobal.org/resources#annual-reports-financials

IDEO.org. (2015). *The field guide to human-centered design*. Retrieved from https://www.designkit.org/

Institute for Health Metrics and Evaluation (IHME). (2017). Ethiopia country data. IHME, University of Washington. Available from http://ghdx.healthdata.org/gbd-2017s

Jenkins, M. W., & Curtis, V. (2005). Achieving the 'good life': Why some people want latrines in rural Benin. *Social Science & Medicine, 61*(11), 2446-2459. doi:10.1016/j.socscimed.2005.04.036

Jenkins, M. W., & Scott, B. (2007). Behavioral indicators of household decision-making and demand for sanitation and potential gains from social marketing in Ghana. *Social Science & Medicine, 64*(12), 2427-2442. doi:10.1016/j.socscimed.2007.03.010

Langwick, S. A. (2007). Devils, parasites, and fierce needles: Healing and the politics of translation in southern Tanzania. *Science, Technology, & Human Values, 32*(1), 88-117. doi:10.1177/0162243906293887

Mitchell, P. D. (2016). *Sanitation, latrines and intestinal parasites in past populations*. Routledge.

Montgomery, M. A., Desai, M. M., & Elimelech, M. (2010). Assessment of latrine use and quality and association with risk of trachoma in rural Tanzania. *Transactions of the Royal Society of Tropical Medicine and Hygiene, 104*(4), 283-289. doi:10.1016/j.trstmh.2009.10.009

Montresor, A. (2012). *Eliminating soil-transmitted helminthiases as a public health problem in children: Progress report 2001−2010 and strategic plan 2011−2020*. Geneva: World Health Organization. Retrieved from https://www.who.int/neglected_diseases/resources/9789241503129/en/

National WaSH Steering Committee. (2018). *OneWaSH National Programme (OWNP) Annual report 2009EFY* (Rep.). Addis Ababa. Retrieved from https://www.cmpethiopia.org/media/ownp_2009efy_annual_report_27march.

Prüss-Ustün, A., Bartram, J., Clasen, T., Colford, J. M., Cumming, O., Curtis, V., Bonjour, S., Dangour, A. D., De France, J., Fewtrell, L., Freeman, M. C., Gordon, B., Hunter, P. R., Johnston, R. B., Mathers, C., Mäusezahl, D., Medlicott, K., Neira, M., Stocks, M., . . . Cairncross, S. (2014). Burden of disease from inadequate water, sanitation and hygiene in low- and middle-income settings: A retrospective analysis of data from 145 countries. *Tropical Medicine & International Health, 19*(8), 894-905. doi:10.1111/tmi.12329

Prüss-Ustün, A., Wolf, J., Bartram, J., Clasen, T., Cumming, O., Freeman, M. C., Gordon, B., Hunter, P. R., Medlicott, K., & Johnston, R. (2019). Burden of disease from inadequate water, sanitation and hygiene for selected adverse health outcomes: An updated analysis with a focus on low- and middle-income countries. *International Journal of Hygiene and Environmental Health, 222*(5), 765-777. doi:10.1016/j.ijheh.2019.05.004

Rogers, E. M. (1995). *Diffusion of innovations* (4th ed.). New York, NY: Free Press.

Sommer, M. (2010). Putting menstrual hygiene management on to the school water and sanitation agenda. *Waterlines, 29*(4). doi:10.3362/1756-3488.2010.030

The human rights to safe drinking water and sanitation, GA Res 70/169, UNGA 70th session, A/RES/70/169 (17 December 2015), available from undocs.org/en/A/RES/70/169.

Transforming our world: the 2030 Agenda for Sustainable Development, GA Res 70/1, UNGA 70th session, A/RES/70/1 (25 September 2015), available from undocs.org/en/A/RES/70/1.

Wang, H., Tesfaye, R., Ramana, G. N., & Tesfaye Chekagn, C. (2016). *Ethiopia Health Extension Program: An institutionalized community approach for universal health coverage* (Publication). Washington, DC: World Bank. doi:10.1596/978-1-4648-0815-9

Wilson, R., Faris, K., Getaneh, A., & Admasu, A. (2018). *One WaSH National Programme, a multi-sectoral SWAp: Phase II programme document* (Rep.). Retrieved from https://www.cmpethiopia.org/media/ownp_phase_ii_final_version_2019.

Workneh, T., Emirie, G., Kaba, M., Mekonnen, Y., & Kloos, H. (2018). Perceptions of health and illness among the Konso people of southwestern Ethiopia: Persistence and change. *Journal of Ethnobiology and Ethnomedicine, 14*(1). doi:10.1186/s13002-018-0214-y

Wolf, J., Hunter, P. R., Freeman, M. C., Cumming, O., Clasen, T., Bartram, J., Higgins, J. P. T., Johnson, R., Medlicott, K., Boisson, S., & Prüss-Ustün, A. (2018). Impact of drinking water, sanitation and handwashing with soap on childhood diarrhoeal disease: Updated meta-analysis and meta-regression. *Tropical Medicine & International Health, 23*(5), 508-525. doi:10.1111/tmi.13051

World Health Organization. (2014, November 17). Five moments for hand hygiene. Retrieved from https://www.who.int/gpsc/tools/Five_moments/en/

World Health Organization. (2019). *National systems to support drinking-water, sanitation and hygiene: Global status report 2019. UN-Water global analysis and assessment of sanitation and drinking-water (GLAAS) 2019 report* (Rep.). Geneva. Retrieved from https://www.who.int/water_sanitation_health/publications/glaas-report-2019/en/.

World Health Organization. (1997). Chapter 6: Houseflies. In J. A. Rozendaal (Ed.), *Vector control: Methods for use by individuals and communities*. Geneva: World Health Organization.

(WHO & UNICEF) World Health Organization (WHO) and the United Nations Children's Fund (UNICEF) Joint Monitoring Programme. (2016). *Ethiopia sub-national household sanitation service levels* [Data set]. Retrieved from https://washdata.org/data/household

(WHO & UNICEF) World Health Organization (WHO) and the United Nations Children's Fund (UNICEF) Joint Monitoring Programme. (2017). *Progress on sanitation and drinking water: 2017 update and SDG baselines* (Rep.). Geneva: UNICEF and World Health Organization.

(WHO & UNICEF) World Health Organization (WHO) and the United Nations Children's Fund (UNICEF) Joint Monitoring Programme. (2019). *Progress on household drinking water, sanitation and hygiene 2000-2017: Special focus on inequalities* (Rep.). New York: UNICEF and World Health Organization.

Ziegelbauer, K., Speich, B., Mäusezahl, D., Bos, R., Keiser, J., & Utzinger, J. (2012). Effect of sanitation on soil-transmitted helminth infection: Systematic review and meta-analysis. *PLoS Medicine, 9*(1). doi:10.1371/journal.pmed.1001162