



**ADDIS ABABA UNIVERSITY
COLLEGE OF DEVELOPMENT STUDIES
CENTER FOR RURAL DEVELOPMENT**

**WOMEN'S ACCESS TO AND UTILIZATION OF RURAL HEALTH
EXTENSION SERVICE AND ITS EMPOWERMENT EFFECT:
FOCUSING ON SANITATION AND HYGIENE SERVICES IN EAST
GOJJAM ZONE, NORTHWEST ETHIOPIA**

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DOCTOR OF PHILOSOPHY IN DEVELOPMENT STUDIES (RURAL
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**A Doctoral Dissertation Submitted to Center for Rural Development, College
Of Development Studies, Addis Ababa University**

**In Fulfillment of the Requirements for the Degree of Doctor of Philosophy in
Development Studies (Rural Development)**

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Declaration

I, the undersigned, declare that this PhD dissertation is a result of my research investigations and findings. Sources of information other than my own have been acknowledged and a reference list has been appended. This work has not been previously submitted to any other university for award of any type of academic degree.

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Abstract

Access to sanitation and hygiene facilities and the practice thereof have become the most pressing development and human right concerns of the 21st. The global community has pledged to achieve universal access to sanitation and hygiene by 2030 under the umbrella of SDG. The Ethiopian government has also promoted safe sanitation and hygiene through its rural health extension program since 2004. The program has targeted women as both service providers and beneficiaries and aimed to empower them and the community at large. But, women's level of access to and utilization of the said facilities is far from investigation. Women are disproportionately affected by poor sanitation and hygiene due to traditional gender roles and biological factors such as menstruation, pregnancy and nursing. The traditional gender division of labor makes women to conduct more sanitation and hygiene related works which in turn contribute to the burden of unpaid domestic work and limit their time for income generation, decision making and leisure. Despite such important links sanitation and hygiene have on women empowerment, empirical evidences are negligible. This study is, therefore, aimed to assess the availability of sanitation and hygiene facilities, the practice thereof by women and its effect on empowerment. The determinants of women's sanitation and hygiene access and utilization are also other objectives of the study. The study used mixed method research approach and data was collected from Dec 2018-March 2019 in two districts of East Gojjam zone, Amhara region, Ethiopia. For the quantitative part, a total of 380 women have been selected using multistage cluster sampling technique and data was collected using questionnaire. Interview and observation methods were also employed to generate qualitative data that supplement the quantitative analysis. A total of 30 women have been selected using convenience sampling technique and data is analyzed using thematic analysis. The quantitative data collected through questionnaire is analyzed using IBM SPSS version 20 and Stata /SE 14.0. Descriptive statistics is used to analyze women's level of sanitation and hygiene access and utilization while proportional odds model and partial proportional odds model are used to estimate the association between different factors and women's sanitation and hygiene access and utilization level. The study found that a large number of women have high sanitation access (42.6%, n=162) but in terms of utilization a large majority of them (50.85%, n=193) have low sanitation utilization indicating a mismatch between sanitation access and utilization. In relation with hygiene access, however, a slightly larger number of women have medium hygiene access (46.6%, n=177) and utilization (53.2%, n=202) status. The PPOM estimation has identified marital status, district, occupation, household income and wealth, participation in women health development team, frequency of health extension contact, household size and dependency ratio as the key determinants of women's level of access to sanitation facilities while the POM analysis shows that household size, access to sanitation facilities, and knowledge about the benefit of latrine utilization have significant association with women's level of sanitation utilization. Sanitation and hygiene utilization are found to have statistically significant association with women empowerment. A woman who has high level of sanitation utilization is, on average, 36% more likely to be empowered than a woman who has low level of sanitation utilization. Similarly, a woman who has high level of hygiene utilization is, on average, 16% more likely to be empowered than a woman who has low level of hygiene utilization. On the contrary, statistical significant association is not found between sanitation and hygiene access and women empowerment; signifying that the mere presence of sanitation and hygiene facilities has no effect on women empowerment unless it is actually utilized. Therefore, it is recommended that the government should strengthen its work towards promoting and monitoring not only the access to sanitation and hygiene facilities but also their utilization.

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Abbreviations and Acronyms

EDHS= Ethiopian Demographic and Health Survey

EPRDF= Ethiopian People's Revolutionary Democratic Front

Gologit2=Generalized ordered logistic regression

HEW= Health Extension Worker

HEP= Health Extension Program

MDG= Millennium Development goal

Ologit=Ordered logistic regression

PHC= Primary Health Care

PPOM= Partial Proportional Odds Model

POM= Proportional Odds Model

SDG= Sustainable Development goal

UN= United Nations

UNICEF=United Nations Children's Fund

WHO=World Health Organization

WHDT= Women Health Development Team

Definitions of Local Terms

- Areki- homemade alcoholic beverage made from different cereals and hop.
- Dega- is a traditional climatic zone found between altitudes 2,500 and 3,500 meters above sea level and its temperature ranges from 10 to 15 degrees Celsius. It is equivalent to temperate climatic zone
- Derg- is a geez word which means committee and this committee rules the country from 1974 to 1991
- Kebele- is the lowest administrative area which has at least 5,000 people.
- Woreda- is an administrative area which is found in the middle of zone and kebele administrations in the current administrative division of the country. It is district level of administrative Unit.
- Woyna Dega- is a traditional climatic zone between altitudes 1,500 and 2,500 meters above sea level and its temperature ranges from 15 to 20 degrees Celsius. It is equivalent to subtropical climatic zone.
- Protected spring- natural springs protected from contamination by constructing structures at their sources. Some are without distribution pipelines (capped at spot) and others are with distribution pipelines and more than one water point.
- Jerrican- plastic container used to fetch water
- Drinking water- water used for drinking, cooking, washing and cleaning

CHAPTER 1: INTRODUCTION

1.1 Background of the Study

Sanitation and hygiene is one component of the rural health extension program in Ethiopia. The rural health extension program was introduced in 2003. The program is part of the global health preventive and promotive movement that has begun in 1978 at Alma Ata during the first international conference on primary health care. The conference was organized by UNICEF & WHO in response to widespread lack of access to health care services in rural areas of developing countries and it is considered as the landmark event for the emergency of the concept of primary health care. The conference has resulted in the declaration of “health for all by the year 2000” (Cueto, 2004, Topp & Abimbola, 2018) and primary health care was seen as the route to health for all (Getachew,1990). Since, the Alma-Ata conference, different primary health care programs which correspond to the health extension program in Ethiopia have been introduced in countries such as Brazil, Nepal, Pakistan, India, Uganda, Indonesia, Tanzania and Venezuela (Kloos, 1998).

The concept of primary health care was first used in Ethiopia during the socialist government or Derg administration (1974-1991). The Ethiopian health policy during this time was formulated in line with the Alma Ata Declaration and in the government's democratic revolution declaration of 1976 where the provision of adequate health services for the broader mass was pledged (Getachew, 1990; Kloos, 1998). The Derg policy emphasized disease prevention and control and gives priority to rural health services, and community participation. The ten-year health plan (1984/85-1993/94) prepared following the then policy outlined for the development of 36,000 community health service centers and stations, each run by a community health agent and a trained traditional birth attendant. The plan has also aimed to serve 1,000 rural people by one community health agent and a trained traditional birth attendant (Provisional Military Government of Socialist Ethiopia, 1984 cited in Kloss, 1998). In practice, however, the plan was not fully implemented. Organizational weakness, lack of budget, poor selection of community health workers, low accessibility and transportation problems have made the primary health care program also known as a community health agent program to deteriorate. The prolonged civil

war and recurrent famine have also weakened both the primary health care program and the Derg itself (Kloss, 1998).

When the Ethiopian People's Revolutionary Democratic Front (EPRDF) came to power in 1991, it did not invest in the Derg's community health agent program for ten years. EPRDF, instead, has begun to invest in the newly designed health extension program developed with core elements of the principles of the Alma Ata primary health care declaration namely; community participation, emphasis on preventive and promotive health care services, application of locally available technology and multisectoral approach to expand access and coverage (Maesa, Closser, Vorel & Yihenew, 2015). The health extension program has first started in 2003 in rural areas and later expanded to urban and pastoralist areas and now it has become a nationwide platform. The program is aimed to create health awareness and ultimately achieve an empowered and healthy society through the provision of health education and communication services via health extension workers. The program focuses on households and gives special emphasis on women and children. Women are given greater importance both as service providers and beneficiaries. As beneficiaries, they are given greater responsibility to protect their own and their communities' health through the adoption of better health practices such as washing hands with soap and treating drinking water before consumption among others. As service deliverers, health extension workers are deliberately made to be women and their selection is seen as an aspect of empowerment as they will get employed. Two female extension workers are assigned in each rural kebele and they are expected to provide health education and promotion services both at household level and in health posts. At the household level, health extension workers are expected to promote the adoption and utilization of sanitation and hygiene facilities such as latrine construction and usage, construction of separate housing for people and domestic animals, utilization of safe drinking water storage and transportation facilities, personal hygiene management and adoption of safe domestic liquid and solid waste disposal practices. They also promote the utilization of reproductive health services such as antenatal care, delivery, breastfeeding and family planning. At the health post level, they are expected to provide injectable contraception, and limited curative services such as provision of anti-malaria treatment, first aid, and management of diarrheal diseases and intestinal parasites (Canavan et al., 2017 & Bilal et al., 2011). In sum, the program focuses on women because health communication is believed to be easier between women service providers and women

beneficiaries than among different sexes (Bilal, Herbst, Zhao, Soucat & Lemiere, 2011). Thus, it is possible to say that the health extension program is devised based on the assumption that women will empower themselves and also empower each other.

So far, the program has been implemented in two phases:-The first phase has run from 2004-2015, and the second phase is running since 2016. The focus of the program during the first phase was on training and deployment of health extension workers, construction of health posts and expansion of health extension service coverage while the emphasis in the second phase is providing quality services besides expanding the health services coverage. In both phases, however, the health extension services were given as a package. There were 16 health extension packages during the first phase, and these have increased to 18 during the second phase. In both phases, the packages were categorized into four main themes; hygiene and environmental sanitation, disease prevention and control, family health, and health education and communication. The health education and communication component is a cross cutting issue or it is a tool for the implementation of all the packages while the rest three themes have their own several kinds of health extension services under their umbrella. The disease prevention and control theme, for instance, has around six components which includes prevention and control of malaria, prevention and control of tuberculosis and leprosy, prevention and control of HIV/AIDS and other sexually transmitted infections, prevention and control of major non-communicable diseases, prevention and control of neglected tropical disease and first aid. Similarly, the family health services theme has consisted of services such as maternal and neonatal health, family planning, adult and youth health and immunization. In the same manner, the environmental sanitation and hygiene component of the rural health extension program consists of services such as food and water hygiene, personal hygiene, institutional hygiene, healthy housing, and construction and use of a latrine, and solid and liquid waste disposal facilities. Since it is impossible to address all the core themes and focus areas of the health extension program, the present study has focused only on the access and utilization of sanitation and hygiene services in some selected kebeles of east Gojjam zone, North West Ethiopia.

1.2 Statement of the Problem

Sanitation and hygiene have become the most pressing development issues of the 21st century and their achievement is important for healthy living, empowerment and economic development (Ohwo, 2019). The international community has pledged to achieve better sanitation and hygiene access and utilization in different times. In the year 2000, for instance, the United Nation [UN] and its member states, under the millennium development goals [MDG], have agreed to reduce the number of people without access to safe drinking water and basic sanitation between 1990 and 2015 by half. The same community has again promised to achieve universal access to safe water, sanitation and hygiene by 2030 under the umbrella of sustainable development goals. In its human right to sanitation and water framework, UN (2010) has further declared that all humans should have access to safe and affordable drinking water and sanitation services at all times (cited in Ohwo, 2019).

These global efforts have brought a notable achievement in improving access to water and sanitation globally. An instance of this is that MDG target for halving the proportion of people without access to safe drinking water was met in 2010 by many countries except in sub-Saharan Africa, Central Asia, Northern Africa, and Oceania (UNICEF & WHO, 2015). By the end of the MDG period (2015), 91% of the world population had access to an improved source of drinking-water compared with 76% in the base year (1990) (World Health Organization [WHO], 2016). Ethiopia, despite being in Sub-Saharan Africa was able to achieve the MDG target for water by making 57% of its population to have access to improved drinking water (97% in urban areas and 42% in rural areas) (ibid).

In spite of the positive achievements so far, there are still inequalities and unmet sanitation and hygiene needs. The MDG target for sanitation has not been achieved both in Ethiopia and elsewhere. In 2015, about 2.3 billion people worldwide did not have a basic sanitation service and about 892 million people were practicing open defecation (WHO & UNICEF, 2017). Sub-Saharan Africa had the lowest rate of sanitation coverage globally and only 17% of the population had access to sanitation compared with 50% in West Asia and 41% in North Africa (Roche, Bain & Cumming, 2017). The case is not different in Ethiopia. In 2015, one in three (32%) households had no toilet facility at all (39% in rural and 7% in urban areas) (CSA & ICF, 2016) and about 41% of the population had no handwashing facility (46% in rural and 19% in

urban areas) (UNICEF & WHO JMP, 2019). Soap and water, the essential hand washing agents were absent in 68% of rural households. On a regional basis, the availability of soap and water was high in Addis Ababa (39%) and low in Amhara region (5%) (CSA & ICF, 2016). Two years after the MDG has ended and sustainable development goal was introduced, about 144 million people across the globe used surface water sources for drinking, 1.4 billion had no handwashing facility at all and 673 million practiced open defecation (UNICEF & WHO JMP, 2019).

Lack of sanitation and hygiene is severe in rural areas and it affects women who need them the most. UNICEF & WHO progress reports show that water, sanitation and hygiene services are better available in urban areas than in rural areas. Globally, 84% of the rural population in 2015 had access to improved drinking water sources compared with 96% in urban areas. About 51% of the global rural population had access to improved sanitation facilities compared with 82% in urban areas (WHO, 2016). In sub-Saharan Africa, 33% of the population in urban areas had piped water on premises compare with 5% in rural areas and 15% of the rural population used surface water for drinking compared with 2% in urban centers (Ohwo, 2019). In the same vein, about 97% of urban households in Ethiopia had access to an improved source of drinking water compared with 57% in rural areas. Besides, about 77% of households in urban areas had piped water in their premises compared to 6% in rural areas (CSA & ICF, 2016).

In case of poor sanitation and hygiene access, women suffer more than men. Menstruation, pregnancy, childbirth and nursing all create women specific sanitation and hygiene needs (Sweetman & Medland, 2017). Women are also responsible for the sanitation and hygiene needs of others and the responsibility is too high in households and communities who do not have access to the said facilities. In areas where water is scarce, women save water for other family member's consumption regardless of their own needs. A study by Rheingans, Anderson, Luyendijk & Cumming (2013) on water insecurity and its impact on women in rural Ethiopia found that 27.8% of women surveyed have reduced the amount of water they used for bathing, 12.7 % went to bed thirsty and 3.7 % went an entire day without drinking water. Women are highly responsible for water collection sometimes from sources located far from home (UNICEF & WHO JMP, 2019). According to Graham, Hirai & Kim (2016), more than two-thirds of women in Sub-Saharan Africa leave their home to collect water and about, 14 million women spend more than 30 minutes each day to undertake the same task. In the same way, more than

half of women (53%) in rural Ethiopia travel 30 minutes or longer round trip to fetch drinking water (CSA & ICF, 2016). Altogether, women spend several hours every day traveling to water sources and carry heavy loads and this will take their time and energy which could be used for income generating activities, schooling, community activities and leisure time. This burden is much worse for women who are pregnant and carrying children. Carrying water containers on head and back are reported to bring back, neck and head pain, fatigue, musculoskeletal and early degenerative bone and soft tissue damages (Geere, Hunter, & Jagal, 2010; Graham, Hirai & Kim, 2016). Women are also exposed to infectious disease risks such as Shistosomes (snail fever) contracted through contact with contaminated water (Cairncross & Cliff, 1987 cited in Graham, Hirai, Kim, 2016). Risk of sexual violence, as well as the stress associated with that risk, also increases when women travel long distances away from home to collect water (Sommer, Ferron, Cavill & House, 2015 cited in Graham, Hirai & Kim, 2016). Just as water, lack of sanitation facilities such as latrine and other waste disposal facilities brings poor health in women. Though open defecation is an issue that can affect both men and women, women are often at more risk of experiencing violence and multiple health vulnerabilities (Carolini, 2012 cited in Saleem, Burdett & Heaslip, 2019). Women with no access to toilet predominantly suffer from diarrheal diseases (Corburn & Hildebrand, 2015 cited in Saleem, Burdett & Heaslip, 2019). They also become vulnerable to verbal, physical and sexual forms of violence when they travel far from their house to defecate (Fiasorgbor, 2013 cited in Saleem et al., 2019). In cases where there is no latrine, women have to wait for dark to eliminate their wastes and this is reported to cause urinary tract infection, stress and discomfort (SIDA, 2015). The impact is relatively severe for women in their reproductive age as they face an added challenge of managing their menstruation. Menstrual blood is considered as taboo and clothes used during menstruation need to be washed in secrete (Sweetman & Medland, 2017). Therefore, lack of sanitation and hygiene facilities and materials such as latrine and sanitary pads inhibits women to manage their menstruation safely, comfortably and with dignity. All in all, because of women's biological feature and their involvement in domestic works, they are more in need of and linked to sanitation and hygiene and lack of such facilities disproportionately affects them. Regardless of such important links women have with sanitation and hygiene, studies on women's access to and utilization of such services and facilities are limited. Some of the available empirical studies have focused on households and used women as a source of information for the household level analysis, simply

in their role as mothers and caretakers and not as an independent individual. These kinds of studies have focused on households and did not give attention to the individual differences within the household. Other studies have focused either only on a specific sanitation and hygiene intervention such as latrine, water or menstrual hygiene and ignored the multidimensionality of sanitation and hygiene concepts. Still, more others have treated sanitation and hygiene concepts as if they mean the same thing and failed to provide any conceptual distinction between what sanitation actually means and hygiene implies. Similarly, the term access and utilization have also been used interchangeably without providing conceptual clarification. More importantly, empirical studies that have tried to see the link between sanitation and hygiene and women empowerment have focused on how empowerment of women has contributed for better sanitation and hygiene achievement and ignored how better sanitation and hygiene has contributed for women empowerment. In doing so, empowerment is seen as a tool to obtain sanitation and hygiene improvement instead of enhancement in women's own life. Most qualitative reports claiming the relationship between access to sanitation and hygiene facilities and women empowerment are made by NGOs working in the WASH sector and there are no empirical evidences. Besides, most sanitation and hygiene related studies are conducted based on their relationship with the incidence of disease but not on empowerment. In short, women's access to and utilization of sanitation and hygiene facilities and its empowerment effect is under-researched area including in a specific Ethiopian context. This research, therefore, argues that women empowerment should not be always measured against the successes of sanitation and hygiene projects and improvements in women's own life situation, their decision making power, their self-esteem and their participation in development activities as a result of the interventions should be investigated and measured. Empowerment of women is a prerequisite for achieving people centered development and without the power to secure essential resources such as sanitation and hygiene, it is difficult to bring empowerment.

1.3 Research Objectives

1.3.1 General Objective

The general objective of this study is to assess women's level of access to and utilization of sanitation and hygiene facilities, determinant factors and its empowerment effect.

1.3.2 Specific Objectives

More specifically, the research attempts to:

1. Assess women's level of access to sanitation facilities.
2. Understand women's level of sanitation utilization and their lived experience
3. Examine women's level of access to hygiene facilities
4. Understand women's level of hygiene practice and their lived experience
5. Identify factors that determine women's access to sanitation facilities
6. Identify factors that determine women's access to hygiene facilities
7. Identify factors that determine women's utilization of sanitation facilities
8. Identify factors that determine women's hygiene practice
9. Analyze the effect of sanitation access and utilization on women empowerment
10. Analyze the effect of hygiene access and utilization on women empowerment

1.4 Research Questions

Arising from the study's objectives, this research addresses the following research questions:-

- How is women's access to sanitation facilities in the study area?
- How is women's utilization of sanitation facilities in the study area?
- To what extent do women have access to hygiene facilities in the study area?
- To what extent do women use hygiene facilities and how is their hygiene practice in the study area?
- What factors determine women's sanitation access?
- What factors determine women's sanitation utilization?
- What factors determine women's hygiene access?
- What factors determine women's hygiene utilization?
- Does access to sanitation and hygiene facilities empowered women?
- Does utilization of sanitation and hygiene facilities empowered women?

1.5 Scope of the Study

Writing the scope of a study requires identifying the limitations and delimitations of the study. Limitations are aimed to identify potential weaknesses of the study while delimitation is a choice/boundary made by the researcher. Thus, the limitation of the present study is that tools to measure empowerment in sanitation and hygiene sector are nonexistent despite the fact that there

are sector specific empowerment measurements such as empowerment in agriculture index, the women economic empowerment index and the women empowerment in health index. The women empowerment in health index also known as the SWPER index has identified questions that are relevant to measure women empowerment in health interventions. However, some of the questions such as beating not justified if the wife refuses to have sex with a husband and age of woman at first birth have no direct relation with sanitation and hygiene. These indicators are more appropriate to analyze women empowerment in reproductive and maternal health interventions. Thus, due to lack of tools specifically designed to measure empowerment in the WASH sector, the present study has used different empowerment indicators identified from existing literatures. The second limitation of this study is that all sanitation and hygiene related practices were self-reported by women. Thus, the self-reported sanitation and hygiene practices of women might have brought a bias towards positive sanitation and hygiene related behavior. The third limitation of the study is that the research has focused on the experience of women, and the experiences of men are not included.

When it comes to the delimitation of the study, this research has delimited itself to the sanitation and hygiene component of the health extension program. Other components of the program are not considered. The health extension program has 18 packages. Since, it has been impossible to cover all these packages; the scope of the study has been narrowed down only to sanitation and hygiene services. The paper has also looked into women's access to and utilization of sanitation and hygiene facilities in two woredas of east Gojjam zone. Hence, the study is geographically delimited in two rural woredas.

Furthermore, empowerment is a broader concept which can be measured in different dimensions. This study has, however, focused only on women's self-esteem, household decision making and participation in health related development activities. Other dimensions of empowerment such as economic empowerment in terms of women's involvement in income generating activities as a result of better sanitation and hygiene services access and utilization are not considered.

1.6 Significance of the Study

This study has conceptual/theoretical, methodological and practical significance. Theoretically, the concepts of access and utilization and sanitation and hygiene have their own meanings. Yet, most of the existing literature has blurred their distinction so far. The interchangeable usage of seemingly similar but different concepts has created confusion. In this study, an attempt has been made to clarify and identify access from utilization and sanitation from hygiene. In doing this, the study will add to the existing body of knowledge on the subject matter by improving the conceptual definitions of the original constructs. By examining these different and overlapping concepts, the study will also help to understand the complex phenomena of sanitation and hygiene as well as access and utilization.

Many studies have been conducted on sanitation access and utilization. However, sanitation was mostly measured by a single indicator that is latrine. But, sanitation is not only about latrine. It consists of other waste disposal facilities as well. Similarly, hygiene is not about handwashing facility. It also includes safe water handling mechanisms and menstrual hygiene management. Therefore, this broader view of sanitation and hygiene and the corresponding methodology used to analyze the data will add greater significance to the existing knowledge on methodology. Besides, researchers have treated access and utilization as binary outcomes: access, no access, utilize, do not utilize. However, people have different level of access to and utilization of sanitation and hygiene facilities. Some have no access, some have relatively better access and other have high access and the same is true for utilization and empowerment. Therefore, the treatment of the outcome variables; access, utilization and empowerment as ordinal variables will have knowledge contribution on data analysis methodology.

Thirdly, there are very few researches conducted on the association between sanitation and hygiene access and utilization, and women empowerment. On the contrary, empowerment has become one of the goals of sanitation and hygiene interventions. This study will therefore contribute empirical knowledge to this trending issue.

1.7 Challenges

A lack of conceptual clarity on the difference between access and utilization, sanitation and hygiene in the literature reviewed has posed a particular challenge. Even where the outcomes under investigation were termed the same as sanitation, hygiene, access, utilization and empowerment, the measures for the outcomes were often unclear, mixed or even undefined and this has posed a particular challenge.

Participants' expectation to obtain financial aid from the researcher was also a big challenge. Besides, they were expecting the researcher will solve their problem, particularly of water problem. The political unrest throughout the country and related government measures such as shutting down of internet and power cut, mob attack of researchers particularly on health related issues in Amhara region which is related to the political unrest, covid 19 pandemic and stay at home measures were also added challenges to finish the research as planned.

1.8 Organization of the Dissertation

The dissertation is organized in eight chapters. The first chapter is an introductory chapter and presents background of the study and statement of the problem among others. The second chapter reviews the conceptual, theoretical and empirical literature as well as the conceptual framework of the research. The third chapter explains the philosophical foundation of the research, research design and research methods (data sources and types, instruments of data collection, sampling and sample size and techniques of data analysis). The fourth chapter presents the descriptive statistics particularly the socioeconomic and demographic characteristics of respondents and their level of sanitation and hygiene access and utilization. Chapter five and six explain the determinants of access to and utilization of sanitation and hygiene facilities respectively. Chapter seven describes the effect of access to and utilization of sanitation and hygiene facilities on women empowerment and the last chapter presents conclusion and recommendation.

CHAPTER 2: REVIEW OF RELATED LITERATURE

2.1 Concepts and Definitions of Health Service Access and Utilization

Access and utilization are the most commonly used words in development-related literature particularly in agricultural extension and health promotion fields. Their conceptual difference and similarity are, however unclear. Though, the title of many scholarly works is about access and utilization, their content inside has failed to provide conceptual clarification of what access really means and what utilization denotes. In some literature, access and utilization are seen as synonymous and used interchangeably while in others, they are defined and measured in their own right. Overall, the term access and utilization are not only unclear in sanitation and hygiene sector but also in the general health sector as well. Donabedian (1972), for instance, has defined health service access as “the use of services and not simply the presence of a facility” (cited in Aday & Andersen, 1974, p.219). In contrast, Fiedler (1981) and Oliver & Mossialos (2004) stated that access should not be equated with the use of services and shows how access and utilization are different concepts. According to Fiedler, access is a prerequisite for utilization and he termed the concept of access as potential utilization (opportunity to use the facilities available) while utilization is defined as the actual use of the facilities or realized access. Added to Fiedler’s point, Oliver & Mossialos (2004) argued that the availability of health facilities does not provide evidence of people’s utilization of the facilities, but utilization is evidence that access has been achieved. It is true that a service may be technically available, but some people may not use it showing how access and utilization are different concepts. Related to this, Lopez et al. (2019) stated that latrine access does not indicate use as many individuals who own latrines do not consistently use them. Bindari (1992) on her part has also stated that utilization of health services is expressed as the proportion of people who actually received the services, such as, the proportion of children who are immunized, the proportion of pregnant women who receive prenatal care, or have their deliveries supervised by a trained attendant (cited in Rahman, 2001). Similar to Bindari’s definition of health care utilization, Shengelia et al. (2003) have defined utilization as “quantity of health care services and procedures used” (cited in Levesque, Harris & Russell, 2013).

The present study also views the concept of access and utilization as different ideas. The concept of access itself is complex and sometimes used interchangeably with other concepts as equity, availability, and coverage, and equating it with utilization is problematic. Related to this, Penchansky & Thomas (1981) in their access framework, which is sometimes called theory of access have provided five dimensions of access; - availability, accessibility, affordability, accommodation, and acceptability. Similarly, UN in its 2010 human right to water and sanitation framework has provided four different access indicators; - availability, physical accessibility, quality and safety, affordability and acceptability (Hall, Van Koppen, & Van Houweling, 2013).

Availability refers to the presence of health services, resources and programs (Penchansky & Thomas, 1981; McIntyre, Thiede & Birch, 2009). Availability in the water and sanitation sector refers to the presence of sufficient and continuous water and sanitation supply systems (Kirschner, 2011). UN (2010) has provided three indicators to measure water availability. The indicators are (1) sufficient quantity (real water consumption in litres per person per day); (2) survey respondents' perception of water amount availability; and (3) reliability of supply (daily provision of water or not) (cited in Flores, Jiménez, & Pérez-Foguet, 2013). According to WHO, the indicator for sufficient water quantity is measured by individual's water requirement criteria. Accordingly, consumption of 5 liters of water per capita per day is considered as no access, and consumption of 20 litres of water per capita per day is considered as having a basic or minimum access while consumption of 100-200 litres per capita per day is considered as optimal access. Consumption of 50 liters per capita per day on average is considered as intermediate access (WHO drinking-water quality guidelines, 2011:84). Consumption in this context refers to water used for drinking, cooking and personal and domestic hygiene.

Accessibility, according to Penchansky & Thomas (1981) is the relation between the location of the facility and of beneficiaries taking account of travel time from the location of service users to the location of the service, transportation cost and means of transport. When this is translated into water and sanitation sector, it is taken to mean that water and sanitation facilities must be located or constructed within or in close proximity of each household (Hall, Van Koppen & Van Houweling, 2013). Accessibility also requires sanitation and hygiene facilities to be within safe physical reach (Flores, Jiménez, & Pérez-Foguet, 2013). In other words, physical security should not be threatened during access to water and sanitation facilities and services (United Nations,

2002 cited in Flores, Jiménez, & Pérez-Foguet, 2013). Accessibility also includes awareness or information accessibility whereby individuals should be granted the right to receive and impart information concerning sanitation and hygiene issues through effective communication and information strategies (Kirschner, 2011; Saurman, 2015). The UN accessibility to drinking water criteria has provided two indicators; 1/proximity to the water point measured as total collection time and 2/water collector's perceptions about the physical security on the way to fetch water (Flores, Jiménez & Pérez-Foguet, 2013). In relation to proximity to the water point, WHO has recommended that the water source has to be within 1,000 meters of the home, and collection time should not exceed 30 minutes. In other words, if the distance between the water source and people's home is within 1 km or within 30 minutes round trips, it is considered as there is basic (minimum) access. In contrast, traveling more than 1 km or more than 30 minutes round trips to collect water is considered as no access to water. If there is at least one tap at yard/plot level, it is considered as there is intermediate access and if there are multiple taps within the house it is considered as having optimal access (WHO drinking-water quality guidelines, 2011: 84).

Affordability is concerned with the individual's ability to pay the cost of the facilities and technologies given other household expenditures such as food, cloth, childcare and lost income or productivity while attending health education and promotion services (Penchansky & Thomas, 1981). When it comes to affordability, the UN framework suggests that water and sanitation facilities and services should be affordable for all and no individuals or group should be denied access to safe drinking water and sanitation because they cannot afford to pay. This does not, however, imply that water and sanitation services should be provided free of any payment to everyone. Instead, the framework proposes that in certain circumstances, access to safe drinking water and sanitation should be provided for free if the person or household is unable to pay for it. The government is made responsible in ensuring the satisfaction of, at the very least, minimum essential levels of access to water by adopting free or low-cost water and sanitation facilities (Flores et al, 2013).

Acceptability refers to the beneficiaries' attitude and perception about the characteristics of sanitation and hygiene facilities and technologies. According to Kirschner (2011), sanitation facilities must not only be sufficiently available in terms of numbers but also of culturally

acceptable quality; hygienic and safe to use. Similarly, acceptability criterion in the water sector refers to the ideas that water should be of an acceptable odor, color and taste and it is also linked to user's perception about the quality of the water, whether chlorination is being practiced, and people's satisfaction with the properties of the water (Flores et al, 2013). Acceptability, as to Penchansky & Thomas (1981) also refers to attitudes and beliefs of users and providers about each other's characteristics. In other words, acceptability refers to the beneficiaries' attitude about provider's characteristics and vice versa. The beneficiaries' attitude about provider's characteristics and the health system itself can include perception of the people on the competence of the health service providers, negative experience with the health service system in the past, and the sex of the service provider. For instance, self-care or traditional healing may be seen as the most appropriate response to a particular illness than adopting what is recommended by the health extension workers such as construction and use of latrine and practicing safe handwashing. Penchansky & Thomas (1981) concept of accommodation is similar to the concept of acceptability. Accommodation refers to cultural acceptability or beneficiaries' perception of the appropriateness of services provided (McIntyre, Thiede & Birch, 2009). Finally, quality and safety, refers to the safety of the water and sanitation facilities. That is water should be free from diseases causing microbes and parasites, chemical substances and radiological hazards (Flores et al, 2013). Sanitation facilities shall be also safe to use and prevent contact between people and human excreta.

Access in this paper is therefore; defined as the availability or the physical existence and accessibility of sanitation and hygiene facilities while utilization is seen as the practice or the actual utilization of the said facilities.

2.2. Concepts and Definitions of Sanitation and Hygiene

Sanitation and hygiene are poorly defined concepts. In many sanitation related studies, projects and interventions, sanitation is seen as synonymous with hygiene and or water and used interchangeably. Researchers have used sanitation and hygiene indicators altogether labeling their topic either as sanitation or hygiene and sometimes sanitation and hygiene without a clear differentiation of what is sanitation and what is hygiene. This interchangeable usage of seemingly similar but different concepts has brought inconsistencies in defining and measuring sanitation and hygiene. For instance, in their study of creating demand for sanitation and hygiene

through community health clubs in Zimbabwe, Waterkeyn & Cairncross (2005) have used sanitation and hygiene concepts interchangeably. Though their title says sanitation and hygiene, the authors did not give any conceptual clarity about what is sanitation and what is hygiene. They have used sanitation and hygiene indicators such as availability of ladle, individual cups, plates, pot racks, borehole water, rubbish pit, latrine and hand wash facility in mix and labeled them as hygiene. Similarly, Abate, Mesele, Zinau & Dejen (2018) have studied the availability and utilization of sanitation facilities in Tigray region and they have used the presence of latrine, hand washing facility near the latrine and presence of improved drinking water source as indicators of sanitation access. In doing this, the authors have mixed sanitation and water indicators altogether and label their title as sanitation. This mixed uses of sanitation and hygiene and water will make it difficult to clearly measure the existing sanitation and hygiene access and utilization separately. Integrating different intervention programs in one package will assist the development practitioners to save costs than providing either intervention alone. This, however, should not blur the academic community that these integrated interventions; water, sanitation and hygiene (WASH) should be studied in their own right as much resource, energy and attention could be given to one intervention and another might be over-passed.

Though there is a general lack of consistency and specificity in the indicators used to measure sanitation and hygiene access and utilization, some documents from different organizations and few scholarly works have provided conceptual clarity on sanitation and hygiene. For instance, the blended learning module on hygiene and environmental health for the rural health extension program of Ethiopia has defined hygiene as practices related to personal cleanliness such as cleanliness of the hair, body, hands, fingers, feet and clothing, and menstrual hygiene (the Open University, n.d.). Similarly, the Ministry of Health [MOH] (2011) in its hygiene and sanitation strategic action plan for rural, per-urban & informal settlements in Ethiopia, has defined hygiene as hand washing with soap and water at critical times, safe drinking water handling from source to the point of consumption, food hygiene, and menstrual hygiene and its management. Furthermore, the SDG in its target 6.2 has described availability of latrine as an indicator of sanitation and presence of hand washing facility as hygiene indicator. Giné Garriga & Pérez Foguet (2013a & 2013b) have also defined sanitation in terms of latrine availability, affordability, and utilization while hygiene was defined in terms of drinking water hygiene, food hygiene, personal hygiene and domestic household hygiene. Similarly, Webb et al. (2006) have

defined hygiene as whether interior water storage container is covered, clean dishes are covered, mother is wearing shoes, no trash outside house, exterior water storage container is clean, clean dishes are kept high, mother's hands are clean and no trash inside the house, all food is covered, child's hands are clean, no unrestrained animal in the house, no accumulation of dirty clothes, insignificant number of flies in the house, and no standing water in or around the house. Additionally, O.Sintondji, (2017) has measured hygiene using the sources of drinking water, transport, storage, handling and water treatment techniques, cleanliness of the container, whether the container is covered during transport, materials and location of the storage container, cleanliness of the collection cup, washing of hands before eating and after handling stools as indicators while place of defecation, existence of latrines, cleanliness of latrines, method of evacuation of waste water and household waste were used as indicators to measure sanitation. Akter et al. (2015) in their study of the status of water, sanitation, and hygiene in rural Bangladesh, have also measured respondents' hygiene practice by using indicators such as utilization of filtered or boiled surface water, safe collection and storage of drinking water, availability of hand washing station, and availability of water and soap near the latrine.

According to Evans (2005) sanitation includes latrine and solid waste collection and management while the World Health Organization (1988) and the rural health extension program of Ethiopia also included the need to have a separate dwelling for people and domestic animals as one part of the sanitation movement.

In sum, the term sanitation according to Pandve (2008) and Rautanen (2010) loosely falls under the broader definition of environmental sanitation, which refers to issues related to flood management, collection and disposal of garbage and removal of human excreta (cited in Montoute & Cashman, 2015) while hygiene refers to a practice that is either personal or domestic. Personal hygiene refers to the use of water for cleaning parts of the body while domestic hygiene refers to water used to clean items in the home such as food, utensils and floors (Esrey et al. 1991 cited in Montoute & Cashman, 2015).

In this paper sanitation and hygiene are seen differently. Hygiene is more related to practices such as menstrual hygiene management, availability of protected drinking water source, safe water use practice from source to the point of use, presence of hand washing facility at/ in the latrine, presence of water in the hand wash facility and presence of soap near to the hand

washing facility while sanitation is related to environmental cleanliness such as latrine availability and utilization, availability of separate dwelling for people and domestic animals, and household waste disposal practices (availability and utilization of garbage pits and domestic liquid waste disposal facility). Related to this, Imtiaz et al. (2015) in their study of the practice of personal hygiene among rural women in Bangladesh, have used hand washing and safe drinking water as a measure of hygiene practice while Nwakile, Celestina & Arinzechukwu (2017) have defined sanitation as the maintenance of hygiene conditions through services such as latrine use, garbage collection and waste water disposal.

2.3 Global Guidelines on the Concepts and Measurement of Sanitation and Hygiene Access and Utilization

2.3.1 Millennium Development Goals and Sanitation and Hygiene Access and Utilization

In September 2000, leaders from 189 countries have gathered to discuss about how to eradicate poverty and bring development. They have also adopted the United Nations Millennium Declaration which sets out quantified and time bounded targets with a deadline of 2015. The targets have become known as Millennium development goals and sanitation and water have become one of the targets (World Health Organization & UNICEF, 2006). The millennium development goal target 7.C has clearly outlined the need to reduce the number of people without sustainable access to safe drinking water and basic sanitation by half in 2015. The indicators proposed to measure progress towards this target are:-1/ proportion of the population using an improved drinking water source; and 2) proportion of the population using an improved sanitation facility. Access to safe drinking water is again estimated by the percentage of the population using improved drinking water sources which include piped water into dwelling, plot or yard, public tap/standpipe, tube well/borehole, protected dug well, protected spring and rainwater collection while access to improved sanitation is measured by the percentage of the population using latrines with flush or pour –flush to piped sewer system, septic tank or pit latrine, ventilated improved pit latrine, pit latrine with slab and composting toilet. The utilization of latrine with pour–flush to the street, yard or plot, a ditch, or a drainage way, utilization of pit latrine without slab or open pit, bucket, and practice of open defecation are considered as

unimproved sanitation facilities (World Health Organization & UNICEF, 2006). Improved water sources are also known as protected water sources while unimproved sources are known as unprotected sources and include unprotected dug well, unprotected spring, cart with small tank/drum, bottled water, tanker-truck and surface water (river, dam, lake, pond, stream, and canal and irrigation channels). The joint monitoring program of UNICEF and WHO which is a UN mechanism established to monitor water, sanitation and hygiene progress of the MDG has defined improved drinking water source as “type of water source that by nature of its construction is likely to be protected from outside contamination” (JMP, 2012). This JMP definition of improved water denotes water sources protected by stonework, concrete or other materials and are fully fenced or covered and no surface water and animal excreta can run directly into it and people do not step into the water while collecting it.

In summary, MDG has specified utilization as the measured variable. But, the improved and unimproved classification of sanitation and water facilities indicates the physical presence of the facilities not their utilization. Besides, MDG did not provide any hygiene specific target (Turman-Bryant, Clasen, Fankhauser & Thomas, 2018).

2.3.2 Sustainable Development Goals and Sanitation and Hygiene Access and Utilization

Millennium development goal has ended in 2015 and substituted by sustainable development goals. Sustainable development goals were developed based on the lessons learned from the MDGs and in contrary to the aim of halving the proportion of the population without access to water and sanitation by 2015 as stated under the MDG, SDG has targeted to achieve universal access to water and sanitation by 2030. More specifically the SDG target 6.1 is intended to achieve universal and equitable access to safe and affordable drinking water for all by 2030. Universal access is defined as providing access to 100% of the population including households, schools, health facilities, workplaces and public spaces while equitable access is defined as the elimination of inequalities between population subgroups (Génevaux et al., 2018). Similarly, safe drinking water is defined as water derived from improved sources based on MDG definition and used for drinking, cooking, food preparation and personal hygiene (Génevaux et al., 2018).

Similar to the water sector, sanitation related MDG was aimed at halving the proportion of the population without access to basic sanitation by half in 2015 but SDG in its target 6.2 is specifically designed to achieve universal access to adequate and equitable sanitation and hygiene by 2030, paying special attention to the needs of women and girls. Adequate sanitation access involves a system that hygienically separates excreta from human contact as well as safe treatment of excreta in situ, or safe transport and treatment off-site while equitable access implies the elimination of inequalities among population subgroups (ibid). Hygiene, which was not addressed in the MDGs, was also included in the SDG and defined as “conditions and practices that help maintain health and prevent spread of disease including handwashing, menstrual hygiene management and food hygiene” (Génevaux et al., 2018).

The JMP which was responsible for monitoring the 2015 Millennium Development Goal (MDG) target 7C is now responsible for tracking progress towards the 2030 sanitation and hygiene related Sustainable Development Goals (SDG) and defined the terms used in the targets. The concepts in the target are interpreted based on the MDG established improved and unimproved facility type classification and the newly introduced service ladder approach. During the MDG, drinking water sources and sanitation facilities were classified as improved and unimproved. In the SDG period, however, these improved and unimproved indicators are further classified based on a hierarchical scale and distinguishes different levels of access to water and sanitation. In other words, people using improved drinking water sources are subdivided into three groups as safely managed service, basic service and limited service. In order to meet the criteria for a safely managed drinking water service, people must use an improved drinking water source located on premises, available when needed, and is free from contamination. If the improved source does not meet any one of these criteria, but a round trip to collect water takes 30 minutes or less, then it will be classified as a basic drinking water service and if water collection from an improved source exceeds 30 minutes, it is categorized as a limited service. The use of surface water is defined as no service (UNICEF/WHO JMP, 2017). Safely managed drinking water services may be provided via piped networks or via non-piped supplies such as boreholes, protected wells and springs, rainwater harvesting or tanker trucks (Ibid).

Similarly, the JMP ladder approach has provided five indicators to measure progress in access to improved sanitation. The five service levels are safely managed service, improved facility/basic

service, shared facility, unimproved facility and open defecation. Safely managed sanitation service is defined as the use of improved facilities that are not shared with other households and where excreta are safely disposed of in situ or transported and treated offsite and which includes hand washing facilities. Basic sanitation facility refers to the use of improved facilities that are not shared with other households. These includes, flush/pour flush to piped sewer system or septic tank, pit latrine, ventilated improved pit latrine and composting toilet. Basic sanitation facilities in SGD were known as improved sanitation facilities in MDG (Hoek, Evans, Bjerre, Calopietro, Konradsen, 2010). Limited sanitation facility, on the other hand, is defined as the use of improved facilities shared between two or more households while unimproved sanitation facility refers to pit latrine without a slab, hanging latrines and bucket latrines. Open defecation is explained as human feces disposed of in fields, forest, bushes, open bodies of water, beaches or other open spaces or disposed of with solid waste (UNICEF/WHO JMP, 2017).

Along with water and sanitation, progress in hygiene during SDG is proposed to be measured by three indicators. The first is basic access and signifies the availability of hand washing facility with soap and water in the household. The second is unimproved handwashing facility and refers to the availability of hand washing station without soap and water and the third is absence of handwashing facility at all.

As described by the service ladder, SDG is primarily concerned with latrine for sanitation and hand washing for hygiene. Other sanitation and hygiene behaviors such as domestic waste disposal facilities, food hygiene and menstrual hygiene management are not given attention.

2.4 Theoretical Perspectives on Sanitation and Hygiene Access and Utilization

2.4.1 The Integrated Behavioral Model for Water, Sanitation and Hygiene (IBM-WASH)

The integrated behavioral model for water, sanitation and hygiene (IBM-WASH) was developed by Dreibelbis et al. in 2013. The model provides three dimensions that influence water, sanitation and hygiene behaviors in less developed countries. The three dimensions are the contextual dimension, the psycho-social dimension and the technological dimension. These three dimensions function at five aggregate level; structural/societal, communal, household,

individual, and habitual (Hulland et al., 2013). These multi-dimensional and multi-level factors intersect each other and influence people's adoption and utilization of improved water, sanitation and hygiene facilities and technologies. The intersections of these factors are depicted in the table below.

Table 1: The Integrated Behavioral Model for Water, Sanitation, and Hygiene

Levels	Contextual factors	Psychosocial factors	Technological factors
Habitual	Favorable environment for habit formation	Existing habitual behavior, expectation	Easy of routine use of the product
Individual	Wealth, age, education, gender , occupation	knowledge, perceived threat, disgust	attributes of a product (perceived cost, value, convenience and other characteristics of the product)
Household	Roles & responsibilities Household structure, division of labor , wealth, available space	Aspiration & norms	modelling/demonstration of use of products
Community	Access to market, access to enabling resources such as water for handwashing), physical environment, limited credit, poor soil conditions	Shared values, collective efficacy, stigma, social integration	Location, availability, individual Vs collective ownership, maintenance of the product
Societal	law, policy, regulation, climate, geography & geology	Leadership/advocacy, cultural identity	Manufacturing, financing, promotion & distribution of products

Source: Dreibelbis et al.,(2013,p.3)

As indicated above, the contextual factors represent the background characteristics of the setting, individual, or environment that influence people's adoption and utilization of specific sanitation and hygiene products or behaviors. Some of the contextual factors include access to markets and products, access to enabling resources such as water for handwashing, socioeconomic and demographic characteristics, characteristics of the household, and the natural environment (Dreibelbis et al., 2013). Availability of sanitation and hygiene products and services plays a key role in sanitation and hygiene behavior or habit formation. If a person working in an agricultural field does not have access to a latrine nearby, then he or she will defecate in an open field. Similarly, a person may drink safe water at home but may drink unclean water in the field.

Household structures, division of labor, and decision making abilities and roles will also determine people's access to and utilization of sanitation and hygiene facilities. In order to have a latrine facility in a household, decision on the type of latrine to be built, the features needed, the amount of money to be spent, the place where the latrine should be installed, the people who will be able to access and use it, who will install the latrine, who will choose the construction materials and who will do the actual purchase are important (Devine, 2009).

The psychosocial dimension of the IBM-WASH model consists of different factors that have been described by different names in different models. For instance theory of reason action and the health belief model (section 2.4.2 & 2.4.4) have called the psychosocial dimension of the IBM-WASH model as behavioral determinants while the RANAS model (section 2.4.3) has described them as factor blocks (Dreibelbis et al., 2013). Psychosocial factors include knowledge, perceived threat to disease, perceived severity of the diseases, perceived benefit of the action, and social norms. Knowledge of trachoma transmission and preventions; beliefs and values about trachoma infection, hygiene, latrine use; perceived risk for trachoma and self-efficacy to wash hands and faces correctly, influence the likelihood of someone adopting sanitation and hygiene behaviors. Similarly, a person knows whether or not she/he has to wash her/his hand before eating with other people. Handwashing before eating is a social norm. Social norms govern how individuals in a group or society behave and any behavior outside the norm is considered abnormal. Depending on the situation, social norms can serve as an enabler or hindrance to sanitation and hygiene behaviors (Coombes & Devine, 2010).

The technological dimension, on the other hand, refers to the characteristics of the sanitation and hygiene facilities and technologies, their location, and acceptability by the people (Dreibelbis et al., 2013). The type of sanitary technologies available in local market will influence the type of sanitation facility a household will build (Devine, 2009). Access to soap and water is important for handwashing. However, the attributes of soap and water may function as either a catalyst or an obstacle to handwashing, depending on when and where the soap is used. For instance, a woman may use bathing soap with strong scent to wash her hand after eating meals such as fish but may not use it before eating. Similarly, water attributes such as clarity, color, and odor will influence water treatment activities. The attributes of a handwashing facility, such as cleanliness and odor, may also influence its use and, therefore, handwashing behavior (Devine, 2009).

In sum, the IBM-WASH explains that a specific sanitation and hygiene behavior is influenced by three factors that exist at the individual, household, community, and societal levels. This model is, therefore, important to analyze the determinants of women's sanitation and hygiene access and utilization which are one objective of the present study.

2.4.2 Theory of Reasoned Action/ Planned Behavior

Theory of reasoned action was first developed by Fishbein and Ajzen in 1975 (Gehlert & Browne, 2019) and later advanced to theory of planned behavior by Ajzen and Madden in 1986 and 1991. The theory proposes that behavioral intention/motivation is the most important direct determinant of health service utilization. Motivation refers to whether the individual wants to perform the sanitation and hygiene behavior or not. It suggests that, if people intend to do something, they will eventually perform the behavior but, without motivation, a person is unlikely to carry out a recommended behavior (Montaño & Kasprzyk, 2015). If a person intends to wash hands with soap, he/she might buy soap, fetch water, or ensure a handwashing station is functional (Coombes & Devine, 2010).

The theory further assumes that people's intention or motivation to use health services is determined by their attitude towards the behavior. For example, a woman may not wash her hands with a strong-smelling soap before eating, if she expects this will cause trouble (Coombes, Devine, 2010). In sum, a person's overall positive or negative view towards the behavior, peer pressure or the influence of significant others such as family and friends, having bad previous experience on the behavior, and the knowledge and skills an individual believes he or she must have to perform the behavior, could affect their intention to use health services and facilities (Gehlert & Browne, 2019; Montaño & Kasprzyk, 2015; Mosler, 2012).

2.4.3 The Risks, Attitudes, Norms, Abilities, and Self-regulation (RANAS) Model

The Risks, Attitudes, Norms, Abilities, and Self-regulation (RANAS) model is developed by Hans-Joachim Mosler in 2012 for explaining why people use or do not use water, sanitation and hygiene facilities and technologies in developing countries. The model provides five blocks of factors that determine people's use of the said facilities and technologies. The five blocks of factors are risk factors, attitudinal factors, normative factors, ability factors, and self-regulation factors (Mosler, 2012; Dreifelbis et al., 2013).

Risk factor consists of all factors that are related with an individual's understanding and awareness of the health risk of not practicing the appropriate sanitation and hygiene behavior. Mosler (2012) has provided two risk factors that he believes will influence people's utilization of sanitation and hygiene facilities. These two risk factors are perceived vulnerability/susceptibility and perceived severity. Perceived vulnerability refers to "a person's subjective perception of his or her risk of contracting a disease" (Mosler, 2012, p.433). According to Sharma & Romas (2012) and Mosler (2012), people are ready to use health services if they believe that they are susceptible or will acquire disease. Perceived susceptibility to COVID-19 infection, for instance, motivates people to wash their hands and wear face masks. Perceived severity/seriousness, on the other hand, is defined as a person's perception of the seriousness of the consequences of contracting a disease (Floyd et al. 2000 cited in Mosler, 2012). If individuals believe that illness has serious consequences for causing death or injury, adverse effects on family, job or relationship, they will use preventive measures. However, if a person does not perceive the illness or the condition as serious, he/she will not adopt preventive behavior such as utilization of latrine or drinking water treatments (Sharma & Romas, 2012; Mosler, 2012).

Attitudinal factors are the individual's rational perception of benefits versus costs or outcome expectancy from the new behavior. It's the person's opinion of the costs of a new behavior in terms of money, time, and effort, and benefits in terms of savings, health, or other advantages. An individual will, thus, tend to adopt healthier behavior when he/she believes that the new behavior will increase the benefit and decrease the cost (Sharma & Romas, 2012; Mosler, 2012). Attitudinal factors also include the individuals' self-evaluation of the obstacles they may face to adopt a new behavior (perceived barriers). These obstacles can be gender, income, education, religious affiliation and age. An individual may believe that drinking disinfected water is effective in reducing susceptibility to disease (perceived susceptibility) and or will not cause death (perceived severity), but may consider the action as expensive, inconvenient and embarrassment(Sharma & Romas, 2012).

Normative factors, on the other hand, are factors which are related to the individual's perception about the behavior such as perceptions of what is typically performed by others and perceptions of which behaviors are typically approved or disapproved by relatives, friends, or neighbors

(Schwartz 1977 cited in Mosler, 2012). Normative factors also include institutional norms expressed as dos and don'ts by authorities.

Ability factors represent the individual's confidence in her or his ability to perform a behavior such as the knowledge and skill to install latrine, hand washing station, and to treat drinking water at home. Ability factors also include individuals' estimation of their own competence in dealing with barriers that arise during the course of the action, and the experience of failure and recovery from obstacles.

Self-regulation or self-management factors are factors that help an individual to manage different goals and continue to practice the recommended sanitation and hygiene practice sustainably. Self-regulation factors also include individuals coping strategies to deal with difficulties arising from the implementation of a specific sanitation and hygiene behavior (Gollwitzer & Sheeran 2006 cited in Mosler, 2012). Remembering to wash hands with soap after each latrine visit regularly together with other daily routines is an example of self-regulation factor.

In sum, the RANAS model is developed based on the idea of health belief model developed by Hochbaum, Kegels and Rosenstock in 1950 to explain why only few people were participating in chest x-ray and free screening for tuberculosis programs in the United States of America. Health belief model provides six factors that explain why individuals did or did not use preventive and curative health services (Rimer & Glanz, 2005). These six factors are individual's perceived threat to sickness or disease (perceived susceptibility), belief of consequence of contracting diseases (perceived severity), potential positive benefits of action (perceived benefits), perceived barriers to action, exposure to factors that prompt action (cues to action), and confidence in ability to succeed (self-efficacy). Perceived susceptibility and perceived severity components of the health belief model are explained as risk factors in Mosler's RANAS model. The perceived benefit component of the health belief model is explained as attitudinal factors in Mosler's RANAS model. Similarly, self-efficacy is identified as ability factor in Mosler's RANAS model. Mosler's norm factors are also related to cue to action component of the health belief model. Cues to action are triggering forces that make a person utilize health services. These forces can be self-perceived health status, having social ties, media, health promotion activities, education, and illness of family members (Sharma & Romas, 2012). Both the health belief model and

RANAS model add significantly to understand the phenomenon of the current study. Yet, individual level determinants of health service utilization are the focus of both models. The models have ignored environmental, demographic, economic and structural factors that can deter or facilitate people's utilization of health services. As an overcome to this deficiency, and also to incorporate other variables that determine people's health services utilization, Anderson behavioral model is also used.

2.4.4 The Behavioral Model of Health Service Use

Behavioral model of health service use was developed by Ronald M. Anderson in 1968. The model was first developed to assist the analysis of national survey data collected by the Center for Health Administration Studies at the University of Chicago on why and how people use health services. Hence, the purpose of the model is to discover conditions that either facilitate or impede health service utilization by individuals. The model has incorporated both the individual and contextual determinants of health service use (Babitsch, Gohl & Von Lengerke, 2012). Since its development in the 1960s, the model has gone through three phases (Gehlert & Browne, 2019). The original model also known as Anderson behavioral model has divided determinants of health service use into three groups of variables: predisposing, enabling, and need factors.

Predisposing factors are variables such as demographic factors and health beliefs and attitudes that influence an individual's use of health services. These factors include age, sex, education, occupation, place of residence, marital status, ethnicity, family status and structure, attitudes, values, and knowledge related to health and health services and cultural norms (Babitsch et al., 2012).

Enabling factors, on the other hand, includes the availability of health personnel and facilities, education, employment, income, wealth and the relative price of goods and services, travel and waiting time, social relationships and social support and resources available within the community (Babitsch et al., 2012, Gehlert & Browne, 2019).

Additionally, need factors are defined as people's need or interest to use health services. Need factors include health-related conditions of the environment such as epidemiological indicators of mortality, morbidity and disability. Need factors also include perceived need for health services (how people view and experience their own general health, functional state and illness

symptoms) and evaluated need (professional assessments and objective measurements of people's health status and need for medical care). Evaluated need is the most direct cause for health services use (Aday & Shortell, 1988). But, it is less important for preventative health measures such as safe sanitation and hygiene practice compared with predisposing and enabling factors.

2.5 Conceptual View of Empowerment

Empowerment has become one of the most widely used development concept. Women's right activists, politicians, governmental and non-governmental organizations always refer empowerment as one of their development intervention goals. Regardless of its popularity, however; the concept lacks universal and commonly agreed definition and when it comes to water, sanitation and hygiene (WASH) sector, it is even worse. Empowerment has different meanings in different contexts and in different fields of study. However, as far as this research's capacity to find any evidence in the literature, there is no different definition of empowerment in the WASH sector. Ibrahim and Alkire (2007) have listed around 32 different definitions of empowerment provided by different scholars. Yet, it is not clear how empowerment is defined in the WASH sector.

Empowerment is equated with different concepts such as status, power, control, autonomy, well-being, gender equality, gender equity, voice, collective organization/grass root movement, domestic economic power, participation, agency/choice, decision-making, consciousness-raising, and rights awareness. These different conceptions of the term empowerment in the development discourse and their interchangeable usages have contributed for the multiple interpretations and definitions of the term empowerment (Malhotra & Schuler, 2005). Mason and Smith (2000), for example have treated empowerment, autonomy, and gender stratification interchangeably. Similarly, Jejeebhoy (2000) considers autonomy and empowerment as equal terms, and defines both in terms of women "gaining control of their own lives vis-a-vis family, community, society and markets." In contrast, other authors have explicitly argued that autonomy is not equivalent to empowerment, stressing that autonomy implies independence, while, empowerment can be achieved through interdependence (Malhotra & Mather, 1997; Govindasamy & Malhotra, 1996 & Kabeer, 1998 cited in Tandon, 2016).

Empowerment is also multi-dimensional. It can be economic empowerment, socio-cultural empowerment, legal empowerment, psychological empowerment and political empowerment (Malhotra, Ruth & Boender, 2002). Furthermore, empowerment is a multilayered concept. It can occur at the individual or household level, community level or regional, national or beyond. Hence, the different empowerment dimensions can be analyzed at different level of aggregation. For instance, the legal dimension of women empowerment can be measured in terms of individual's knowledge and/or use of their legal rights, representation of women's interests and concerns in community, regional or national laws (ibid).

In sum, empowerment in general and women empowerment in particular is defined in many different ways. Kabeer (2005) one of the most often cited writer on women empowerment, defines empowerment as “the processes by which those who have been denied the ability to make choices acquire such an ability” p. 13. Kabeer's understanding of empowerment is based on the ability to make a choice also known as agency and to be dis-empowered is to be denied choice. But for people to choice, there has to be alternatives, and the capacity to exercise choices. Kabeer sees three dimensions to empowerment namely resources, agency and achievements/outcome. Resources such as education and employment, credit and land are necessary for women to be able to exercise choice. Resources are not empowerment per se, but catalysts, conditions, enabling factors or sources of empowerment. They are the medium through which agency is exercised. Thus, for women to be empowered, they must have access to material, human and social resources. Agency, on the other hand, encompasses the ability to exercise control over decisions or resources and formulate strategic choices that affect important life outcomes (Malhotra & Schuler, 2005). Some of Kabeer's life choices are decision to treat drinking water, decision to fetch water from safe wells and decision to build and use latrine. The critical factor in Kabeer's life choices/ decisions are whether women are making choices based on their own preferences, and priorities, or because of limitations in their options. Choices open to women are often limited compared to men of the same community, and this makes women internalize their lesser status in society (Kabeer, 1999). Kabeer also noted that to be considered 'empowered', women themselves must be significant actors in the process of change. That is, women must engage in agency. For example, health and development strategies may support or enable women's empowerment, but they cannot provide empowerment as if they were health services or commodities themselves. This, however, does not mean that all improvements in

women's position must be brought through the actions of women themselves or that empowering themselves is the responsibility of individual women. Governments need to have policies and interventions to give women greater access to resources. Kabeer's well-being outcomes are achievements that women experience as a result of their access to resources and agency such as health and wellbeing, income, participation in extra-familial groups and social networks, local campaigns against domestic violence, campaigns for rights awareness and representation in local bodies of government.

Strandberg (2001) who is also the most cited scholar in relation to women empowerment has defined empowerment as "the processes by which women take control and ownership of their lives through expansion of their choices" p.4). The main idea in Strandberg's definition of empowerment is that empowerment is a process or a journey towards the capability of taking ownership and control of one's own life through expanding life changing alternatives/ decision making. Strandberg (2001) definition of empowerment resembles Moser (1993) definition of women empowerment. Moser's (1993) has defined empowerment as "the ability to determine choices in life and to influence the direction of change, through the ability to gain controls over crucial material and non-material resources" (p.74). Moser's definition of empowerment encompasses the idea of power and decision making. For Moser, the control over resources – tangible or not is crucial for the empowerment process. Both Moser's and Strandberg's definition of empowerment implies that women need to have greater power or control on their own lives and they need to set their own interests, needs and priorities. Women should not be told what to do, and they should not be involved in actions that are designed and controlled by others. The authors' believe that when women are involved in actions that are designed and controlled by others, the action can be used as control mechanisms to silent women from demanding space. Therefore, women should take initiative and actions that are stimulated by their own thinking, analysis and decision. Related to this, Rowlands stated that empowerment is for individuals being able to maximize the opportunities available to them without or despite, constraints of structure and State" (Rowlands, 1995).

Sen (1993), on the other hand, has defined empowerment as "altering relations of power which constrain women's options and autonomy and adversely affect health and well-being" (cited in Tandon, 2016:p.7). Sen's definition of empowerment emphasizes power as a core element of

women empowerment and implies that women were dis-empowered because they have less power than men. Therefore; there is a need to change the relation of power between men and women. Sen acknowledges the importance for women to increase their power and choice. But this increase in women's power is not to dominate men and substitute men's domination with that of women instead increasing women's power is enhancing their skill, knowledge and ability to define their own needs and act upon them. Hence, empowerment for Sen like that of Kabeer entails going from a dis-empowered state to a more empowered one.

In sum, empowerment is an ambiguous term and it is possible to say that the literature has defined it based on four approaches; the power approach, the choice or agency approach, the decision making approach and participation approach. The definition of empowerment is also different according to language, location, cultural contexts as well as field of study. Thus, empowerment has different meanings in different contexts and in different fields of study. In relation to this, Mehra (1997) has recommended for empowerment to be defined according to specific contexts for which it is to be used. A behavior that signifies empowerment in one setting may indicate something else in another. For example, belonging to self-help group may indicate empowerment in Northern Nigeria, but not in Southern Nigeria (Ozoya et al., 2018). Similarly, the characteristics of an empowered woman in Uganda may differ from those of an empowered woman in Pakistan. In one setting, an empowered woman's mobility might be limited only by the availability of affordable transportation, while in another context a woman may not be allowed to travel at all without a man's permission (Lombardini, Bowman & Garwood, 2017). Shetty (1992) also supports Mehra (1997) view that empowerment can be defined only within the local social, cultural, economic, political, and historical context (cited in Tandon, 2016). A woman's level of empowerment varies depending on her class, caste, ethnicity, relative wealth, age, education and family position. Language and cultural contexts are also relevant when breaking down the term empowerment. Empowerment may not have a direct translation into other languages, as it is the case in Amharic, where the term has been adjusted from English. In Amharic empowerment is translated as "*maebkat*" literally to say enabling women.

This paper has, therefore; defined women empowerment as a change in women's life as a result of sanitation and hygiene interventions. Poor hygienic and sanitary practices and conditions play a major role in the spread of infectious diseases, economic loss and indignity. On the contrary,

access to water, sanitation and hygiene increases health, well-being, economic productivity, good quality of life, time and dignity. Thus, the change in women's life is measured in terms of increase in self-esteem, their ability to make household decisions and participation in health extension activities.

2.6 Historical Origin and Development of Women Empowerment

The idea of women empowerment has a long history in women's right movements in Europe and America in the 18th c. First, in Europe and latter in America, women's right movements have been carried out through the publication of books. A vindication of the rights of women by Mary Wollstonecraft in 1792 is often characterized as the first women right book and remains groundwork for women's right thought. Since, Wollstonecraft, many other writers have published books on women's right. The subjection of women by John Stuart Mill in 1869 in Europe, and the woman's Bible by Elizabeth Candy Stanton in 1898 and the enfranchisement of women by Harriet Taylor in 1851 in USA are few to be mentioned (Ozoya et al., 2018, p308). Women in Europe and America have demonstrated, wrote books and speeches demanding equal civil, political, economic and social rights, but, did not use the term women empowerment. Emancipation and liberation were the most widely used concepts of the time. These women's right movements have latter expanded into developing countries through missionaries and NGOs of the developed world. This global sisterhood movement was not welcomed in developing countries and was highly challenged. Women right advocates in the third-world argued that women all over the world do not have a similar experience. Women experience oppression differently according to their race, class, and colonial history, current position in the international economic order, religion, geographical location and ethnic background. They further argued that third world women's struggle was not only against gender subordination but also other forms of oppression. They link the struggle against gender subordination with other oppressions and suggested a wide-ranging development of women free from all systems of domination (Sen, Grown & Era, 1988; Antrobus, 2004). Thus, the term women empowerment has developed out of the critique of top down Women in Development (WID) approaches of the 1970s articulated by American liberal feminists who advocated legal and administrative changes to integrate women into the economic systems (Jaquette 1982 cited in Rathgeber, 2015).

In WID, there has been an inherent belief that the main problem of women in the third world was their insufficient participation in the process of development. Boserup's (1969) seminal work on "Woman's Role in Economic Development" shows the invisibility of women's contribution in the development endeavor and stated that women had been marginalized from the development process. Inspired by Boserup's study, the development policy approach during this time has focused on integrating Women in Development (Sen, Grown & Era, 1988). However; third world women have challenged this paradigm and argued that women were already 'integrated' into the development process and their integration has even worsened their situation and subjected them to more exploitation. They further argued that the exploitation of women's time and labor was central to capitalist development and not for the advancement of women. Hence, they suggested the need for a more fundamental change in the development process that could tackle the inequities in the global economic system, exploitative class relations as well as women's subordination (Antrobus, 2004).

Generally, the modernization based WID approaches of welfare, equity, anti-poverty and efficiency were later substituted by the empowerment approach. According to Sen, Grown & Era (1988), the best-known articulation of women empowerment has been made by the third world and women of color feminist network called the Development Alternatives with Women for a New Era (DAWN) at Bangkok in 1979.

The welfare approach in 1950 sees women as passive beneficiaries of development interventions while the empowerment approach sees women as active participants in the development endeavor. In welfare approach, women were seen as mothers and housewives, and their most important role in the society was giving birth and taking care of their family. The main method of helping them was through direct food aid, health care services or providing nutritional education (Moser, 1993). The welfare approach recognizes only the reproductive role of women and utilizes women's organizations as a top down means of delivering services. In contrast, the empowerment approach recognizes the triple role of women (productive, reproductive and community) and seeks to raise women's consciousness through bottom-up women's organizations and challenge their subordination.

The term women empowerment has become a popular concept after the 1995 fourth world conference on women in Beijing. The Beijing Declaration (section 13), presents women's

empowerment as a key strategy for development: “Women’s empowerment and their full participation on the basis of equality in all spheres of society, including participation in the decision-making process and access to power, are fundamental for the achievement of equality, development and peace”. Since then, the term is included as goal number three of the millennium development goals in 2000 and goal number 5 of the sustainable development goals in 2015. The African Union has also declaring the year 2015 as the year of women’s empowerment and development towards realizing Africa’s agenda 2063. The union has also declared the years from 2010 to 2020 as the African women’s decade focusing on empowerment of women in economy, health, agriculture, and food security, education, science and technology, environment and climate change and in decision making position (African Union, 2011). As a confirmation of its commitment to the fourth world conference on women, the Ethiopian government has introduced the concept of empowerment and gender mainstreaming within national sector-specific plans such as the health sector development plan (HSDP). In relation to HSDP, the government has prepared the health extension package to intensify the preventive aspect of health service delivery and also to empower women and the community at large.

2.7 Measuring Women Empowerment

Measuring women empowerment and deciding how empowered a woman or a group of women are is a difficult task. In the literature, there is much confusion about what women empowerment means and how to measure it. Researchers, organizations, and academia have used different measurements and indicators of women empowerment depending on the dimension of empowerment they wanted to study as well as the level of their analysis. Some empowerment indicators are used to measure social empowerment, others are used to measure economic empowerment. Some empowerment indicators are used to measure women empowerment at the national level. Others are used at the community level and still more others are used to measure women empowerment at an individual level. For instance, the Gender Empowerment Measure (GEM) is a tool developed to measure men’s and women’s participation in economic and political life and the tool is used to capture global gender disparities. The tool is not helpful at the country level as it does not directly measure individual empowerment or household and community power relations. Approaches using individual-level data have also been developed such as the women’s empowerment in agriculture index (WEAI) and women empowerment in

health index also known as survey-based women's empowerment index (SWPER index). Women's empowerment in agriculture index measures the empowerment of men and women in the agricultural sector (Alkire et al., 2013). Though the index is calculated based on individual-level data collected by interviewing men and women within the same household, it is an aggregate index reported at the country or regional level. More importantly, the index lacks an aspect of health. Similarly, the survey-based women's empowerment index focuses on women empowerment from the sexual and reproductive health aspect.

Despite the important links between sanitation and hygiene services and women empowerment, measurement of empowerment in the sanitation and hygiene sector has so far been limited, especially compared to other areas of development such as access to financial services, reproductive health, and agriculture. Empowerment has been discussed, but not well quantified or measured in sanitation and hygiene-related interventions. The only available evidence that this research was able to find regarding the measurement of women empowerment outcomes in the water, sanitation and hygiene sector was made by Carrard, Crawford, Halcrown, Rowland & Willetts in 2013, Kayser, Rao, Jose & Raj in 2019 and Dery, Bisung, Dickin & Dyer in 2019. Carrard et al. (2013) has proposed a conceptual framework generated from a review of documented gender equality outcomes from WASH initiatives in Fiji and Vanuatu. The indicators proposed to measure gender equality and women empowerment outcomes associated with WASH were changes in gender roles and changes in self-perceptions and attitudes. Similarly, Kayser et al. (2019) based on literature review have offered a compilation of indicators used to measure gender equality and empowerment outcomes in water, sanitation, and hygiene researches. The indicators include women's water-fetching responsibility and time-use burden, the spinal injury, neck pain, spontaneous abortion and caloric expenditure that women experience while fetching water, the time available to them to pursue education, for leisure, for child care and other income-generating activities, physical and sexual harassment women experience, stress faced by women and girls while they access shared sanitation facilities or openly defecate, feelings of insecurity and mental and physical health outcomes, women and girls' participation in decision making on water, sanitation and hygiene design, maintenance, and service availability, access to menstrual management materials and quantity of water in litres per person per day, women's participation in the local governance such as women's participation in

key water committee positions, their participation in household decision-making and control over resources.

Dery et al. (2019) have conducted a review of literature aimed for the identification of tools used for measuring empowerment within the WASH sector. The authors have reviewed 13 peer reviewed journal studies on empowerment within the WASH sector. Of the 13 reviewed journal studies, nine of them have emphasized participation as a critical dimension of women empowerment. Participation comprised of activities such as community engagement, partnerships, and involvement in the design and governance of WASH projects. Decision making was also another important indicator used by these nine studies. Decision making comprised of activities such as women make inputs into household and community sanitation and hygiene planning issues or the resolution of WASH problems. Access to WASH information was the third empowerment dimension used by nine studies.

Empowerment in other sectors is also measured using different indicators. For instance, Allendorf (2007), in his study of women's land right and its contribution to the empowerment of women in Nepal has used decision making on; women's own health care, making large household purchases, making household purchases for daily needs and visiting families and friends as measures of women's empowerment. Similarly, Mahmud, Shah & Becker (2012) in their study of measuring women empowerment in rural Bangladesh have used self-esteem, role in decision-making, freedom of mobility, and control of resources as indicator of women empowerment. In order to measure women empowerment in self-esteem, Mahmud and his colleagues have collected data using two self-esteem indicators which are considered universal. The first self-esteem indicator is if the woman wants to have decision input in buying furniture, buying livestock, spending family savings, taking a loan, treatment for sick children, visiting doctor for self, her working outside the home, her visiting father's home, having more children and using family planning. The second self-esteem indicator is whether the woman accepts or rejects gender-based violence such as if she thinks a wife's beating is justified when: she burns the food, she neglects the children, she argues with a husband, she talks to other men, she wastes husband's money, and she goes out without telling a husband. In addition, Biswas and Kabir (2004) in their study of measuring women's empowerment in Bangladesh have used mobility, decision making power, autonomy, ownership of household assets, freedom from domination, awareness, participation in public protests and political campaigns, contribution to family

income, reproductive rights, exposure to information, and participation in development programs as indicators of women empowerment.

Hashemi, Schuler & Riley (1996) in their study of the effect of rural credit programs on women empowerment in Bangladesh, have used eight indicators to measure women empowerment. The indicators are mobility, economic security, the ability to make small purchases, the ability to make large purchases, involvement in major household decisions, and relative freedom from domination within the family, political/legal awareness, and participation in campaign/protest. The Ethiopian Demographic and Health Survey (2016) has used employment and cash earnings, control over wife's earnings, control over husband's earnings, ownership of assets, women's participation in decision-making on their own health care, women's participation in making major household purchases and their participation in the decision to visit family or relatives, women's attitude towards wife-beating and knowledge of law against domestic violence as indicators of women empowerment. Women's participation in household decision-making and women's gender role attitude/ acceptance or rejection of violence against women are becoming widely accepted universal indicators of women's empowerment particularly in demographic and health surveys (DHS) (Kishor & Subaiya, 2008). The assumption behind the gender-role attitude questions is that truly empowered women will not accept such obvious gender-inequalities in power. Empowered women would not agree with any justification for a husband beating his wife. Agreement with specific justifications for a husband beating his wife demonstrates women's acceptance of norms that give men the right to discipline women with force. Related to this, Kishor and Subaiya (2008) stated that acceptance of wife-beating is an indicator of women's acceptance of their lower status relative to men.

2.8 Theoretical Literature on Women Empowerment

Different theories have been developed at different times to explain how women empowerment could be achieved and the factors that influence the process. For this thesis, however, Sen's and Nussbaum capability approach is selected as it has the strength of providing concepts and ideas that are helpful to understand women's empowerment. Capability approach is also important to evaluate policies and interventions in their impact on people's capabilities and functionings. Related to this, Robeyns (2005) as cited in Dasuki, Abbott & Azerikatoa (2013) and Qizilbash

(1997) have stated that capability approach is helpful to understand individual's well-being and gender inequality at both conceptual and empirical levels.

The capability approach was first developed by Amartya Sen in 1999 to assess human wellbeing, development and justice and later expanded by Martha Nussbaum in 2000. Sen has used the concepts of agency, wellbeing, freedom and achievement to indicate human empowerment while Nussbaum has used the concepts of choice and freedom to indicate the same (Keleher, 2007). Sen argues that achievement (functioning) and freedom (capabilities or opportunities) are the two most important aspects of individual well-being. Consequently, the expansion of freedom is considered as a means and an end of development. In this means and ends distinction, Sen has argued that policies and interventions should be assessed according to their impact on the expansion of freedom (capabilities) as well as their actual functionings/ achievements (the capability approach, Stanford Encyclopedia of Philosophy, 2019). Sen's development as freedom encompasses social freedom (provision of education & health) economic freedom (employment opportunities), cultural freedom, legal freedom, political freedom (the freedom to choose), and the freedom to move from place to place and the freedom to decide without asking permission from others. Conversely, Sen's unfreedoms are poverty, tyranny/ dominancy or patriarchy, neglect of public facilities, social deprivation and poor economic opportunities. Unfreedom/lack of freedom is believed to be a cause for economic poverty, which robs people of the freedom to obtain remedies for treatable illnesses, or the opportunity to be adequately clothed or sheltered, or to enjoy clean water or sanitary facilities. Sen, therefore, argues that development requires the removal of major sources of unfreedom such as poverty, tyranny/ dominancy or patriarchy and neglect of public facilities. Sen has also discussed about the role of resources/opportunities or conversion factors for the realization of achievements/functionings. Sen's conversion factors include physical condition, sex, education, public policies, social norms and practices, power relations related to class, gender or race, and the physical environment such as climate, geographical location, proneness to diseases, the presence or absence of water sources, roads, and bridges, and the means of transportation and communication (ibid). These assumptions of Sen are important to assess the progress that the health extension services have brought in enhancing women's freedom to choose such as fetching water from their premises against going out far to fetch water, practicing open defecation against using latrine and using traditional open mouthed water transportation containers against narrow mouthed containers among others.

In sum, the concept of agency, freedom, well-being and achievement play a prominent role in Sen's capability approach and according to Keleher (2007), there are two cross-cutting divisions at the heart of Sen's capability approach. These are agency achievement, well-being achievement (functionings), agency freedom, and well-being freedom (capabilities). Agency achievement refers to the realization of goals and values a person chooses and this could include being well-nourished, owning a house, and protecting the environment. Agency freedom, on the other hand, signifies the freedom to choose and bring about the achievements one has reason to value. A woman, who lives in a wonderful house, has plenty to eat and a lot of nice clothes to wear may not be free to choose how to dress, or to invite others to her home for a meal. Furthermore, she may even be denied access to these resources upon the death of her husband. Such a woman has limited access to resources, but no control over them. Sen recognizes that agency freedom is constrained by social, political, and economic opportunities that are available to people. Well-being achievement (functioning) is defined as the quality (wellness) of the life an individual is currently living in terms of achieved beings and doings. If one is poor or oppressed, her well-being achievement will reflect ill-being. Things such as being adequately nourished, being in good health, avoiding unnecessary morbidity and mortality, being happy, having self-respect and taking part in the life of the community are examples of well-being achievements. Well-being freedom (capabilities) refers to the freedom to achieve the beings and doings (alternate lifestyles) that are important for one's well-being. Well-being freedom also refers to the various alternative realities or lifestyles that a person is free or empowered to achieve. For instance, person A has opted to fast despite the fact that she/he has the available option of eating, while person B, has no choice but to starve. Both A and B may have realized the same functioning of malnourishment. However, A has chosen not to eat while she/he has the resources and is free to do so, but B has no resources and is not free to choose. For this reason, A is said to have a better standard of living than B. This comparison between person A and person B indicates an individual's freedom, or power, to engage and make significant decisions about what she/he will be and do in her life. This in Sen's term is known as capability set and it includes the un-chosen options. A person's capability set reflects the level of empowerment that person is experiencing. The more valuable capabilities a person has, the more empowered she/he is. On the contrary, if a person lacks certain basic capabilities, she/he may be recognized as poor, oppressed, or disempowered. Sen's concept of well-being freedom is related to empowerment in that well-being can be limited

by the power one has to make choices. For example, choosing to eat enough nutritious food to be healthy can have a tremendous effect on one's standard of living, but not everyone is free (or empowered) to do so. A well-fed and healthy individual is more likely to be empowered to achieve employment or political participation, than someone who is weak from malnourishment or illness. Sen's capability approach offers an understanding of the process of empowerment as the process of expanding an individual's well-being freedom, or set of valuable capabilities. These two central concepts of agency and capability-set expansion can be helpfully understood as the fundamental empowerment concepts of Sen's version of the approach (Keleher, 2007). While Sen has not provided a list of core capabilities, Nussbaum (2000) has developed a list of ten central capabilities or basic social minimum/threshold limits at which a person's capability becomes 'worthy of a human being' (or 'truly human'). Nussbaum argues that thresholds of capabilities should be secured for all human beings and a truly human functioning is not available to people if the central human capability is beneath the basic social minimum or threshold level of each capability. Some of Nussbaum's central human capability components/quality of life are 1/ being able to live to the end of a human life of normal length; not dying prematurely; 2/ being able to have good health; to be adequately nourished; to have adequate shelter; 3/ being able to move freely from place to place; to be secure against domestic violence; 4/ being able to engage in various forms of social interaction (Affiliation), 5/ being able to laugh, to play, to enjoy recreational activities; 6/ being able to hold property (both land and movable goods), and having property rights on an equal basis with others (Guna, Nithiya, Karupiah, Premalatha & Parthiban, 2015).

In sum, both Sen and Nussbaum agree that empowerment is an important aspect of human development and they believe that for people to be empowered or their wellbeing to be improved, they need to have the required capabilities and functionings. Capabilities are opportunities to achieve functionings and these includes having clean water, adequate sanitation, having sufficient food supplies and food entitlements, access to doctors, protection from infections and diseases, basic knowledge on health issues, equipment, finance, skills and creativity. The central idea of Sen and Nussbaum capability approach is the primacy of people or their well-being as the purpose of development. That is the 'real purpose of development' should be to improve human lives (Fukuda-Parr, 2011). The argument of this thesis also goes in line with the basic tenet of the capability approach.

Functionings are the various activities one engages in and includes being able to have good health, to be adequately nourished; to have adequate shelter, being able to move freely from place to place; to be secured against violence such as sexual assault and domestic violence; being able to engage in various forms of social interaction, having the social bases of self-respect and non-humiliation; the ability to access information and take decisions, not suffering from lack of self-respect, and taking active part in the life of the community and leisure activities (Karim, Brazier & Basarir, 2016). These are important contexts to analyze women empowerment in sanitation and hygiene related intervention which is the focus of the present study.

In sum, the capability approach offers an understanding of empowerment as a process of expanding women's choice, opportunities, freedom, wellbeing and agency and for health empowerment, this translates into expanding the choice of health extension services, negotiating the conditions of accessing the services, the choice of whether to participate in decision-making processes and structures, and expanding the conditions under which active participation of women takes place. The purpose of this study is also to investigate if access to and utilization of sanitation and hygiene services have brought a change in women's lives and wellbeing in terms of increase in their self-esteem, participation in health related activities and participation in household decision making.

2.9 Review of Empirical Literature

2.9.1 Access to and Utilization of Sanitation and Hygiene Facilities

Access to and utilization of sanitation and hygiene is a well-researched topic in Ethiopia and elsewhere. Many researches have also been conducted on the determinants of people's access to and utilization of sanitation and hygiene facilities. Brief review of some of these studies is done here.

Abate, Mesele, Zinau, Dejen (2018) have studied the availability and utilization of sanitation facilities in Tigray region and the authors have used the presence of latrine, hand washing facility near the latrine and presence of improved drinking water source as indicators of sanitation access; mixing sanitation, hygiene and water altogether and labeling their title as sanitation. In doing this, the authors have treated, sanitation and hygiene as synonymous. The authors have also measured sanitation utilization by using indicators of the presence of water for hand

washing, presence of soap on the hand washing facility, presence of cover/slab for the latrine hole, absence of any observable faeces around the compound, absence of any observable faeces around the squat hole, and if the latrine is shared or not. These indicators are not, however, utilization measures per se. Availability of hand washing material with water and soap and lack of any observable feces in the compound do not also prove households utilization of the facilities. In rural areas, when people defecate in the open, they defecate far from their compound, which shows the practice of open defecation than latrine utilization. Moreover, the mere presences of facilities do not provide proof of utilization. There has to be another way of measuring utilization such as by employing extended observation methodology or from the respondents' subjective report of their utilization of the facilities.

Similarly, in their study of creating demand for sanitation and hygiene through community health clubs in Zimbabwe, Waterkeyn & Cairncross (2005) have used sanitation and hygiene concepts interchangeable as if they mean the same thing. The authors have measured hygiene access by using indicators such as; availability of ladle, individual cups, plates, pot racks, borehole water, rubbish pit, latrine and hand wash facility. Similarly, hygiene utilization was measured by whether individuals have used the ladle or not, covered their drinking water or not, swept their yard or not, and if they have used the hand wash facility or not. The limitation of their study is that they have mixed sanitation and hygiene and there is no clarity which one is sanitation and which one is hygiene as indicated in their title of the research. The strength of their study is that they have measured access and utilization independently and the indicators used to measure utilization are utilization measures per se.

Nigatu, Sundaraa & Kalkidan (2017) have studied about access to, and utilization of information on sanitation and hygiene by rural households in Alaba district in Southern Ethiopia. The strength of their research is that they have categorized their respondents into four groups based on their level of access to and utilization of sanitation and hygiene information as high, medium, low, and very low level of access to and utilization. This categorization is important to show the variation in the level of respondents' access to and utilization of sanitation and hygiene information as every respondent will not have the same level. Besides, they have measured sanitation access and utilization independently. However, the authors did not provide conceptual clarity of what sanitation means and hygiene signifies. They simply treated sanitation and

hygiene interchangeably. Another limitation of their study is that they have a small sample size (162 respondents).

Gedamu (2017) has studied water handling and sanitation practices among rural communities of Farta Woreda, Northwest Ethiopia, and the author has used descriptive statistics such as proportion, mean and standard deviations and the same is true for Abate et al. (2018). By simply using frequency distribution, the authors have shown the availability and utilization distribution of individual sanitation indicators or they simply count how many people have each of the sanitation facilities and they have failed to provide overall or aggregate sanitation availability and utilization. They have not compiled or create a composite measure of sanitation access and utilization to indicate the overall sanitation access and utilization level of their respondents.

Generally, many limitations have been found in the empirical literature related to sanitation and hygiene access and utilization. Lack of consistency in measuring sanitation and hygiene access and utilization, the mixed use of the term sanitation and hygiene altogether and lack of clarity on which one is sanitation and which one is hygiene, the use of a single indicator to measure multidimensional concepts of sanitation and hygiene; for instance, the use of latrine to measure sanitation access and the use of hand washing facility as an indicator to measure hygiene behavior are some of the drawbacks identified in the empirical literature. Sanitation is not about latrine and hygiene is not only about hand washing facilities. Other waste disposal facilities and practices as well as hygiene behaviors need to get the researchers' attention as both sanitation and hygiene are multidimensional.

2.9.2 Determinants of Access to and Utilization of Sanitation and Hygiene Facilities

Many researches have been conducted focusing on the determinants of peoples' access to and utilization of sanitation and hygiene facilities. Fikralem, Abera, Girmay, Teshome & Phoebe (2017) in their study of the socio-ecological analysis of barriers to the adoption, sustainability and consistent use of sanitation facilities in rural Ethiopia have used a qualitative research method employing focus group discussion (FGD) and in-depth interview data collection techniques. The limitation of their study is that the findings cannot be generalized. Similarly, O.Sintondji (2017) in his study of socio-demographic determinants of access to water, hygiene and sanitation in Benin has used qualitative method. In doing so, the study has limitation of

establishing cause and effect relationships between variables. The strength of the study is that it has clearly indicated how hygiene and sanitation practices are measured.

Nyanza et al. (2018) has studied the determinants of access to and utilization of water and sanitation facilities among pastoralists in the rural areas of northern Tanzania. The authors have used multivariate logistic regression to analyze the causal relationships between socio-demographic factors and access to sanitation facilities. The limitation of their study is that they have classified their dependent variable as access and no access and ignored the different level of people's access to sanitation facilities. Yet, the authors have found that socio-economic status, family size, presence of under-five children, history of diarrhea diseases, having ever received education on sanitation and motivation for improvement in defecation place to be the key determinants of sanitation access. Similarly, in their study of the determinants of access to improved sanitation facilities in rural districts of southern Ghana, Akpakli, Manyeh, Akpakli, Kukula & Gyapong (2018) have used multivariate logistic regression to analyze the relationship between the dependent and independent variables and they have classified their dependent variable as improved and unimproved. Their study has, however, found that sanitation facilities used by households were significantly influenced by age, gender, level of education, occupation, marital and socioeconomic status of household heads.

Irianti, Prasetyoputra & Sasimartoyo (2016) have studied about the determinants of household drinking-water source in Indonesia. The strength of their study is that the authors have classified their dependent variable as unimproved drinking water sources, improved drinking water sources and piped water on the premises. The authors found that having adequate sanitation facility, household size, marital status of household head, educational status of household head and wealth as determinant factors associated with access to improved drinking-water sources in Indonesia. Osumanu, Kosoe & Ategeeng (2019) have studied the sociocultural and economic factors determining open defecation in Wa Municipality in Ghana. The authors have classified their dependent variable into two as using latrine and open defecation. The authors have reported that age, education, sex, size of household, marital status, occupation, income, local taboos, traditional norms and beliefs, ownership of a toilet facility, and knowledge of the effect of open defecation as the main factors that determine open defecation in Ghana.

2.9.3 The Empowerment Effect of Sanitation and Hygiene Access and Utilization

The goal of empowerment has become a common component of water, sanitation, and hygiene interventions, particularly in developing countries. However, there is limited empirical evidence on how access to and utilization of sanitation and hygiene services have contributed for women empowerment. Many sanitation and hygiene related studies are conducted based on their relationship with the incidence of diseases. The case in this point are a study by Beselam, Alemayehu, Abera & Solomon (2017) on the effect of water, sanitation and hygiene interventions on active trachoma, a study by Jung et al (2016) about the effect of improved sanitation on diarrheal prevalence, a study by Cooten, Selamawit, Samson & Spigt (2018) about the association between acute malnutrition and water, sanitation, and hygiene and a study by Kwami, Godfrey, Gavilan, Lakhanpaul & Parikh (2019) about the linkage between stunting and water, sanitation, and hygiene.

The health benefits are usually considered to be the most important impacts of sanitation and hygiene services and there is very little published empirical evidence on the impact of sanitation and hygiene services on women empowerment. Though, there are few qualitative findings claiming the relationship between access to and utilization of sanitation and hygiene services and women empowerment in other countries, no study was made to explore the nexus between sanitation and hygiene access and utilization and women empowerment in the Ethiopian context. Most of the existing literature in other countries has also focused on the link between women empowerment and its contribution for better sanitation and hygiene access and utilization. The cases in this point are a study made by Routray, Torondel, Clasen & Schmidt (2017); Hirai, Graham & Sandberg (2016) and Abu, Bisung & Elliott (2019). Routray, Torondel, Clasen & Schmidt (2017) has studied about women's role in sanitation decision making in rural coastal Odisha, India, and the authors have examined the association between women's decision-making autonomy and latrine construction. Similarly, Hirai, Graham & Sandberg (2016) and Abu, Bisung & Elliott (2019) have studied about women's decision-making power and its linkage with improved household sanitation in Kenya. The studies have focused on how better sanitation can be achieved by empowering women instead of how access to and utilization of sanitation and hygiene services and facilities have empowered women. In doing this, the researchers have assumed that there is prior existing empowerment of women and they wanted to investigate how

this preexisting empowerment of women has helped them or their families to access and utilize sanitation and hygiene services. This kind of thinking has come from the 1970s and 1980s belief that women's involvement in water, sanitation, and hygiene programs and projects is crucial to improve the effectiveness and sustainability of WASH projects and programs (Ivens, 2008, Wakeman & et al., 1996 cited in O'Reilly, 2010). The thinking was that simply building latrines, for instance, does not mean that they will be used, and their non-use was attributed to a failure to include women. The solution recommended was to make women participate in latrine projects (van Wijk-Sijbesma 1998 cited in O'Reilly, 2010).

Despite the fact that women play a key role in improving access to WASH services, how improved WASH services have contributed to their empowerment is not studied well. The linkage between sanitation and hygiene access and utilization and women empowerment is under-researched topic compared to studies conducted on the link between sanitation and health and sanitation and education. Whether the provision of practical gender needs such as access to safe water and sanitation facilities has brought a change in women's strategic gender needs such as participation in household-decision making is far from investigation. The only qualitative evidence that this research was able to find regarding the nexus between WASH and women empowerment were made by Ivens (2008), Leahy, Winterford, Nghiem, Kelleher, Leong & Willetts (2017), Sultana (2011), Kilsby (2012) and Carrard, Crawford, Halcrow, Rowland & Willetts (2013).

Ivens (2008) has undertaken a literature review to determine if increased water access has empowered women or not. Though Ivens has pointed out that she did not find any evidence showing the empowerment role of women's access to water and participation in WASH-related decision-making, she came up with a list of benefits that women have got and the benefits include better health for women and girls due to improved quality and increased quantity of water, enhancement in women's dignity, and less exposure to risks associated with water fetching such as gender-based violence, water-borne diseases, animal attacks, and physical problems due to heavy water loads. Ivan's finding in other words indicates that access to water facilities has improved women's practical gender needs and no evidence of its role in enhancing women's strategic gender needs such as household decision making.

Leahy, Winterford, Nghiem, Kelleher, Leong & Willetts (2017) have studied the empowering potential of WASH program in some parts of Vietnam. The authors, however, did not use any statistical model to test the association between the resultant changes in women empowerment and the WASH program. Yet, they found that the WASH program has improved communication between male and female members of the household which in turn has increased women's influence over household decision-making and increased their participation in community meetings. The program has also increased women's participation in communal works such as construction, cleaning and maintenance of public water sources and equipped them with information and knowledge, particularly technical knowledge on WASH, which later has helped them to participate in domestic and community level decisions.

Similarly, Kilsby (2012) has studied the gendered outcomes of Water aid's WASH program in Timor-Leste, and found that the WASH program has increased harmony in women's relationship with their husbands, and changed or expanded gender roles for both women and men. Women and men were working together to build latrines, and men were also found helping women in what is called traditional women's roles such as the collection of water, childcare (including helping to bathe), assisting in the kitchen and general domestic tasks while women's participation in community roles such as in WASH management committee, women's group activities, literacy classes & women's organizations have increased. Women have also got more opportunities to contribute to the household economy and more time to spend in traditional craft activities. The WASH program was also reported to bring increased women's sense of well-being in terms of dignity, freedom, and happiness as well as a growing awareness and acceptance that women have rights of various kinds. Both women and men have got awareness that women have rights. On the contrary, lack of access to and utilization of water, sanitation and hygiene facilities have brought women's low participation in the labor market and community activities, adverse biomedical outcomes, psycho social stress, and poor educational outcomes (Bisung & Elliott, 2016). The opportunity cost of water collection time was also reflected in fewer hours available for women to take care of their children, and the sick as well as for leisure, and engaging in income-generating activities (Ibid).

Abu, Bisung & Elliott (2019) have studied women's experience of decision-making around the implementation and management of WASH infrastructure in Kenya. The authors have found that lack of safe WASH, coupled with the lack of women's participation in WASH decision-making

has brought insecurity, higher rates of school dropout, disease acquisition, psychosocial impacts and wasted time among women and girls.

2.10 Conceptual Framework of the Study

Sanitation and hygiene access and utilization are becoming the trending issues in global development and in developing countries in particular. Sanitation and hygiene have become fundamental to achieve other sustainable development goals, notably, gender equality and women empowerment (SDG5), good health and well-being (SDG-3), no poverty (SDG1) and zero hunger (SDG-2). Despite these multiple effects, the reason why lack of access to and utilization of sanitation and hygiene facilities has persisted so far is a question that remains largely unanswered. Besides, there is very little published empirical evidence on the impact of sanitation and hygiene services on women empowerment though there are qualitative claims that access to sanitation and hygiene has enhanced women's dignity, decreased their exposure to gender-based violence, increased their household decision-making and increased their participation in community activities (Ivens, 2008; Leahy, Winterford, Nghiem, Kelleher, Leong & Willetts. 2017).

The conceptual framework represented in Figure 1 below is developed by taking insights from empirical, theoretical, and conceptual literature reviewed above and provides an understanding of how sanitation and hygiene access and utilization, and women empowerment are connected with each other and also with the identified socioeconomic, environmental, institutional and individual factors. The framework shows that the rural health extension program (HEP) has created opportunities or access which leads to potential utilization which in turn leads to empowerment. The framework also shows that sanitation and hygiene access depends on several factors such as age, marital status, education, occupation, income and wealth status, exposure to health extension information, place of residence, household size, environmental factors/climate and sanitation and hygiene related knowledge (Dreibelbis et al., 2013). The utilization of sanitation and hygiene facilities is also a function of several different factors such as age, sex, education, marital status, occupation, social networks, knowledge, attitudes and culture, household size, and composition, income, wealth, availability of facilities, waiting time and distance of the facilities from people's home, social interactions, knowledge and demand/need for the facilities (Anderson 1968 cited in Babitsch et al., 2012). Though it may not be always the

case, sanitation access is one of the determinants of sanitation utilization. Access to resources such as soap and water determine people's practice of hygiene indicating how access and utilization are influenced by different factors even though the same factors can affect both of them. The framework also provides an understanding of how empowerment is measured and how it can be influenced by other factors in addition to sanitation and hygiene. Women are empowered when they have access to and control over resources. According to Kabeer (1999), resources are preconditions for empowerment. For women to be empowered, the preconditions for empowerment in this case, sanitation and hygiene access and utilization are important.

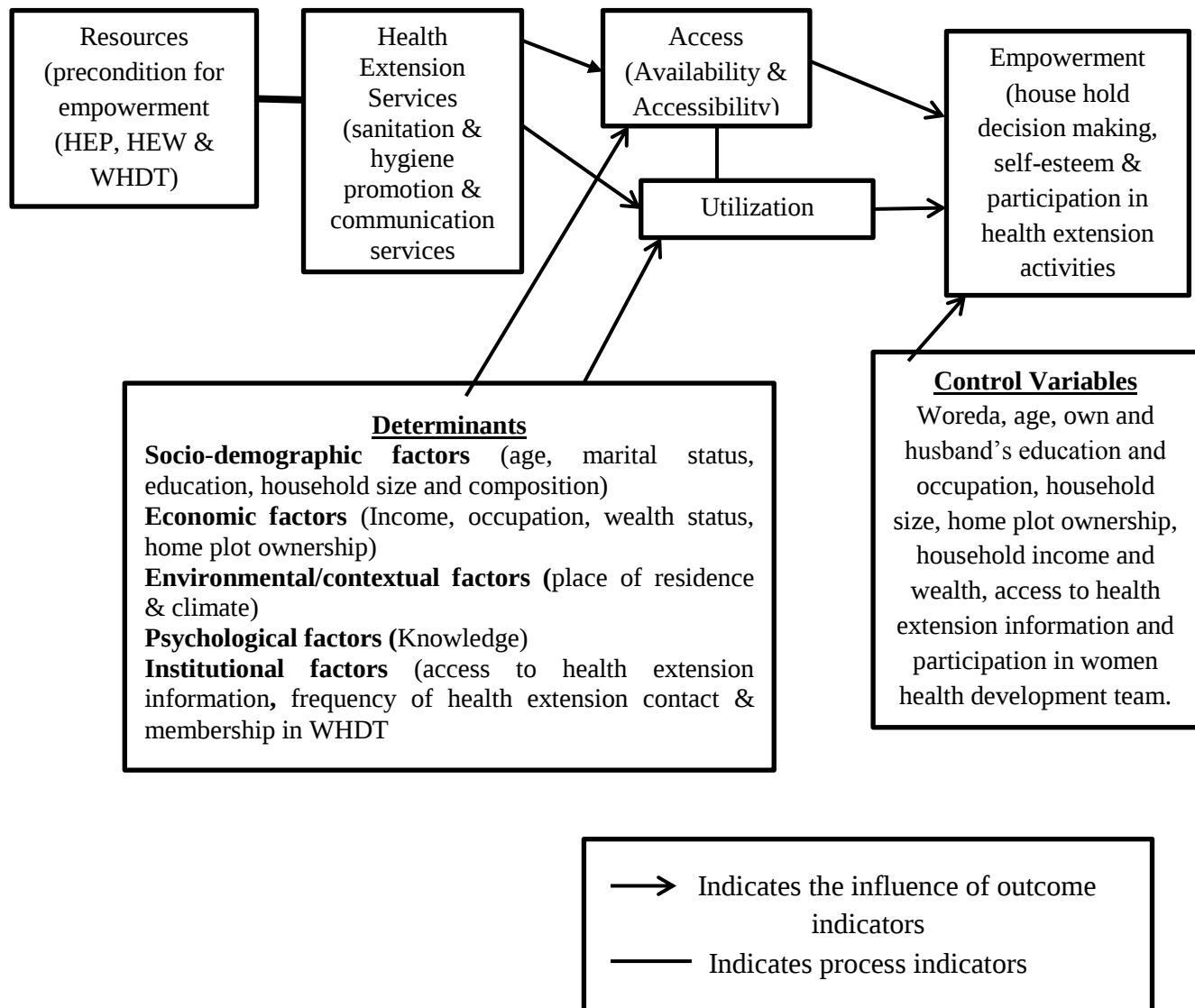


Figure 1: Conceptual Framework of the Study
Source: Constructed by the author on the basis of literature

CHAPTER 3: RESEARCH METHODOLOGY

This chapter explains the philosophical foundation of the research and the research method. The chapter is organized in eight main sections. The first section explains the study area and the second section entertains the philosophical foundation of the research. The third section deals with the research design and the fourth section contains information about methods of data collection. The fifth section deals with sampling technique and sample size determination. Section six covers techniques of data analyses and interpretations while section seven deals with ethical considerations and the last section describe the study variables.

3.1 Description of the Study Area

This study is conducted in some selected rural kebeles of Machakel and Gozamin woredas in East Gojjam Zone. East Gojjam zone is one of the 10 zonal administrative divisions in Amhara Region, Northwest Ethiopia. The Zone is divided into 18 woredas/ districts and Machakel and Gozamin are the biggest woredas in terms of areal size and population. In areal size, Gozamin is the second-largest woreda next to Machakel (Teshome, 2007). The two woredas are also adjacent woredas having similar religious, language, climatic, and ethnic setup.

In terms of the geographical location of the study woredas, Machakel is located at 10° 19' 75" and 10° 41' 00" N latitudes and 37° 16' 46" and 37° 45' 42" E longitudes. The total area of the woreda is 79,558 ha or 2250.68 km². Machakel woreda is bordered with Dembecha woreda in the west, Gozamen woreda in the east, Debre Elias woreda in the south, and Sinan and Bibugn woredas in the north. Machakel is 328 km and 265 km far from Addis Ababa and Bahir Dar respectively (Machakel woreda finance and economic development department megazine, 2009). Amanuel is the administrative center of the woreda and lies about 30 kilo-meters west of the zonal capital Debre-Markos. There are 25 rural and one urban kebele administrations in the woreda.

Gozamin woreda, on the other hand, lies between 10° 1' 46" and 10° 35' 12" N latitudes and 37° 23' 45" and 37° 55' 52" E longitudes (Yared, 2019). The woreda is located about 300 km away from Addis Ababa and 260 km away from Bahir Dar. Gozamin woreda is a host for the administrative seat of East Gojjam zone. According to Amhara Bureau of Finance and Economic

Development Annual Statistical Bulletin 2009/10, Gozamin woreda has a total area of 1218.07 km² and it is bordered with Aneded and Debay Tiltatgin woredas in the east, Machakel and Debre Elias woredas in the west, Sinan woreda in the north and Baso Liben woreda and Oromia Regional State (Abay River) in the south.

3.1.1 Climate

Ethiopia has adopted an agro-ecological classification based on altitude/elevation and the corresponding climate. This classification provides five traditional agro-ecological zones as wurch (>3200m), dega (2300m-3200m), woyna dega (1500-2300m), kolla (500-1500m) and bereha (<500m) (Dereje & Eshetu, n.d). In light of this classification, both Gozamin and Machakel woredas are reported to have four climatic conditions namely dega, woina dega, kola and wurch. According to Bizuayehu (2014), Machakel woreda has 58.76% dega, 39.1% woina dega, 2.12% wurch and 0.02% kola climatic conditions while Gozamin woreda has 16% dega, 74% woina dega, 9% kola and 1% wurch (Gozamen Woreda Agricultural and Rural Development Office Annual Report, 2014). The mean annual temperature of Machakel woreda varies between 8°-24°C and for Gozamin it varies between 11⁰ C and 25⁰ C. The total annual rainfall for Machakel woreda is between 1500 - 1900 mm (Mosseye & Belay, 2018) while the mean annual rain fall distribution of Gozamin woreda is 1342 mm (Nigussie, Yilkal, Mulugeta, Addisu & Gashaw, 2018). The rainfall pattern of both Machakel and Gozamin woredas is unimodal mainly occurring between June and September. In both woredas, the highest monthly rainfall was recorded in July and August while the lowest was observed in January and February (Gozamen Woreda Agricultural and Rural Development Office Annual Report, 2014).

3.1.2 Population

The CSA (2013) population projection for 2016-17 shows that Machakel woreda had a projected total population of 141,576 in July 2017 of which 11% live in urban areas and 89% live in rural areas. Of the 89% people residing in rural areas, 50.8% are women and 49.2 % are men. And about 53.15% of the total population in Machakel woreda is between the ages of 15-64 years (productive age). A similar population projection for Gozamin woreda shows that the woreda has a total projected population of 155,012 in 2017 of these only 3% live in urban areas and 97% live in rural areas. Of the total 97% rural residents, 50.3% are women and 49.7% are men.

3.1.3 Socio-economic Activities

Mixed agriculture is the most important economic activity in both Machakel and Gozamin woredas. More than 92% of the total population in Machakel woreda depends on mixed farming involving both crop production and animal husbandry. Cereal crops such as teff, barley, wheat, maize, and millet (locally known as engido) are the major crops cultivated in the woreda. Other crops and vegetables including triticale, wild oat, faba bean, field pea, lupine, niger seed/Nuge, len seed, rape seed, paper, scared basil/beso bela, potato, apple, and hop are cultivated in the woreda. In places where there is irrigation, banana, mango, papaya, and oranges are also cultivated. The agricultural system in the woreda is dominantly characterized by subsistence type of production.

Similarly, majority of the population in Gozamin woreda is engaged in the production of varieties of crops and rearing of livestock. Information from the woreda agriculture office shows that wheat, teff, maize, barley and oats are the most important crops grown in the woreda. Vegetables, and fruits such as horse beans, chickpeas, linseed, niger seed, onion, garlic, potato, tomato, pepper, carrot, banana, mango, papaya, orange and lemon also grow in the woreda. During the time of the survey, 50,084 hectare of agricultural land in the woreda was covered by harvest and the woreda had a total cattle population of 175,798 and 31,332 Equus (donkeys, horse and mules).

3.1.4 Health and Health Services

Available information on the health aspect of Machakel woreda shows that malaria, intestinal parasite, respiratory infection, and pneumonia are the main health problems in the woreda (MOH, 2010 cited in Yitayh, 2011). During data collection time for the present study, there were six health centers (one in urban and 5 in rural areas) and 25 health posts (24 in rural and one in urban kebeles) and 50 health extension workers in the woreda. In Gozamin woreda also, there were 25 health posts and 2 health centers. The most common diseases in Gozamin woreda include tuberculosis, malaria, diarrhea, trachoma, helminths, skin diseases, typhoid, eye diseases, and upper respiratory tract (Nigussie, Yilkal, Mulugeta, Addisu & Gashaw, 2018).

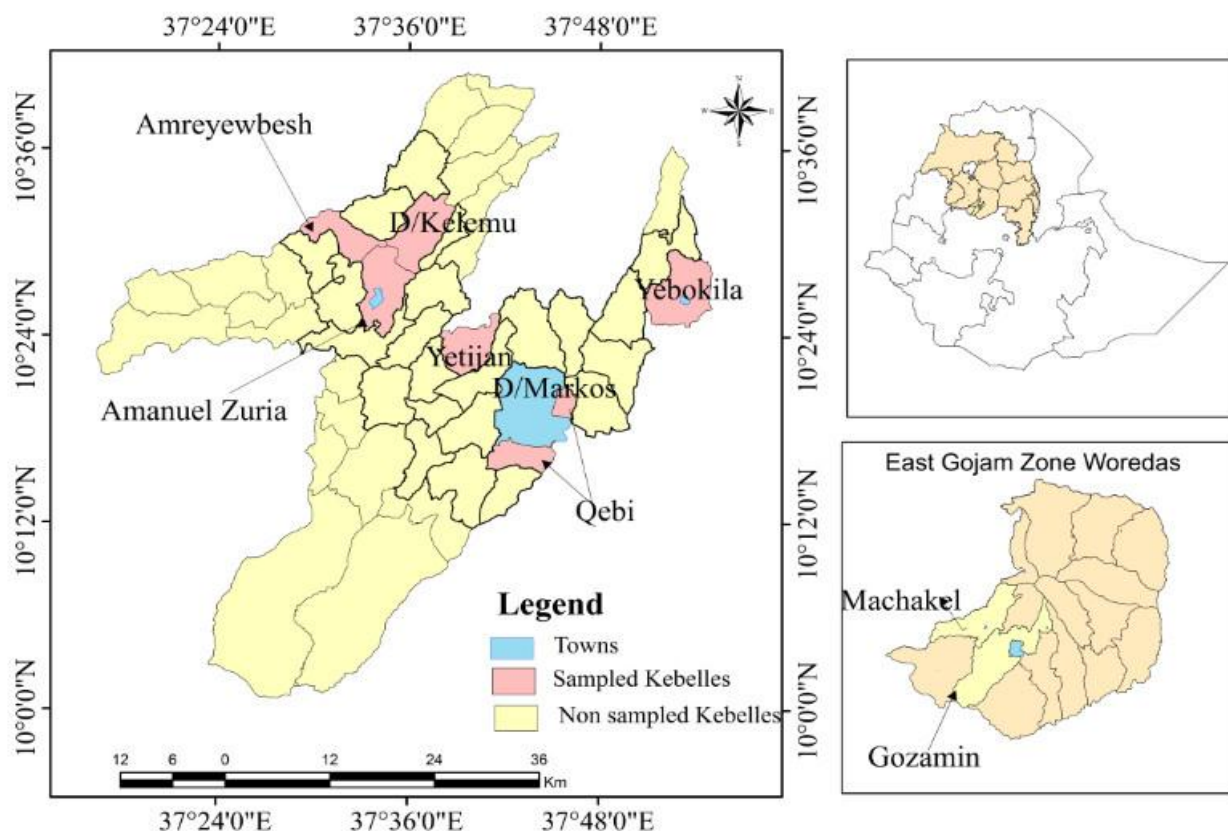


Figure 2: Map of the Study area

Source: GIS data:-CSA (2007), prepared by Liku, GIS expert, 2019

3.2 Research Paradigm

Thomas Kuhn (1962), an American philosopher, who first has used the word paradigm has defined paradigm as a “*philosophical way of thinking*” (cited in Kivunja & Kuyini, 2017). Paradigm is considered as the lens of how a researcher sees the world and how s/he interprets and acts within that world. Paradigm is also known as the researcher’s worldview or thinking. According to Yvonne Feilzer (2009), a paradigm consists of four elements: epistemology, ontology, methodology, and axiology.

Epistemology is concerned with the bases of knowledge, its nature, form, and how it can be acquired and communicated to others (Kivunja & Kuyini, 2017). Yvonne Feilzer (2009) also stated that epistemology is about how we come to know something or how we know the truth or

reality. It deals with the kind of relationship between the researcher, and what is known. The relationship between the researcher and what is known is important to discover what else is new that the researcher can offer given what is known. Ontology, on the other hand, is a branch of philosophy that is concerned with the researcher's assumptions about the nature or essence of the social phenomenon they are investigating (Scotland, 2012 cited in Kivunja & Kuyini, 2017). Ontology is how the researcher makes meaning out of the data she/he gathered. Methodology according to Crotty (1998) is the strategy or action plan that justifies the use and choice of certain techniques (cited in Yvonne Feilzer, 2009). Keeves (1997) on his part defined methodology as the research design, methods, approaches, and procedures as data gathering, participants, instruments, and data analysis used in an investigation (cited in Kivunja & Kuyini, 2017). Axiology refers to the ethical issues considered when planning research. Different researchers have proposed different numbers of paradigms. Some offer three and others provide four. Positivism, interpretivism, and critical theory are the most widely known paradigms in the literature (Rehman & Alharthi, 2016). Borrowing elements from these three paradigms, pragmatic paradigm was proposed as the fourth type of research paradigm by Tashakkori and Teddlie in 2003 (cited in Kivunja & Kuyini, 2017). Positivism/ post-positivism believes that there is a single reality discovered by objective and value-free inquiry (Yvonne Feilzer, 2009) while constructivists/ transformative argue that there is no single objective reality and truth is discovered subjectively (Creswell & Plano Clark, 2007). Pragmatism, on the other hand, is a thinking that it is not possible to discover truth neither only through a single scientific method as advocated by the positivist paradigm nor through the thinking that reality is socially constructed as supported by the interpretivist paradigm. Pragmatism is a non-singular reality ontology that believes that there is no single reality and all individuals have their own and unique interpretations of reality (Kivunja & Kuyini, 2017).

This study uses pragmatism paradigm and the paradigm is selected because the researcher believes that some truth is subjective and others are objective and the world is a mixture of the two, i.e objective truth and the relative truth of multiple realities.

3.3 Research Design

Research design according to Creswell (2006) is the procedure for collecting, analyzing, interpreting, and reporting data in research studies. This research has used mixed-method research design. Mixed method design is a research design that combines both quantitative and qualitative methods in a single study, and it has the capacity to test research hypotheses and examine the strength of association between variables of interest, measure specific constructs and generate detailed accounts of human experiences (emotions, beliefs, and behaviors) and narrative accounts (Tashakkori & Teddlie, 1998).

According to Creswell (2006), once a researcher has selected a mixed-method approach for a study, the next step is to decide on the specific design that best addresses the research problem. There are different mixed-method designs identified in various research books and journal articles. Creswell, Plano Clark, Gutmann & Hanson (2003) have classified mixed methods designs into two major categories: sequential and concurrent. In sequential design, either the qualitative or quantitative data is collected in an initial stage, followed by the collection of the other data type during a second stage. Concurrent designs, on the other hand, are characterized by the collection of both types of data at the same time. Creswell and his colleagues have also provided three specific designs within each of these two categories. The specific designs are offered based on the level of emphasis given to the qualitative and quantitative data (equal or unequal, the dominant-less dominant), the process used to analyze and integrate the data (nested/embedded, triangulation) and whether or not the theoretical basis underlying the study methodology is to bring about social change or advocacy (transformative). Accordingly, the three types of sequential mixed methods designs are sequential exploratory, sequential explanatory and sequential transformative while the three concurrent/simultaneous/parallel mixed methods designs are concurrent triangulation, concurrent nested and concurrent transformative designs (Creswell et al., 2003 cited in Castro, Kellison, Boyd & Kopak, 2010).

The present study uses concurrent nested/embedded mixed-method design. This design is used because the design is helpful to collect both qualitative and quantitative types of data in one field visit and one phase of the research. This concurrent collection of data helps the researcher to complete the research project within a given time frame and financial resources. Besides, the design is helpful for data management as the qualitative method requires less data than the

quantitative method. The qualitative data in this study is used to support the study based primarily on the quantitative data and according to Creswell (2006), concurrent nested design is particularly useful when a researcher needs to embed a qualitative component within a quantitative design.

3.4 Methods of Data Collection

In terms of data sources, the present study has obtained data from primary sources using qualitative (interview and observation) and quantitative (questionnaire) methods. A structured questionnaire was administered in a face- to-face interview with women head of households. The questionnaire had questions on socio-demographic, household characteristics, and access to and utilization of sanitation and hygiene services among others. Questions on sanitation and hygiene access and utilization were designed following examples from various guiding documents such as WHO and UNICEF's core questions on drinking water and sanitation for household surveys. Sanitation and hygiene-related questions used by other similar studies have also been referenced. With regards to questions related to women empowerment, insights were taken from various literature particularly from Routray & et al. (2017), Allendorf (2007), Mahmud, Shah & Becker (2012) and Norwood (2014) and questions were developed to reflect locally tailored indicators as there was no single set of standardized survey instrument to measure women empowerment in the WASH sector.

The questionnaire was first prepared in English and later translated into Amharic and it had both close-ended and open-ended questions. Five enumerators were recruited to administer the questionnaire. The enumerators were selected based on their educational background (diploma and degree), knowledge of Amharic language, and familiarity with the study areas. Enumerators were given two days of training on the objective of the survey, how they can approach and conduct interview with the respondents and the questions themselves. They were made to practice the questions by asking one another. The questionnaire was pilot tested three weeks prior to the actual data collection endeavor, and some questions were modified and amended. The actual data was collected from 23 December 2018 to 24th March 2019 under close monitoring and supervision of the principal investigator.

Interview was also conducted with women respondents, and a total of 30 women heads of households have participated. Key informant interview was also conducted with health extension workers and a total of six health extension workers were used as key informers. Health extension workers were selected as key informants for the reason that they are the health workers closest to the most rural women, and they play a crucial role in promoting sanitation and hygiene service adoption. Since there were two health extension workers in each kebele health post that we have visited, only one health extension worker in each kebele was invited to participate in the key informant interview based on their experience, willingness and presence in the health post during the data collection time.

Available facilities such as latrine sites, hand washing facilities, drinking water sources, water transportation, and storage containers, and other utilities were observed and some of them photographed. Secondary sources of information obtained from books and journal articles whose data were collected and published by other researchers were used for literature review and as a comparison or complement for the finding of the present study.

3.5 Sampling and Sample Size Determination

Sampling in mixed-method research involves the combination of qualitative and quantitative sampling techniques (Teddlie & Yu, 2007). According to Teddlie & Yu (2007) and Leech & Onwuegbuzie (2007), the mixed method (MM) researcher chooses probability sampling techniques when addressing a quantitative aspect of the study and non-probability/purposeful sampling techniques to address the qualitative part of the study. According to Onwuegbuzie & Collins (2007), two criteria are useful for the mixed method researcher to select a mixed methods sampling scheme. These are time orientation and relationship of the qualitative and quantitative samples. Time orientation refers to whether the qualitative and quantitative data are gathered concurrently, or whether these two data types are gathered sequentially, one after the other. With regards to the relationship of the qualitative and quantitative samples, Onwuegbuzie & Collins (2007), have provided four types of relationships; identical, parallel, nested, or multilevel. An identical relationship indicates that exactly the same sample members will participate in both the qualitative and quantitative phases of the study. A parallel relationship, on the other hand, specifies that the samples for the qualitative and quantitative components of the research are different but are drawn from the same population of interest. A nested relationship implies that

the sample members selected for one phase of the study represent a subset of those participants chosen for the other aspect of the investigation. Finally, a multilevel relationship involves the use of two or more sets of samples that are extracted from different population e.g health extension workers and beneficiaries. Based on the time orientation and relationship of the qualitative and quantitative samples, Onwuegbuzie & Collins (2007), have provided eight types of mixed method sampling techniques. These are concurrent identical, concurrent parallel, concurrent nested and concurrent multilevel, sequential identical, sequential parallel, sequential nested and sequential multilevel (p. 294). This study has used concurrent parallel mixed method sampling design where both quantitative and qualitative data were collected concurrently from different samples but the samples were drawn from the same population.

The samples for the qualitative aspect of the research were selected using convenience sampling strategy while samples for the quantitative portion of the study were selected using multistage cluster sampling technique. First, woredas; Gozamin and Machakel were selected purposively based on their level of health extension service adoption/performance. Machakel woreda is considered as relatively better adopter/ best performer of health extension services while Gozamin woreda is considered as a low performer by the Zone health extension office. Hence, these two woredas were selected to see if there is a difference in women's access to and utilization of sanitation and hygiene services. Selecting adjacent woredas with similar socioeconomic makeup except that there is a difference in the level of health extension service adoption is believed to show the effect of the extension service on women empowerment. Previous exposure of the researcher to the woredas was also another rationale for selecting these woredas. Previous knowledge of the study areas will help the researcher to build confidence and thereby facilitate the study. In the second stage, kebeles in the selected woredas were clustered into four based on the traditional agro-ecological classification. As the information obtained from the respective woreda's bureau of health, both Gozamin and Machakel woredas have four traditional agro-climatic conditions namely dega, woina dega, kola and wurch. The health bureau's classification is based on topography and the areas exposure to diseases causing vectors such as malaria. The areas exposure to diseases causing vectors is believed to show variations in sanitation and hygiene technology adoption and utilization. Therefore, based on the respective woreda's health bureau exposure to diseases causing vectors information of kebeles, one among the 25 rural kebeles in Gozamin woreda namely, Gedemala is considered wurch and only two

kebeles Chimit and Mayi Angetam have kola agro-ecology, even Chimit and Mayi Angetam kebeles have mixed agro-climate; woina dega and kola. The kola part is a non-residential area and located near Abay Gorge. Similarly, among the kebeles considered wurch and kola in Machakel woreda only one kebele namely Dingayber is considered wurch among the 25 rural kebeles and workma/kusquam is considered Kola. Hence, both kola and wurch agro-ecologies were discarded from the study because of their non-representativeness. Hence, kebeles from two agro-climatic conditions; dega and woina dega were selected. Thirdly, four kebeles from woinadega agro climate and two kebeles from dega were selected using lottery method (see table 2). In the fourth stage, households were selected from each selected kebele by a systematic sampling method. First, a list of households in each selected kebele was obtained from health extension workers, agricultural extension workers, and kebele administration household registration. In some kebeles, health extension workers did not have a complete list of households in their respective kebeles. In cases like this, lists of registered households of the kebeles were obtained from a registration made by either agricultural extension workers, or kebele administration as per the availability of the information. The selected sample kebeles have a total of 7934 households. Since it was difficult to collect data from such a large number of households, the researcher determined a sample size using Yamane (1967) formula of sample size determination. There are many approaches to determine sample size which includes using a census for small populations, imitating a sample size of similar studies, using published tables, and applying formulas (Israel, 1992). Using a census for small populations was not applicable as the number of women residing in the two woredas is too large to undertake census. Applying the imitating strategy of sample size determination was not followed because there were no similar past studies with the same objective conducted in the study areas. Using published sample size tables could be applied since information on the population of kebeles to be sampled was obtained a priori. However, according to Israel (1992) sample sizes in the published sample table reflect the number of obtained responses, and not necessarily the number of surveys mailed or interviews planned. Thus, Yamane (1967) formula for determining sample size was used as follows; $n = \frac{N}{1+N(e)^2}$, where n=the required total sample size, N= the total household size in the selected kebeles, e= level of precision or sampling error is estimated at 0.05 with the assumption of 95% confidence interval. The formula has yielded a total sample size of 380 households.

In order to obtain, the required household sample size from each sampled kebele, simple proportion was used as $n1 = \frac{N1}{N}(n)$ where $n1$ = the required household sample size from each kebele, $N1$ =Total number of households in each selected kebele, N = total number of households in all selected kebeles, n = total sample size selected from all selected kebeles i.e 380. To select participant households or housing units for questionnaire administration, a number was assigned to each head of household name on the total household list in each sampled kebele. The participant households were then selected from this numbered list of households. The first household was picked randomly. Then subsequent households were selected using a fixed sampling interval, i.e. every n^{th} household (calculated as N/n). N = the number of total households in each selected kebele and n = sample size allocated for each kebele. N/n gives the interval (n^{th}) for selecting participant households. The second household was selected by adding n^{th} interval to the first selected household. Finally, female heads of the households were selected as study participants. In cases where female heads of the household were absent at the time of the survey, data collectors have revisited the household. But, when respondents refused to be interviewed, they were substituted with the female head in the nearest household.

Table 2: Sample kebeles, total no of households in the sampled kebeles and the required household sample size from each sampled kebele.

Woreda	Agro ecology	Sampled Kebeles	Total no of households	The required household sample size from each sampled kebele	Sample selection interval
Machakel	W/ Dega	Amanuel Zuriya	1211	58	Every 20th house
	W/ dega	Amreyewbesh	890	43	Every 20th house
	Dega	Debrekelemu	1015	49	Every 20th house
Gozamin	Dega	Yebokla Zuria	2010	96	Every 20th house
	W/Dega	Yetjan	1538	73	Every 21 st house
	W/ Dega	Qebi	1270	61	Every 20th house
Total			7934	380	

Source: Filed Survey, 2018

For the qualitative aspect of the research, five women in each of the six sampled kebeles were chosen for interview based on their convenience. This makes the total qualitative sample to be 30. Sample size of 15 to 30 interviews are considered as adequate for qualitative case studies by Marshall and his colleagues in 2013 as cited in Boddy (2016). Boddy (2016) has also stated that a sample size over 30 in qualitative research is awkward to administer and analyze.

3.6 Data Processing and Methods of Analysis

The quantitative data obtained through questionnaire was coded and entered into a computer for analysis using Statistical Package for the Social Sciences (IBM SPSS version 20). The entered data is checked for completeness and incorrect coding and errors in measurement scales such as nominal, ordinal, and ratio are corrected. Descriptive statistics was run to check if data are missed wrongly. The errors detected were corrected by looking at the raw data. Re-coding of some variables was done as required. Once the data cleaning and editing is done, the data is transferred into Stata/SE version 14 to perform the ordered and generalized ordered logistic regressions. The qualitative data, on the other hand, is analyzed using thematic analysis. In sum, since the study uses a mixed-method research approach, both quantitative and qualitative methods of data analyses were employed. According to Schoonenboom & Johnson (2017), the use of both types of analysis in mixed method research is called multi-analysis/ multiple mixed analyses. Therefore, the present study has used multiple mixed data analysis methods as explained below.

3.6.1 Descriptive Data Analysis

Descriptive analysis is used as a first step to describe respondents' characteristics. Quantitative data such as respondents' socioeconomic and demographic information as well as their level of access and utilization of sanitation and hygiene services are analyzed using descriptive statistics such as percentages, frequencies, mean, standard deviation, maximum, minimum and scale. All this information is done using SPSS and the analyzed data is presented using tables.

Descriptive statistics is also used to identify variables that will be included in the regression analysis. Before all the independent variables are included in the regression model and their association with the dependent variable is tested, their association with the dependent variables

was first confirmed in descriptive cross tab statistics. Different chi-square tests of association were used to test the association between the independent and dependent variables depending on the nature of the independent variables and ordinal dependent variables. As such, the gamma coefficient is used to determine the association between ordinal independent and ordinal dependent variables while the contingency coefficient also known as Pearson coefficient is used to measure the association between nominal independent variables and ordinal dependent variables. There is very little literature about the measurement of association between continuous independent variable and ordinal dependent variable. Thus, all continuous independent variables were included in the final model automatically, and their association is tested using the regressing analysis. For the categorical independent variables, variables that have significant association with the dependent variable based on the chi-square test of association at $p \leq 0.05$, $p \leq 0.01$, and $p \leq 0.1$ are included into the final model. Variables that were not having significant association with the dependent variable at $p \leq 0.05$, $p \leq 0.01$ and $p \leq 0.1$ level of significance but had a chi square test value with a p-value below 20% ($P < 0.20$) were also taken into the final model. The inclusion criterion of 20% significance level was set so that important variables that do have a significant association at 0.1 should not be excluded from the analysis. Thus, variables that showed significance at $p \leq 0.20$ in the chi-square tests were retained for final regression analysis while other variables that fail to meet all these thresholds were removed.

After the relationships between independent and dependent variables were checked using chi-square tests of association and variables that will go into the final model are identified, a multicollinearity test is conducted to assess if there is similarity or inter-correlation within the independent variables. Kendall tau-b correlation is used to test if categorical independent variables were statistically independent of each other while Variance Inflation Factor (VIF) and tolerance were used for detecting multicollinearity among the continuous independent variables. Categorical independent variables with Kendall tau-b correlation coefficient values between $-1 < 0 < 1$ and continuous independent variables with VIF below 10 and a tolerance values beyond 20 were included. Literature provides different figures on how high the VIF has to be to know the presence of collinearity. Some say a VIF of four, others say five. But, the most common rule of thumb is 10. According to O'Brien (2007), Hair, Anderson, Tatham & Black (1995), a VIF of 10 or more is regarded as a sign of severe or serious multi-collinearity while a VIF of less than 10 is indicative of insignificant collinearity. Similarly, Menard (1995) has stated that a tolerance

(1/VIF) of less than 0.20 is a cause for concern and a tolerance of less than 0.10 certainly indicates a serious collinearity problem. Thus, both the tolerance and VIF test results were determined in line with these references, and there was no multicollinearity problem as the variance inflation factors of all the continuous variables were found to be less than 10 and their tolerance value was more than 0.20.

Once variables that should be included into the final model are identified and their multicollinearity is tested, the ordered logit regression model is run. In cases where the ordered logit regression assumption is rejected, generalized ordered logistic regression is used.

3.6.2 Ordered Logistic Regression

Access in this paper is a latent variable defined as the availability/presence of sanitation and hygiene facilities in the surveyed households. Utilization, on the other hand, is defined as the actual utilization of the available sanitation and hygiene facilities by women. Both access to and utilization of sanitation and hygiene facilities are measured as ordinal variables (low, medium, and high) because people have a different level of access to and utilization of sanitation and hygiene facilities. Ordered logit and ordered probit models are the two appropriate models to estimate ordinal response variables having more than two ordinal categories. According to Gujarati (2004), logit and probit models are similar, in the sense that, they generate similar predicted probabilities (0 and 1) as well as similar inferences. The main difference between these two analytical models is how they define the functional form $f(*)$ of the cumulative distribution function (CDF). The logit model uses the cumulative distribution function of the logistic distribution while the probit model uses the cumulative distribution function of the standard normal distribution. Therefore, the choice of probit versus logit regression depends largely on the distribution assumption one makes. Logit is, however, preferred because of its comparative mathematical simplicity. Sirak & Rice (2015) have also argued that logistic regression is powerful, convenient, and flexible and is often chosen if the independent variables are a mix of continuous and categorical variables and/or if they are not normally distributed (cited in Kirui & Mirzabaev, 2019). Since the independent variables in this study are a mix of both continuous and categorical variables, the ordered logit model is used to analyze factors affecting women's access to and utilization of sanitation and hygiene facilities.

Ordered logistic regression also known as proportional odds (PO) model or cumulative odds (CO) model is an extension of binary logistic regression. Binary logistic regression estimates the probability that people have access to sanitation and hygiene facilities or not given the values of independent variables. But, people have different levels of access to and utilization of sanitation and hygiene facilities indicating that the outcome variable can be beyond binary access, no access categorization. People's access to and utilization of sanitation and hygiene facilities can be categorized as low, medium, and high based on their level of access to and utilization of the facilities. When outcome variables are ordinal rather than continuous, Williams (2016) stated that the ordered logit model is a popular analytical method. Similarly, O'Connell (2006) wrote that the proportional odds model is used for modeling a dependent variable that has more than two levels and K set of independent variables.

The proportional odds model is used to estimate the odds of being at or below a particular level of the response variable. Given that our outcome variables; sanitation access, sanitation utilization, hygiene access, and hygiene utilization have three ordered possibilities as low, medium and high, the proportional odds model according to Liu (2016) makes j-1 predictions, each estimating the cumulative probabilities at or below the jth level of the outcome variable. This model can also estimate the odds of being beyond a particular level of the response variable because below and beyond a particular category are two complementary directions (p.194). More specifically, given j-level ordinal response variable such as sanitation access with j=3, we would have a j-1=2 characterization of the data. J-level ordinal data is partitioned by j-1 cut points. The interest under this partition of the data is to identify factors associated with an increased likelihood of having low sanitation access relative to having medium or high sanitation access or increased likelihood of having high sanitation access relative to having medium and low sanitation access.

Being an extension of binary logistic regression, the full formula of proportional odds model as stated in Liu (2016) follows the formula of simple and multiple logistic regression as follows;

$$\ln \frac{\pi}{1-\pi} = \alpha + \beta x \dots\dots\dots (1)$$

Where ln is the natural logarithm of the odds, read as log- odds or log-odds of the odds (ln (odds))

π = is the probability when the outcome variable equals 1; $P(Y=1)$.

α = is the intercept,

β = is the logit regression coefficient,

X = is the independent/ predictor variable

Equation one above shows the formula of simple logistic regression (binary logit regression); where one independent variable is regressed with one dichotomous/binary outcome. Since the relation between the independent and dependent variables in the bivariate analysis are not always one-to-one and there is interaction effect, multivariable or multivariate analysis is important. Multiple logistic regressions/ multivariate analysis refer to the regression application with one dichotomous dependent variable and more than one independent variable. The form of the multiple logistic regression models is expressed as;

$$\ln \left(\frac{\pi(x)}{1-\pi(x)} \right) = \alpha + \beta_1 X_1 + \beta_2 X_2 \dots + \beta_p X_p$$

Where;

α , is the intercept, $X_1, X_2, \dots, X_p$, are the independent variables and $\beta_1, \beta_2, \dots, \beta_p$, are logit or regression coefficients of the independent variables.

This equation can also be expressed as,

$$\text{logit}[\pi(x)] = \alpha + \beta_1 X_1 + \beta_2 X_2 + \dots + \beta_p X_p \dots \dots \dots (2)$$

In both simple and multiple binary logit regressions, there are two probabilities; the probability of having an event and the probability of not having an event. The probability of having an event is denoted as $P(Y=1)$ and the probability of not having an event is $1-p$. Now the effect of an independent variable on the binary dependent variable is nonlinear, as it gets channeled through a nonlinear cumulative distribution function (logit in our case). To make the interpretation easier, we make use of the odds ratio. The odds in binary logit are the ratio of two probabilities, the probability of having an event (p) to the probability of not having an event ($1-p$).

$$\text{Odds} = \frac{p}{1-p}$$

In simple logistic regression, $\ln\left(\frac{\pi}{1-\pi}\right) = \alpha + \beta X$ exponentiating both sides of the equation, we get the odds of having an event as;

$$\frac{\pi}{1-\pi} = \exp(\alpha + \beta X) \text{ and this can be rewritten as } \text{odds}(y=1) = \exp(\alpha + \beta X) \dots \dots \dots (3)$$

If the independent variable X is a categorical variable with the values of zero and 1, the odds ratio is expressed as $\exp\left(\frac{\alpha + \beta}{\exp(\alpha)}\right) = \frac{\exp \alpha + \exp \beta}{\exp \alpha} = \exp \beta$.

By exponentiating the logit coefficient, we get the odds ratio (OR). The OR in logistic regression is also known as the exponentiated logit coefficient.

Similar to the binary logistic regression above, the ordinal logistic regression model defines the cumulative probabilities, cumulative odds, and cumulative logits for the j-1 categories of the response.

Cumulative probabilities of ordinal logistic regression can be defined as;

$$\pi_{j(x)} = \pi(Y \leq \left(\frac{j}{X_1, X_2, \dots, X_p}\right)) \dots \dots \dots (4)$$

$\pi_{j(x)}$ = is the probability of being at or below category j, given the set of X predictors.

Equation #4 gives the cumulative probability that $\pi_{j(x)}$ falls in a category j and below (i.e., in category 1, 2,or j).

Now the effect of an independent variable on the ordered dependent variable is nonlinear, as it gets channeled through a nonlinear cumulative distribution function (logit in our case). This makes interpretation of the Ordered Logistic Model somewhat complicated. To make the interpretation easier, we can make use of the odds ratio.

The odds of the cumulative probabilities of the response variable for the j-1 categories equals the probability of being at or below a category divided by 1 minus the probability of being at or below that category

$$\text{Odds}(Y \leq j) = \frac{P(Y \leq j)}{1 - P(Y \leq j)} \dots \dots \dots (5)$$

In sum, the ordinal logistic regression model can be expressed in the logit form as,

$$\ln(y_j^*) = \text{logit}[\pi(x)] = \left(\frac{\pi_j(x)}{1-\pi_j(x)} \right) = \alpha_j + (-\beta_1 X_1 - \beta_2 X_2 \dots - \beta_p X_p) \dots \dots \dots (6).$$

Where $\pi_j(x) = \frac{\pi(y \leq j)}{(x_1, x_2, x_3 \dots x_p)}$, which is the probability of being at or below category j given a set of independent variables, $j=1, 2 \dots j-1$

α_j are the cut points and $\beta_1, \beta_2, \dots, \beta_p$ are the logit coefficients

To estimate the $\ln(\text{odds})$ of being at or below the jth category, the proportional odds model can be rewritten as,

$$\left[\pi \left(\frac{y \leq j}{x_1, x_2, \dots, x_p} \right) \right] = \ln \left(\frac{x \left(\frac{y \leq j}{x_1, x_2, \dots, x_p} \right)}{x \left(\frac{y > j}{x_1, x_2, \dots, x_p} \right)} \right) = \alpha_j + (-\beta_1 X_1 - \beta_2 X_2 \dots - \beta_p X_p) \dots \dots \dots (7)$$

Equation # 7 is used to compute cumulative probabilities for the proportional odds model which is equivalent to J–1 binary regressions assuming that the logit coefficients (β) and odds ratio are identical across each regression. This important assumption for the proportional odds model is known as the parallel regression or proportional odds assumption (Long & Freese, 2001). However, there is a key problem with the ordered logit model. Its assumption that the independent variables have the same coefficients and odds ratio across the different response categories is often violated (Liu, 2016, Brant, 1990; Peterson & Harrell, 1990, Williams, 2008) particularly when the numbers of independent variables are large (Brant, 1990), when the sample size is large or when there is a continuous independent variable in the model (Allison, 1999 cited in O’Connell, 2016). Rejection of the assumption of proportional odds or parallelism indicates that at least one of the independent variables has a differential effect (odds ratio) across the outcome levels. Brant test, which is the most popular proportional odds assumption test, is used to determine if the proportional odds assumption is met or not. If brant test becomes significant, it indicates that the proportional odds assumption is rejected and an alternative model has to be used while a non-significant p-value for same test indicates that proportional odds assumption is met (Williams, 2016; Peterson & Harrell, 1990). Williams (2016) and Peterson & Harrell (1990) further stated that when the assumption of the proportional odds model is rejected, or if the data fail to satisfy the proportional odds assumption, a valid solution is fitting a partial proportional

odds model also called generalized ordered logit model. In view of these, generalized ordered logit /partial proportional odds model was used in cases where the assumption of the proportional odds model was violated. The main difference between ordered logit and generalized ordered logit is that the ordered logit model requires the β 's to be the same for each value of j , while the generalized ordered logit model relaxes all or some of the β 's across values of j .

To test the statistical significance of each independent variable, likelihood ratio test is used. A significant likelihood ratio test means that a variable is a significant predictor in the model. Logit coefficients and marginal effects (delta method and associated p-values) are used to interpret the model output. Logit coefficient shows the direction of the relationship between the independent and dependent variables while marginal effect tells the strength and magnitude of the relationship between the independent and dependent variables. Marginal effects further signify the effect of independent variables on the probability of a change in the dependent variable. Marginal effect measure how much the probability of having access to sanitation would change as a result of a variation in each of the determinants. In linear regression model, the regression coefficients can be interpreted as marginal effects. In non-linear regression models, however; coefficients cannot be interpreted as marginal effects. Instead, the marginal effect of an independent variable is obtained by calculating the difference in the dependent variable Y for a change in the independent variable X (Norton, Wang & Ai, 2004, Cornelißen, 2005). Literature has provided different approaches for calculating marginal effects for non-linear models. The most common listed approaches are average marginal effect (AME), marginal effect at the mean (MEM) and marginal effect at representative value (MER) (Williams, 2012, Leeper, 2018).

Average marginal effect calculates the marginal effect of an independent variable x while the other independent variables are kept as they were observed. Marginal effect at the mean on the contrary, computes the marginal effect of an independent variable x when all other independent variable in the model are kept at their mean (Perraillon, 2019; Leeper, 2018 & Williams, 2012). Both average marginal effect and marginal effect at the mean estimates the average marginal effect of each independent variable on the dependent variable. However, MEM keeps other independent variables at their mean value to calculate the average marginal effect of a single independent variable while AME keeps them at their observed values. Some of the independent variables used in the data such as education, occupation, and marital status do not have mean

value, thus, using marginal effect at the mean (MEM) is not found acceptable. Similarly, the marginal effect at representative value approach, the researcher has to give representative values for each independent variable and in a model where there are many variables; it is very broad and cumbersome to specify representative values for every independent variable. It takes much computation time and resources. Thus, using marginal effect at representative value approach is not selected. Instead, average marginal effect approach is used because the approach helps to estimate the marginal effect of each independent variable x at every observed value of another x . In doing so, AME respects both the distribution of the original data/ the actual observed values and fixed values of a variable. The use of both the actual observed values and fixed values of a variable makes AME superior than MEM (Leeper, 2018).

3.6.3 Generalized Ordered Logistic Regression

Generalized ordered logistic regression also known as partial proportional odds model was first proposed by Fu in 1999 to relax the assumption of the proportional odds model. The original generalized ordered logit model (gologit) and sometimes written as gologit1 or Fu's gologit assumes that each independent variable has a different impact on different categories (cut points) of the ordinal outcome variable and no variable is required to meet the parallel lines assumption (Ucal & Gunay, 2019). In practice, however, this is not always true as some independent variables will have the same effect across the different outcome categories. To overcome the major drawbacks in the proportional odds model and Fu's gologit model, Richard Williams has improved the original generalized ordered logit model in 2005. The improved generalized ordered logit model is usually written as gologit2.

Gologit2 is a user-written program in statistical package Stata that estimates both the proportional odds model that is the same as Fu's gologit1 model and the partial proportional odds model. Gologit2 or the partial proportional odds model relaxes the proportional odds assumption for some independent variables while being maintained for others (Williams, 2005). The partial proportional odds model (PPO) assumes the presence of both the same odds ratio and different odds ratios across the different categories of the outcome variable (Williams, 2016). It also restricts some coefficients to be the same for every cut point or ordered dependent variable while other coefficients are free to be different. The proportional odds model, on the contrary, restricts the coefficients to be the same for every ordinal dependent variable (Williams, 2005).

Therefore, in cases where the proportional odds assumption is violated by the data (brant test becomes significant), partial proportional odds model (gologit2) with auto fit command is used.

Given that the dependent variables in this study are ordered as low, medium, and high sanitation and hygiene access and utilization and not empowered, relatively empowered and empowered categories, the gologit2 model provides the Stata output in two panels. The first panel contrasts category 1 with categories 2 & 3 and the second panel contrasts categories 1 and 2 with category 3. Related to this, Williams (2006), Soon (2010), and Ucal and Gunay (2019) stated that when $m > 2$, the gologit2 model becomes equivalent to a series of binary logistic regressions where categories of the dependent variable are combined. For instance, in the objective that tries to examine determinants of women's access to sanitation facilities, the dependent variable sanitation access has three ordinal categories; low, medium, and high and the gologit2 model has estimated the model result in two panels. In the first panel, low sanitation access is contrasted with medium and high sanitation access categories and in the second panel, low and medium sanitation access categories are contrasted with high sanitation access category. Each panel gives the results for coefficients (β) and the odds ratio estimates (e^β). A similar procedure has been used for other objectives such as for determinants of hygiene access and utilization as well as for the empowerment effect of sanitation and hygiene access and utilization.

The independent variables that met the proportional odds assumption in gologit2 have the same coefficients and odds ratio across the different levels of response categories and for those independent variables violating the proportional odds assumption, the Stata output provides different coefficients and odds ratio across the different levels of response categories. Hence, two different coefficients and odds ratio estimates are shown in two panels. Besides, the positive coefficients indicate that higher values on the independent variables make it more likely that the respondent will be in a higher category of the outcome variable, "Y" than the current one, whereas negative coefficients indicate that higher values on the independent variables increase the likelihood of being in the current or a lower category (Williams, 2006). In sum, the partial proportional odds model is specified as below following Williams (2005) expression.

$$P(Y_i > j) = \frac{\exp(\alpha_j + X_{1i}\beta_1 + X_{2i}\beta_2 + X_{3i}\beta_3)}{1 + [\exp(\alpha_j + X_{1i}\beta_1 + X_{2i}\beta_2 + X_{3i}\beta_3)]}, j = 1, 2, \dots, M - 1 \dots \dots \dots (8)$$

Where i refer to individuals,

M represents the number of categories of the ordinal dependent variables and j represents its cut points.

X represents the independent variables, where x_i is a vector of independent variables,

β Represents coefficient/parameter of every dividing point m-1, β_1 is a vector of estimable parameters, and α_j and α (m-1) are the upper and lower thresholds for sanitation and hygiene access and utilization M.

In equation number 8, the β 's for X_1 and X_2 are the same for all values of j but the β 's for X_3 are free to differ (Williams 2005 & 2006, Ucal & Günay, 2019).

Finally, the proportional odds model was deemed suitable for analyzing the determinants of women's sanitation utilization as the assumption of the proportional odds model was met, whereas the partial proportional odds model was preferred for sanitation access, hygiene access, and hygiene utilization as the assumption of the proportional odds model was violated.

During model estimation, confidence interval for coefficients, odds ratios and marginal effects were calculated at 95% level of confidence and all the independent variables with p-values of <0.05%, <0.01 and < 0.1 are considered significant.

3.6.4 Thematic Analysis

To analyze the qualitative data obtained through interview and observation methods, first tape-recorded interviews, field notes, and photographs are organized. To obtain a general sense of the information gathered, a thorough thought is done observing photographs and listening recorded stories of participants. After the researcher made herself familiar with the qualitative data, and getting the general sense of what people were saying, the large data set is reduced and transcribed from tape to paper. The transcribed information is then translated from Amharic to English. The English translated information is crosschecked if the ideas were fit into the Amharic transcription. Once, the translated information is found consistent with the Amharic

transcript, recurrent words, stories, and ideas were grouped together. These themes were used to analyze the qualitative data. *Thematic analysis*, according to Maguire & Delahunt (2017) “is the process of identifying patterns or themes within qualitative data” (P.3352).

Braun & Clarke (2006) have provided two levels of thematic analysis; semantic and latent. In semantic thematic data analysis, the researcher does not look far beyond what a participant has said. The researcher focuses on the surface meaning of the data and describes what is said to focus on interpreting and explaining it. In the latent thematic analysis, the researcher looks beyond what has been said and examines the underlying ideas, assumptions, conceptualizations, and ideologies that are theorized as shaping or informing the semantic content of the data (cited in Maguire & Delahunt, 2017).

The present study uses semantic thematic data analysis. The voice of the study participants or their personal experiences are directly quoted followed by the researcher's own interpretation and displayed jointly next to the quantitative analysis. The joint display of quantitative and qualitative analysis is done to see the comprehensive information about the issue or improve understanding of the issue from different perspectives. The qualitative data are used to provide a supportive, secondary role to the primary quantitative data type.

3.7 Ethical Considerations

The ethical behavior of researchers has become an important foundation for effective research. Quantitative and qualitative researches have their own ethical considerations. According to Creswell (2012), mixed-method research designs should also follow the ethical considerations connected to both quantitative and qualitative methods. For example, quantitative studies require researchers to obtain permission, protect privacy, and communicate the purpose(s) of the study accurately while qualitative studies require researchers to communicate the purpose(s) of the study accurately, avoid deceptive practices, respect the study population, respond to potential power concerns, and confidentiality. All of these ethical issues are also ethical issues for mixed-method research (cited in Subedi, 2016).

In line with this reference, this study has adhered to the following research ethical considerations.

3.7.1 Ethical Clearance

First, support letter was obtained from Addis Ababa University College of rural development. The letter consists of the name of the researcher, the research title, the purpose of the research, and place of the research. The letter was taken to respective woreda health bureaus. From there, the researcher was referred to talk to woreda health extension office coordinators. The woreda health extension coordinators have checked the questionnaire and official oral consent was obtained from them to enter into the research sites. In the research sites, health extension workers were informed about the research and in some instances, they introduced the researcher and data collectors to the community. This way we have reduced, the fear of the community seeing us strangers moving from house to house.

3.7.2 Informed Consent

Informed consent was obtained directly from women involved in the study, as well as their husbands. In the first section of the questionnaire and interview guides, informed consent is stated with clear identification of the research title, research purpose, and procedures to be carried out. Data collectors were also told about how they have to approach their respondents (respect, not threaten them, and patience) and the need to explain the consent statement to the research participants and get their agreement. This way, participants were made clear about the purpose of the study and the demand from them. They were also ensured that they have the freedom to participate or withdraw from it at any time. Informed consent was obtained orally and it was after the consent was obtained that data collection has begun.

3.7.3 Protection from Harm

No risk of harm is anticipated as a consequence of this study. During the time of data collection, where couples were found at home, both the husband and wife were informed about the study and prior consent was obtained from both couples. In some instances, where husbands were already left home for other activities, consent was obtained from the wives only. However, there were instances where husbands came from the field in the middle of the interview, shouted, and try to deter their wives from taking part. Watching their husband coming, some women even decline to participate. This time, husbands were briefed about the purpose of the study, and what

kind of information we are collecting. After they were informed and their consent was obtained, they were requested to give us sometime privately. This way, participants were made to feel secured and any potential harm on them has been minimized.

3.7.4 Confidentiality

Confidentiality was also another ethical consideration that was employed in this research. To this effect, interviews were conducted in private, participants were told that the information they provide would be used only for research purpose. They were also informed that their names/identity will be kept anonymous if they do not want to be made public and all the names of research participants in the findings will be pseudonyms. There was variation in this case. Some informants were willing to have their names disclosed in the research while others were not willing. To have uniformity the researcher has coded their names. But, some visual images like photos were used based on their consent.

3.8 Description of Variables

3.8.1 Dependent variables

There are multiple dependent variables in the study since the research is interested to answer several research questions. The different dependent variables are used in different sections of the thesis and they are described below.

1. Sanitation Access and Utilization

Sanitation access is a latent variable that is not directly observed. Instead, it was indirectly observed through other observed variables such as the presence of latrine, liquid waste disposal pit, and the presence of separate houses for people and animals. Thus, in the specific objective that tries to examine the association between different independent variables and women's access to sanitation, the dependent variable is sanitation access, which is divided up into three ordinal categories as low (coded as 1), medium (coded as 2) and high (coded as 3). The three sanitation access categories were obtained from the three sanitation-related questions that were prepared and presented to respondents. These sanitation access questions were; 1/ does your household owns a latrine? 2/ does your household have a household liquid waste disposal facility? And 3/

do you or your household have any domestic animal? And if yes, do you have a separate dwelling for people and the animals?

Similarly, the variable, sanitation utilization is a latent variable measure by respondents' actual utilization of latrine, and liquid and solid waste disposal practices. A three-category dependent variable is constructed as low (coded as 1), medium (coded as 2), and high (coded as 3) sanitation utilization from the respondents' response to the above-mentioned sanitation indicators.

3. Hygiene Access and Utilization

Hygiene access in this paper is also a latent variable defined as the availability of facilities, technologies and material where individuals can keep their cleanness, cleanness of their household utensils, and of water hygiene. Respondents were asked 11 hygiene-related questions and their hygiene access score was calculated based on their responses to the availability of these 11 hygiene-related indicators. Finally, a three-category dependent variable is constructed as low (coded as 1), medium (coded as 2), and high (coded as 3) hygiene access. Hygiene access measurement indicators were whether respondents have access to protected water, the time they spent to get water(round trip), whether drinking water is available to them at all times they need, if they have separate drinking water transportation container and if the container has its own cover, availability of separate drinking water storage container, availability of its own cover for the water storage container, availability of handwashing facility near the latrine, availability of water in the hand washing facility, availability of shelf for household utensil and availability of shower facility. The responses for most of these hygiene indicators were binary; yes (coded as 1) and no (coded as 0). Some hygiene questions had multiple responses which later were brought into binary responses. For instance, respondents were asked where they get their drinking water from and there were five options; 1/from protected spring, 2/public tap/standpipe, 3/protected dug well, 4/river and 5/unprotected spring. Following the definition of these indicators provided by WHO/UNICEF Joint Monitoring Program (JMP) for the Millennium Development Goals (MDGs) seven particularly of its targets on halving the proportion of people without sustainable access to safe drinking water and basic sanitation by 2015, these options were later categorized into protected/improved and unprotected/unimproved sources. Accordingly, respondents who checked/selected their water source as originated from protected spring, public standpipe and

protected dung well were categorized as having protected water source and re-coded as 1 or yes) and those respondents who selected river and unprotected spring were categorized as unprotected water source and re-coded as 0 or no.

Similarly, time spent to get water (round trip) had five response options, 1/ water source is in the premise, 2/ less than 30 minutes, 3/ within 30 minutes, 4/ 31 to 60 minutes, and 5/ more than 60 minutes. Howard & Bartram (2003) stated that in order to say that people have access to water, the water has to be in the premises, or the collection time does not exceed 30 minute round trips. If the person travels more than 30 minute round trips or 1000 m, it is defined as no access. Hence, the first three response options were re-coded as yes (1) indicating that the respondent has access to water and the last two response options (31 to 60 minutes and more than 60 minutes) were re-coded as no access to water (0). This way, responses were standardized into binary responses.

Hygiene utilization is also a latent variable measured through the responses obtained from six hygiene-related indicators and is categorized into three; low utilization (coded as 1), medium utilization (coded as 2), and high utilization (coded as 3). The six hygiene indicators used were, 1/whether the respondent usually uses soap to wash their hands after defecation, 2/ whether they treat their drinking water at home, 3/the type of water container mostly used to transport drinking water, 4/type of water storage container they use, 5/common withdrawal means of drinking water from the container/storage and 6/ whether they use sanitary materials for menstrual hygiene management. Questions number one & two have binary response options as yes (coded as 1) and no (coded as 0) while question number three to six has multiple response options, which are later transformed into binary responses. For instance, question number three, which deals about the specific water container usually used by the respondents to transport drinking water has clay pots, jerry can and barrel/ baldi as response options and if the respondent has checked/selected jerican, it is re-coded as narrow neck container (coded as 1) and if checked either clay pot or barrel, it is re-coded as open neck container (coded as 0). Similar procedure is used to recode question number four, which deals with the specific water container usually used by respondents to store drinking water. Question number five, which deals with the common withdrawal means of drinking water from the container/storage has two response options; tilt & pour into a cup/mug and dip the hand with any available mug, glass, or tin. The response tilt & pour into a

cup/mug indicates safe withdrawal practice and coded as 1 and the response dip the hand with any available mug, glass, or tin indicates unsafe withdrawal practice and coded as 0. Finally, the question on whether the respondent uses sanitary materials for menstrual hygiene management has three options; yes (coded as 1), no (coded as 0) and does not apply (treated as missing).

3. Women Empowerment

In the study objective that tries to see the effect of sanitation and hygiene access and utilization on women empowerment, the dependent variable is the cumulative empowerment index composed of self-esteem, household decision-making, and participation in rural health extension activities. A number of sub-indicators were also considered under each of these three empowerment indicators. Each of the empowerment indicators and the sub-indicators are described as follows.

Self Esteem

Sanitation and hygiene are important for increasing women's self-esteem or how they think about themselves. Better sanitation and hygiene practices make women feel positive about themselves, increases their social acceptance and eventually boost their self-esteem. Latrine utilization, for instance, provides cleanliness, comfort, privacy, freedom and security, and avoids shame and embarrassment which ultimately led to greater self-esteem. Cleaning the domestic environment, cleaning oneself and wearing neat clothes is related to being confident at home and in public. In contrast, a person with poor environmental sanitation and personal hygiene will have low self-esteem. Poor sanitation and hygiene also affects interpersonal relationship and it can be a cause of conflict among couples. Abu, Bisung & Elliott (2019), in their study of women's involvement in WaSH decision making in Kenya have found that women have experienced domestic violence because of water unavailability in the house and the husband's clothes were not washed. Long hours spent by women to fetch water were also reported to be the cause of conflict among couples as husbands did not believe that so much time is needed for the task. Thus, access to and utilization of sanitation and hygiene services and facilities are believed to reduce violence against women. Besides, health promotion and education programs such as the rural health extension program of Ethiopia are believed to make women aware of their rights and the potential harmful effects of gender inequalities leading to changes in attitude and

behavior. Therefore, the attitude of women towards the incidence of gender based violence and their confirmation and disconfirmation of such violence is taken as one measure of empowerment because empowered women do not justify violence against themselves. Related to this, Sen in his capability approach has argued that interventions should be assessed according to their impact on the expansion of freedom (capabilities) such as the freedom to move from place to place, the freedom to decide without asking permission from others and an opportunity to be free from tyranny/ dominance or patriarchy. Having self-respect, according to Sen (1999) is considered as well-being achievement. Nussbaum (2000) also argues that the freedom to be secured from domestic violence is the basic social minimum/threshold limit by which development should provide for individuals. Empowerment of women in self-esteem is, thus, measured by two self-esteem indicators which are considered universal according to Mahmud, Shah & Becker (2012). Mahmud and his colleagues have provided two classes of self-esteem derived by the number of household decisions in which the woman reports she should be involved, and the number of scenarios in which the woman believes that beating is not justified. Following Mahmud, Shah & Becker (2012) self-esteem measures, women's own evaluation of their self-esteem level is measured by 1/ the number of decisions in which the woman thinks she should be involved and 2/ the number of scenarios in which the woman believes that beating is not justified. There were nine questions about self-esteem in decision-making and nine questions about self-esteem with regard to acceptance or rejection of gender-based violence (see Appendix 1A). The response options for each of the specific self-esteem in decision making questions were yes (coded as 1), no (coded as 0) and I do not know (coded as 2). Similarly, the response options for each of the specific self-esteem in acceptance or rejection of gender-based violence were yes, no and I do not know. However, the response options were reverse coded. If the respondent says yes, it is coded as zero, showing dis-empowerment, and if no, it is coded as 1, showing better empowerment. I do not know option is treated as missing. Finally, individual scores were added to get the total scores out of nine self-esteems in decision-making, and nine self-esteems in gender equality attitudes. The maximum sum score in both decision making and gender equality attitude is nine and the minimum is two. The maximum score of nine in gender equality attitude questions indicates the respondent's disapproval of violence against women in all of the scenarios described. Similarly, the maximum score of nine in self-esteem in decision-making indicates the respondent's willingness in making decisions in the entire decision-making

scenarios described or the respondent thinks that she should have a say in all the decisions mentioned.

In ordered to assess how empowered the respondents are in terms of self-esteem with regard to acceptance or rejection of gender based violence as well as self-esteem with regard to decision-making, a separate self-esteem index is constructed using the following formula;

$$M_{ij} = \frac{X_{ij} - \min_k(X_{ik})}{\max_k(X_{ik}) - \min_k(X_{ik})}$$

Where M_{ij} = index of self-esteem with regard to gender equality attitude (SEGEA) or self-esteem in decision-making

X_{ij} = actual score of self-esteem with regard to gender equality attitude or decision-making

Min (X_{ik}) = minimum score of self-esteem with regard to gender equality attitude or decision-making

Max (X_{ik}) = maximum score of self-esteem with regard to gender equality attitude or decision-making.

The self-esteem index with both gender equality and decision-making dimensions was estimated using the above formula. After the individual self-esteem scores for the two self-esteem indicators were obtained, the scores were again added together and divided into two to get a composite self-esteem index. The composite self-esteem index is a summary of the two self-esteem dimensions obtained using simple arithmetic average as follows,

$$\text{Self-esteem index} = \frac{\text{self-esteem in decision making index} + \text{self-esteem in gender equality attitude index}}{2}$$

After the composite self-esteem index is constructed by a simple arithmetic average, respondents were categorized into three groups as having low self-esteem empowerment, having moderate self-esteem empowerment, and having high self-esteem empowerment on the basis of cumulative square root frequency method.

The cumulative square root frequency method is a useful method of strata construction developed by Dalenius and Hodges in 1957. The method consists of cumulating the values of

the square root of frequency ($\sqrt{f(Y)}$), where $f(y)$ is the frequency function of the study variable Y . The last cumulative square root frequency value is divided by the number of groups the researcher wants to classify the study participants and this gives the cutoff value or interval value. The cutoff value helps to obtain an optimum strata boundary by taking equal intervals on the cumulative of $\sqrt{f(Y)}$. This method was used to classify respondents as low, medium, and high empowerment by Niketha, Sankhala, Prasad & Kumar (2017) in their study of empowerment of women through dairy cooperatives in Karnataka, India.

The final cumulative square root frequency value for the cumulative self-esteem index is 70.7 and this is divided by three (the numbers of group respondents were needed to be classified) which gives a value of 23.6. The number 23.6, is the interval value or cut point to categorize respondents. Hence, cumulative square root frequency that ranges from 0-23.6 (or self-esteem index value 0-0.45) is categorized as having low self-esteem empowerment; cumulative square root frequency that ranges from 23.7- 47.3 (or self-esteem index value 0.46-0.75) is categorized as having moderate self-esteem and cumulative square root frequency above 47.3 (or self-esteem index value 0.76-1.00) is categorized as having high self-esteem empowerment. Accordingly, of the total 325 currently married respondents, 26.5 % ($n= 86$) have low self-esteem empowerment, 32 % ($n=104$) have moderate self-esteem empowerment and 41.5% ($n=135$) have high self-esteem empowerment respectively (see appendix 1B).

Decision Making

Decision making is also another indicator used to measure women empowerment. Decision making in the self-esteem section above shows how much the respondent is willing to participate in decision making, while decision making in this section is about how far the respondent is really participating in household decision making.

Investments in sanitation and hygiene facilities will reduce the burden of unpaid work on women and believed to facilitate participation in household decision making. Household- level decisions made by spouses who often have different preferences and bargaining power have significant implications for women empowerment. Thus, a woman's decision-making power within her household is measured by the extent of her involvement in making decisions with respect to (1) spending her own earning, (2) spending her husband's earning, (3) making purchase for her

clothe, (4) making purchase for her husband's clothe,(5) crop selling or buying in large quantity, (6) crop selling or buying in small quantity, (7) cattle selling or buying, (8) borrowing or lending money, (9) construction and use of latrine, (10) raw material type for latrines, (11) have hand washing facility near latrine, (12) where to collect water, (13) how to use land, (14) household financial administration, (15) respondent's visit to health post for different services, and (16) respondent's participation in women's health development team. The response options in each of these identified areas were respondent alone (coded as 2); respondent and husband jointly (coded as 1); husband alone (3) other people (coded as 4) and decision was not made or not applicable (coded as 5). These responses were further re-coded into husband or others (0), jointly (1), and the respondent alone (2), and not applicable was treated as missing. 0 indicates that the woman did not participate in the decision at all. It was possible to give a score of 1 to each decision a woman participates alone or jointly with someone else and 0 otherwise. In Ethiopian context, however, especially in rural areas, it is believed that there is unequal balance of bargaining power within the household even though a woman replies that decision was made jointly. Thus, it is found important to see the relative difference in the level of participation in the decision making as sole decision maker, jointly and or did not participate in the decision at all.

To get the total score of a respondent in relation with her participation in household decision making, individual scores from a total of 16 decision making responses were added. The possible maximum score would be 32 if the respondent makes all of the 16 decisions alone and the expected minimum decision making score would be zero if the respondent did not participate in all of the 16 cases. The actual result, however, shows the minimum decision making score of 3 and the maximum is 30. The minimum decision making score of 3 signifies that respondents have participated in at least some of the decision aspects either alone or jointly and the maximum score of 30 indicates that no woman was making all of the 16 decisions alone.

Once, the minimum and maximum decision making score of respondents is identified, decision making index is calculated to classify respondents according to their level of participation in household decisions. The decision making index is calculated by using the following formula, which is the same formula used by Shahida, Azam & Mahmud (2014), Niketha, Sankhala, Prasad & Kumar (2017) and Mostofa, Tareque, Haque & Mahfuza (2008).

$$DMI = \frac{X_{ij} - \min_k(X_{ik})}{\max_k(X_{ik}) - \min_k(X_{ik})}$$

Where DMI = decision making index

X_{ij} = the actual score of each respondent in decision making which is derived by summing the score of the respondent in each of the 16 decision making cases.

$\min(X_{ik})$ = minimum score in the decision making score

$\max(X_{ik})$ = maximum score in the decision making score.

After the decision making index is calculated, respondents were categorized into three groups as not empowered, relatively empowered and empowered based on cumulative square root frequency method.

To obtain the cumulative square root frequency value, frequency distribution of respondents according to their decision making index value is done followed by the calculation of square root of each frequency. Finally, the total cumulative square root frequency value of 86.5 is divided by 3 (the number of groups that respondents are needed to be classified). This gives the cutoff point 28.83. Accordingly, cumulative square root frequency that ranges from 0-28.83 (or index value that ranges from 0.00-0.39) is classified as having low empowerment in decision making, cumulative square root frequency that ranges from 28.84-57.68 (or decision making index value that ranges from 0.3901-0.5800) is classified as having relative empowerment in decision making, and cumulative square root frequency above 57.68 (or decision making index value that ranges from 0.5801-1.00) is categorized as empowered in decision making. In line with this classification, 27.7 % (n=90) of the total 325 currently married respondents, have low participation in decision making or they are not empowered, 44% (n=143) are relatively empowered in household decision making and 28.3% (n=92) are empowered in decision making (see appendix 2).

Participation in Rural Health Extension Activities

The rural health extension program of Ethiopia is intended to engage the community in the promotion and protection of its own health through various mechanisms namely model families

or model households, one to five groups and one to 30 networks. Model households are households who are first trained on the health extension program packages and adopted these packages afterward. Model households are expected to influence their neighbors to adopt the same practice. The one to five groups and one to 30 networks, commonly known as women health development teams are also responsible for promoting health by sharing information to their neighboring households. Both one to five and one to 30 networks are an organized movement of neighboring households responsible to lead all women in their catchment area towards a healthy lifestyle. One to five networks indicate one team leader to about five neighboring households and the leader is responsible for promoting the health of five neighboring households under the supervision of the health extension workers. A group of five or six “one-to-five” networks are in turn organized into women’s development team. Women’s development team comprises of 25 to 30 households. This grouping is also known as “one-to-30” denoting one team leader to about 30 member households. The team leader serves under the direct supervision of the health extension worker and she is supposed to help educate and organize the one to five leaders. Both 1 to five and one to 30 networking, mobilization and message sharing is believed to achieve a better health outcome as well as women empowerment. One individual learns new information and then passes this on to others in their community. One to five leaders help during immunization campaigns, keep track of pregnancies and illnesses, and communicate messages between households and health extension worker. They are also expected to have a weekly meeting to discuss issues related to children’s health, hygiene, nutrition, antenatal care, birth, and so on. Therefore, participation in such kinds of rural health extension activities is taken as one indicator of women empowerment. When women’s sanitation and hygiene needs are met, their unpaid domestic work burden will reduce and they will have time to participate in community activities leading to their social empowerment. Related to this, Sen (1999) stated that taking part in the life of the community is example of well-being achievement or empowerment. Similarly, Nussbaum (2000) stated that the ability to engage in various forms of social interaction is among the central human capability that development should provide. Thus, respondents were asked about their participation in five health extension related activities as: 1/participate in communicating health information between households and HEWs, 2/participate in sensitizing and monitoring neighbors’ adoption of healthy behaviors, 3/participate in making neighboring households’ become member of community based health insurance

scheme? 4/participate in child immunization campaign and service use 5/ participate in supporting neighboring women to deal with administrative matters? These questions had binary or dichotomous responses; yes (coded as 1) and no (coded as 0). Participation score was first calculated by summing the number of activities a respondent has participated. The expected minimum score is zero indicating that a respondent did not participate in any of the five activities listed and the maximum expected score is 5 indicating that the respondent has participated in all of the five listed rural health extension activities. The actual score was also as expected, the minimum total score is 0 and the maximum is 5. Once the total participation score for each respondent is obtained, the second step is estimating participation index using the same formula used above in the calculation of decision making and self-esteem indices.

After the participation index is calculated, respondents were categorized into three groups based on their level of participation using a similar approach of cumulative square root frequency method. In order to obtain the cumulative square root frequency value, number of participants according to their participation index is first calculated. Then, the square root of each specific participation index frequency is obtained. The final cumulative square root frequency value has become 40.2 and this was divided by three (the number of groups respondents were required to be classified) and result the cutoff point 13.4. Accordingly, cumulative square root frequency value that ranges from 0-13.4 (or participation index value that ranges from 0.0-0.1) is classified as having low participation and hence low empowerment, cumulative square root frequency that ranges from 13.5-26.9 (or participation index value that ranges from 0.2-0.7 as having medium participation and hence relatively empowered) and cumulative square root frequency above 26.9 (or participation index value that ranges from 0.8-1.0) is categorized as having high participation and hence empowered. Based on this classification, 24% (n= 78) of respondents are not empowered, 46.5% (n=151) are relatively empowered and 29.5% (96) are empowered.

Composite/Cumulative Empowerment Index

After the scores of each empowerment indicator as explained above were obtained, the final step was to combine the scores of the three indexes into a composite score. Accordingly, the cumulative empowerment index is computed by simple average of the three empowerment indices as follows;

$$CEI = \frac{SEI + DMI + PI}{3}$$

Where CEI= Composite women empowerment index

SEI= Self-esteem index

DMI= Decision making index

PI=Participation Index

Each empowerment indicators may have different importance relative to each other. In situations like this, giving a different weight to the different dimension of the index may be considered important. However, according to Sharpe & Andrews (2012), the use of equal weighting is justified when prior weights assigned by previous researchers on the components of an index are not available. Since the index components in this study are a unique set of indicators and no prior weights are assigned to them, all the three components are treated equally. Lack of theoretical justification to give a different weight to each component of the empowerment index made the researcher not to assign any weight. No weighting or equal weighting is helpful for simplicity of index construction and it is also good for objectivity relative to the ‘subjective’ exercise of a developer who sets the weights arbitrarily (Greco, Ishizaka, Tasiou & Torrisi, 2018). Once, the composite women empowerment index is computed, respondents were classified into three groups using cumulative square root frequency method. The final cumulative square root frequency value of 48.52 is divided by three .This gives a cut value of 16.17. Accordingly, cumulative square root frequency below 16.17 or cumulative empowerment index value of 0.0-0.40 is categorized as group 1 which classify respondents as not empowered, cumulative square root frequency that ranges from 16.18-32.35 or cumulative empowerment index value of 0.41-0.58 is classified as second group which signifies relatively empowered respondents and cumulative square root frequency above 32.36 or cumulative empowerment index value of 0.59-1.0 is classified as empowered. In line with this method, the result indicates that 32.3% (n=105) of the respondents from a total of 325 married women are not empowered, 35.4 (n=115) are relatively empowered and 32.3 % (n=105) are empowered (see appendix 4). Salahuddin and Ahmad (2017) in their study of women empowerment in Pakistan have classified their respondents level of empowerment into three as not empowered, partially empowered and

empowered. On the other hand, Sultana & Sharafat (2013) in their study of the role of employment in women empowerment have classified the cumulative empowerment index (CEI) into five categories as very low empowerment, low empowerment, medium empowerment, high empowerment and very high empowerment.

3.8.2 Independent Variables

The independent variables listed out here-under are used to analyze different objectives. Some of the independent variables are used to analyze access to sanitation and hygiene facilities while others are used to analyze utilization of such facilities. More others are still used to analyze women empowerment. However, for structural purpose, all the independent variables used in different sections of the study are described here.

1. Woreda

Location, with all its dimensions of market access, demographics, and agro-climate has remained a key tool to understand people's potential for technology adoption and utilization (Staala, Baltenwecka, Waithakab, DeWolffa, Njorogea, 2002). Dreibelbis et al. (2013) has also pointed out that environmental factors such as biological, social, and the physical environment determines people's access to and utilization of water, sanitation, and hygiene facilities. Thus, location variable is believed to capture a wide range of locational effects. Gozamin and Machakel woredas, yet are adjacent woredas and have similar religious, linguistic, economic, cultural and agro-climatic characteristics, there might have differences in structural opportunities and social variables such as in terms of the availability of sanitation and hygiene hardware like water supply systems, sanitation technologies, differences in community participation and social mobilization, differences in enforcement mechanisms such as sanctions and approximate distances to urban centers which determine people's access to and utilization of sanitation and hygiene technologies and information. Hence, locational difference in terms of woreda/district is taken as one of the independent variables in the analysis. Locational dummy variable is created as Machakel (coded 0) and Gozamin (coded 1).

2. Climate

Climate is included as an independent variable because it is related to the adoption and utilization of sanitation and hygiene infrastructures. Climatic characteristics such as landscape, soil conditions, and exposure to different kinds of disease causing vectors are believed to be helpful to understand people's potential for sanitation and hygiene technology adoption and utilization. To date, there is little evidence on the association between climatic differences and access to and utilization of sanitation and hygiene facilities, yet, there are qualitative reports indicating how environmental conditions have a profound effect on the same. Environmental factors strongly influence the sanitation facilities built which may in turn discourage people from adoption. Besides, the presence of vegetation resources which are important inputs for building latrine and house are also different by altitude (Oswald, Stewart, Flanders, Kramer, Tekola, Mulat et al., 2016). Thus, climate or agroecology is incorporated as a variable because soil conditions which are important for the durability of sanitation facilities are determined by agro climatic zones. Besides, health is determined by altitude and more importantly, dry and wet climate is important in sanitation and hygiene technology adoption and utilization. Climate is a dummy variable coded as dega (0) and woinadega (1).

3. Age of the Respondent

Age of the respondent is assumed to explain variations in respondents' level of access to and utilization of sanitation and hygiene facilities. Data on the age of respondents was first collected as continuous variable and latter converted to categorical variable. The conversion from continuous to categorical variable is done to see the different attributes and skills attached to the different age groups and its effect on respondents' access to and utilization of sanitation and hygiene facilities. Respondents are categorized into four age groups as young (15- 24 years), middle adult (25-34), adult (35-49), and old (50 years and more). The age group categorization is made based on information from different references as there is no clear cut and commonly accepted categorization of people based on their age. Different countries and scholars have used different age ranges for categorizing people as young, adult and old. For instance, Paul & Meena (2016), in their study of access to and control over resources have classified young age as people with the age range of <35 years, middle age as (35-50) years and old age as >50 years. Similarly, Petry (2002) in her study of a comparison of young, middle-aged, and older adult treatment-

seeking pathological gamblers has classified young age as people with the age range of 18- 35 years, middle age adult as 36-55 and old age adult above 55. On the other hand, UN (1982) has provided guideline for standard International age classification as infancy (under 1), youth (1-14), young adulthood (15-24), middle adulthood (25-44) and older adulthood (45-64). Similarly, UN General Assembly resolution 35/129 has designated 60 years and older as a guide for the working definition of old (cited in Kowal & Peachey, 2001). Most developed countries have accepted age 65 years as a designation of 'elderly' or older person (OECD, 2012). In the African context, however, there is no general agreement on the age at which a person becomes old. Majority of the people in Africa live in rural areas and work outside the formal sector where there is no formal retirement benefit. Thus, according to Kowal & Peachey (2001), the use of 50 years of age is believed to be a better representation of a lower age threshold for working definition of old age in Africa. Ethiopian social security and development policy has defined youth as age ranges between 15-24 (cited in Ministry of Youth Sport and Culture, National Youth Policy, 2004).

4. Marital Status

Marriage gives numerous social and economic benefits such as social support, pooled assets, and shared household labor. Thus, marital status is taken as one of the independent variables to see its association with women's access to and utilization of sanitation and hygiene facilities. Data on marital status was first gathered as single (coded as 1), currently married (coded as 2), divorced (coded as 3), and widowed (coded as 4). Currently married women are women who were living with husbands during the data collection time. Widowed and divorced women, on the other hand, are considered as not currently married. Marital status is recoded as 1 = if the respondent was living with the husband during the survey time and; 0 otherwise.

5. Education

Education is believed to be an important determinant of health resource access and behavior change. Education enables people to have access to health information. Besides, the knowledge and skills acquired through it are believed to create a favorable mental attitude for the acceptance of new practices. Health resource access and utilization is also gained from the education of others in important social relationships. Marriage being one of the important social relationships,

the education of spouses in the household provides greater incentive to share acquired skills, knowledge, and information. In this study, therefore, data was collected on the educational status of both the respondent and her husband as required. The educational status of the respondent and her husband were coded as; (1) no education, (2) primary education, (3) secondary education and (4) above secondary education. No education represents the respondent has no formal education even if she can read and write her name. Some respondents and husbands were able to read and write their names through the skill they have got from either religious education or from informal adult literacy programs. When it comes to understanding health extension services, however, any big difference was not observed between the two kinds of respondents (literate) and the illiterates. Hence, respondents who said they are illiterate and those who said they can read and write their names were categorized as no education and coded as 1. Respondents who have an educational status of grade one to eight were categorized as having primary education and coded as 2, respondents who have an educational status of grade nine to 12 were categorized as having secondary education and coded as 3 and respondents who have finished or attended TVET and college education were categorized as having above secondary education and coded as 4. The same procedure was used to categorize husband's educational status. The descriptive statistics shows that of the total 325 currently married respondents 80.3% (n=261) said their husbands have no formal education, 12.0% (n=39) said their husbands have primary education and 6.8% (n=22) said their husbands have secondary education and only 0.9% (n=3) have said they have above secondary education.

5. Occupation

Occupation of both the respondent and the husband is considered as an independent variable because it is related to income source which is an important tool for sanitation and hygiene technology adoption. Occupation is also related to sanitation and hygiene behavior. For instance, a respondent may use latrine to pee or defecate while at home, but may use bush while in the farm field. Similarly, a respondent may drink water from protected sources while at home, but may drink unprotected and unclean water in agricultural fields. Hence, the researcher wanted to study the effect of occupation on women's access to and utilization of sanitation and hygiene facilities.

People in rural areas participate in a variety of livelihood strategies which can be generally categorized into three as farm, off-farm and nonfarm activities. Farming activities include crop production, livestock husbandry, and mixed farming of crops and livestock. Off-farm activities contain selling of grains, vegetables and fruits and selling of local drinks such as areki and tela. Nonfarm activities, on the other hand, include working in construction sites, selling wood, dung, grass, stone mining, pottery and handicrafts and gatekeeper. Related to this, Lanjouw & Feder (2001) have defined the nonfarm sector as all economic activities in rural areas except agriculture, livestock, fishing, and hunting and it includes manufacturing, industrial, mining, commerce, construction & services, and transport activities.

Generally, the types of activities reported by respondents about their own and their husbands occupation are recoded as farm only (coded as 1) and nonfarm only or farm plus (coded as 2). Accordingly, of the total 325 married respondents, 87.4% (n=284) reported farming as the main occupation of their husband while 11.4% (n=37) said their husbands are engaged in both farm and non-farm activities and only 1.2% (n=4) said their husbands are involved in nonfarm activities.

6. Household Size

Household size is a continuous/scale variable and this variable is included in the study because a household is the center of demographic, social, and economic processes. Decisions about health care, consumption, labor force participation and savings occur primarily at the household level and the size of a household affects consumption, labor force participation, and savings and hence sanitation and hygiene technology adoption and utilization. Household size in this paper is defined as the total household members in a housing unit. The definition of the household for this study was adapted from CSA (2014). CSA (2014) has defined a household as “a person or group of persons, irrespective of whether related or not, who normally live together in the same housing units and have common cooking and eating arrangements”. In this study, however, besides sharing living arrangements, a person who was temporarily absent from the household at the time of the survey such as for schooling purposes in urban areas and who does not have his/her own regular income is considered as a member of the household. However, unusual residents such as visitors/guests were not considered as member of the household.

7. Dependency Ratio/ Labor

Dependency ratio is used as an independent variable because it tells us the amount of the labor force available in a household. Labor is an important factor in technology adoption and utilization. Dependency ratio is calculated by summing the number of people in a household whose age is between 0-14 and the number of people whose age is over 65 years divided by the number of people whose age is between 15-64 years and multiplying that percentage by 100. The formula is adopted from Todaro & Smith (2012).

$$DR = \left(\frac{\text{household members aged 0-14} + \text{household members aged 65+}}{\text{Household members whose age is from 15-64}} \right) \times 100$$

Though the assumption that people under 15 years and over 65 years (65+) are dependents and 15-64 are workers do not reflect the productivity profile of people in Ethiopia and has limitations, there is no better alternative. There are arbitrary age delineations of working age in the existing literature. Some literature classify working people as people whose age is between 15-59 (Hadley, Tefera, Lindstrom & Fasil, 2011) while the CSA of Ethiopia defines active labor as starting from age ten and above.

High dependency in the household means higher pressure on household services, low per capita income, and low level of saving and asset accumulation with serious implication on sanitation and hygiene technology adoption and utilization. High dependency ratio within the households also means that labor is limited, as the few will work to produce and meet the needs of many. Shortage of labor is hypothesized to be a determinant factor for sanitation and hygiene technology adoption and utilization. Dependency ratio tells the number of dependents in the respondents' household and it is measured as a continuous variable.

8. Household Crowding

Household crowding is a condition where the number of household occupants exceeds the capacity of the dwelling space available. Crowding has a number of adverse effects on health. It increases the spread of infectious diseases such as cold, asthma, influenza and diarrhoea (Gray, 2001) and it also increases physical congestion, which is not good for cleanliness. As the number of people in a household increases, activities such as using latrine and bath facilities have to be coordinated with others and this creates overburdened services. Crowding also

increases women's sanitation and hygiene responsibility in the home which in turn affects their access to social and economic resources.

Literature provides different ways to measure household crowding and the measurements include; person per room, people per bedroom rate, household area per bedroom and bedroom area per person (Gray, 2001). Person per bedroom measure of household crowding requires information about the relationship, age and sex of the dwellers. For example, a dwelling might be considered crowded if two adults share a bedroom, but not crowded if the adults are in a relationship. Couples and children under 10 years are calculated as half-person (Morrison 1994 cited in Gray, 2001). Collecting all these kinds of information require a length of time and resources. Similarly, household area per bedroom; and bedroom area per person requires measuring each house and bed room which needs a lengthy of time. Generally, the bed room standard is very problematic in Ethiopian rural context as children of different sexes and age are permitted to share a room and unlike in urban areas, rural areas do not have separate rooms for children.

In this paper, therefore, crowding is measured by person per room calculation. Person per room is a widely used indicator of household crowding, and it is calculated by dividing the number of rooms in the house by total household members. Terefe & Djamba (2015) in their study of overcrowding of residential houses in Ethiopia have calculated overcrowding by dividing the number of rooms available in the household by the number of persons living in the same household. The authors have then classified a household as crowded if the resulting value was equal or more than 2.5 and not-crowded if it was less than 2.5. Similarly, Kumie (2002) in his study on crowding in traditional rural housing ("Tukul") in Ethiopia has used person per room criteria to calculate crowding and households were categorized as under crowded if there is one person per room and crowded if there are more or equal to two persons per room. Kumie's classification of 2 people per room as crowded is problematic in rural Ethiopia because the criterion has ignored the relational aspect of family members.

In sum, crowding in this paper is calculated in line with Terefe and Djamba (2015) categorization. Crowding is measured by the number of individuals of all ages per room and a household is categorized as crowded if equal to or more than 2.5 persons are found in a single room and not-crowded if less than 2.5 people are found per room. Room is defined as living and

sleeping rooms. Separate rooms such as kitchens and animal dwellings outside the main sleeping home are excluded. Crowded is coded as 1 and not crowded is coded as 2.

9. Home Plot Ownership

Land for residential housing is assumed to be one of the most important factors for sanitation and hygiene technology adoption. When people own land plots to construct home, there will be a greater tendency to build private latrines, hand wash facilities, private water wells as well as other sanitation and hygiene technologies. A study by Awunyo-Akaba et al., (2016) in Ghana about sanitation investments found that decreasing amounts of land available for housing, non-ownership of land, and insecure tenancy have contributed negatively for people's ability and willingness to invest in sanitation facilities. Respondents were found unwilling to invest in someone else's property. The present study has, therefore; asked respondents about the type of home plot tenure or ownership status of their homestead. The response options were having title dead, inherited, family gifted/free of rent, and rental house. These options were later re-coded as owned (coded as 1) if the homestead has title dead or if it is inherited and not owned (coded as 2) if the homestead is obtained from families free of rent or if the house is rented.

10. Household Income

Income is an important indicator to determine people's standard of living and their capacity to invest in sanitation and hygiene technologies. It is with this assumption that income is taken as one variable of interest. Income in this paper is defined as the combined gross annual income of all members of a household derived from the sale of livestock and livestock products, income from the sale of crops, vegetables, and fruits, income from wage, income from the sale of the local drink, remittance, employment, and others such as the sale of firewood, dung cake, grass, pottery and other handicrafts, inheritance, pension, NGO assistance, income from providing transport service, cash from PSNP and income from rent especially land or animal. This definition of income was adopted from the definition provided by the Canberra Group Handbook in 2011. The Canberra Group Handbook (2011) has defined household income as it consists of all receipts whether monetary or in-kind (goods and services) that are received by the household or by individual members of the household at annual or more frequent intervals and includes

income from employment (both paid and self-employment), property income and current transfers received.

It was difficult to get actual and reliable income information from a traditional rural society where agriculture is the main source of income. Hence, the amount of money or its equivalent earned by every member of a single household disclosed by the respondents during the household survey is used. It was also difficult to get consumption data. Respondents only remembered their total income earned from selling a specific item such as grain, ox, vegetables, hop, and local drink, but could not remember how much they spent and for what purpose. Thus, income in this paper is considered as the household aggregate income or gross income than the net income.

Respondents were asked how much income their household has gained during the last one year before the survey date (the survey has taken place between 23, December 2018 to 24 March 2019). Crop selling is the main source of income reported by many of the respondents. People sell crops continuously in big and in a small amount. They sell crops in a small amount to buy other household consumption such as kerosene, clothes for kids, salt, food oil, etc. Since the income they have got is consumed this way, respondents could not remember the exact amount they have got from the sale of crops. Therefore, information about crop income was collected in terms of total annual crop production in quintal, which latter was converted into the cash equivalent.

The main crop season in the study areas is the Meher season (between September and February). Major cereals grown in the study areas were first identified and teff, wheat, maize, barley, millet, and triticale are found to be the major crops grown in the selected kebeles at different quantities. Then, respondents were asked about their one-year production of these crop items/cereals prior to the survey date. Information about the crops produced was recorded in quintal. The recorded crop amount in quintal is later converted to the cash equivalent. The cash equivalent was estimated using the price of each specific crop at the local market in birr during the time of the data collection. The average local market price of one quintal of teff for February 2019 at Debremarkos and Amanuel towns was birr-2537 while for wheat it was 1526 birr, for maize 999 birr, for barley 850 birr, for millet 1450 birr and triticale was sold for 1700 birr. The converted

cereal income was finally summed to create crop income which resulted in total household crop income.

Finally, the total household income is calculated by summing both crop income and non-crop income. The mean total household annual income is birr 36,588.01 birr. The minimum total household annual income is 1000 birr, and the maximum is 14,782 birr.

Table 3. Household Income by Source

Income Source	Mean	Median	Minimum	Maximum	SD
Income from sale of animals	1341	0	0	21680	3184
Income from sale of animal products such as egg, honey, butter, milk	1038	0	0	13000	2070
Income from sale of vegetables and fruits	1038	600	0	7250	1350
Income from wage	167	0	0	12000	1058
Income from sale of local drinks	473	0	0	5000	784
Income from remittance	717	0	0	15000	2384
Income from employment	744	0	0	16800	2959
Crop income cash equivalent	31067.74	31497.50	.00	66081.00	12706.84
Others such as sale of firewood, cow dung, grass etc.	750.00	750.00	500.00	1000.00	250.00
Total household annual income	36588.01	36,794.50	1000.00	75,752.00	14,782.00

Source: Filed Survey, 2019

11. Household Wealth Status

Although the researcher expected the income variable to be correlated with the wealth measure estimated here, it was fully believed that the two will capture different dimensions of economic well-being, as previous studies have found (Gasparini et al., 2008; Lora 2008 cited in Córdova, 2009). Asset-based measures depict an individual's or a household's long-run economic status, and it also shows the household's ability to pay for sanitation and hygiene facilities and technologies as poor and non-poor people will not have equal capacity to invest. Thus,

information about how households vary by wealth and the extent to which this relates to the access and utilization of sanitation and hygiene facilities is central.

Wealth is a multidimensional concept that cannot be captured by the use of a single indicator. Hence, data was collected on household's ownership of many kinds of assets and the lists of assets used to collect data were adapted from literature reviews particularly of the Ethiopian Demographic and Health Survey (2016), Chakraborty, Fry, Behl & Longfield (2016), and Hirai et al. (2016). However, assets that are not common in rural areas such as car, air conditioner, computer, refrigerator, and electric mitad were excluded. WASH-related asset questions were also excluded as they are the main focus of the study. Housing structure, ownership of domestic assets, type of cooking fuel, livestock ownership, land ownership, land ownership status and land size, and access to credit were the asset variables used to gather information about respondents household wealth status (see Appendix 5 for a detailed description of the asset types used to collect data to calculate the wealth index).

Once data on the household's ownership of different assets is collected, asset variables were recoded. The dichotomous or dummy binary variables with yes and no options were kept as they were and yes is coded as 1 and no is coded as 0. While some other asset variables such as land size, number of rooms, and number of livestock which were continuous variables were transformed into categorical variables. For instance, respondents have reported their land size in “*Timad*” which is a traditional form of measurement that equals around $\frac{1}{4}$ ha. Therefore, the reported size of land in timad is converted into hectare. The mean size of land held by respondents at the household level is 1.324 hectare while the minimum and maximum is 0.25 hectare (1 timad) and 2.50 hectare (10 timad) respectively. Based on the mean value, respondents are categorized into two groups as having less than one hectare (coded as 1) and having more than 1 hectare (coded as 2) (see the descriptive statistics in Appendix 5). A study by Berhanu, and Gebre-Selassie (2013) on current land policy issues in Ethiopia shows that the average farm size holding in the Amhara region was 0.75 ha while the national average is 1.02.

Once the information on the respondents' ownership of agricultural land and its size is obtained, the follow up question was about the tenure status of their agricultural land. In Ethiopia, land ownership is vested on the government and farmers have use right only. Farmers can use the land for agriculture production, and they have full ownership of the produce collected from there.

They also have the right to rent to other farmers (sharecropping), lease to investors, inherit and donate (as a gift) to family members. The only thing is that farmers cannot sell and mortgage land (Daniel, 2012). There are different modalities that farmers can get land. The federal land administration and the subsequent regional land laws recognize government grants and land redistribution, inheritance, donation, and rent as a means for farmers to gain agricultural land (The revised Amhara rural land Administration and use proclamation (No. 133/2006). 456/2005). In line with this background information, the response options to know about the land ownership status of the respondents were framed as 1/ has title deed certified by the officials, 2/ inherited, 3/ rental/ sharecrop, 4/ communal land and 5/ donation without title. Since rent is a way to transfer land use rights to other farmers temporarily, and donation/gift is made by family members without transferring the title, respondents do not feel that they have land. Therefore, the response options were recoded as without title deed (coded as 1) if the respondent said she or her household has gained land through donation, rent and communal land, and with title deed (coded as 2) if the respondent said she or her household has gained a land through land grant by the government/has title or certificate or the land is inherited.

Besides ownership of agricultural land, respondents were asked if they or their household have any livestock and the numbers of each livestock owned. Once, the number of each specific livestock type owned is collected (# of an ox, #of cow,# of calf, # of donkey,# of horse, # of mule, #of sheep and # of goat), each species of livestock owned is converted into a common unit using tropical livestock unit weighting factors. The tropical livestock unit provides a weighting factor of 0.5 for cattle (cow, ox, calves, and bulls), 0.1 for sheep and goats, and 0.8 for mule, donkey, and horse. Based on these tropical livestock unit weighting factors, the numbers of cattle were combined and added to generate a total cattle score. A similar procedure is used to add sheep and goat and other livestock species. Accordingly, respondents whose household have 1-4 cattle are coded as 1, those who have 5-9 cattle are coded as 2, and those who have 10 or more are coded as 3. Similarly, respondents whose household have 1 equine (horse, donkey and mule) are coded as 1, those who have 2 equines were coded as 2, and those who have 3 and more are coded as 3. Respondents whose household have 1-4 sheep and/or goat are coded as 1, those who have 5-9 sheep and or goat are coded as 2 and those who have 10 and more are coded as 3. This classification is done following Córdova's (2009) work.

After the coding and recoding is done, descriptive analysis is made to know the distribution of respondents in terms of household asset ownership (Appendix 5). Based on the descriptive analysis, asset types capable of distinguishing households' relative wealth status were selected to compute the wealth index. Asset types that could not distinguish households' relative wealth status were discarded from wealth index calculation. For instance, flooring, roofing and wall materials of houses, ownership of TV, Bajaji, weaving equipment, livestock ownership, and firewood were removed from wealth index calculation as there was no significant variation in ownership status of these assets among respondents. Some assets were owned by over 95% of the respondents or less than 5% of the respondents. For instance, knowing that 97.9% of households don't own Bajaj is not helpful to distinguish between rich and poor households by this asset ownership. Similarly, almost all respondents (99.7%) have earth as flooring and wall material and 97.6% have iron sheet as roofing material. The distribution of these variables did not vary across households and hence excluded in the asset index calculation.

Once the descriptive analysis is made and asset types that could not distinguish households' relative wealth status are discarded, a relative wealth index is computed using multiple correspondence analyses. There are different popular approaches for the construction of wealth index. One of such approaches is the application of principal components analysis (PCA). PCA is, however, used for a set of quantitative variables measured in the same units. Besides, PCA is statistically inappropriate for use with discrete or categorical data (Kabudula et al., 2016). Therefore, MCA was selected over PCA because MCA is important for the analysis of categorical data. When all the asset indicators are discrete or categorical, scholars have argued that MCA is the most appropriate measure (Kabudula et al., 2016). Finally, based on the estimated wealth score, households were separated into broad socio-economic categories using wealth quantile as lowest (coded as 1), second (coded as 2), middle (coded as 3), fourth (coded as 4) and highest (coded as 5).

12. Access to Health Extension Information

Access to health extension information is considered as an important factor for access to and utilization of sanitation and hygiene facilities. The impact of access to extension information on agricultural technology adoption is well documented (Tsefamichael et al., 2017). Thus, respondents were asked if they themselves or their family members have ever heard any message

or information, from health extension workers or women development team leaders in the form of a speech at a public meeting or home visit. Those who said yes are coded as 1, and those who said no are coded as 0.

13 Frequency of Health Extension Contact

The number of contacts people made with extension agents is important for a better understanding of technology messages promoted and enhances technology adoption. Ofuoku, Olele & Emah (2008) in their study of the determinants of adoption of improved fish production technologies among fish farmers in the Delta state of Nigeria argued that the more extension agents visit farmers and educate them, the better farmers were found to understand and adopt technologies. Thus, access to extension information is not enough in itself. The frequency of contact also matters. Accordingly, respondents were asked about the number of times that either any household member or the health extension agents have visited each other during the previous one year prior to the survey date on the issue of sanitation and hygiene. Health extension contacts are defined in terms of meetings and discussions, trainings, visits made by each other either to home or health post, and health extension agents telling households to do some sanitation and hygiene related activities while moving on the road. Finally, the reported total number of contact time (frequency of contact) between a household and the health extension agents is used as a continuous variable.

14. Membership in Women Health Development Team

The impact of group membership in the adoption of agricultural technologies is well recognized in agricultural-related studies. The rural health extension program of Ethiopia also promotes participatory extension where women are made to be members of the health development team also known as one to five and one to 30 networks. Therefore, the effect of group membership on respondents' access to and utilization of sanitation and hygiene technologies is one of the variables of interest in this study. Respondents were asked whether they participate in the health development team in their village and the response options were binary as yes (coded as 1) and no (coded as 0).

15. Knowledge

Respondents' sanitation and hygiene-related knowledge is considered as a major influence on the adoption and utilization of sanitation and hygiene technologies. Most empirical studies on technology adoption have found a significant relationship between respondents' knowledge about that specific technology and their adoption and utilization rate. For instance, Lui & Hui (2011) has studied the effects of information security knowledge on users' adoption of security technologies, and they found that respondents' information security knowledge had affected their adoption decision. Jabbar, Saleem, Solomon & Hailu (2003) also stated that adopting a technology requires acquiring knowledge and people move from learning to adoption, to continuous or discontinuous use over time. Accordingly, women's knowledge about sanitation is examined by asking two main sanitation-related questions. These questions were 1/ whether they recall any sanitation-related message/s they have ever heard from health extension workers or women health development team members and 2/ whether they knew about the benefits of latrine utilization. The question on whether they recall any sanitation related message had five multiple response options as 1/ latrine construction and usage, 2/ adoption and utilization of liquid waste disposal pit, 3/ adoption and utilization of solid waste disposal pit, 4/ shelf construction and usage and 5/ smokeless stove construction and usage. Based on their response, respondents are grouped into two main categories; as having poor knowledge if scored between 0-3, and having high knowledge if scored 4-5.

In the second question, respondents were asked if they can mention any of latrine utilization benefits. The question had five multiple response options as 1/environmental cleanliness, 2/ convenience and privacy, 3/ improves dignity and status, 4/ it is a sign of modernity, and 5/ health benefits. Respondents' level of knowledge about the benefits of latrine utilization is categorized into two groups as having poor knowledge if the respondent scored 0-3 and having high knowledge if scored 4-5.

Regarding respondent's level of hygiene knowledge, respondents were asked five hygiene related questions: 1/ if they know how drinking water can be contaminated at home, 2/ if they know how drinking water can be treated at home, 3/ if they know how food can be contaminated at home 4/ if they know about critical times for hand-washing and 5/ if they know reasons for washing hands after defecation.

The survey question about knowledge of how drinking water can be contaminated at home had four response options as 1/ unhygienic water transportation facilities, 2/ unhygienic water storage facilities, 3/ unhygienic water serving utensils, and 4/ leaving water without cover/lid. If the respondent circles or tells all these four response options, then a score of 4 is given, if the respondent answered only three options, then a score of three is given, if two then two, if 1 then 1 and if none then a score of zero is given. Finally, the knowledge level of the respondent for this particular issue is classified as having poor knowledge if the respondent has scored 0-1 (coded as 1), having medium knowledge if the respondent has scored 2-3 (coded as 2) and high if the respondent has scored 4 (coded as 3).

Similarly, the survey question; do you know any water treatment method used to treat drinking water at home had four options as; 1/ boiling, 2/ using sand filtering technique, 3/ using water guard and 4/ using solar water disinfection method. If the respondent circles or tells all these four water treatment methods, then a score of one is given for each multiple answers making the maximum score to be four. If the respondent answered only three options, then a score of three is given, if two, then two, if one, then one and if none then a score of zero is given. Finally, the knowledge level of the respondent for this particular issue is classified as having poor knowledge if the respondent has scored 0-1 (coded as 1) having medium knowledge if the respondent has scored 2-3 (coded as 2) and high if the respondent has scored 4 (coded as 3).

Knowledge score is arbitrarily classified in all the sanitation and hygiene related questions. An arbitrary classification of knowledge has been used in other similar researches such as by Mohd and Malik (2017) in their study of sanitation and hygiene knowledge, attitude and practices in urban setting of Bangalore.

The survey question; do you know how food can be contaminated at home has four options as; 1/ preparing food with unhygienic hand, 2/ eating food with unhygienic hand, 3/ preparing food inside unhygienic kitchens and 4/ leaving food uncovered. If the respondent was able to circle or tell all the four options listed, then a score of 4 is given, if three then 3, if two then 2, if one then 1, and if none, then a score of zero is given. Finally, respondent's knowledge level about this issue is classified as poor, if the score of the respondent ranges from 0-1, medium if the respondent scores about 2-3 and high if the respondent scores four out of four.

To understand respondents' level of knowledge about the critical times for handwashing, they were asked to mention the critical times for handwashing. The response options were; 1/ to wash hand after defecation, 2/ to wash hand before preparing food, 3/ to wash hand before eating and 4/ to wash hand after handling garbage. If the respondent was able to circle or tell all the four critical times listed, then a score of 4 is given, if 3 then 3, if 2 then 2, if 1 then 1, and if none, then a score of zero is given. Finally, respondent's knowledge level about the critical times of hand washing is classified as poor, if the score of the respondent ranges from 0-1, medium if the respondent scores about 2-3 and high if the respondent scores four out of four.

Respondents' level of knowledge about reasons for handwashing after defecation is also measured by whether or not they have checked the four response options: 1/ to remove diseases causing germs like bacteria or virus 2/ to remove dirty and feel clean, 3/ to appear good, and 4/ because everyone does/ moral behaviour. This survey question had only three correct answers. If the respondent said they wash their hands after defecation because it is a moral behaviour, it shows lack of knowledge about why people need to wash their hands after defecation. However, if the respondent did not check this option, then it shows their knowledge. The answer to this specific response option is reverse coded. If the respondent chooses option number four, it is coded as zero, if not, it is coded as 1. The response for the other three options (#1-3) is coded as 1 if the respondent chooses that option and zero if the respondent did not choose. The maximum score for this specific knowledge question is four, and the minimum is zero. If the respondent circles all the three correct options and did not circle the last option, then, a score of 4 is given and the respondent is categorized as having high knowledge. If the respondent scored 2-3, then she is categorized as having medium knowledge and if scored 0-1, then she is categorized as having poor knowledge.

Table 4. A Summary Description of variables

Dependent variables	Independent variables	Explanations	Measurement
Sanitation Access Low Access: 1	Woreda	Machakel:0, Gozamin:1	Nominal
	Climate	Dega: 0 Woinadega: 1	Nominal
	Age	Young (15-24):1,	Ordinal
		Middle adult (25-34): 2 Adult (35-49): 3,	

Medium Access: 2		Old (≥ 50):4	
High Access:3	Marital Status	Currently not married: 0	Nominal
		Currently married:1	
	Education	No education: 1	Ordinal
Sanitation Utilization		Primary education: 2	
		Secondary & above: 3	
Low utilization:1	Occupation	Farm only: 0	Nominal
Medium utilization: 2		Nonfarm only or farm plus:1	
High utilization:3	Household size	Continuous	Scale
	Dependency ratio	Continuous	Scale
	Crowding	Crowded:1; Not crowded: 2	Nominal
Hygiene Access	Home plot ownership	Owned: 1; Not owned:2	Nominal
Low access :1	Household income	$\leq 20,000$:1	Ordinal
Medium access: 2		20,000.01-45,000:2	
High access:3		45,000.01+:3	
	Wealth	Lowest:1;Second:2, Middle:3; Fourth:4;	Ordinal
Hygiene Utilization		Highest: 5	
Low utilization:1	Access to extension information	Yes:1, No: 0	Nominal
Medium utilization: 2	Frequency of health extension contact	Continuous	Scale
High utilization:3	Participation in women health development team	Yes:1, No: 0	Nominal
Women empowerment	Knowledge about the benefit of latrine utilization	Poor: 1, high:2	Ordinal
Not empowered: 1			
Relatively empowered :2	Knowledge of sanitation messages promoted	Poor: 1, High:2	Ordinal
Empowered :3	Knowledge of how water can be contaminated	Poor: 1, Medium: 2, High:3	Ordinal
	knowledge of how water can be treated	Poor:1, Medium:2 , High:3	Ordinal
	Knowledge of how food can be contaminated	Poor:1, Medium:2, High:3	Ordinal
	awareness about critical times for handwashing	Poor: 1, Medium:2, High:3	Ordinal
	Knowledge of reasons for hand wash after defecation	Poor:1, Medium:2 , High:3	Ordinal

CHAPTER FOUR: RESULTS AND DISCUSSION: DESCRIPTIVE STATISTICS

This chapter presents the geographic, economic, socio-demographic and institutional characteristics of the study participants and their access to and utilization of sanitation and hygiene facilities.

4.1 Geographical Characteristics of Respondents

A total of 380 female heads of households have participated in the quantitative survey with 100% response rate. Of the total 380 female heads of households participated in the survey, 150 are from Machakel woreda and the rest 230 are from Gozamin woreda. Of the total 22.6% (n=86) respondents who have low sanitation access, 11.6% (n=10) are from Machakel woreda while a large majority; 88.4% (n=76) are from Gozamin woreda. Similarly, of the total 34.7% (n=132) respondents who have medium sanitation access, 30.3% (n=40) are from Machakel woreda and 69.7% (n=92) are from Gozamin woreda. Of the total 42.6% (n=162) respondents who have high sanitation access, 61.7% (n= 100) are from Machakel woreda and 38.3% (n=62) are from Gozamin woreda. In terms of sanitation utilization, majority of the respondents (50.8%, n=193) have low sanitation utilization. Of the total 50.8% (n=193) respondents who have low sanitation utilization, 27.5% (n=53) are from Machakel woreda and 72.5% (n=140) are from Gozamin woreda. Of the total 90(23.7%) respondents who have low hygiene access, 60% (n=54%) are from Machakel woreda and 40% (n=36) are from Gozamin (see appendix 6 &7 for the descriptive analysis of variables).

In terms of agro-climatic characteristics, 61.8% (n=235) of the respondents are from woinadega while 38.2% (n=145) are from Dega. Of the total 50.8% respondents who have low sanitation utilization, 67.9% (n=131) lives in woinadega.

4.2 Economic Characteristics of Respondents

Farming is the dominant occupation of majority of the respondents (65.8%, n= 250) followed by mixed livelihood strategy of both farming and non-farming activities. Farming includes the production of crops and animal husbandry while non farming activities carried out by women in the study areas include selling of local drinks mainly Areqi, selling of hop, and fruits and

vegetables such as orange, lemon, apple and potato, selling of wood and dung cake, and cotton weaving.

In terms of home plot ownership, 70.3% (n=267) of respondents have a title for the land their house is built on while 29.7% (n=113) do not. Among the 29.7% (n=113) respondents who have no title for their residential plot, 4.4% (n=5) live in a rented house while 95.6% (n=108) have built their houses on the land acquired from family donation. Donation in this context is that the legal deed of the land belongs to families, but siblings are allowed to build houses on that land. The land is gifted free. It is not based on lease agreement or rent. Despite the fact that families donate residential plot for their siblings, siblings do not feel secured.

Regarding total annual household income, respondents have a mean annual household income of 36,588.01 birr with a considerable variation of (SD=14,782.00). The maximum annual household income of the respondents is 75,752.00 birr while the minimum is 1000.00 birr. A great majority of respondents (59.2% n=202) have an annual household income between a range of 20,000.01 – 45,000.00 birr and about 26.3% (n=100) have an annual household income of more than or equal to 45,000.01 while a slightly small number of respondents (14.5%, (n=55) have an annual household income between a range of 0-20,000 birr. In relation to wealth status, 20% of respondents (n=76) have poorer wealth status, 20% have poor wealth status, and 20% have, medium, rich, and richer wealth status, respectively.

4.3 Socio-demographic Characteristics of Respondents

The socio-demographic results from the survey show that 85.5% (n= 325) of respondents were currently married while the rest 14.5% (n=55) were not or they were either widowed or divorced. Of the total 22.6% (n=86) respondents who have low sanitation access, 72.1% (n=62) are currently married and 27.9% are not currently married. Similarly, of the total 42.6% (n=162) respondents who have high sanitation access, 88.9% (n=144) are married women (see appendix 6).

The minimum age of the respondents is 18 years while the maximum is 64 and the mean age is 38.29 (with SD of 11.023). Nearly half of the respondents, 48.2% (n=183) fall with the age range of 35-49 or they are adults while the least 11.3% (n=43) are with the age range of 15-24 or they are young women. Of the total 22.6% (n=86) respondents who have low sanitation access, 41.9%

(n=36) are adults with the age range of 35-49 and of the total 50.8% (n=193) respondents who have low sanitation utilization, adults constitute 48.2% (n=93). Similarly, of the total 23.7% (n=90) respondents who have low hygiene access, 50% (n=45) are adults (see appendix 6 & 7 for the descriptive analysis of variables).

Education-wise, significantly large numbers of respondents; 78.9% (n= 300) have no formal education although some were able to read and write their names through the skills they have got from adult literacy programs and religious education. About 16.6% (n=63) of respondents have some form of primary education; that is, they either have attended first cycle (grade 1-4) (10%, n=38) or second cycle education (grade 5-8) (6.6%, n=25). Around 4.5% (n=17) have secondary and above secondary education (3.2%, n=12 have attended grade 9 to 10 and 0.8% or n=3 had attended senior secondary (grade 11 to 12) education and only 0.5% or n=2 have TVET level education). Of the total 50.8% (n=193) respondents who have low sanitation utilization, 76.2% (n=147) are respondents with no education.

Regarding household size, the surveyed respondents have an average household size of 3.96 with small variations (SD= 1.374). This result is relatively close to the national average of 4.9 in rural households and total national average household size of 4.6 persons according to CSA & ICF (2016). The minimum household size of the surveyed respondents is one, and the maximum is eight. According to the United Nations Department of Economic and Social Affairs, Population Division (2017), a household is a small average household size if there are fewer than three persons per household. A household is having large average household sizes if it has five or more persons per household. A household with 3-4 average household size is having medium average household size. With this reference, close to half of the respondents in the survey (47.9% (n=182) have medium average household size while 35.3% (n= 134) respondents have high average household size and 16.8% (n=64) have small average household size.

In terms of dependency ratio/ labor, the result shows that the minimum dependency ratio is zero, implying that there is no dependent member in the household and the maximum dependency ratio is 300% indicating that three people are dependents on one person in a household. The mean dependency ratio is 80.73% (with a SD of 66.98) with the implication that each respondent has at least one dependent household member. In terms of household crowding, the survey result

shows that 92.6% (n=352) of respondents live in a crowded household, that is more than 2.5 people live in a single room while only 7.4% (n= 28) live in a household that is not crowded.

Most respondents (66.6%, n=253) have poor knowledge of sanitation messages promoted by either health extension workers or women health development team members. On the contrary, a slightly large number of respondents (53.7%, n=204) have high knowledge about the benefit of latrine utilization. In terms of respondents' knowledge about hygiene issues, the descriptive result shows that 37.4% (n=142) have low knowledge about how drinking water can be contaminated at home and about 22.4% (n=85) and 40.3%(n=153) have medium and high knowledge respectively. In terms of knowledge of any water treatment method used to treat drinking water at home, the result indicates that 18.4 %(n=70) have low knowledge, 27.4 %(n=104) have medium and 54 %(n=206) have high knowledge. About 27.9% (n=106) of the respondents have low knowledge, 51 % (n=195) have medium knowledge and 20.8% (n=79) have high knowledge about how food can be contaminated at home. Similarly, about 42.9% (n=163) of the respondents have low knowledge, 12.6 % (n=48) have medium knowledge and 44.5% (n=169) have high knowledge about the critical times for handwashing. Furthermore, 67% (n=255) have low knowledge, 17.4% (n=66) have medium knowledge, and 15.5% (n=59) have high knowledge about reasons for handwashing after defecation.

4.4 Institutional Characteristics of Respondents

A large majority of respondents (68.4%, n=260), among from the total 380 sampled respondents, do not participate in women health development team or they do not feel that they are members. A slightly significant number of respondents (31.6%, n=120) participate in women's development team at various positions; from being a team leader to just being member. Despite the fact that women health development team has become a very popular form of health extension provision in Ethiopia, majority of the respondents do not feel that they are members of the team. Some respondents have pointed out that since they do not participate frequently in meetings and because of lack of assignment from the health extension workers, they do not see themselves as a member now even if they consider themselves as members before. They further stated that their feeling about being representative of their communities and being a service provider has gone. They feel that they are not part of the team anymore.

A large majority of respondents (92.6%, n=352) have access to health extension information and only few respondents (7.4%, n=28) do not. Despite the fact that the rural health extension program is a nationwide program and it has been there for the last 15 years since its launch, there are still people who do not have access to health extension information. This result is in contrary to what Nigatu et al. (2011) have found in their study of access to and utilization of information on sanitation and hygiene by rural households in Alaba district in southern Ethiopia. The authors found no one who did not hear about sanitation and hygiene at all. The variations in findings may be because of the differences in study settings and population as well as the study period. In 2011, where Nigatu and his colleagues have conducted their study, the health extension program was at its early stage and much attention was given by the government to achieve the millennium development goals.

Respondents were also asked about the frequency of health extension contacts they have made during the previous one year prior to the survey date. The survey result shows that the minimum frequency of contact is zero, while the maximum is six times a year. The average number of times a household has contacted the health extension agents or vice versa is 3.11 times (with SD of 1.68). The number of visits made by the health extension agents and community meetings had declined due to the political unrest in the county and limited supervision from woreda health officials.

4.5 Access to and Utilization of Sanitation Facilities

In this section, women's level of access to and utilization of sanitation facilities is presented. The analysis is made based on the information obtained from 380 survey respondents and 30 interview participants. The term access and sanitation are latent variables that are not directly measured. Access is, therefore, taken to mean the presence or availability of sanitation facilities while sanitation is defined as the presence of latrine, household liquid waste disposal facility, and separate dwelling for people and domestic animals. Similarly, women's sanitation utilization is measured by self-reported behaviors regarding women's utilization of latrine and solid and liquid waste disposal practices. In order to understand women's level of sanitation access and utilization, the combined result of these three sanitation indicators was used. Details of each specific sanitation indicator that made up the composite sanitation access and utilization score

are presented first followed by cumulative sanitation and hygiene access and utilization level of respondents.

4.5.1 Access to and Utilization of Latrine

Latrine is the most important indicator that comes to people's mind when talking about sanitation. Excreta disposal using latrine is an important part of overall environmental sanitation and improved health. Respondents were, thus, asked if their household has owned any kind of functional latrine which was confirmed through observation. The utilization of latrine by women themselves was also assessed. The result in table six below shows that 79.5% (n=302) of the respondents have a functional latrine in their household while 20.5% (n=78) do not. A functional latrine is a latrine facility that has unbroken pan/slab or floor, unblocked entrance, and has a wall and roof. The 20.5% (n=78) of respondents who do not have latrine includes respondents who do not have the facility at all, have the facility but the slab of the latrine is broken, its superstructure is collapsed and its entrance is blocked. Latrines with broken slab, collapsed super structure and blocked entrance are recorded as absent even if the respondents said they have a latrine and they use it (see picture 3-B below for example of nonfunctional latrines). The result of 79.5% latrine availability in the study areas shows a slight increase from what was found by Edenshaw et al. in 2013. Edenshaw and his colleagues have reported that household latrine ownership in rural areas of Amhara region ranges between 40% and 70% (cited in Oswald et al., 2016). A similar study by Aiemjoy et al. (2016) also found that 71% of households in Amhara region had a latrine. The present study also shows remarkable progress in terms of access to latrine compared to the initial year the health extension program was launched in 2004 where only 4% of households in rural Amhara had latrine facilities (O'Loughlin, Gashu, Flannery & Emerson, 2006). The latrine coverage of 79.5% from this study is higher than the national data of 61% latrine coverage for rural areas in Ethiopia as of 2016 (CSA & ICF, 2016).



Figure 3- A: Functional latrines

Figure 3-B: Nonfunctional latrine

Figure 3: Photo of dry pit latrines observed in the study kebeles

Source: Photo captured during field observation, 2019

With regard to latrine utilization, the study finding shows that 73.2% (n=278) of respondents use latrine to defecate while 26.8% (n=102) do not use. The 26.8% latrine nonusers include respondents who do not have latrine facilities at all (20.5%, n=78) and respondents' who have latrine facilities in their household but do not use it (6.3%, n= 24) for various reasons. The 26.8% latrine non-utilization indicates that many women in the study areas still practice open defecation which is against the government's plan of zero open defecation by 2020. The government has planned to increase the proportion of latrine utilization nationwide from 71% in 2016 to 100% in 2020 (MOH 2016, National Hygiene and Environmental Health Strategy and Strategic Action Plan). The rate of latrine utilization found in this study (73.2%) is different from what was found in Hulet Ejju Enessie district, East Gojjam Zone, Amhara Region where latrine utilization rate was 60.7% (Anteneh, 2010 cited in Niguse , Lalit , Azeb, Huruye & Dejen, 2015) and 57.3% in Gulomekada district in Tigray region (Niguse , Lalit , Azeb, Huruye & Dejen, 2015). The disparity might be due to variation in time and place of the studies conducted.

Respondents were also asked about what has motivated or deterred the adoption of latrine in their household. The result in table six below shows that a regular push from health extension workers and women development team leaders have made a large majority of respondents (38.4%, n=116) to adopt latrine followed by neighbors' adoption of latrine (29.1%, =88). The

fact that neighbors' adoption of latrine has become the second most mentioned reason for respondents' adoption of latrine goes in line with what the government has planned to create model citizens who can diffuse their experience to their neighbors. The health extension program is designed to increase the coverage of primary health care services mainly by producing model households who can be an example for their neighbors to imitate.

Discussion in a village meeting is the third most frequently mentioned reason for respondents' adoption of latrine in their household and consists of 13.6%(n=41). Whenever men head of households have meetings to discuss agricultural or other village issues, they are told to build latrine, and this has contributed a lot for households' latrine adoption. Increase in awareness about the benefit of latrine is also one of the most important factors for respondent's adoption of latrine (9.4% n=19); however, it is not as expected. The primary focus of the health extension program is to create awareness and enable people to practice safe sanitation, but many respondents did not check this response. Other reasons provided by respondents for their adoption of latrine includes latrine building has become a common experience in their village, having latrine is seen as a pride and prestige for the family, the need to have a modern lifestyle, to try new experiences and increase in convenience and comfort.

Latrine non-adopters have also provided different reasons for their non-adoption. As indicated in table six, the most frequently mentioned reason for lack of latrine in the household is being busy with other activities or lack of labor (30.8%, n= 24) while significant other respondents (24.4%, n=19) have mentioned risks of damage or collapse from flooding during rainy seasons and wearing down of soil as a reason for their non-adoption of a latrine. Most of the respondents who mentioned risks of damage had once built latrine, but their latrine has collapsed and this experience has discouraged them to rebuild. The presence of a lot of open space and bush to defecate is also another reason that discourages around 21.8% (n= 17) respondents from having latrine. This shows that people are still unaware of the negative consequences of open defecation. On the other hand, about, 17.9% (n=14) of respondents have failed to adopt latrine because of lack of space to construct. Most of these respondents are young and newly married respondents who do not have their own land for residential home construction. They have constructed their house on the plot given by their families and this does not give them decision making power to

have a latrine. Related to this, here is an excerpt from one of the interview participant at Yetjanshebalema keble at gozamin woreda.

We do not have land, especially the young generations like us. This land (the land her home was built on) belongs to my families, and they give us temporarily until we get ours. In our area, there was “yemeret Shinshena” (land redistribution) around 20 years back. During this time, we were very young. Now we are grown and have our families, but we do not have our own land. We hope that the government will solve our problem though we do not know when. Unless we have land to build a house, how can we think about latrine? The land we now have will be taken by our families sometime in the future especially if there is family disagreement. We do not have security. There is frequent quarrel within our family because of this land. So latrine is not our priority. We have so many problems to be solved. You see that spring (pointing her finger towards a nearby spring)! it was protected while we were kids. Now, no protection, both animals and we drank together. Animals pee there, and sometimes they put their waste inside the water. So the government has to solve this problem for us first than telling us to worry about our waste. Land and water are important for us than latrine (30 years old, Feb.27, 2019).

From the above quotation it is possible to understand that besides lack of homestead land, lack of priority for latrines and the presence of other pressing issues like safe water are reasons for the non-adoption of a latrine. As pointed out by interview participants, poverty is also an added reason for respondents’ non-adoption of a latrine. One of the interview participants expressed that latrine is a luxury thing to have, and it is assumed for the haves and not for the have-nots. Here is what she had to say:

Emm (expression of amusement)! Latrine? Latrine is for the rich people! We have nothing! We are poor. We are always in a run to fulfill our food, cloth and other household necessities. For us getting food is enough than thinking about latrine. Those who have the money and labor may have latrine but we do not (Qebi Keble, Gozamin woreda, Feb.28, 2019).

Other reasons provided by quantitative respondents for their non-adoption of latrine include latrine is not yet considered as a habit, open defecation is better than using a latrine and no enough education about the goodness of latrine.

Table 5: Respondents Access to and Utilization of Latrine

Survey Questions	Response	Frequency	Percent
Does your household own a latrine	Yes	302	79.5
	No	78	20.5
Do you usually use latrine to defecate	Yes	278	73.2
	No	102	26.8
If you do not use latrine what is the main reason?	the latrine has unpleasant smell	100	98%
	presence of flies	34	33.3%
	dislike of latrine	25	24.5%
	Absence of latrine in the household	24	23.5%
	lack of comfort while sitting	15	14.7%
	Distance from the house	5	4.9%
	Others	7	6.9%
What motivates you or your household to build a latrine?	Regular push from health extension workers and WHDT	116	38.4%
	Neighbors adoption of latrine	88	29.1%
	Discussions in village meetings	41	13.6%
	We have got awareness about the benefits of latrine	19	9.4%
	Presence of educated and school going children	12	4%
	Others	26	8.6%
	Others	7	2.3%
Reasons for non-adoption of latrine	Lack of labor/busy with other activities	24	30.8%
	Risk of damage/collapse from flooding and wearing down of soil	19	24.4%
	Lack of space to construct latrine	14	17.9%
	A lot of space to defecate	17	21.8%
	Others	7	9.0%

Source: Field Survey, 2019

4.5.2 Separate Housing for people and domestic animals

Housing or the physical structure in which people live is an important indicator of environmental sanitation. The need to have separate housing for people and domestic animals is one of the focus areas of the rural health extension program under sanitation and hygiene package. The need to have a separate dwelling for animals and people is also recommended by the World

Health Organization in its 1988 guideline for healthy housing. The organization in its guideline has stated that when people share their homes with animals, diseases such as anthrax, tetanus, tuberculosis, rabies, and histoplasmosis can be transmitted to humans either through direct contact or via soil and dust. Exposure to animals and animal feces has been associated with increased risk of diarrhea and trachoma by potentially providing breeding sites for flies that propagate the infection. Active trachoma was found to be more common among children in rural Ethiopian households who let cattle sleep in people's sleeping quarters (Adane, Resom & Molla, 2015). A similar study in rural Ethiopia by Cumberland, Girum & Todd (2005) also noted that the presence of animal feces near the house was associated with active trachoma in at least one child in the study households. Hence, the animals' shed should not be part of the main rooms and should be placed outside. Respondents were, thus, asked if they have a domestic animal or not and for those respondents who have animals, a follow-up question was whether they have separate houses for themselves and their domestic animals. The survey result shows that from a total of 362 respondents who have any kind of domestic animals, 95.6% (n= 346) have separate dwelling while 4.2% (n=16) do not. The remaining 4.7% (n=18) respondents do not have any domestic animal. The finding is in disagreement with what was found by Kare et al. (2012) in Wolayta and Kembata Tembaro Zones where 52.6% of respondents among from a total of 1400 households were found to have separate dwelling for people and animals. The disparities in findings may be attributed to differences in location and time.

Table 6: Separate housing for people and domestic animals

Survey question		Frequency	Percent
Do you or your household own any domestic animal?	Yes	362	95.3
	No	18	4.7
	Total	380	100.0
If yes, do you have separate dwelling for people and animals	Yes	346	91.1
	No	16	4.2
	Total	362	95.3
	Missing	18	4.7
	Total	380	100

Source; Field Survey, 2019

Though majority of the respondents have separate housing for people and domestic animals, in some households it was observed that animal housing units share a wall with people's house or they are attached. Their proximity to each other and absence of proper animal waste disposal system has created unpleasant smell and sight around the housing compound. The following photo depicts cattle faeces and urine piled improperly in front of the entrance to people's house due to lack of proper urine diversion facility.



Figure 4: Lack of Proper Animal Waste Disposal System

Source: Photo by the researcher in Amereyewubesh Kebele, Machakel Woreda April, 17, 2019.

In households where there is no separate dwelling for animals and people, it is observed that both animals and people live together in the same dwelling. The first picture below was taken at Yetjanshebalem Kebele and shows a two-room house where sheep are kept in one room and the people reside in the next room divided only with half tall wall made of mud. Both people and sheep have only one entrance. There was a visible accumulation of urine and defecation debris where the smell was bad and disturbing during observation. Besides, the sanitation concern, their noise and movement was also disturbing. In the second photo, calve is observed being kept in the same room where people eat and sleep.



Figure 5: Dwelling for people and animal

Source: Photo captured during field survey at Yetjanshebalem and Yebokla kebeles, Gozamin Woreda, from left to right respectively on January, 2019

4.5.3 Access to and Utilization of Household Liquid Waste Disposal Facility

Safe domestic/household liquid waste disposal has become one of the key components of the rural health extension program under the sanitation and hygiene service package. Household liquid waste is greywater that emanates from domestic activities such as yeast, utensil wash, hand and cloth washes. Proper collection and disposal of such domestic wastewater is important for environmental sanitation and health. Respondents were thus asked if they have a household liquid waste disposal facility or not. The survey result in table seven below shows that out of the total of 380 respondents, less than half (45.8%, n=174) have the facility while a large majority of them do not. As observed, a soak pit, known in Amharic as *yefesashi qoshasha masregia* is the liquid waste disposal facility that is widely adopted in respondents' household. The soak pit is made from locally available materials such as mud, clay pot, grass, sand and gravel. The soak pits photographed below are prepared from clay pot (with its bottom removed) on the top installed on a pit filled with gravel, sand and stone. Grass is kept on the mouth of the clay pot to protect solid wastes such as food debris from soak. The clay pot is covered by any available material to prevent smell. Some households have prepared a shelter for the soak pit to protect it from sunlight and rain, as can be seen in the first photo below.



Figure 6: Household Liquid Waste Disposal Facility

Source: Photo captured during field observation in different study sites, 2019

With regard to safe liquid waste disposal practices, respondents were asked how they usually dispose of their household liquid wastes and the response options were disposing into liquid waste disposal facility (coded as 1(yes)) and pouring anyplace (coded as zero (no)). The result in table seven below shows that less than half of the respondents (37.9%) use liquid waste disposal pits while a large majority of them do not (62.1%, $n = 236$). The fact that the large majority of respondents do not practice safe household liquid waste disposal mechanism indicates that people in rural areas still dump domestic wastes indiscriminately, which will in turn create a favorable breeding condition for disease vectors such as mosquitoes, flies, and other insects. Fly causes diarrhea, cholera, and eye illness (trachoma).

Table 7: Access to and Utilization of Liquide Waste Disposal Pit

Survey Question	Response	Frequency	Percent
Do you have household liquid waste disposal facility	Yes	174	45.8
	No	206	54.2
How do you usually dispose your household liquid waste	Using liquid waste disposal facility (yes)	144	37.9
	Pouring any place (No)	236	62
	Total	380	100.0

Source: Field Survey, 2019

4.5.4 Domestic Solid Waste Disposal Practice

Little attention was paid for rural domestic solid waste disposal practices until recently when the government through its health extension program has promoted proper disposal of solid wastes to rural people. With the introduction of the rural health extension program, different solid waste disposal methods such as burning, burying, composting and biogas are promoted. However, there is no evidence if people are practicing the recommended solid waste disposal mechanisms or not. Respondents were therefore asked how they usually dispose of their household solid waste (wastes from house sweeping, wastes from cattle shed and ash). The response options were burning, burying, use it for compost making, and use it for biogas and throwing into the field. Respondents were able to check all the multiple responses they practice and after data on each solid waste disposal practice was collected, it was re-coded as safe and unsafe solid waste disposal practice. Burning, burying, and using it for compost making are positive practices and recoded as safe while throwing into the field is recoded as unsafe. Using it for biogas was not reported by any of the respondents.

The result in table eight below shows that majority of the respondents (54.7%, n=208) practice unsafe solid waste disposal practice or open dumping. This finding partially agrees with Bizatu & Negga (2010) study in Kersa woreda where 66% of their respondents have practiced open-dumping while only 6.9% had temporary storage means for solid waste disposal. A study by Kare et al (2012) in Wolayta and Kembata Tembaro Zones also found that only 31.2% of respondents among from a total of 1400 households had a solid waste disposal place.

Table 8: Solid Waste Disposal Practice

Survey Question	Response	Frequency	Percent
How do you usually dispose your household solid waste?	Safe solid waste disposal practice	172	45.3
	Unsafe solid waste disposal practice	208	54.7
Total		380	100.0

Source: Field Survey, 2019

4.5.5 Sanitation Access and Utilization Status of Women

As described in section 4.5.1, 4.5.2, and 4.5.3 above, women were asked if their household own a latrine, if there is a separate dwelling for people and domestic animals and if there is liquid waste disposal pit in their household. Based on the respondents' responses for these three sanitation indicators, respondents' level of sanitation access is estimated using a simple average method as $SA = \frac{\sum x_i}{N}$, where X_i is the sum score of each sanitation access indicator ($S_1 + S_2 + S_3$), N = number of sanitation access indicators used (three in this case). First, each respondent's score on all the three sanitation indicators is summed to get their total score. After the total score for each respondent is computed, the score is divided into three (the number of sanitation indicators used). The division is made to get the average sanitation access score of each individual respondent. Average sanitation access score was preferred that an additive score because there were missing values and with the presence of missing values, additive score is not plausible to calculate sanitation access score and use that score to compare respondents. The result indicates that the average sanitation access score is 0.7311 (with SD of 0.26966) with the minimum score of zero and the maximum score of one. The minimum score of zero implies that the respondent has none of the sanitation facilities and the maximum score of one indicates that the respondent has all the three sanitation facilities. Depending on the average sanitation access score, respondents were finally categorized into three groups as having low, medium, and high sanitation access levels. Since there are no previously defined cutoff scores in the literature that can be taken as a reference, a cut of score is defined arbitrarily and respondents are classified as

having low sanitation access if their average score is between 0 to 0.50, medium if their average score is between 0.51 to 0.75 and high if their average score is between 0.76 to 1.0. Based on this categorization, the finding of the study indicates that large numbers of respondents 42.6% (n=162) have high sanitation access while 34.7% (n=132) have medium sanitation access level and 22.6% (n=86) have low sanitation access status.

To identify the most widely available sanitation facility from the overall sanitation access scale, sanitation access index is constructed by adopting a formula used by Farouque & Sarker (2018) as follows;

$$\text{Sanitation Access Index (SAI)} = (Pl \times 1) + (Pm \times 2) + (Ph \times 3)$$

Where,

Pl= Number of respondents with low sanitation access

Pm = Number of respondents with medium sanitation access

Ph = Number of respondents with high sanitation access

The total sanitation access index computed by using this formula is 836 (86 x 1+132 x 2+162 x 3). However, the sanitation access index ranges from 380 to 1140, where 380 indicates that all the 380 respondents have low sanitation access (380x1) and 1140 indicates that all the 380 respondents have high sanitation access. To calculate the index score of latrine access for those respondents who have a latrine, it is calculated as 16x1+124 x 2+162 x 3)=750. The numbers 1, 2 and 3 indicate the codes used to label low, medium and high sanitation access. The same procedure has been used to rank the other sanitation facilities as well. Table nine below shows that among the sanitation facilities available to respondents, availability of a separate house for people and animals is top in the rank order with sanitation access index of 785 followed by latrine ownership with a rank ordered of 748. This index ranking is also validated by examining the extent to which the index is related to the individual items that were included in it. As the descriptive statistics shows, 91.1% (n=346) of respondents among from a total of 380 have a separate house for people and animals, 79.5% (n=302) have a latrine in their household and 45.8% (n=174) have liquid waste disposal pit. Liquid waste pit ownership is the least available sanitation facility promoted by the health extension program with a rank order of 509.

Table 9: Distribution of Respondents According to Their Level of Sanitation Access

Survey Questions	Response	Sanitation Access Level			Total	Sanitation Access Index
		Low	Medium	High		
		Frequency	Frequency	Frequency		
Own latrine	No	70 (89.7%)	8 (10.3%)	0 (0%)	78 (20.5%)	86
	Yes	16 (5.29%)	124(41.1%)	162(53.6%)	302(79.5%)	748
Own liquid waste disposal facility	No	85(41.3%)	121(58.7%)	0(0)	206 (54.2%)	327
	Yes	1(0.6%)	11(6.3%)	162(93%)	174(45.8%)	509
Separate house for people and animals	No	13 (81.3%)	3 (18.75%)	0(0)	16(4.4%)	18
	Yes	62(17.9%)	129(37.3%)	155(44.8%)	346(95.6%)	785
Total		86(22.6%)	132(34.7%)	164(43.2%)	380	380-1140

Source: Own computation

Regarding sanitation utilization, respondents were asked if they personally use the latrine, if they practice safe solid waste disposal and if they use liquid waste disposal pit. Based on the respondents' responses for these three sanitation indicators, respondents overall sanitation utilization score is estimated using simple arithmetic mean as used above to calculate sanitation access. The estimated result shows the minimum average sanitation utilization of zero and the maximum average sanitation utilization of one. The average sanitation utilization of zero indicates that the respondent does not use any of the three sanitation facilities promoted by the health extension program while the maximum of one indicates that the respondent uses all the three sanitation indicators. Based on this sanitation utilization score, the level of women's sanitation utilization is categorized as low if the mean score ranges from 0.00-0.50, medium if the mean score ranges from 0.51-0.75 and high if the mean score of the respondent ranges from 0.76-1. Accordingly, of the total 380 sampled respondents, half of them, 50.9% (n=193) have low sanitation utilization, 20.5% (n=78) have medium sanitation utilization and 28.7 % (n=109) have high sanitation utilization status.

In order to identify the most widely used sanitation facility from the overall sanitation utilization scale, sanitation utilization index is constructed by adopting the formula used by Farouque & Sarker (2018) as used above. The total sanitation utilization index computed by using the

formula is $676 (193 \times 1 + 78 \times 2 + 109 \times 3)$. However, the sanitation utilization index (SUI) ranges from 380 to 1140, where 380 indicates that all the 380 respondents have low sanitation utilization (380×1) and 1140 indicates that all the 380 respondents have high sanitation utilization. As the result in table 10 shows, latrine utilization is top in the rank order with a sanitation utilization index of 568 followed by safe solid waste disposal practice with a rank order of 444. Liquid waste pit utilization is the least used sanitation technology promoted by the health extension program with a rank order of 392.

Table 10: Distribution of Respondents According to their level of Sanitation Utilization

Survey Question	Responses	Sanitation Utilization			Total	Sanitation utilization index
		Low	Medium	High		
		Frequency	Frequency	Frequency		
Latrine utilization	No	96 (94%)	6 (5.9%)	0 (0%)	102 (26.8%)	102
	Yes	97(34.9%)	72(25.9%)	109(39.2%)	278(73.2%)	568
liquid waste pit utilization	No	188(79.7%)	48(20.3%)	0 (0%)	236(62.1%)	284
	Yes	5 (3.5%)	30 (20.8%)	109(75.7%)	144(37.9%)	392
Safe solid waste disposal practice	No	184(88.5%)	24(11.5%)	0(0%)	208(54.7%)	464
	Yes	9(5.2%)	54(31.4%)	109(63.4%)	172(45.3%)	444
Total		193(50.8%)	78(20.5%)	109(28.7%)	380	380-1140

Source: Researcher's own computation

In sum, the findings of this study revealed that large majority of respondents have high sanitation access (43.2%, n=164) while in terms of utilization, however, large majority of them have low overall sanitation utilization status (50.8%, n=193).

4.5.6 Discussion

The results of this study show that a slightly significant number of respondents have relatively high sanitation access status (43.2%) compared with 34.7% medium and 22.6% low level of sanitation access respectively. In terms of sanitation utilization, however, half of the respondents have low sanitation utilization status (50.8%) compared with 20.5% medium and 28.7% high. The result further indicates that there is a mismatch between sanitation access at household level

and utilization status of women. Not all women who have the sanitation facilities in their household are making use of the available facilities. For instance, of the total 79.5% (n=302) respondents who have latrine in their household, 7.95% (n= 24) do not use the available latrine. There are different reasons for the non-utilization of sanitation facilities. As the result in table five above shows, 98% (n=100) of respondents have stated that the unpleasant smell of latrine has discouraged them to use latrine while 33.3% said presence of flies has discouraged them to use latrine. Absence of latrine in their household, lack of comfort while sitting and distance from the house were also frequently mentioned by respondents as factors for their non-utilization of latrine.

During the qualitative interview some women have mentioned lack of durability on the part of liquid waste disposal pits, their small size nature and filling of easily, and presence of enough open space in their compound as reasons for their non-utilization of the facilities even if they exist. The sliding nature of soil and associated collapsing of latrines, flood during rainy seasons and associated filling of latrines and their overflow were mentioned as causes for non-adoption of latrine facilities. In the same way, the protection of domestic animals from theft at night, and the belief that animal breath will give warm to people's dwelling were mentioned as reasons for not having a separate dwelling for people and domestic animals. Lack of financial and non-financial resources such as time, labor, and technical skill were also mentioned as factors influencing the construction of latrines, separate dwelling for people and domestic animals, and waste disposal pits. Lack of demand for the low-cost sanitary technologies and related drawbacks, and aspiration for better sanitation facilities such as large waste pits that would not fill easily, and a latrine made from cement has also inhibited some respondents not to have the facilities currently. Some households have also adopted the sanitation technologies to escape the 50 birr penalty instead of demand-based decision. As illustrated by interview participants, if a household does not have a latrine, it will pay 50 birr penalty and told to have one next. Thus, some households have adopted the sanitation facilities for showing up to the health extension workers that they have a latrine or other waste disposal pits. Otherwise, they do not use the facilities. Some households have also adopted the technologies for the sake of helping health extension workers. The fact that the health extension workers are recruited from their own community and they know each other very well, households have adopted sanitation technologies to help the health extension workers not to miss their job. Health extension workers

are evaluated by the number of latrines and other sanitation technologies they have made their communities adopt. As a consequence of this, health extension workers convince households to adopt sanitation technologies, saying that they will lose their job unless the households help them by adopting the recommended technology. Thus, some households have adopted the technologies as a way of showing empathy to the extension workers. These households, since, they do not adopt the facilities by the belief that the facilities will improve their quality of life; they do not use the facilities. Lack of continuous supervision on the part of the health extension workers or other concerned government offices was also commonly mentioned as a reason for not using the available sanitation facilities. Health extension workers promote the adoption of sanitation technologies, but they are less involved in actively following the utilization of technologies. Related to this, one of the interview participants has pointed out that “health extension workers will come to us and check if our handwashing station has water, and if we have latrine, when they know their bosses are coming to supervise them, otherwise, they do not come often” (Interview participant 7, Qebi kebele, Gozamin woreda, 2019).

The health and other quality of life improvement benefits respondents have got from adopting and practicing one type of sanitation facility has encouraged them to adopt another kinds of sanitation facilities. One of the interview participants was quoted saying the following;

*We used to dump all of our rubbish into our field. What we think was that rubbish is not at home anymore. We did not have any knowledge of what that will bring to us. We throw it into the field, and the wind will scatter papers, leaves, dust and ash all over the field and sometimes it brings even to our house and compound. Once we throw the waste away, domestic animals like dogs and hen used to toss it. Our kids also do the same sometimes. One day, my son was looking for ekaka (game) and a broken tin had cut his fingure and shouted. I was at home and run out. He was bleeding and was wounded at his fingure for long. We used to feel disgusted with the sight of wastes all over the field. We even stop over waste piles when we work in our field. We used to suffer from **Kuslemen** (scratch and burn feeling inside feet and toes) but now, thanks to the health extension workers, they told us how to segregate wastes and dispose properly and accordingly. Now we do not have worries like before. We use sweepings from cattle's home to make compost or as **kilazi** (fertilizer) while we burn torn and old clothes and wastes from compound sweepings. You see that (showing a pile of ready to be burn waste), I have collected it to burn it during the evening. Learning from this experience we have now installed latrine (Interview participant 15, age 43, literate and married, from Machakel woreda).*

4.6 Access to and Practice of Hygiene

Introduction

The term hygiene like that of sanitation is a multi-dimensional concept comprising of many practices performed for the preservation of healthy living and health. Hygiene is a latent variable that cannot be directly observed or measured, and indicator variables are used to define it. Accordingly, women's hygiene access and utilization status are measured by using different indicators. The first part of this section presents a detailed description of each hygiene indicator used to form the combined hygiene access scale while the second part covers the summary measure of women's hygiene access and utilization status.

4.6.1 Access to Drinking Water

Drinking water is water used for drinking, food preparation, personal hygiene and washing (Megersa, 2018). Water and hygiene are interlinked. People use water for hygienic purpose, and to be hygienic, the water itself has to be clean and safe. Without access to clean water, one cannot talk about hygiene because there is no way to clean dishes or people. This relation between water and hygiene has made it important to see access to water as one indicator of measuring hygiene access and utilization.

Respondents' access to water is assessed by asking them about what their source of drinking water is? The survey result in table 12 below shows that protected hand pump is the most commonly reported type of water source (50.8%, n=193) followed by unprotected spring (20.3%, n=77). The fact that majority of the respondents get water from protected hand pump is a positive thing to be strengthened. However, it has to be noted that there are still people using water from unimproved sources such as unprotected spring and river.

Table 11: Source of drinking water of respondents

Survey question		Frequency	Percentage
Main source of drinking water	Protected hand pump	193	50.8%
	Unprotected spring	77	20.3%
	Protected spring	61	16.1%
	protected dug well	31	8.2%
	River	18	4.7%

Source: Filed survey, 2019



Figure 7: Example of protected water sources in different study sites



Figure 8: Examples of unprotected water sources in different study sites

Source: Filed Observation, 2019

4.6.2 Time Spent to Get Drinking Water

The UN-human right to water and sanitation framework stated that drinking water must be physically accessible for everyone. When water facilities exist in nearby people's dwelling, the quantity of water available for the household for drinking, cooking, washing and cleaning will increase and this in deed helps to have good hygiene. Conversely, when water sources are far, the quantity of water available for the household reduces and this affects women's hygiene practice. Empirical evidences show that, when water sources are in the premises of each household, the average per capita use per day ranges from 150 to 400 liters. In contrast, when water sources are more than 1 km farther away, the per capita use per day will be less than 10 liters on average (Gleick 1996 cited in Billig, Bendahmane & Swindale, 1999).

The result in table 12 below shows that of the total 380 respondents, a large majority of them (37.4%, n=142) have access to drinking water in less than 30 minutes time and few women 3.4% (n=13) travel more than 60 minute to get drinking water. According to the WHO (2011) access to drinking water measurement, traveling more than 30 minutes collection time is considered as there is no access to drinking water. Thus, 16.8% (n=64) of respondents do not have access to drinking water.

Table 12: Time spent to get drinking water

Survey Question	Response	Frequency	Percent
How long does it take you to go to the nearest water source, get water and come back?	the water source is in the premise	43	11.3
	Less than 30 minutes	142	37.4
	within 30 minutes	131	34.5
	31 - 60 minutes	51	13.4
	More than 60 minutes	13	3.4
	Total	380	100.0

Source: Filed survey, 2019

4.6.3 Continuity/ reliability of water sources

Improved water facilities may be available in near-by household premises or they can be physically accessible but water may be variable and unreliable and compromise women's need to meet the requirements for personal and domestic use such as for drinking, food preparation, washing, cleaning and personal hygiene. Continuity/reliability in this paper is defined as ongoing stability or uninterrupted access to protected water sources. The UN in its

General assembly in 2015 has proposed a new benchmark indicator that helps to monitor progress towards water related SDG. The new benchmark indicator namely safely managed drinking water services has included the continuity of water sources as one of the highest level of service countries should aim to reach. Continuity refers to water sources that are available when needed and can be measured by hours per day, days per month and by season (Flores Baquero, Jiménez Fdez. de Palencia & Pérez Foguet, 2015).

Accordingly, reliability of water sources in this paper is measured by respondents' overall subjective report about the availability of water when they need. The result in table 13 shows that 60% (n=228) of respondents have access to water at all time they needed while 40% (n=152) do not have. The most frequently mentioned reason for lack of reliable water access in the study areas was overcrowding at water sources (53.3%, n=81) followed by water shortage in the water sources particularly during dry seasons (41.4%, n=63). Sporadic failure of the water sources due to facility breakdowns was also the third most cited reason.

Table 13: Continuity of water sources

Survey Question	Response	Frequency	Percent
Is drinking water available to you at all time you need?	Yes	228	60.0
	No	152	40.0
	Total	380	100.0
If your answer is No what is the cause for not getting water at a particular time or season?	Overcrowding at water source	81	53.3%
	Sporadic failure of the water source	46	30.3%
	Water shortage	63	41.4%
	Distance from the house	35	23.0%
	Not clean	27	17.8%
	Others	0	0.0%

Source; Field survey, 2019

Although a significant number of respondents in the quantitative study have reported that they have a reliable access to water, participants in the qualitative interview indicated that reliability of water sources is unpredictable as it varies by season and by day. Some of the interview participants have pointed out that during rainy seasons, water in rivers become flood and muddy and hence unreliable. During this time, women have to travel far looking for clean looking water either from natural springs or other water sources. In cases like this, some revert to use protected water while others still use unprotected water but from a different source like unprotected spring which are far from their house at the outset. This kind of seasonal discontinuity often reduces the quantity of water available at home and constrains hygiene practice. Women's time and energy is also lost in water collection. Participants have also mentioned the non-functionality of water sources as a cause for lack of reliable access to safe drinking water sources. As mentioned, when hand pumps are broken, it takes long time to repair. This time, access to protected water will discontinue and women and girls will go to nearby rivers which are not protected. Depletion of protected dug well during dry seasons, long queue time in the water source, restricted pumping time, and peak demand and volume limitation were also mentioned as a cause for lack of continuous access to water. One of the interview participants is quoted saying:-

We have now water that is clean but if you always come see us, there is often long queue. Sometimes we wait here for around 10-15 minutes. We sometimes also quarrel with each other saying it is my turn; it is my turn/ “worefa” in Amharic. At times, we go back home, leaving our pot in the water source, and we come back after finishing some domestic activities. Pumping is also allowed only for a short period each day. We can only fetch water in the morning until 10:00 am and later in the afternoon after 3:00pm. Otherwise it will be locked by water source administrators. The quantity of water we fetch varies from day to day and sometimes it depends on some occasions. If I have some special ceremony such as mahber, or wedding, others will give me their water share. Another time, I will do the same as well. On Friday each week, we collect large volumes of water around 4 to 6 jerican as water is not fetched on Saturday and Sunday. Everyone fetches water on Friday and on this day; we spent a long time to get water. Had we kept time! It takes us more than 1 hr. to have the amount of water we need. In the dry season, when water becomes scant, it becomes worse even. It takes long minute to fill one jerican and half of the day will go like that. This way or another, we have water but not plenty for all our domestic needs (Yetjanshebalma kebele, March, 2019).

4.6.4 Availability of Handwashing Facility near Latrine

Hand washing facilities are expected to be present near latrine facilities so that people can wash their hands after defecation. The result in table 14 below shows that out of the total 79.5% (n=302) respondents who have latrine, more than half (53.6 %, n=162) have hand washing facility near latrine while 46.4% (n=140) do not. Availability of hand washing facility in rural Ethiopia is 55% as of 2016 (CSA & ICF, 2016). Therefore, the finding of the present study is somewhat in harmony with the national average. The Joint monitoring program of WHO and UNICEF (2017) in its progress measure towards the SDG related to hygiene has defined the mere presence of handwashing facility near latrine without water and soap as having limited access and distinguishes it from those households that have no facility at all. Therefore, the fact that 53.6 % (n=162) of respondents have hand washing facility near their latrine indicates that they are better off in the hygiene ladder than those respondents who do not have the facility at all.

4.6.5 Availability of Water in the Hand Wash Facility

Washing materials such as water are essential for effective personal hygiene. To be utilized, hand washing facilities need to have clean water in them. A woman, who has touched faeces, can spread disease agents for others or to her-self. Infected hands contaminate domestic appliances, thus facilitating the spread of disease. Studies have shown that the availability of water for hand

washing is an important factor in reducing the incidence of Shigella infection (WHO, 1988). As the result in table 14 shows, out of 53.6 % (n=162) respondents who have hand washing facility near their latrine, water is available in 58.6% (n=95) of the hand washing facilities and missed in 41.4% (n=67) of the hand wash stations. The Joint monitoring program of WHO and UNICEF (2017) has defined households with water in their handwashing facility near latrine as having basic hygiene. Therefore, it is possible to say that 58.6% (n=95) of respondents in this study have basic hygiene access.

Table 14: Availability of Hand Washing Facilities

Survey Question	Response	Frequency	Percent
Availability of hand washing facility near latrine	Yes	162	53.6
	No	140	46.4
	Total	302	100.0
	Missing	78	20.5
Availability of water in the hand washing facility	Yes	95	58.6
	No	67	41.4
	Total	162	100
	Missing	218	57.4

Source: Field Survey

4.6.6 Hand Washing with Soap After defecation

People use their hands for many kinds of daily activities causing their hands to get dirty frequently. Microorganisms are more likely to be attached to dirty hands and cause different kinds of communicable diseases. Consequently, hand washing with soap after defecation is given greater attention in global hygiene and public health movements. Handwashing with soap has also become one of the indicators within the SDG (specifically, SDG 6.2.1). Hand washing with soap was found to reduce pneumonia incidences by 23% and diarrhoea by 45% (Jennifer & Param, 2014 cited in Alula, Dejene, Terefe, Abinet & Bazie, 2018). Handwashing with soap also reduces the risk of acute lower respiratory infections and soil-transmitted helminths (Hirai et al., 2016).

Because of their domestic role as food servers and preparers, women's washing of hands with soap after defecation is vital for their own as well as their families' health. Thus, women were asked if they usually use soap to wash their hands after defecation. The self-reported survey result shows that out of the total 380 respondents, only 6% (n=23) usually uses soap to wash their hands after defecation while a large majority of respondents do not (93.9%, n=357). Women's hand washing experience using soap after defecation is unacceptably low. The expensiveness of soap was the most important impeding factor for women's non utilization of soap to wash their hands after defecation (57.4%, n=205) followed by their own laziness (45.9%, n=164). Literature indicates that only 19% of the global population is estimated to wash hands with soap after defecation (Freeman et al., 2014 cited in Hirai et al., 2016). A study by Hirai et al. (2016) in Indonesia also found that only 26.7% of their respondents were washing hands with soap after defecation.

Table 15: Respondents' utilization of soap to wash hands after defecation

Survey Question	Response	Frequency	Percent
Do you usually use soap to wash your hands after defecation	Yes	23	6.1
	No	357	93.9
	Total	380	100.0
If no, what is the main factor(s) that prevent you from using soap	Soap is expensive to buy	205	57.4
	Laziness	164	45.9
	Water alone cleans the hand	45	12.6
	Others	9	2.5
Total		357	

Source: Filed Survey 2019.

Washing hands after defecation is a common practice or habit among women in the study areas. There is a saying that “*badere eji sira ayjemerem/*” literary to mean *no activity is carried out before washing hands*. The water they use to wash their hands and their genital has its own name and known as “*yegibre wuha*”. However, handwashing after defecation is not done properly and continuously. Culturally, every woman is expected to wash her hand after defecation but this is

mostly done in the morning and evening. If it is urination and the defecation takes place during day time (though this is rarely done by women due to cultural reasons), hand washing is not practiced. Hand washing is done in the morning and evening, but soap utilization is very inconsiderable as was mentioned by qualitative interview participants. Women use open containers like small pot (“*tofa*”) or “*jog*” to take water to the defecation place and they wash their hands inside the pot. They continue rubbing their hands inside the pot and this could put dirt on their hands again leading to contamination and diseases. Burton et al. (2011) stated that handwashing should not only involve getting the hands wet or a quick rinse under a tap. It should instead remove microorganisms from contaminated hand using soap or detergent. Hand washing with non- antibacterial soap and clean water was found to be more effective than just using water (cited in Kumwenda, 2019). Research shows that a \$3.35 investment in handwashing brings the same health benefits as an \$11.00 investment in latrine construction, a \$200.00 investment in household water supply and an investment of thousands of dollars in immunization (Meleko, 2018). In conclusion, the result of the present study indicates that more work needs to be done on the issue.

4.6.7. Drinking Water Collection Containers

Water from improved sources is not always safe. It can be contaminated during collection, transportation, storage and drawing at home (WHO, 2012). Safe drinking water chain requires the need to protect drinking water at its source and continue to protect it during collection, transportation, storage and at the point of use (Ssemugabo, Wafula, Ndejjo, Oporia, Osuret et al., 2019). Many households in rural areas do not have tap water connected to their house, thus, they collect water from different sources using a variety of containers. As a result, respondents were asked if they have separate drinking water collection and transportation container, if their transportation container has its own cover and the type of water transportation container they have. The result in table 16 below shows that of the total 380 respondents, majority of them (78.9%, n=300) have separate drinking water transportation facility and about 77.6% (n=295) have reported that their water transportation facility has its own cover. Respondents who reported to have separate water collection facility use small sized jerrican mostly 5-20 liters to transport drinking water and use a different container to fetch water for other domestic activities such as cooking, cleaning and washing. On the contrary, respondents who do not have separated

water collection facility use one kind of facility to collect water that would be used for cooking, drinking and washing and will take out from it for any activity they needed. The utilization of one water facility for different purposes, however, will bring continuous contact with the water and this could expose the water for contamination particularly if safe water withdrawal is not practiced. Therefore, the promotion of the need to have separate drinking water collection containers should be strengthened.

The results of the analysis of the type of container used by women to transport water indicated that 82.4% (n=313) of respondents used jerrican followed by clay pot (accounted for 12.6% (n=48)). A similar finding was reported by Desalegn, Sissay & Tesfaye in their study of water handling practices among rural communities of Dire Dawa administrative council in 2013 where Jerrican was found to be the most widely used water collection container for 59.4% of their respondents followed by clay pots (accounted for 40.6%). A similar finding was also reported by Gedamu (2017) in Farata woreda Amhara region where 94.6% of his respondents have used Jerrican to collect water. As the result shows, Jerrican is the most widely used water transportation container and it has its own cover. However, clay pot, which is the next most widely used water transportation container has wide mouth and women have been observed using different kinds of covers such as plastic dish, can, leaves and grass. The utilization of leaves, grass, can and plastic dish does not properly cover the container mouth. Water was observed being spilled on the body of women carrying the water. Besides, it is easy for contaminates such as dust and other particles to enter. Jerrican with its own lid is safe in this sense. The fact that majority of the respondents have narrow neck container (jerrican) that minimizes contamination is a good practice and it has to be strengthened. Utilization of jerrican is also reported by some participants during the qualitative interview, to be comfortable for carrying. Some interview participants, however, mentioned that they prefer clay pots over jerrican because clay pots are good for cooling water and are easy for inside cleaning than jerrican. The taste of the water is also reported to be good in clay pot than when in jerrican. The proof for this, however, needs further research.



Figure 9: Examples of drinking water collection & transportation containers

Source: Filed Observation, 2019

Table 16: Water Collection/transportation containers

Survey Question	Response	Frequency	Percent
Availability of separate drinking water collection container	Yes	300	78.9
	No	80	21.1
Availability of its own cover for the water transportation container	Yes	295	77.6
	No	85	22.4
Kind of water container mostly used in transporting drinking water	clay pot	48	12.6
	jerry can	313	82.4
	barrel or baldi	19	5.0
Total		380	100

Source: Field Survey, 2019

4.6.8 Drinking Water Storage Container

In rural areas, due to the distances and limited availability of water sources inside the households, women are forced to store drinking water. Inadequate storage conditions such as wide openings or buckets, uncovered or poorly covered containers increase the risk of contamination, which can lead to infectious diseases (Potgieter, 2007). Households also need two

water containers; one for collection and one for storage. Respondents were asked about the availability of separate drinking water storage container, type of water storage container used and availability of its own cover for the water storage container. The survey result in table 17 below shows that of the total 380 respondents, 81.8% (n=311) have separate drinking water storage facility and 84.5% (n=321) have reported that their water storage facility has its own cover and Jerrican is the most widely used water storage facility reported by 82% (n=312) of the respondents. With regards to the availability of separate water storage container, the finding in the present study is partly in disagreement with what was found by Gedamu (2017) in Farta woreda Amhara region where only 40.5% of his respondents had separate containers to store drinking water. However, in terms of the type of water storage facility used, the result of the present study is in agreement with Gedamu's (2017) finding where 59.4% of his respondents have used Jerrican to store drinking water followed by clay pot (21.6%). The fact that a large majority of respondents have used jerrican to store water is an indication that women in the study area are practicing safe water storage that minimizes contamination and it is a good practice. Jerican has a small opening and it does not allow hands or other water serving utensils to dip into the water. The water is, thus, poured out and it is a good option for safe storage.

Though large majority of quantitative respondents have used Jerrican to store drinking water, women in some households were also observed using different kinds of open/wide mouth water storage containers such as clay pots and buckets (known commonly as plastic Rotto). The clay pots known in Amharic as “*gan*” do not have their own cover. Their covers are made from mud bricks and straw of Teff and known in Amharic as “*merget*”. The mergit is used to cover the water storage container in which particles from both mud and straw enter into water. Straw was noticeable on the glass of water taken-out from the storages. The use of buckets to store water is not different either. Though buckets have their own cover, their wide mouth makes women dip their hands or other water serving utensils in the water and this could contaminate the water. On the contrary, a small opening/ narrow container with a lid or cover discourages users from placing potentially contaminated items such as hands, cups, or other water servers into the stored water. Wide mouthed storage vessels have been associated in transmission of cholera. A study by Deb, Sircar, Sengupta, Mondal & Gupta (1986) in Calcutta, India found that cholera infection was four times higher using wide-mouth storage vessel. Clay pot and buckets are categorized as an open container while Jerican is categorized as narrow mouth container (Potgieter, 2007).

Therefore, in order to keep water hygienic, some innovative works can be done on wide-mouth storage vessel such as clay pots. It is possible to make clay pots to have either narrow mouth on the top and tap at the bottom or they can be made to have tight lids. Local pot makers can be given training to manufacture either the pots or their lids.



Figure 10: Image of water storage containers used by women in their households to store drinking water: clay pot and buckets from left to right

Source: Field observation, 2019

Table 17: Water Storage Containers

Survey Questions	Response	Frequency	Percent
Availability of separate drinking water storage container	Yes	311	81.8
	No	69	18.2
Availability of its own cover for the water storage container	Yes	321	84.5
	No	59	15.5
Type of water container mostly used in storing drinking water	Clay pot	53	13.9
	Jerry can	312	82.1
	Rotto, barrel/baldi	15	3.9
Total		380	100.0

Source: Field Survey, 2019.

4.6.9 Treating Drinking Water at Home

Drinking water sources are not always safe. They can be contaminated by a variety of organisms entered into by different means. Water treatment is thus important to eliminate disease-causing organisms and make water safe for drinking. Respondents were asked if they treat their drinking water at home or not and the survey result shows that almost all of the respondents do not treat their drinking water at home (93.7%, n=356). This result is in agreement with the finding of L.B. Kunwar, B.B Kunwar, Jain & Subedi (2014) in their study of hygiene practices in rural area of Nepal where they found that 91.37% of their respondents don't treat water before consumption. The survey result in the present study also shows that only 6.3% (n=24) of respondents treat their drinking water at home before consumption and this finding is similar to the Ethiopian demographic and health survey report (2016). CSA & ICF (2016) reported that only 6% of households in rural Ethiopia treat their drinking water. But, inconsistent with a similar study done in rural communities of Farta Woreda in Amhara region by Gedamu (2017) where he found that only 2.8% of his respondents had practiced household water treatment. This deviation may be attributed to difference in place of residence. The low rate of drinking water treatment at home observed in the present study is against the government's plan of achieving 35% households nationwide to use water treatment practice during GTPII or by the end of 2020 from 7 % in 2016. There are different reasons for the non-exercise of water treatment at home and the survey result shows that the perception that water is treated at the source (42.5%, n=150) is the most widely mentioned reason followed by lack of time (14.7%, n=52). About 13.3% (n= 47) of respondents said that they do not treat water because they do not drink water alone as they drank it mixed with *Tella* (the local alcohol). A significant number of other respondents (12.2 %, n=43) also stated that they do not know if water is treated. Among the other factors mentioned by respondents as a cause for their non- treatment of drinking water are 1/ being accustomed to the water they drink and the fact that it did not bring any health related problem so far 2/ disliking the color and test of water, 3/ clean look of the water and 4/ lack of treatment chemicals.

Table 18: Drinking water treatment

Survey Question	Response	Frequency	Percent
Do you treat your drinking water at home	Yes	24	6.3
	No	356	93.7
	Total	380	100.0
Reasons for non-treatment of drinking water	The water is treated at the source	150	42.5%
	lack of time	52	14.7%
	I do not know if water is treated	43	12.2%
	we drunk it together with Tella	47	13.3%
	Others	71	20.1%

4.6.10 Safe Removal of Water from Container

Water withdrawal practices from storage play a great role to keep drinking water hygienic and safe. Respondents were asked how they usually withdraw drinking water from storage container. The response options were 1/ tilt & pour into a water serving utensil (coded as 1) and 2/ dip the hand with water serving utensils (coded as 0). One indicates safe drinking water withdrawal practice and zero indicates unsafe withdrawal. The study result in table 19 shows that a large majority of respondents (82.9%, n= 315) practice safe water withdrawal and get their drinking water from storage by tilting and pouring into water serving utensils while 17.1 % (n=65) dip their hand into the water container. This finding is in agreement with Gedamu's (2017) finding that 92.5 % of his respondents have practiced pouring method for drawing water from storage containers. The result is also consistent with Desalegn, Sissay & Tesfaye (2013) study where 78.12% of their respondents were found to practice pouring method of water withdrawal from containers compared with 21.87% who practice dipping.

Table 19: Common Withdrawal means of drinking water from storage container

Survey question	Response	Frequency	Percent
How do you usually withdraw drinking water from storage container?	tilt and pour	315	82.9
	Dipping the hand	65	17.1
	Total	380	100.0

Source: Filed Survey, 2019

4.6.11 Presence of Shelf for Household Utensil

The rural health extension program promotes the construction and usage of shelves to keep drinking water storage containers, drinking utensils and other kitchen utensils up the floor so that they cannot be easily contaminated with dust, animals as well as avoid contact with children. Studies have shown that utensils, such as spoons, cups, pots, and plates, are potential sources of pathogens and should be kept high in an elevated place (Chidziwisano, Slekiene, Kumwenda, Mosler, and Morse, 2019). Respondents were asked if they have shelf/cupboard to keep their kitchen and drinking utensils up the floor and the facilities were observed. The survey result in table 20 shows that majority of the respondents 218 (57.4%) have shelf for household utensils.

Table 20: Presence of Shelve

Survey Question	Response	Frequency	Percent
Do you have shelf/cupboard to keep your kitchen and drinking utensils up the floor?	Yes	218	57.4
	No	162	42.6
Total		380	100

Source: Field Survey, 2019

Shelves made from different materials were observed in many of the surveyed households. Some were made from wood while others were made from mud. The shelves were located in storeroom or closets literarily known as “*majet*” or “*guada*” and at the corner of the living room. Serving dish, glasses, drinking water storage containers and other kitchen utensils were observed being kept high as seen in the photo below.



Figure 11: Shelves made from different materials in the study sites

Source: Field Observation

Though majority of respondents' have shelf to keep their utensils high, it was also observed that some shelves were covered with dust. The method of cleaning and drying utensils also lacks proper mechanism. Women were observed to use wash water repeatedly. Dirty clothes were also used to dry the washed utensil. Some women were also observed when they put wet utensils on the shelf. Still, more others were observed storing utensils on the ground after washing. This kind of poor drying and storage of kitchen utensils is not safe from contamination. The health extension program, therefore, should focus not only on shelf promotion but also on promoting washing and drying facilities. In doing so, there will be a hygienic chain from washing, to drying and then storage.

4.6.12 Presence of Shower Facility

Personal washing facilities are essential for effective personal hygiene. Respondents were asked if there is body washing facility in their household. Accordingly, only 25% (n=95) had shower facility in their household while majority of the respondents, 75% (n=285) do not have shower facility. The fact that majority of the respondents do not have a Shower facility in their household may inhibit the regular washing of their body. Regular washing of the body is necessary to remove dirty, sweat and dead skin while lack of it causes the skin to attract more dirty and bacteria leading to bad body smell and different skin diseases (WHO, 1988).

Table 21: Presence of Shawor Facility

Survey question	Response	Frequency	Percent
Does your household have shower facility?	Yes	95	25.0
	No	285	75.0
	Total	380	100.0

Source: Filed Survey

4.6.13 Menstrual Hygiene Management

Menstrual hygiene management (MHM) is an important component of personal hygiene for women and girls. If menstrual hygiene is not properly managed, it can result in bad body odor, fungal and urinary tract infection and it can also make women vulnerable to infertility. Safely practiced menstrual hygiene on the other hand prevents infections, body odor and it gives confidence and comfort (Kumwenda, 2019). Safe menstrual hygiene practices include the use of water, soap, toilets, menstrual absorbents and safe disposal of used sanitary materials (FMOH, 2016). Menstrual hygiene management in the present study is defined as the utilization of menstrual absorbents. There are different types of sanitary absorbents or products used by women during menstruation. These are reusable cloth pads, commercial sanitary pads, menstrual cup and pads made from wool (Rajanbir, Kanwaljit & Rajinder, 2018). Respondents were asked if they use sanitary pads for menstrual hygiene management and the type of sanitary absorbents they use. The result in table 22 below shows that majority of the respondents (72.6%, n=276) do not use any menstrual hygiene absorbents and only 9.7% (n=67) utilize menstrual hygiene absorbents of which 52.2% uses reusable cloth pads and 47.8% uses pads made from wool. The reusable cloth pads are made from ragged cloth and they are not the kind of reusable pads that are being introduced by NGOs, indicating utilization of unimproved menstrual products or materials. Wearing of underwear/panty and wearing of dresses one on top of the other were also mentioned again and again as other means of menstrual hygiene management materials used by women in the study areas. Lack of sanitary material nearby is the most widely identified reason for respondents non-utilization of menstrual hygiene management material (89% n=246) followed by lack of information about sanitary pads (72%, n=199). Lack of skill on how to use sanitary pads is also the third mostly mentioned reason for non-utilization of sanitary materials (61.2%, n=169). Lack of confidence to ask for and buy sanitary materials and money are the

least marked reasons for non-utilization of menstrual hygiene management materials. As the result indicates, women in the study areas do not have easy access to sanitary materials nor have the information about the available sanitary options. Since they do not have information about the products, they do not know how to use them. The causes are interrelated. Available sanitary materials are often targeted to urban women and school girls. The Federal Ministry of Health guideline prepared to encourage awareness of menstruation itself has focused on school girls in rural areas and gives little attention on how to support women and girls outside of the school environment. Therefore, attention should be given on this aspect. Table 22 below shows reasons for respondents' non utilization of sanitary pads as marked by respondents themselves.

Table 22: Menstrual Hygiene Management Practices

Survey Question	Response	Frequency	Percent
Do you use sanitary materials for menstrual hygiene management?	Yes	67	17.6
	No	276	72.6
	does not apply	37	9.7
	Total	380	100.0
If yes what are the materials you use for menstrual hygiene management?	Commercial sanitary pad	-	-
	reusable cloth pads	35	52.2
	Pads made from wool	32	47.8
	Total	67	17.6
	Missing System	313	82.4
	Total	380	100.0
If No what are the reasons for non-utilization of sanitary materials?	Sanitary pad is not available in nearby	246	89.1
	I have never heard about sanitary pads	199	72.1
	I do not know how to use sanitary pad	169	61.2
	I do not have money to buy sanitary pad	23	8.33
	I am ashamed to buy sanitary pad	6	2.2
	Total	276	100

Source: Field Survey, 2019.

4.7 Women's Hygiene Access and Utilization Status

Hygiene is a multidimensional concept and women's hygiene access is measured using 11 hygiene related indicators. Most of these 11 hygiene indicators have binary responses (yes and no). Survey questions with multiple responses were also converted into binary for standardization purpose following standardized definitions from the literature review. For instance, respondents were asked what their source of drinking water is (see section 4.6.1) and the response options were 1/ protected hand pump, 2/ protected spring, 3/ protected dug well, 4/ river and 5/ unprotected spring. These options were later categorized into protected/improved and unprotected/unimproved sources following the Joint Monitoring Program of UNICEF and WHO (2012) definition. Thus, respondents who checked/selected their water source as from protected hand pump, protected spring and protected dug wells are categorized as having protected source of drinking water and recoded as Yes and those who selected river and unprotected spring are categorized as having unprotected drinking water source and recoded as no (see table 11 & 23).

Similarly, the survey question about the time spent to get water (round trip) had five response options as 1/ water source is in the premise, 2/ less than 30 minutes, 3/ within 30 minutes, 4/ 31 to 60 minutes and 5/ more than 60 minutes. According to the WHO (2006 & 2012) drinking water guideline, a person is said to have access to water if the water is in the premises, or the collection time does not exceed 30 minute round trip. In contrast, if a person travels more than 30 minutes or 1000m/1km, then he/she is said to have no access to water. In line with this reference, responses were recoded and the first three response options (no 1, 2 &3) are recoded as yes or 1 indicating that the respondent has access to drinking water and the last two response options (no 4&5) are recoded as No or zero, indicating the respondent's lack of access to water. Once the multi-category response options were standardized into binary response (yes and no), respondents overall hygiene access status is estimated using simple average (arithmetic average)

method as used above in sanitation access section as; $HA = \frac{\sum_{k=1}^n X_i}{n} = \frac{x_1 + x_2 + \dots + x_n}{n}$, Where

HA= hygiene access, X_i = data values to be averaged, and n = number of hygiene indicators used,

$\sum_{k=1}^n X_i$ = sum of all data values.

Average score is preferred than additive summary because there are missing values and it is not plausible to compare respondents who have different range of responses using cumulative added values. For instance, the survey question on the availability of water in the hand washing facility is asked for those respondents who reported to have a hand wash facility near their latrine. Data on respondents with no handwashing facility is missing. The average of the normalized responses gave a numerical score for each respondent. The minimum average hygiene access score is 0.10 and the maximum is 1.00. The maximum average score of one indicates that the respondent has access to all of the 11 hygiene indicators while the minimum mean hygiene access score of 0.10 indicates that the respondent has access to at least one of the 11 hygiene indicators in her household. After the mean score of each respondent is calculated from the 11 indicators, respondents were classified into different groups according to their level of average hygiene access score. A woman's hygiene access level is categorized as low if her mean score ranges from 0.00-0.50, medium if the mean score ranges from 0.51-0.75 and high if the mean score ranges from 0.76-1. Since, there was no previously defined cutoff scores in the literature that can be taken as a reference, a cut off score is defined arbitrarily. This arbitrary cutoff for hygiene access level is made with the assumption that the probability of having low, medium and high hygiene access in rural households is not believed to be the same. The probability of having high hygiene access in rural areas is assumed to be low. Thus, equal distance cutoffs like 0-0.33 (low), 0.34-0.67 (medium) and 0.68-1 (high) is not considered plausible.

The result in table 23 below shows that of the total 380 sampled respondents, a large majority of them (46.6%, n=177) have medium hygiene access. In order to identify the most widely available hygiene facility from the overall hygiene access scale, hygiene access index is constructed by adopting a formula used by Farouque & Sarker (2018) practice index as: HAI (Hygiene Access Index) = $(Pl \times 1) + (Pm \times 2) + (Ph \times 3)$ Where, Pl = number of respondents with low hygiene access/ utilization, Pm = number of respondents with medium hygiene access/utilization, Ph = number of respondents with high hygiene access/ utilization. The total hygiene access index computed by using this formula is 783 ($90 \times 1 + 177 \times 2 + 113 \times 3$). However, the hygiene access index (SUI) ranges from 380 to 1140, where 380 indicates that all of the 380 respondents have low hygiene access (380×1) and 1140 indicates that all the 380 respondents have high hygiene access. The numbers 1, 2 and 3 indicates the weights used to label low, medium and high sanitation access respectively. The result shows that, among the

hygiene facilities available to respondents, availability of its own cover for the water storage container tops in the rank order with hygiene access index of 707 followed by availability of separate drinking water storage container with a rank order of 690. Availability of shower facility ranks least in hygiene access index with a rank order of 238. This index ranking is also validated by examining the extent to which the index is related to the individual items that were included in it. As the descriptive statistics shows, 84.5% (n=321) of respondents among from a total of 380 have cover for their water storage container followed by 81.8% (n=311) of respondents who have separate drinking water storage container.

Table 23: Distribution of respondents according to their level of hygiene access

Survey Question	Response	Hygiene Access Level			Total	Hygiene Access Index
		Low	Medium	High		
Access to protected water	Yes	55(19.3%)	128(44.9%)	102(35.8%)	285(75.0%)	617
	No	35(36.8%)	49(51.6%)	11(11.6%)	95(25.0%)	
Time spent to get water(round trip)	Yes	64(20.3%)	140(44.3%)	112(35.4%)	316(83.2%)	680
	No	26(40.6%)	37(57.8%)	1(1.6%)	64(16.8%)	
Is drinking water available to you at all time you need	Yes	44(19.3%)	97(42.5%)	87(38.2%)	228(60.0%)	499
	No	46(30.3%)	80(52.6%)	26(17.1%)	152(40.0%)	
shelf for household utensil	Yes	31(14.2%)	93(42.7%)	94(43.1%)	218(57.4%)	499
	No	59(36.4%)	84(51.9%)	19 (11.7%)	162(42.6%)	
availability of separate drinking water transportation container	Yes	43(14.3%)	146(48.7%)	111(37.0%)	300(78.9%)	668
	No	47(58.8%)	31(38.8%)	2(2.5%)	80(21.1%)	
availability of its own cover for the water transportation container	Yes	40(13.6%)	144(48.8%)	111(37.6%)	295(77.6%)	661
	No	50(58.8%)	33(38.8%)	2(2.4%)	85(22.4%)	
availability of separate drinking water storage container	Yes	43(13.8%)	157(50.5%)	111(35.7%)	311(81.8%)	690
	No	47(68.1%)	20(29.0%)	2(2.9%)	69(18.2%)	
availability of its own cover for the storage facility	Yes	47(14.6%)	162(50.5%)	112(34.9%)	321(84.5%)	707
	No	43(72.9%)	15(25.4%)	1(1.7%)	59(15.5%)	
availability of hand washing facility near latrine	Yes	12(7.4%)	77(47.5%)	73(45.1%)	162(42.6%)	385
	No	78(35.8%)	100(45.9%)	40(18.3%)	218(57.4%)	
availability of water in the hand washing facility	Yes	3(3.2%)	34(35.8%)	58(61.1%)	95(58.6%)	245
	No	9(13.4%)	43(64.2%)	15(22.4%)	67(41.4%)	
Availability of Shawor facility in the household?	Yes	5(5.3%)	37(38.9%)	53(55.8%)	95(25.0%)	238
	No	85(29.8%)	140(49.1%)	60(21.1%)	285(75.0%)	
Total		90(23.7%)	177(46.6%)	113(29.7%)	380(100%)	

Source: Survey result

With regards to the measurement of women's hygiene practice or utilization status, overall hygiene utilization score was first computed by combining respondents score on six hygiene related indicators listed in table 24 below. Some of the survey questions regarding women's hygiene practice had binary response options while others had multiple category responses. Survey questions with multiple category responses were first dichotomized for standardization purpose and the dichotomization is done following literatures. For instance, the survey question, do you use sanitary materials for menstrual hygiene management had three response options: yes (coded as 1), no (coded as 0) and does not apply (coded as 2). The response option does not apply is treated as missing. Similarly, the survey questions on what specific kind of water container do you use most in collecting drinking water? And what specific water container do you usually use to store your drinking water? Had more than two answers. However, the response options were recoded as open container (coded as no) and narrow container (coded as yes). Accordingly, the responses of clay pot and buckets (Rotto or Baldi) containers are categorized as open mouthed container while Jerri can is categorized as narrow mouth container. Similarly, the survey question on how do you usually withdraw drinking water from the storage container had two response options: 1/ Tilt & pour into a water serving utensil and 2/ dip the hand with the water serving utensil. Tilt & pour into a water serving utensil is safe drinking water withdrawal practice and coded as yes while dip the hand with the water serving utensil is not safe drinking water practice and coded as no.

Once the survey questions are standardized, hygiene utilization score of each respondent on the six hygiene indicators is computed using simple average method as used above. Average score is preferred than additive summary because there were missing values and it is not plausible to compare respondents who have different range of responses using additive summation scores. The result indicates that the minimum hygiene utilization score is zero showing the respondent has not practiced any of the mentioned hygiene behaviors and the maximum is 0.83 indicating that the respondent has practiced at least some of the hygiene behaviors mentioned. Once the average score of hygiene utilization for each individual respondent is known, respondents are categorized into three groups based on their level of average hygiene utilization score. Thus, a respondent whose average hygiene utilization score ranges from 0- 0.28 is arbitrarily categorized as having low hygiene utilization while a respondent whose average score is between 0.29-0.56 is categorized as having medium hygiene utilization status and a respondent whose average

hygiene utilization score is equal to or greater than 0.57 is categorized as having high hygiene utilization status. Based on this categorization, 17.1% (n=65) of the respondents among from a total of 380 have low hygiene utilization, 53.2% (n=202) have medium hygiene utilization and 29.7 % (n=113) have high hygiene utilization status. The fact that majority of the respondents have medium hygiene practice is expected as the study areas are rural and there is low hygiene practice in rural areas overall.

In order to identify the most widely practiced hygiene behavior among the given lists of behaviors, hygiene utilization index is constructed by adopting a formula used by Farouque & Sarker (2018) as used above in calculating hygiene access index. The total hygiene utilization index computed by using Farouque & Sarker (2018) formula is 808 (65 x1+ 202 x 2+113 x 3). However, the actual hygiene utilization index (HUI) ranges from 380 to 1140, where 380 indicates that all of the 380 respondents have low hygiene utilization (380x1) and 1140 indicates that all the 380 respondents have high hygiene utilization. The index score of each hygiene indicator is calculated only for the positive behavior as shown in the table below.

Table 24: Distribution of Respondents According to their level of hygiene utilization

Survey question	Response	Hygiene Utilization			Total	Hygiene Utilization Index
		Low	Medium	High		
Use sanitary materials for menstrual hygiene management	Yes	9(13.4%)	3(4.5%)	55(82.1%)	67(19.5%)	180
	No	44(15.9%)	199(72.1%)	33(12.0%)	276(80.5%)	
use soap to wash hands after defecation	Yes	1(4.3%)	1(4.3%)	21(91.3%)	23(6.1%)	66
	No	64(17.9%)	201(56.3%)	92(25.8%)	357(93.9%)	
Treat drinking water at home	Yes	2(8.3%)	1(4.2%)	21(87.5%)	24(6.3%)	67
	No	63(17.7%)	201(56.5%)	92(25.8%)	356(93.7%)	
safe withdrawal of water from storage container	Yes	1(0.3%)	201(63.8%)	113(35.9%)	315(82.9%)	744
	No	64(98.5%)	1(1.5%)	0(0.0%)	65(17.1%)	
Use narrow neck water transportation container	Yes	11(3.5%)	189(60.4%)	113(36.1%)	313(82.4%)	728
	No	54(80.6%)	13(19.4%)	0(0.0%)	67(17.6%)	
Use narrow neck water storage container	Yes	4(1.3%)	195(62.5%)	113(36.2%)	312(82.1%)	733
	No	61(89.7%)	7(10.3%)	0(0.0%)	68(17.9%)	
Total		65(17.1%)	202(53.2%)	113(29.7%)	380(100%)	

Source: Survey result

As the table above shows, safe withdrawal of water from storage container (pouring method of drinking water withdrawal) is the top hygiene practice in hygiene utilization index followed by the utilization of narrow neck water storage container. Utilization of soap to wash hands after

defecation is the least practiced hygiene behavior with hygiene utilization index of 66. Drinking water treatment is also the least practiced hygiene behavior next to soap utilization with hygiene utilization index of 67. This index ranking is validated by examining the extent to which the index is related to the individual items that were included in it. As the descriptive statistics shows, 82.9% (n=315) of respondents have practiced pouring method of drinking water withdrawal followed by 82.1% of respondents who have narrow neck water storage container.

4.8 Discussion

The section on hygiene access and utilization is undertaken to assess the availability of materials necessary to practice hygiene and the actual hygiene practice among rural women in East Gojjam Zone. The study result shows that among a total of 380 respondents, a large majority of them have medium hygiene access and utilization status. Participants have reported different factors as working against the realization of better access to hygiene facilities and the subsequent hygiene practice. For instance, the expensiveness of soap was the most widely mentioned reason for respondent's non utilization of soap to wash hands after defecation. As the survey result indicated, majority of the respondents have access to protected water sources and the perception that water is treated at the sources was the top mentioned reason for respondents non- treatment of drinking water at home. However, water from improved sources is not always safe (WHO, 2012). Water can be safe at its source but it can be contaminated during collection, transportation, storage and withdrawal. The safe drinking water chain, therefore, requires the need to protect drinking water from its source up to consumption. Being familiar with the water source and the belief that it has not caused any health related problem, not liking the color and test of water treated via boiling, clean looking water based on its color and physical appearance, lack of water treatment chemicals and materials such as wuha agar and ceramic filters were also stated as factors for the non- treatment of drinking water at home. Unavailability of modern menstrual hygiene management materials in rural areas, lack of information and knowledge about the available materials and how to use them are mentioned as factors that inhibit women's access to and utilization of hygiene facilities and materials.

As the result showed, majority of the respondents use jerrican as water collection and storage container. Jerrican has narrow neck and it has its own cover which is good to prevent contaminants from entering. But, there is concern on the cleanliness of jerrican. Interview

participants have mentioned that it is not easy to clean the inside of jerrican like that of pots. Pots can be cleaned easily inserting hand and other cleaning materials such as *Girawa/ Vernonia amygdalina*. Therefore, cleaning methods should be promoted together with the promotion of narrow neck containers to transport and store drinking water. The water warming character of jerrican was also another reason mentioned by some interview participants time and again as a rationale for their non-utilization of jerrican which is highly promoted by the health extension program.

CHAPTER FIVE: DETERMINANTS OF WOMEN'S ACCESS TO AND UTILIZATION OF SANITATION FACILITIES

Introduction

Rural women's desire to have and use sanitation facilities is determined by different factors. This chapter has, therefore, tried to examine if there is a statistically significant association between the different factors and women's level of access to and utilization of sanitation facilities. The chapter is organized in two major sections. The first section deals with the determinants of women's access to sanitation facilities while the second section deals with determinants of women's sanitation practice or utilization. In both sections, the analysis is made based on a questionnaire interview of 380 female household heads. A three-category ordinal dependent variable; sanitation access and utilization (low, medium, and high) were constructed under the assumption that the levels of sanitation access and utilization have a natural ordering as low, medium and high. When dependent variables are measured on an ordinal scale, there are many options for their analysis such as Ordinary least-squares (OLS) and multinomial logistic regression. OLS regression, however, treats the dependent variable as though it is continuous and multinomial logistic regression treats the dependent variable as nominal and ignores its ordinality. Ordered logit regression, on the other hand, treats the dependent variable as it is measured on an ordinal scale (Williams, 2016). Since the dependent variables are measured on an ordinal scale, ordered logistic regression model (ologit) also known as proportional odds model is used to estimate the association between the independent and dependent variables. In cases where proportional odds assumption has failed, generalized ordered logistic regression or partial proportional odds model is used. The results of each model estimates are discussed in their respective sections as follows.

5.1 Determinants of Women's Access to Sanitation Facilities

Table 24 presents the results of generalized ordered logit estimation of the association between the different independent variables and women's level of sanitation access. The result shows that, the variable *woreda* ($p=0.002$) has a negative and statistically significant association with women's level of sanitation access in the first panel at a 1% level of significance. The negative

logit coefficient of -1.926 for the variable indicates that a respondent who lives in Gozamin woreda is less likely to have medium and high sanitation access compared to a respondent who lives in Machakel woreda. In other words a respondent who lives in Machakel woreda is more likely to have better sanitation access than a respondent who lives in Gozamin woreda.

Marital status has positive and statistically significant ($p=0.079$) association with women's sanitation access in both panels at a 10% level of significance. The variable meets the proportional odds assumption and thus has the same effect across the outcome levels. The positive logit coefficient of 0.773 for the variable indicates that a woman who is currently married is more likely to have a higher level of sanitation access compared to a woman who is not, holding all other variables constant.

Participation in women's health development team has positive and statistically significant ($p=0.022$) association with women's sanitation access at 5% level of significance. The positive log coefficient 1.094 for the variable indicates that a woman who takes part in women's health development team is more likely to have medium or high sanitation access than a woman who does not participate in the team.

Occupation of the respondent has positive and statistically significant ($p=0.000$) association with women's sanitation access at 1% level of significance in the second panel. The positive logit coefficient 1.509 for the variable indicates that a woman whose main occupation is non-farm only or nonfarm and farm plus is more likely to have high sanitation access than a woman whose occupation is farm only.

Household income has positive and statistically significant association on women's level of sanitation access. The positive logit coefficient 0.997 for the variable in the second panel indicates that a woman whose household annual income ranges from 20,000-45,000 birr is more likely to have high sanitation access than a respondent whose household annual income is less than or equal to 20,000 birr. The positive logit coefficient of 0.945 for the same variable indicates that the probability of having high sanitation access increases for a woman whose household annual income is equal to or greater than 45,000 birr compared to a woman whose household annual income is less than 20,000 birr.

Wealth in its middle quantile has positive and statistically significant ($p=0.084$) association with women's level of sanitation access. The positive logit coefficient 1.050 for the variable wealth in the first panel indicates that the probability of having either medium or high sanitation access increases for a respondent whose household wealth status is at the middle quantile compared to a respondent whose household wealth status is at the first quantile.

Frequency of health extension contact has positive and statistically significant ($p=0.000$) association with women's level of sanitation access. The variable meets the proportional odds assumption and thus has the same effect across the outcome levels. The positive logit coefficient of 0.540 for the variable in both panels indicate that as the number of health extension contact increases by one day from the mean ($\bar{x}=3.11$), the probability of having high sanitation access also increases. More specifically, as the number of health extension contact increases by one day from the mean, the level of having high sanitation access increases by a factor of 1.717.

Household size has positive and statistically significant ($p=0.005$) association with women's sanitation access level. The variable meets the proportional odds assumption and thus has the same effect across the outcome categories. The positive logit coefficient of 0.386 for the variable indicates that as household size increases by one unit from the mean ($\bar{x}=3.96$), the probability of having high sanitation access also increases. More specifically, as household size increases by 1 unit from the mean, the level of having high sanitation access increases by a factor of 1.472.

Dependency ratio has negative and statistically significant ($p=0.034$) association with women's sanitation access in the second panel. The negative logit coefficient of -0.005 for the variable indicates that as dependency ratio increases by one percent from the mean ($\bar{x}=80.73\%$), the probability of having high sanitation access decreases by a factor of 0.995 or 1.

Log likelihood ratio test at the bottom of the table evaluates model fit in partial proportional odds model. According to Liu (2016), log likelihood ratio test is a goodness of fit measure in partial proportional odds model and is used to test the overall fit of the model. The log likelihood ratio test is done by comparing the log likelihood of the full model with all the independent variables included with the intercept only model with no independent variable. A significant likelihood ratio chi-square test indicates that the full model rather than the intercept only or reduced model is preferred. Accordingly, likelihood ratio chi-square test (LR χ^2 (27)) of 209.432 with a

significant p-value of 0.0000) at the bottom of the table shows that the partial proportional odds model with all the independent variables are included has provided a better overall model fit than the null model with no independent variables. Pseudo R^2 at the bottom of the table also shows the predictive power of the generalized ordered logistic regression model used to analyze the data. Predictive power of a model is helpful to measure the extent the model can predict/explain the dependent variable based on the independent variables (Agresti & Tarantola, 2018). The coefficient of determination R^2 also known as the squared multiple correlations (R^2) is a single agreed up on measure of predictive power for Ordinary Least Square (OLS) linear regression model (Cohen, Cohen, West & Aiken, 2003; Draper & Smith, 1998 cited in Hu, Shao & Palta, 2006). However, an equivalent statistics to determination R^2 does not exist when analyzing data with a logistic regression, rather there are several Pseudo R^2 's namely McFadden, Cox-Snell, Cragg-Uhler, Count and Count (adjusted) which corresponds to the determination R^2 (Schreiber-Gregory, 2017; Green & Hensher, 2008). Although, there are several Pseudo R^2 's in non-linear regression models, there is still confusion about which pseudo R^2 is superior to the other to determine the model that has better predictive power. However, Allison (2014) and Smith & McKenna (2013) stated that McFadden's R^2 is a better choice as it is the equivalent term for determination R^2 . According to McFadden (1974) and Louviere et al. (2000) as cited in Smith & McKenna (2013), McFadden values of between 0.2 and 0.4 should be taken to represent a very good fit of the model. Hu, Shao & Palta (2006), also stated that Pseudo R^2 with zero indicates a model with no predictive value further showing that the independent and dependent variables are independent or there is no association with the outcome while Pseudo R^2 with one indicates a perfect fit. In line with this recommendation, McFadden R-square value of 0.261 indicates that the partial proportional odds model that is used to analyze the data is acceptable and has provided better improvement in the log likelihood by the addition of variables in the model to null or constant only model. In other words, the result indicates that PPOM provides 26% of improvement in fit over the null model.

Table 25: Factors that determine women's sanitation access (Generalized Ordered Logit Estimates)

Sanitation Access		Panel 1				Panel 2			
		Low Vs Medium & High Access				Low & Medium Vs High Access			
Variables		Coeff.	Std. Err.	OR	P>z	Coeff.	Std. Err	OR	P>z
Woreda	Gozamin	- 1.9255	.6073	.1458	0.002 ***	-.2457	.3856	.7821	0.524
Climate	Woina dega	-.2794	.2525	.7563	0.269	-.2794	.2525	.7563	0.269
Age	middle adult	-.0839	.4679	.9195	0.858	-.0839	.4679	.9195	0.858
	Adult	-.8186	.6285	.4410	0.193	-.8187	.6285	.4410	0.193
	Old	.5459	.7038	1.7262	0.438	.5459	.7038	1.7262	0.438
Marital status	currently married	.7729	.4400	2.1660	0.079 *	.7729	.4400	2.1660	0.079 *
Own education	primary	.4135	.3196	1.5121	0.196	.4135	.3196	1.5121	0.196
	secondary & above	-.0180	.6452	.9821	0.978	-.0180	.6452	.9821	0.978
Own Occupation	non-farm only or farm plus	-.1905	.5075	.8265	0.707	1.5097	.3880	4.5254	0.000 ** *
Home plot Ownership	Not owned	-.3686	.4204	.6917	0.381	-.3686	.4204	.6917	0.381
Household Income	20000.01 - 45000.00	.1302	.3939	1.1390	0.741	.9971	.3798	2.7103	0.009 ***
	≥45000.01	.9448	.4432	2.5725	0.033 **	.9449	.4432	2.5725	0.033 **
Wealth quantile	Second	.1576	.3932	1.1708	0.688	.1576	.3932	1.1708	0.688
	Middle	1.0504	.6078	2.8587	0.084 *	-.7842	.5246	.4565	0.135
	Fourth	-.0908	.4966	.9132	0.855	-.0908	.4966	.9132	0.855
	Highest	-.5763	.5535	.5620	0.298	-.5763	.5534	.5619	.2980
Health Info Access	Yes	-.5568	.5401	.5731	0.303	-.5568	.5402	.5731	0.303
Participation in WHDA	Yes	1.0941	.4792	2.9865	0.022 **	.1039	.3109	1.1095	0.738
Frequency of health extension contact		.5406	.1081	1.7170	0.000 ***	.5406	.1081	1.7169	.000 ***
Household size		.3866	.1368	1.4720	0.005 **	.3866	.1368	1.4720	.005 **
Dependency ratio		.0031	.0028	1.0030	0.270	-.0053	.0025	.9947	0.034 **
_cons		-.3422	.9354	.7102	0.714	-3.7647	.9078	.02318	0.000
Log likelihood= -296.11047; N= 380; LR chi2 (27)= 209.43; Prob > chi2= 0.0000;Pseudo R ² =0.261									
Note: significance at the *10%, ** 5% and *** 1% level. OR= odds ratio									
For the dichotomous and polytomous (takes more than two values) independent variables, one of the categories is left out as benchmark/ base/ reference category and the rest of them are used as an explanatory variable in the model. Therefore, each estimated coefficient shows the effect of the observable category relative to the base/reference category. The base values are not shown in the table.									

5.1.1 Marginal Effects of Independent Variables on Sanitation Access

Table 28 below presents the average marginal effect result of the generalized ordered logit model. The results indicate that the variable *woreda* has positive and statistically significant effect on sanitation access at low sanitation access category and has negative and statistically significant effect at medium sanitation access category. The variable has the largest magnitude of marginal effect ($dy/dx=0.189$) at low sanitation access category than at medium sanitation access category ($dy/dx= -0.147$). On an all other things being equal basis, the marginal effect for the variable *woreda* shows that a respondent living in Gozamin *woreda* is on average, 18.9% more likely to have low sanitation access and 14.7 % less likely to have medium sanitation access than a respondent living in Machakel *woreda*. In other words, the probability of having low sanitation access is 18.9% more or greater for a respondent living in Gozamin *woreda* compared to a respondent living in Machakel *woreda* and the probability of having medium sanitation access is, on average, 15% lower for a respondent living in Gozamin *woreda* than a respondent living in Machakel *woreda*. During discussions held with *woreda* health extension program coordinators to analyze the differences between the results in the two areas, it was suggested that the active engagement of the health extension workers in promoting the sanitation related information and technologies, the presence of NGOs like UNICEF and strong collaborative work between the health extension agents and other sectors (education and agriculture) in Machakel *woreda* might have brought disparities in respondents' level of sanitation access among the two *woredas*. It was also learnt that Machakel *woreda* is selected as a pilot district for promotion of sanitation marketing and this might have contributed for respondents from this *woreda* to have better sanitation access than respondents from Gozamin *woreda*.

The variable *marital status* has negative and statistically significant effect on sanitation access at medium sanitation access category and has positive and statistically significant effect at high sanitation access category. The variable has the smallest magnitude of marginal effect ($dy/dx= -0.031$) at medium sanitation access category than at high sanitation access category ($dy/dx= 0.124$). The result indicates that a woman who is currently married is more likely to have higher level of sanitation access than a woman who is not currently married. The result further indicates that the probability of having medium sanitation access is on average, 3% lower for currently married respondents than currently not-married respondents. Conversely, the probability of

having high sanitation access is on average, 12.4% higher for currently married respondents compared to currently not married respondents. As expected, sanitation facilities such as latrine and presence of separate dwelling for people and animals need the contribution of family resources such as labor and income. Currently not married respondents may lack such resources and thus has lower sanitation access compared with currently married respondents. During the qualitative interview, lack of labor has been identified time and again as a significant constraint for building latrine and separate dwelling for people and animals. This finding also agrees with a qualitative finding obtained by Routray, Schmidt, Boisson, Clasen & Jenkins (2015) in India where by marital status has contributed for latrine ownership. In their study, Routray and his colleagues have found that men head of households were able to construct latrine as they do not want their daughter in laws to be seen by other men defecating in open fields.

Participation in women health development team has negative and statistically significant effect on women's sanitation access at low sanitation access category and has positive and statistically significant effect at medium sanitation access category. The variable has slightly larger magnitude of marginal effect on sanitation access at low ($dy/dx = -0.112$) than at medium sanitation access category ($dy/dx = 0.095$). The result indicates that, holding all other variables constant, the probability of having low sanitation access is on; average 11.2 % lower for a respondent who participates in women health development team compared to a respondent who does not participate in the team. In other words, a respondent who does not participate in women health development team is more likely to have low sanitation access than a respondent who participates. Conversely, the probability of having medium sanitation access is on average 9.5% higher for a respondent who participates in women health development team than a respondent who does not participate. Women health development team is the main platform for the delivery of the rural health extension messages and information. Participation in this group facilitates women's linkage with their own neighbors, with health extension workers and with other stakeholders which in turn enables them to share information, skill and experience and ultimately helps sanitation technology adoption. Women will be influenced by other women within their team. If some health development team members obtain a latrine or waste disposal pit, other members in the group will be encouraged. Status-wise, they do not want to be seen behind their group members. This result is consistent with Routray et al. (2015) finding in India where women's participation in self-help group was found to help them install latrines.

Occupation has negative and statistically significant effect on women's sanitation access at medium sanitation access category and has positive and statistically significant effect at high sanitation access category. The variable has the largest magnitude of marginal effect on sanitation access at medium ($dy/dx = -0.306$) and high sanitation access categories ($dy/dx = 0.284$). The result indicates that, holding all other variables constant, the probability of having medium sanitation access is, on average, 30.6% lower for a respondent whose occupation is nonfarm only or farm plus compared to a respondent whose occupation is farm only. Conversely, the probability of having high sanitation access is on average, 28.4 % higher for a respondent whose occupation is nonfarm only or farm plus compared to a respondent whose occupation is farm only. This finding corresponds with a study finding conducted in Ghana by Osumanu, Kosoe & Ategeeng (2019) where households whose heads were engaged in farming had a lower probability of constructing latrine since they spent most of their time in agricultural fields.

Income has negative and statistically significant effect on women's sanitation access at low and medium category and has positive and statistically significant effect at high sanitation access category. The result indicates that, holding all other variables constant, the probability of having medium sanitation access is, on average 14.5% lower for a respondent whose household gross annual income is between 20,000-45,000 birr compared to a respondent whose household gross annual income is less than or equal to 20,000 birr. Conversely, the probability of having high sanitation access is on average, 16% more for a respondent whose household gross annual income is between 20,000-45,000 birr compared to a respondent whose household annual income is less than or equal to 20,000 birr. The probability of having low sanitation access is, on average, 10% lower for a respondent whose household gross annual income is more than 45,000 birr compared to a respondent whose household annual income is less than or equal to 20,000 birr. The probability of having medium sanitation access is, on average, 5 % lower for a respondent whose household gross annual income is more than 45,000 birr compared to a respondent whose household annual income is less than or equal to 20,000 birr. The probability of having high sanitation access is, on average, 15% higher for a respondent whose household gross annual income is more than 45,000 birr compared to a respondent whose household annual income is less than or equal to 20,000 birr. In sum this finding indicates that respondents with lower levels of income are less likely to have high sanitation access. This result agrees with the finding of Osumanu, Kosoe & Ategeeng (2019) that respondents with lower levels of income

were 34.3% less likely to own toilet facilities. The result is also in harmony with a finding by Worku & Semahegn (2013) where they observed that households who had relatively better income were found to have better access to latrine than households who had relatively low income.

Wealth has negative and statistically significant effect on women's sanitation access at low category ($dy/dx = -0.101$; $p = 0.076$) and has positive and statistically significant effect at medium sanitation access category ($dy/dx = 0.228$; $p = 0.000$). The result implies that, holding all other variables constant, the probability of having low sanitation access is on average, 10% lower for a respondent in the middle wealth quantile compared to a respondent in the first quantile. The probability of having medium sanitation access is on average, 22.8 % higher for a respondent in the middle wealth quantile compared to a respondent in the first quantile. This can be explained by the fact that having better wealth increases the ability to pay for the technologies and facilities. Sanitation technologies in rural areas are not provided by the local authority or government. Households are responsible to have their own sanitation facilities through their own means; making them pay for the labor and input materials. Thus, having better wealth status increases the probability of paying for such facilities. This finding is in agreement with Armah et al. (2018) study in sub-Saharan Africa that rural middle wealth quantile households were more likely to have access to improved sanitation facilities and rural poor households were 6.6 percent less likely to have access to improved sanitation facilities compared to urban poor households. Though their study has compared rural against urban households, they found that middle wealth quantile households in rural areas have better sanitation access than urban poor. A similar study conducted by Gross and Gunther (2014) also shows that a 10% increase in the asset index has contributed for a 3% increase in latrine ownership in rural Benin. Furthermore, Sbrana (2009) study on the determinants of water and sanitation achievements in Yemen found that wealth has a strong and significant positive impact on the probability of having access to improved sanitation.

Frequency of health extension contact has negative and statistically significant effect on sanitation access at low ($dy/dx = -0.060$; $p = 0.000$) and medium sanitation access categories ($dy/dx = -0.030$; $p = 0.000$) and has positive and statistically significant effect at high sanitation access category ($dy/dx = 0.090$; $p = 0.000$). The result indicates that holding all other variables

constant, the probability of having low sanitation access is on average, 6% lower for a one day change in the frequency of health extension contact. The probability of having medium sanitation access is on average, 3% lower for a one day change in the frequency of health extension contact and the probability of having high sanitation access is on average, 9 % higher for a one day change in frequency of health extension contact. In sum, the result shows that as the number of health extension contacts increases by one day from the mean (3.11), the probability of having high sanitation access also increases. Health extension workers are expected to facilitate sanitation promotion at the local level by presenting health packages to the community. Thus, the numbers of contacts they have made with the residents or the numbers of contacts residents have made with health extension agents has better contribution for having high sanitation access. This finding is in agreement with a study by Nigatu et al. (2011) who found that households who had more contact with health extension workers were found to have more access to sanitation and hygiene related messages than households who didn't contact health extension workers.

Household size has negative and statistically significant effect on women's sanitation access at low and medium category and has positive and statistically significant effect at high sanitation access category. The result indicates that, holding all other variables constant, the probability of having low sanitation access is on average, 4.3% lower for a one unit change in household size from the mean (mean=3.96). Similarly, the probability of having medium sanitation access is on average 2% lower for a one unit change in household size from the mean and the probability of having high sanitation access is on average 6.4% higher for a one unit change in household size from the mean. In other words, as household size increases by one unit from the mean, the probability of having high sanitation access also increases. Along with our expectation, the likelihood of sanitation technology adoption increases with the availability of labor. Large households are more likely to adopt sanitation technologies as this would mean sharing labor and family resource. This result is in agreement with a study carried out by Nyanza et al. (2018) which revealed that households with more members had higher odds of owning a sanitation facility than smaller sized households. The result is however in contrary with Gross & Gunther (2014) finding that household size was not found to have significant association with latrine ownership.

Dependency ratio has positive and statistically significant effect on sanitation access at medium sanitation access category and has negative and statistically significant effect at high sanitation access category. The variable has the smallest magnitude of marginal effect on sanitation access at high ($dy/dx = -0.001$) and medium sanitation access categories ($dy/dx = 0.001$). The result further indicates that the probability of having medium sanitation access is on average, 0.1% points higher for a small change in dependency ratio. Conversely, the probability of having high sanitation access is on average, 0.1% lower for a small change in dependency ratio indicating sanitation access declines with dependency ratio. As dependency ratio increases up to a certain level, having medium sanitation access increases; and after a certain level as dependency ratio further increases, having high sanitation access decreases. As expected, high dependency ratio means children and old members of the household will become dependents on the productive member of the household. Thus, the productive member of the family will be vested in fulfilling other consumption needs and run short of labor to adopt sanitation technologies. Besides, as dependency ratio increases, household consumption also increase which in turn affects sanitation related investment.

Table 26: Marginal Effects of the independent variables on Women's Sanitation Access

Sanitation Access		Low Access			Medium Access			High Access		
Variables		dy/dx	Delta-method Std. Err.	P>z	dy/dx	Delta-method Std. Err.	P>z	dy/dx	Delta-method Std. Err.	P>z
Woreda	Gozamin	0.189	0.046	0.000***	-0.147	0.066	0.026**	-0.042	0.068	0.537
Climate	Woinadega	0.030	0.027	0.262	0.016	0.016	0.299	-0.047	0.043	0.272
Age	Middle adult	0.008	0.047	0.856	0.006	0.032	0.860	-0.014	0.078	0.858
	Adult	0.092	0.065	0.159	0.040	0.037	0.291	-0.132	0.101	0.194
	Old	-0.049	0.065	0.448	-0.043	0.055	0.429	0.093	0.119	0.437
Marital status	Currently married	-0.093	0.057	0.100	-0.031	0.013	0.021**	0.124	0.067	0.064*
Own education	Primary	-0.044	0.033	0.177	-0.025	0.022	0.247	0.069	0.054	0.199
	Secondary & Above	0.002	0.074	0.978	0.001	0.032	0.978	-0.003	0.106	0.978
Own occupation	Non-farm only or farm plus	0.021	0.057	0.709	-0.306	0.074	0.000***	0.284	0.074	0.000***
home plot ownership	Not owned	0.042	0.049	0.391	0.019	0.020	0.350	-0.061	0.068	0.376
Household annual income in birr	20,000.01-45,000	-0.016	0.048	0.743	-0.145	0.048	0.003***	0.161	0.058	0.005***
	≥45,000.01	-0.101	0.049	0.037**	-0.051	0.025	0.043**	0.152	0.070	0.029**
Wealth	Second	-0.018	0.045	0.691	-0.009	0.022	0.686	0.027	0.067	0.689
	Middle	-0.101	0.057	0.076*	0.228	0.061	0.000***	-0.127	0.084	0.128
	Fourth	0.011	0.058	0.854	0.005	0.026	0.856	-0.015	0.084	0.855
	Highest	0.071	0.067	0.287	0.023	0.024	0.325	-0.095	0.090	0.290
Health info access	Yes	0.056	0.049	0.257	0.037	0.041	0.362	-0.093	0.090	0.300
Participation in WHDA	Yes	-0.112	0.043	0.008*	0.095	0.055	0.086*	0.017	0.052	0.740
Frequency of health extension contact		-0.060	0.012	0.000***	-0.030	0.007	0.000***	0.090	0.016	0.000***
Household size		-0.043	0.015	0.004***	-0.021	0.008	0.010**	0.064	0.022	0.004***
Dependency ratio		0.000	0.000	0.264	0.001	0.000	0.001***	-0.001	0.000	0.031**

Note: dy/dx for factor levels is the discrete change from the base level. Significance at the *10%, ** 5% and *** 1% level.

5.1.2 Model Fit Measures

In the previous sections, the generalized ordered logistic regression coefficients, and marginal effects are examined. In this section, model fit measures are tested. Model fit measures help to know whether the model used to analyze the data is a good model or not. Different statistics are used to evaluate model fit in partial proportional odds model such as log likelihood ratio test, AIC, BIC and pseudo R^2 (Liu, 2016; Long & Freese, 2001; Peterson & Harrell, 1990). These different types of model fit measures are however used to test different things. Some are used to test goodness of fit of the model (log likelihood ratio test, AIC, BIC) while others are used to test the predictive power of independent variables in the model (pseudo R^2) (Allison, 2014).

Goodness of fit statistics tests how well the model fits with the observed data (Agresti & Tarantola, 2018; Guffey, 2012; Agresti, 2007; Maydeu-Olivares & Garcia-Forero, 2010) and there is no single agreed upon goodness of fit measure for partial proportional odds model (Lee, 2013). Different scholars have provided different kinds of goodness of fit tests. Some goodness of fit tests are used to measure the overall goodness of fit of the model (log likelihood ratio test) while others are used to statistically compare two models to identify the best fitting model (AIC, BIC). Thus, the overall model fit statistics at the bottom of table 25 above shows that the partial proportional odds model has fitted the data well than the intercept only model ((LR chi2 (27)) = 209.432, $p = 0.0000$). However, according to Maydeu-Olivares & Garcia-Forero (2010), overall model fit test alone is not sufficient to test the goodness of fit of partial proportional odds model because a model fits well overall may fit poorly with some parts of the data. Thus, Maydeu-Olivares & Garcia-Forero (2010) recommends the approach of comparing a working model to a more complex model as more useful to test goodness of fit of a model than using overall fit test. Researchers are advised to examine not only the overall fit of their model, but also perform a goodness of fit indices. The two most popular goodness of fit indices according to Allison (2014), Dziak, Coffman, Lanza & Li (2012) and Williams (2019) are Akaike information criterion (AIC) and the Bayesian information criterion (BIC). AIC and BIC goodness of fit measures are used to compare alternative or competing models fitted to the same data sets (Williams, 2019). All else being equal, a model with a lower information criterion is considered as the better fitting model (Williams, 2019, Fabozzi, Focard, Rachev & Arshanapalli, 2014).

Thus, as can be seen from table 27 below, both AIC and BIC for all models which the researcher believes are alternative models to analyze categorical dependent variable are computed. The information criteria test result shows that multinomial logistic regression (mlogit) (which is one of the competing models) has the smallest AIC than the generalized ordered logistic regression model or partial proportional odds model (PPOM) (the candidate/working model) and ordered logistic regression model/ proportional odds model (POM) (which is another competing model). On the contrary, PPOM has the smallest BIC compared to the two competing models. Despite the fact that some literatures advice to use both AIC and BIC together, these different information criteria often do not agree and the question often arises as to which is best to use in practice. In some situations AIC is preferred over BIC and in others BIC is preferred over AIC. When criteria conflicts, Dziak, Coffman, Lanza & Li (2012) recommended going with what

seems most important in a given situation (cited in Williams, 2016). In line with this reference, BIC is considered relevant for this context because partial proportional odds model has the smallest BIC compared to the other two alternative models. The smallest BIC in PPOM indicates that partial proportional odds model is the best fitting model. How much one model is preferred over the other depends on the magnitude of the difference between the AIC and BICs of different models. Literature indicates that if the size of the difference in BIC between two models ranges between 0-2, there is weak evidence about which model better fits. However, if the difference among the BIC of the different models is between 2-6, there is positive evidence about which model better fits (Raftery, 1995). Thus, the difference among the BIC of PPOM and ologit is 7.95 indicating that there is strong evidence that PPOM fits the data better than ologit. Similarly, the difference among the BIC of PPOM and mlogit is 54.84 indicating that there is strong evidence that PPOM fits better than mlogit. If mlogit has been chosen for its smallest AIC, the outcome variable should have been non-ordinal or nominal. Since the outcome variable is truly ordinal, ordinal response models such as partial proportional odds model has to be used.

In sum, both the overall fit test and goodness of fit indices show that partial proportional odds model is the best model that has fitted well with the observed data. As stated above, model fit measures also include test of the predictive power of the model used to analyze the data. Predictive power of a model is helpful to measure the extent the model can predict/explain the dependent variable based on the independent variables (Agresti & Tarantola, 2018). McFadden R-squares of value of 0.261 in table 25 above indicates that partial proportional odds model used to analyze the data has better predictive power of the independent variables in explaining the outcome variable sanitation access and better model fit. In sum, all the goodness of fit tests and predictive power measures indicate that partial proportional odds model fits well with the data.

Table 27: Goodness of Fit Test

Model			Gologit2	Ologit	Mlogit
Goodness of fit indices	IC	AIC	650.221	681.809	645.96
		AIC divided by N	1.711	1.794	1.700
		BIC	(df=29)=764.486	(df=23)=772.433	(df=44)= 819.328

Source: Stata computation

5.1.3 Model Specification Test

Model specification test tests if the statistical model used to analyze the data is correctly specified or not. Theoretically, model specification consists of selecting an appropriate functional form for the model and choosing which variables to include or exclude. Model specification test is important because model misspecification will bring either under fitting (omitting relevant variables) or overfitting (including unnecessary variables) of the model (Gujarati, 2004). Model specification test, thus, helps to identify if relevant variable(s) are omitted from the model, if an unnecessary variable (s) are included in the model and if the correct functional form of the model is used or not.

Literature has provided different kinds of model specification tests that could help to determine if the best regression model is chosen and whether model specification errors are not commit. However, the different recommended model specification tests are applied differently depending on the type of the econometric model used. For instance, according to Gujarati (2004), F-test and T-test are used to detect the presence of an irrelevant variable (or variables) while examining residuals will help in detecting the presence of omitted variables and incorrect functional form in linear regression model. Ramsey Regression Equation Specification Error Test (RESET) is also used to test if there is a specification error in linear regression model. That is, RESET test tests whether there is a non-linear combination of the independent variables to explain the response variable in linear regression models (Ramsey, 1969).

There is limited evidence in the literature regarding model specification tests for generalized ordered logit models. Only Pregibon (1980) has suggested the use of link test to detect model specification errors in partial proportional odds model. Link test uses the linear predicted value ($\hat{\mu}$) and linear predicted value squared ($\hat{\mu}^2$) as the predictors to rebuild the model. As the literature indicates, the variable $\hat{\mu}$ should be statistically significant predictor, while the variable $\hat{\mu}^2$ shouldn't have much predictive power except by chance and hence should not be significant. Significant link test $\hat{\mu}^2$ indicates the presence of model specification error. Thus, the result in table 28 below shows that $\hat{\mu}^2$ in both low ($p=0.364$) and medium sanitation access ($p=0.123$) is not significant. Conversely, $\hat{\mu}$ in both low and medium sanitation access is significant indicating that appropriate functional form for the partial proportional odds model is

selected and all variables that need to be included in the model are chosen correctly and there is no model specification problem.

Table 28: Model Specification Test (link test of the Partial Proportional Odds Model)

Sanitation Access		Coef.	Std. Err.	Z	P>z	[95% Conf.	Interval]
Low	_hat	.9161116	.205006	4.47	0.000	.5143073	1.317916
	_hatsq	.0752797	.0828489	0.91	0.364	-.0871012	.2376606
	_cons	-.0904051	.1851079	-0.49	0.625	-.4532099	.2723997
Medium	_hat	.7638412	.1757098	4.35	0.000	.4194563	1.108226
	_hatsq	-.0447009	.0290105	-1.54	0.123	-.1015605	.0121586
	_cons	-1.734338	.2493148	-6.96	0.000	-2.222987	-1.24569
Log likelihood = -323.36088; N = 380; LR chi2 (4)					=154.93; Prob > chi2=0.0000;		
Pseudo R2=0.1933							

5.2 Determinants of Women's Sanitation Utilization

Women's level of sanitation utilization is measured by their utilization of latrine and solid and liquid waste disposal practices as explained back in the descriptive analysis section. Given that women's sanitation utilization is influenced by different factors, this section examines if there is statistically significant association between the different factors and women's level of sanitation practice.

The outcome women's sanitation utilization is treated as ordinal variable under the assumption that the level of sanitation utilization has a natural ordering as low, medium and high and ordered logistic regression model (ologit) also known as proportional odds model is used to estimate the association between an ordinal dependent variable, sanitation utilization and a set of independent variables. Table 29 presents the results of the proportional odds model and identify factors that determine women's sanitation practice.

The result indicates that the variable household size has negative and statistically significant association with women's level of sanitation utilization at 5% level of significance. The estimated logit coefficient ($\beta=-0.2562$; with $p=0.048$) for the variable indicates that for a one unit

increase in household size from the mean ($\bar{x}=3.96$), the odds of having medium and high sanitation utilization decreases and the odds/probability of having low sanitation utilization increases.

The variable sanitation access has positive and statistically significant association with women's level of sanitation utilization at 1% level of significance. The positive logit coefficient for the variable ($\beta= 3.8598$) indicates that a woman who has high level of sanitation access is more likely to have better sanitation utilization (either medium or high) than a woman who has low level of sanitation access. The researcher suspected a risk of endogeneity problem by including sanitation access as one of the independent variables. Sanitation utilization can be determined by different observed and unobserved factors. For instance, cultural and attitudinal factors, technology related factors and the characteristics of service providers such as the age, educational status, and other personal and professional characteristics of health extension workers which may be a fundamental determinant of sanitation utilization were not considered in this study. Similarly, income and wealth which can influence sanitation utilization indirectly through sanitation access were observed but not included in our model. These kinds of unobserved factors that can influence people's utilization of sanitation services are known as error terms. And, when a variable, observed or unobserved, which is not included in the model, is related to a variable incorporated in the model, there will be an endogeneity problem (Pinzón, 2016). Sanitation access is one variable that can determine people's utilization of sanitation facilities. However, sanitation access by itself is determined by other variables such as income and wealth indicating that the value of sanitation access variable is dependent on the value of other independent variables. Sørensen (2012) stated that when the value of one independent variable is dependent on the value of other independent variables, there could be endogeneity problem. Thus, the researcher suspected that there might be endogeneity problem between the independent variable; sanitation access and other unobserved variables such as income & wealth. Thus, two stage residual inclusion (2SRI) method also known as control function method (Terzaa, Basub & Rathouz, 2008) is used to test if there is endogeneity problem in the model. However, the two stage residual inclusion (2SRI) test (an insignificant residual p-value of 0.708) shows that sanitation access is exogenous and there is no endogeneity problem.

The variable knowledge about the benefit of latrine utilization has positive and statistically significant association with women's level of sanitation utilization. The positive logit coefficient ($\beta = 1.3721$) indicates that a woman who has high self-reported knowledge about the benefit of latrine utilization is more likely to have better sanitation utilization than a woman who has low self-reported knowledge about the benefit of latrine utilization. On the contrary, knowledge about the sanitation messages promoted by the health extension agents has no statistically significant association with women's sanitation practice ($p=0.2150$).

Table 29: Determinants of Women's Sanitation Utilization (Estimate of proportional odds model)

variables	Sanitation Utilization	Coef.	Std. Err.	Odds Ratio	P>z
Woreda	Gozamin	.1106	.4138	1.1169	0.789
Climate	Woinadega	-.2153	.2644	.8063	0.415
Age	middle adult	0.7849	.5468	2.1923	0.151
	Adult	.5661	.5790	1.7613	0.328
	Old	-.1719	.6039	.8421	0.776
Marital Status	currently married	-.2469	.4169	.7812	0.554
Own Education	primary and above	-.2494	.3427	.7793	0.467
Own Occupation	non-farm only or farm plus	-.2328	.4059	.7923	0.566
Health info access	Yes	.9312	.6015	2.5376	0.122
Participation in WHDA	Yes	-.0725	.3181	.9300	0.820
Sanitation access	High	3.8598	.3221	47.4566	0.000***
K latrine benefit	high	1.3721	.2634	3.9437	0.000***
Recall	high	-.3428	0.196	.7098	0.215
Household Size		-.2562	.1294	.7740	0.048**
Frequency of health extension contact		.0490	.1057	1.0502	0.643
/cut1		2.1137	.8612	2.1137	
/cut2		4.1118	.8922	4.1118	
Log likelihood = -241.05622; N =380; LR chi2(15)=298.66; Prob > chi2=0.0000; Pseudo R2= 0.3825					
Note: significance at the ** 5% and *** 1% level.					

5.2.1. Marginal Effects of independent variables on Sanitation Utilization

According to Mize (2019) and Barron (2014), marginal effect tell how the dependent variable changes when an independent variable changes. Leeper (2018) also stated that marginal effect tells the marginal contribution of the independent variable to the dependent variable. Thus, the marginal effect of an independent variable is obtained by calculating the difference in the dependent variable sanitation utilization (Y) for a change in the independent variable X (Dy/Dx).

The results of the average marginal effects of each independent variable on the dependent variable are presented in table 29 below and show that the variable household size has positive and statistically significant effect on women's sanitation utilization at low category ($dy/dx=0.0280$; $p=0.048$) and has negative and statistically significant effect at high sanitation utilization category ($dy/dx=-0.0269$, $p=0.045$) at 5% level of significance. The result further shows that as household size increases by one unit from the mean ($\bar{X}=3.96$), the probability of having low sanitation utilization increases on average by 2.8 % while the probability of having high sanitation utilization decreases on average by 2.7 %.

The variable sanitation access has the largest marginal effect on women's sanitation utilization. The variable has negative and statistically significant effect at low sanitation utilization category ($dy/dx=-0.6797$, $p=0.000$) and has positive and statistically significant effect at medium and high sanitation utilization categories ($p=0.000$). The result further shows that on an all other things being equal basis, a respondent who has high level of sanitation access is on average, 68% less likely to have low sanitation utilization, 14 % more likely to have medium sanitation utilization and 54% more likely to have high sanitation utilization than a respondent who has low level of sanitation access. In relation with this, Dreibelbis et al. (2013) stated that access to enabling resources exert significant influence on people's sanitation behavior. Routray et al. (2015) in their study of socio-cultural and behavioral factors constraining latrine adoption in rural coastal Odisha also found that lack of access to a latrine was one of the reasons for people's practice of open defecation (OD) though it was not the primary reason. The finding also goes in line with the behavioral model of health service use hypothesis which stated that enabling factors such as the availability of health facilities is a determinant factor for people's utilization of health services. Sinha, Nagel, Schmidt, Torondel, Boisson & et al. (2017) also found that the presence of a latrine door and roof have significantly increased the likelihood of household members to

use latrine always, indicating how the presence of sanitation facilities has encouraged people's utilization of the same.

The variable knowledge about the benefit of latrine utilization has negative and statistically significant effect on women's sanitation utilization ($dy/dx=-0.1669$, $p=0.000$) at low sanitation utilization category and has positive and statistically significant effect at high sanitation utilization categories ($dy/dx=0.1561$, $p=0.000$). The negative sign at low sanitation utilization category indicates that a respondent who has high self-reported knowledge about the benefit of latrine utilization is 16.7 % less likely to have low sanitation utilization than a respondent who has poor self-reported knowledge about the same issue. The positive average marginal effect at high sanitation utilization category on the other hand indicates that a respondent who has high self-reported knowledge about the benefit of latrine utilization is 15.6% more likely to have high sanitation utilization than a respondent who has poor self-reported knowledge about the benefit of latrine utilization. The result is in agreement with the health belief model hypothesis which stated that if people believe that they are susceptible or are at risk for a disease, they will be ready to use health services. Besides, if people are aware of the usefulness of a new behavior in decreasing the risk of developing diseases, they will be more likely to practice a healthier behavior.

Women's knowledge of sanitation related message/s promoted by the health extension agents has no statistically significant effect on women's utilization of sanitation facilities. Knowledge about sanitation message/s promoted by the health extension agents is not enough to make people utilize the facilities. In its place, respondents' knowledge about the benefit of a specific sanitation technology such as latrine has effect on their sanitation practice or behavior.

Table 30: Marginal Effects of Independent Variables on Sanitation Utilization (Ordered logit estimate)

Sanitation Utilization		Low			Medium			High		
Variables		dy/dx	Delta-method SE	P>z	dy/dx	Delta-method SE	P>z	dy/dx	Delta-method SE	P>z
Woreda	Gozamin	-.0121	.0453	.7900	.0004	0.0017	.7980	.0116	.0435	.7900
Climate	Woinadega	.0236	.0289	.4160	-.0010	0.0018	.5560	-.0225	.0275	.4130
Age	Middle Adult	-.0861	.0583	.1400	.0041	.0048	.3970	.0819	.0569	.1490
	Adult	-.0610	.0049	.3200	.0017	.0035	.6190	.0593	.0606	.3270
	Old	.0177	.0625	.7770	.0002	.0013	.8840	-.0179	.0629	.7760
Marital Status	Currently married	.0275	.0472	.5610	-.0015	.0037	.6730	-.0259	.0436	.5530
Own education	Primary& Above	.0268	.0362	.4600	-.0006	.0014	.6360	-.0261	.0358	.4650
Own Occupation	Non-farm only or farm plus	.0254	0.0443	.5660	-.0009	0.0018	.6240	-.0245	.0428	.5670
Health info access	Yes	-.0970	.0611	.1130	-.0015	0.0062	.8000	.0986	.0618	.1100
Participation in WHDA	Yes	.0079	0.0346	.8190	-.0003	0.0013	.8160	-.0076	.0333	.8190
Sanitation access	High	-.6797	.0386	.0000***	0.1421	.0326	.0000***	.5376	.0398	.0000***
Klatrine benefits	High	-.1669	.0347	.0000***	.0107	.0094	.2550	.1561	.0289	.0000***
Knowledge of sanitation messages promoted	High	.0361	.0281	.1990	-.0007	.0018	.7120	-.0354	.0281	.2060
Household size		.0280	0.0141	.0480**	-.0011	0.0014	.4370	-.0269	.0134	.0450**
Frequency of health extension contact		-.0054	.0115	.6430	.0002	.0005	.6810	.0051	.0111	.6430
Note: dy/dx for factor levels is the discrete change from the base level (discrete change of dummy variable from 0 to 1) Significance at the *10%, ** 5% and *** 1% level.										

5.2.2 Model Fit Measures

Similar to the model fit measures in partial proportional odds model discussed in section 5.1.2 above, proportional odds or ordered logistic regression model uses log likelihood ratio test, pseudo R^2 , Akaike's Information Criteria (AIC) and Bayesian Information Criterion (BIC) statistics to evaluate model fit (Liu, 2016). Log likelihood ratio test is used to test the overall goodness of fit of the model while pseudo R^2 is used to test the predictive power of independent variables in the model or how well we can predict/explain the dependent variable based on the independent variable (Agresti & Tarantola, 2018). Akaike's Information Criteria (AIC) and Bayesian Information Criterion (BIC) are used to statistically compare two models to identify the best fitting model.

Log likelihood ratio test is done by comparing the log likelihood of the full model with all the independent variables included with the intercept only model with no independent variable included. A significant likelihood ratio chi-square test indicates that the full model rather than the intercept only or reduced model is preferred (Liu, 2016). Accordingly, the likelihood ratio chi-square test (LR χ^2 (15) of 298.66 with a p-value of 0.0000 at the bottom of table 29 above signifies that the ordered logit model as a whole is statistically significant, compared to the null/intercept only model with no independent variable. That is, the full model with all the independent variables has provided a better overall model fit than the null model with no independent variables. Though our overall model fit statistics shows that our model has fitted the data well than the intercept only model, overall model fit is not sufficient to test the goodness of fit of a model. Therefore, the approach of comparing a working model to a more complex model as recommended by Maydeu-Olivares & Garcia-Forero (2010) to measure goodness of fit of a model is done using goodness of fit indices. As can be seen from table 30 below, AIC and BIC for both proportional odds model (the candidate model) and multinomial logit model (which the researcher believes is a competent model) are computed. Williams (2016) has advised to use AIC and BIC together. However, these different information criterion often do not agree and the question always arises as to which is best to use in practice. In some situations AIC is preferred over BIC and in others BIC is preferred over AIC. When criteria conflicts, Dziak, Coffman, Lanza, and Li (2012) recommend going with what seems most important in a given situation. In this context however, the information criteria test shows that proportional odds model (POM) has

the smallest AIC and BIC than multinomial logistic regression model indicating proportional odds model has fitted the data better than multinomial logistic regression model.

Table 31: Goodness of Fit Test by Information Criteria

Model			ologit	mlogit
Goodness of fit indices	IC	AIC	516.112	536.371
		AIC divided by N	1.358	1.412
		BIC	(df=17)=583.095	(df=32)= 662.456

Source: Stata computation

Lee (2013), Fagerland & Hosmer (2012) has also provided three methods to test for goodness of fit of proportional odds model. These are the ordinal version of the Hosmer–Lemeshow test, the Lipsitz test and the Pulkstenis and Robinson tests. Pulkstenis and Robinson (PR) have two test statistics (the Pearson χ^2 and deviance test statistics) (Pulkstenis & Robinson, 2004). However, Pearson chi square and deviance tests are not appropriate when continuous independent variables are present (Hosmer & Lemeshow, 2000 cited in Pulkstenis & Robinson, 2004). Pulkstenis and Robinson tests work if only categorical independent variables are present (Lee, 2013). Since the data in this study has both continuous and categorical independent variables and Pulkstenis and Robinson chi-squared tests are not appropriate for continuous independent variables, Pulkstenis and Robinson chi-squared tests of goodness of fit were rejected and only the ordinal version of the Hosmer–Lemeshow and the Lipsitz test as presented in table 32 below are used. The resulted non-significant p- value for both Hosmer–Lemeshow test and the Lipsitz tests indicate that there is evidence of good model fit. The goodness of fit assessment stops with a goodness of fit test that has $p > 0.05$ (Pulkstenis & Robinson, 2004).

Table 32: Goodness of Fit Test using Hosmer–Lemeshow test

Tests	Number of groups/patterns	Statistic	df	P- value
Ordinal HL	10	25.455	17	0.0850
Lipsitz	10	10.281	9	0.3282
(HL = Hosmer-Lemeshow)				

Source: Stata Computation

5.2.3 Model Specification Test

Specification tests for the ordered choice model are obtained essentially for two issues, functional form and distribution. The functional form question is related to the assumption about the basic model specification or whether the appropriate functional form of the model is used or not while the distributional tests are specifically directed to the question of whether normality (or logistically) is appropriate ((Davidson & MacKinnon, 1984, p. 114). Literature has provided different kinds of model specification tests for ordered logit models that could help to determine if model specification errors are not committed. However, there is confusion regarding model specification tests and model fit measures. For instance, Lagrange multiplier test/score test, likelihood ratio test and Wald test are mentioned by Weiss (1997) as model fit measures while Long & Freese (2001) have mentioned them as model specification measures. A model fit measure is, however, different from model specification test. Model fit measure tests if the measurement model is consistent with the observed data as well as if the model has the ability to reproduce the observed data while model specification test measures if the statistical model used to analyze the data is correctly specified or not and if relevant variables are not omitted from the model. Model fit measures can provide a rough index of whether a model is adequate or not but having a good fitting model does not prove that the model is correctly specified. Tests such as Lagrange multiplier test, likelihood ratio test and Wald tests are more of tests to compare models and hence tend to be model fit measures than model specification tests. Thus, link test which was suggested by Pregibon (1980) to detect model specification errors in proportional odds model is used.

The result in table 33 below shows that the proportional odds model used to analyze the data is specified correctly and there is no model specification problem. Link test uses the linear predicted value ($\hat{\mu}$) and linear predicted value squared ($\hat{\mu}^2$) as the predictors to rebuild the model. The variable $\hat{\mu}$ is the predicted value from the model and it should be a statistically significant predictor. However, if a model is properly specified, the variable $\hat{\mu}^2$ should not have much predictive power except by chance and should not be significant (Mohd & Malik, 2017). The result in the present study also shows that $\hat{\mu}^2$ is not significant ($p=0.111$) and $\hat{\mu}$ is significant (0.003) indicating that the proportional odds model used to analyze the data is free from specification error.

Table 33: Model Specification test for the ordered logit model.

Sanitation utilization	Coef.	Std. Err.	Z	P>z	[95% Confidence Interval]
_hat	.6565932	.2227801	2.95	0.003	[.2199523, 1.093234]
_hatsq	.0666186	.0417767	1.59	0.111	[-.0152622, .1484994]
/cut1	1.929257	.2283121	-	-	[1.481773, 2.37674]
/cut2	3.965132	.3242656	-	-	[3.329583, 4.600681]
Log likelihood = -239.80394; N= 380; LR chi2 (2) = 301.16; Prob > chi2 = 0.0000, Pseudo R2 = 0.3857					

Source: Stata Computation

5.3 Discussion

This chapter has tried to understand the association between different factors and women level of sanitation access and utilization in some selected rural kebeles of East Gojjam zone, Amhara region. Woreda, marital status, occupation of the respondent, household income and wealth, participation in women health development team, frequency of health extension contact, household size and dependency ratio are found to have statistically significant association with respondents level of sanitation access while climate, age, health information access, education of the respondent and home plot ownership are not found to be statistically associated with women's sanitation access in the study area. The variable availability of sanitation facilities (sanitation access), knowledge about the benefit of latrine utilization and frequency of health extension contact are statistically significant determinants of women's sanitation utilization. Statistically significant association is not found between the variables age, education, marital status, respondent occupation, woreda, climate, health information access, participation in women health development team, frequency of health extension contact and knowledge of sanitation related messages promoted by the health extension program and women's level of sanitation utilization.

A careful interpretation of the main findings of this study shows that among the independent variables used in the analysis, some have statistically significant association with both sanitation access and utilization status of women while other variables have statistically significant association with women's sanitation access status but not with utilization. For instance, marital status has positive and statistically significant association with women's level of sanitation access and a woman who is currently married is more likely to have higher level of sanitation

access than a woman who is not currently married. However, there is no evidence of statistically significant association between marital status and women's level of sanitation utilization.

Contrary to the researcher's expectation, statistically significant association is not found between a woman's educational status and her level of sanitation access and utilization. Women who are more literate were believed to be more likely to have better sanitation access and utilization status than less literate women. Education is essential in cognitive development and the acceptance of the need for sanitation. Educated women can understand the effects of open defecation and other unsafe sanitary practices and the need to have and practice safe sanitation. The result, however, is not as expected but it is consistent with other previous studies such as by Sinha et al. (2017) and Budhathoki et al. (2017) where statistically significant association was not found between educational attainments and latrine utilization. Possible explanation for this kind of association between the two variables may be that a higher level of education if not augmented by better income and wealth and training and skills may not expand women's capacity to adopt and utilize sanitation technologies.

Similarly, the variable age is not found to have statistically significant association with women's level of sanitation access and utilization. The finding contradicts with a study by De (2018) who reported a significant relationship between respondent's age and their sanitation access. De found that young people (less than 18 years of age) were less likely to have access to and use latrines. Similarly, age was found to have a statistical significant association with latrine utilization by Gidey et al. (2018) in Laelai Maichew woreda, Tigray region.

A statistically significant relationship is found between household size and women's level of sanitation access and utilization. The relationship is, however different. Household size has positive relationship with sanitation access and negative relation with sanitation utilization. As household size increases, the probability of having high sanitation access increases but the probability of having high sanitation utilization decreases. The negative relation between household size and sanitation utilization was also reported by Sinha et al. (2017) in India and Osumanu, Kosoe & Ategeeng (2019) in Ghana. Osumanu, Kosoe & Ategeeng (2019) found that households with large household size are 40% less likely to use latrine and more likely to defecate in the open than those with smaller household sizes.

Woreda is found to have statistically significant association with sanitation access but no evidence of statistical significant association is observed with sanitation utilization. A woman who lives in Gozamin woreda is 15 times less likely to have medium and high sanitation access compared to a respondent who lives in Machakel woreda. The result indicates that although there is inter-district variability in terms of accessing sanitation facilities which may be due to the active engagement of health extension workers and presence of NGOs working in the sanitation sector, statistical significant association is not found between inter-district variability and sanitation utilization. The fact that Gozamin woreda which is nearer to Debre markos town, a town for East Gojjam Zone and also for Gozamin woreda and assumed to have more access to health education and awareness campaigns and will be more aware about the health consequences of not having sanitation facilities and poor sanitation is less likely to have either medium or high sanitation access indicates the need for strengthening the sanitation promotion work and introduction of sanitation marketing in the woreda.

Besides the quantitative results, qualitative findings also show how domestic and community factors have influenced their adoption of sanitation facilities. Domestically, disagreement between a husband and wife due to the traditional gendered division of labor and lack of women's decision making on sanitation investment were mentioned as constraints for sanitation technology adoption. A quote from one of the interview participants can be a good example in this case.

Whether on Sunday at church meetings where both men and women are present or any other men's meeting to discuss about agricultural issues, we are always told to install latrine. Having heard this, my husband has no interest to have latrine. I always tell him that, this and that neighbors of ours have latrine. Please! Let us have ours too. He always replied "Do you want me to build a house for your faeces!" I think I am unlucky to have such a husband. People are now a days becoming modern and civilized except me and some unlucky women like me (Interviewee at yetjanshebalem kebele, Gozamin woreda, age 48, Feb 22, 2019).

The quote shows that although women have information about latrine and the associated benefits from the concerned stakeholders, their lack of domestic decision making power has constrained them to have access to sanitation facilities. Lack of commonly shared safe sanitation norm among the community (literally, lack of sanitation culture) was also mentioned by qualitative interview participants as a constraint for non-adoption of sanitation technologies.

CHAPTER SIX: DETERMINANTS OF WOMEN’S ACCESS TO AND UTILIZATION OF HYGIENE

Introduction

Hygiene is an important first line of defense against many kinds of contagious diseases such as diarrhea, cold, influenza, trachoma and covid 19. It is documented that hand-washing with soap can reduce rates of diarrhoea disease by 30–47% and rates of respiratory infection by 23% (Aunger et al., 2016). Cold and influenza, apart from transmission by inhalation of airborne particles are also transmitted through unhygienic hand. Despite the likely positive health benefits, hygiene is practiced poorly across the globe. In the UK for instance hand-washing after toilet use is below 70% for females and 50% for males (ibid). As of 2016, soap and water, the essential hand washing agents, were observed only in 7% of rural households in Ethiopia (CSA & ICF, 2016). There are different factors that could be accountable for poor hygiene access and utilization. For people to practice hygiene, necessary materials to undertake the behavior need to be available and people need to have knowhow and information. One cannot wash hands if there is no enough water to wash (Mahasneh, 2001). Inadequate water available is reported as being responsible for poor personal hygiene (Anthonj, Rechenburg, Kistemann, 2016). This sub study is, therefore, intended to identify factors associated with women’s level of hygiene access and utilization. Hygiene access refers to the availability of necessary materials and facilities to practice hygiene while utilization is the actual practice or utilization of the available facilities. Different factors determine women’s hygiene access and utilization status yet the same factors can also influence both of them. Thus, the below sections discuss the different factors that determine women’s access to hygiene facilities and their actual practice/ utilization.

6.1 Determinants of Women’s Access to Hygiene Facilities

The extent of women’s access to and utilization of hygiene facilities is presented in chapter four above. In this section, factors that determine women’s level of hygiene access are explained. Given that people’s hygiene access is influenced by different factors, this section examines if there is statistically significant association between the different factors and women’s level of hygiene access. The analysis is made based on questionnaire interview of 380 female household

heads and factors affecting women's hygiene access are estimated using generalized ordered logit model. The strength of association between the different factors and women's hygiene access is measured by coefficients and marginal effects at their 95% confidence interval and the test of statistical significance is set at the p-value of 10%, 5% and 1% level.

Table 34 presents the results of the generalized ordered logistic regression model and the results indicate that the variables woreda, age, participation in women health development team, education, wealth and income, frequency of health extension contact and household size are found to have statistically significant association with women's level of hygiene access while statistically significant association is not found between marital status, health information access, dependency ratio and women's level of hygiene access.

Woreda has positive and statistically significant association with women's level of hygiene access. The positive logit coefficient of 1.265 for the variable in the first panel indicates that a respondent who lives in Gozamin woreda is more likely to have medium and high hygiene access compared with a respondent who lives in Machakel woreda. Similarly, the positive coefficient of 0.5808 in the second panel indicates that a respondent who lives in Gozamin woreda is more likely to have high hygiene access than having low and medium compared with a respondent who lives in Machakel woreda.

Participation in women health development team has positive and statistically significant association with women's level of hygiene access. The variable meets the proportional odds assumption and thus has the same coefficients and odds ratio across the different cut points. The positive coefficient of 0.7502 for the variable participation in women health development team indicates that the odds of having high hygiene access increases for a respondent who participates in women health development team compared with a respondent who does not participate in the team.

Education has positive and statistically significant association with women's level of hygiene access. The variable also meets the proportional odds assumption. The positive coefficient of 0.6249 for the variable indicates that a respondent who has at least primary education is more likely to have high hygiene access than a respondent with no formal education.

Wealth has positive and statistically significant association with women's level of hygiene access. The variable also meets the proportional odds assumption. The positive coefficient of 1.1456 for the variable indicates that a respondent whose household wealth status is in the fourth quantile (rich) is more likely to have high hygiene access than a respondent whose household wealth status is in the first quantile (poorer).

Frequencies of health extension and household size are found to have positive and statistically significant association with women's level of hygiene access. The variables also meet the proportional odds assumption. The positive coefficient of 0.2426 for the variable frequency of health extension contact indicates that an increase in the number of health extension contacts by one day from the mean ($\bar{x}=3.11$) increases the probability of having high level of hygiene access for the respondent. Similarly, the positive coefficient of 0.3166 for the variable household size indicates that an increase in household size by one unit from the mean increases the probability of having high level of hygiene access for the respondent.

Age and income are found to have negative and statistically significant association with women's level of hygiene access. The variables also meet the proportional odds assumption. The negative coefficient of -0.9799 for the variable age at the middle adult category indicates that a respondent who is in her middle adult age is less likely to have medium or high hygiene access compared with a respondent who is in her young age. In other words young women are more likely to have high hygiene access than middle adult women. The negative coefficient of -0.9799 in the second panel indicates that a respondent who is in her middle adult age is less likely to have medium or high hygiene access compared with a respondent who is in her young age. Similarly, the negative coefficient of -1.2603 for the variable age at the adult category indicates that an adult age respondent is less likely to have medium or high hygiene access compared with a young age respondent. This indicates that young women are more likely to have high hygiene access than adult women.

The negative coefficient of -0.8204 for the variable income at a range of 20,000.01 to 45,000.00 Ethiopian birr (ETB) indicates that a respondent whose household gross annual income is between 20,000.01 to 45,000 ETB is less likely to have high hygiene access compared with a respondent whose household gross annual income is equal to or less than 20,000.01. Similarly, a negative coefficient of -0.8592 for income at a range of 45,000.01 and more ETB indicates that a

respondent whose household gross annual income is 45,000.01 and more is less likely to have high hygiene access compared with a respondent whose household gross annual income is equal to or less than 20,000.01.

Table 34: Determinants of Women's Hygiene Access

Variables	Hygiene Access	Low Vs Medium & High Hygiene Access				Low & Medium VS High Hygiene Access			
		Coeff.	Std. Err	Odds Ratio	P>z	Coeff.	Std. Err	Odds Ratio	P>z
Woreda	Gozamin	1.2651	.2909	3.5434	0.000***	.5808	.2842	1.7874	0.041**
Age	middle adult	-.9799	.4319	.3753	0.023**	-.9799	.4319	0.3753	0.023**
	Adult	-1.2603	.5189	.2836	0.015**	-1.2603	.5189	.2836	0.015**
	Old	-.6615	.5568	.5161	0.235	-.6615	.5568	.5161	0.235
Marital Status	currently married	-.4902	.3873	.6125	0.206	-.4902	.3873	.6125	0.206
Own education	Primary	.6249	.2886	1.8682	0.030**	.6249	.2886	1.868163	0.030**
	Secondary & above	.9038	.5865	2.4690	0.123	.9038	.5865	2.4690	0.123
Wealth quantile	Second	.2768	.3483	1.3189	0.427	.2768	.3483	1.3188	0.427
	Middle	.1302	.4218	1.1391	0.758	.1302	.4218	1.139	0.758
	Fourth	1.145575	.4374	3.1442	0.009***	1.1456	.4374	3.1442	0.009***
	Highest	.7609	.4751	2.1403	0.109	.7609	.4751	2.1403	0.109
Income	20000.01 - 45000.00	-.8204	.3293	.4403	0.013**	-.8204	.3293	0.4403	0.013***
	≥45000.01	-.8592	.4026	.4235	0.033**	-.8592	.4026	.4235	0.033**
Health info access	Yes	-.6996	.4735	.4968	0.140	-.6996	.4735	.4970	0.140
Participation in WHDA	Yes	.7502	.2564	.4723	0.003***	.7502	.2564	.4723	0.003***
Freq. health ext. contact		.2426	.0898	1.2746	0.007***	.2426	.0898	1.2746	0.007***
HH size		.3166	.1224	1.3724	0.010**	0.3166	.12242	1.3724	0.010***
Dependency ratio		-.0028	.0021	.9972	0.186	-.0028	.0021	.9972	0.186
_cons		1.1764	.6525	3.2428	0.071	-.7498	.6569	.4725	0.254
Log likelihood = -367.50829; N=380; LR chi2 (19) = 68.80; Prob > chi2 = 0.000; Pseudo R2 = 0.0856									
Note: significance at the *10%, ** 5% and *** 1% level. OR= odds ratio									

6.1.1 Marginal Effects of Independent Variables on Women's Hygiene Access

Table 35 below presents the results of the marginal effect of each independent variable on the dependent variable and shows that the marginal effect of an independent variable is not constant over the three categories of the dependent variable. For instance, the variable *woreda* has negative and statistically significant marginal effect at low hygiene access category ($dy/dx = -0.2129$) and positive at medium ($dy/dx = 0.1057$) and high (0.1072) hygiene access categories. Similarly, the variable *age at middle adult* has positive and statistically significant marginal effect at the low ($dy/dx = 0.1242$) and negative and statistically significant effect at high (-0.2053) hygiene access categories but it is insignificant at medium hygiene access category ($P = 0.116$).

Generally, according to the model, the variable *woreda* has the largest magnitude of marginal effect on hygiene access at low category ($dy/dx = -0.2129$) than at medium ($dy/dx = 0.1057$) and large ($dy/dx = 0.1072$) categories. The result further indicates that on an all other things being equal basis, the probability of having low hygiene access is on average, 21.3 % less for a respondent living in Gozamin *woreda* compared with a respondent living in Machakel *woreda*. A respondent living in Gozamin *woreda* is 10.6% more likely to have medium hygiene access and 10.7% more likely to have high hygiene access than a respondent living in Machakel *woreda*. In sum, a respondent who lives in Gozamin *woreda* is more likely to have better (medium and high) hygiene access compared with a respondent who lives in Machakel *woreda* indicating the possibility of program implementation bias. Though the two *woredas* are identical in terms of agro climate and socioeconomic activities, some unobserved factors such as closeness to town might have contributed for this heterogeneity between the localities.

The variable *age at middle adult and adult category* has positive significant effect on women's hygiene access at low hygiene access category and has negative and statistically significant effect at high hygiene access category. The result further indicates that on an all other things being equal basis, the probability of having low hygiene access is on average, 12.4 % more/higher for middle adult women compared with young women. Middle adult women are 20.5% less likely/lower to have high hygiene access than young women. Similarly, adult women are 17 % more likely to have low hygiene access and 25.5 % less likely/lower to have high hygiene access compared with young women. This implies that as the age of women increases,

the probability of having high hygiene access decreases. A possible explanation would be that as age increases women's physical capabilities to access hygiene materials and facilities will decline.

The variable participation in women health development team has a significant negative effect on women's hygiene access at low hygiene access category and has a significant positive effect at high hygiene access category. The variable has slightly larger magnitude of marginal effect on hygiene access at low ($dy/dx = -0.1254$) and high hygiene access categories ($dy/dx = 0.0432$). The result shows that on an all other things being equal basis, the probability of having low hygiene access is on average, 12.5% less for a respondent who participates in women health development team compared with a respondent who does not participate in women health development team. Conversely, a respondent who participates in women health development team is on average, 13.5% more likely to have high hygiene access than a respondent who does not participate. This could be explained by the fact that participation in women health development team involves attending in meetings, serving as one to five group leaders, serving as one to 30 team leaders and recruiting other households to become members. Thus, participation in this group facilitates access to hygiene information and also adds responsibility on the participants as they should have to adopt the technologies to serve as role models. During the qualitative interview, it was understood that members of women health development team have a high degree of attachment towards the team. Yet, there were reports of loosening from the government side to mobilize the team as was done previously. The degree of attachment to the team and the feeling of responsibility can be demonstrated with a quote from one of the interviewee as;

"I feel like I am still part of the team. Although the meetings and mobilization is not as it was before, we are still having meetings and trainings as well and I adopt hygiene technologies because it is an important responsibility of mine as a women health development team leader". If I did not do what was recommended by the health extension workers, who else will adopt. I have to be a model. Otherwise, it is a problem (interview participant at Qebi kebele, Gozamin woreda, age 38).

Therefore, the feeling of responsibility and exposure to health information has enabled participants in the team to have high hygiene access compared to non-participants.

The variable education has significant negative effect on women's hygiene access at low category and has significant positive effect at high hygiene access category. The result indicates that on an all things being held constant, a respondent with primary education is on average 9.1 % less likely to have low hygiene access and a respondent with secondary and above education is 12.3% less likely to have low hygiene access than a respondent with no formal education. Conversely, a respondent with primary education is on average 12.5% more likely to have high hygiene access than a respondent with no formal education. In sum, the result shows that there is a positive relationship between education of the respondent and the probability of having better hygiene access. A positive relationship between educational attainment of household head and probability of having access to improved drinking water source was also reported by (Adams et al, 2015 & Rahut et al., 2015 cited in Irianti, Prasetyoputra, & Sasimartoyo, 2016). Education is thought to create a favorable mental attitude for the acceptance of new practices.

The variable wealth has significant negative effect on women's hygiene access at low category and has significant positive effect at high hygiene access category. The variable has the largest magnitude of marginal effect on the likelihood of hygiene access comparable with the magnitude of marginal effect of variables such as age, income and woreda. The result further indicates that on an all things being held constant basis, a respondent whose self-reported household wealth status is in the fourth quantile or rich is on average 17.5% less likely to have low hygiene access and 21.7% more likely to have high hygiene access than a respondent whose self-reported household wealth status is poorer or in the first quantile. Similarly, a respondent whose self-reported household wealth status is in the fifth quantile/richer is on average 13.6 % more likely to have high hygiene access than a respondent whose self-reported household wealth status is poorer or in the first quantile. This shows the probability of women accessing hygiene facilities and materials increases with the level of household wealth. Indeed, wealth plays an important role in technology adoption and the evidence is widely reported in previous studies particularly in agricultural technology adoption studies such as by Ousmane & Nafiou (2019). The finding is also in agreement with a study by Armah (2018). In their study of access to improved water and sanitation in sub-Saharan Africa, Armah & his colleagues found that rural rich households were more likely to have access to improved water sources than urban poor households, indicating rural rich households' capacity to afford hygiene facilities such as improved water sources.

Though they have compared rural to urban areas, their finding provides some empirical support to the finding of the present study.

The variable household size has significant negative effect on hygiene access at low and medium categories and has positive and statistically significant effect at high hygiene access category. The result indicates that as household size increases by one unit from the mean ($\bar{x}=3.96$), the probability of having low hygiene access decreases on average by 5% and the probability of having medium hygiene access decreases on average by 0.9 %. On the contrary, the probability of having high hygiene access increases on average by 5.9 %. This suggests that as household size increases, the probability of women to have high hygiene access increases. This could be due to the fact that large household size could serve as a source of labor and income and thus encourage hygiene technology adoption. The finding of this study is consistent with a previous study by Irianti, Prasetyoputra & Sasimartoyo (2016) in Indonesia where household size was found to have positive significant association with people's access to improved drinking water source. However, the finding here is inconsistent with those found by Armah & et al. (2018) where they conclude that medium and large size households were less likely to have access to improved water sources which is an important aspect of hygiene services. The variation may be due to differences in location specific opportunities. Armah & et al. (2018) has studies the effect of urban-rural environment on access to water and sanitation services while the present study focuses on rural areas where access to drinking water in the premises is very limited.

The variable frequency of health extension contact has negative significant effect on hygiene access at low and medium hygiene access categories and has significant positive effect at high hygiene access category. The result indicates that as frequency of health extension contact increases by one day from the mean $\bar{x}=3.11$, the probability of having low hygiene access decreases on average by 3.8 %, and the probability of having medium hygiene access decreases on average by 0.71% but the probability of having high hygiene access increases on average by 4.6 %. This can be explained by the fact that extension contact has a direct influence on adoption behavior of people. The greater the degree of contact of households with extension agents, the greater is the possibilities of households being influenced to adopt hygiene facilities. Households who have more contacts with extension agents are likely to hear about improved technologies and health and thus have more cue to adopt technologies.

The variable income has significant positive effect on hygiene access at low category and has significant negative effect at high hygiene access category. The result indicates that on an all things being equal basis, a respondent whose household gross annual income ranges from 20,000.01 birr to 45,000 birr is on average, 11% more likely to have low hygiene access than a respondent whose household gross annual income ranges from 0.20,000 birr. On average, a respondent whose household gross annual income ranges from 20,000.01 birr to 45,000 birr is 16.8% less likely to have high hygiene access than a respondent whose household gross annual income ranges from 0.20,000 birr. A respondent whose household gross annual income is 45,000.01 birr or more is on average, 11.9% more likely to have low hygiene access than a respondent whose household gross annual income ranges from 0.20,000 birr and a respondent whose household gross annual income ranges from 45,000.01 birr and more is 17.5% less likely to have high hygiene access than a respondent whose household gross annual income ranges from 0.20,000 birr. The fact that relatively low household income respondents are more likely to have better hygiene access than relatively better off respondents might seem contrary to intuition as well as what most empirical findings on the relation between income and technology adoption have found. However, most of the hygiene technologies promoted in the study areas are low cost technologies that cannot create a divide between poor and non-poor. The only anti poor hygiene facility is to have a private protected drinking water source which was almost non-existent as observed during the field visit. Most of the protected water sources were built by either the government or NGOs. Thus, hygiene technologies were adopted by relatively low income households than relatively better off households because the technologies do not require that much money. There is perhaps another plausible explanation as to why relatively low income respondents have better hygiene access than better income households. Most of the low income households participate in Ethiopia's productive safety net programs (food for work and cash for work programs). Thus, they fear that if they do not adopt the recommended technologies, they will not get the benefits offered through the productive safe net program. Thus, they become more agreeable and open for experience and adopt technologies.

Table 35: Marginal Effects for different Hygiene Access levels

Hygiene access		Low			Medium			High		
Variables		dy/dx	Delta-method Std. Err.	P>z	dy/dx	Delta-method Std. Err.	P>z	dy/dx	Delta-method Std. Err.	P>z
Woreda	Gozamin	-.2129	.0491	.0000	.1057	0.0515	.0400	.1072	.0508	.0350
Age	Middle adult	.1242	.0496	.0120	.0811	.0516	.1160	-.2053	.0919	.0250
	Adult	.1712	.0592	.0040	.0837	.0528	.1130	-.2549	.1068	.0170
	Old	.0768	.0622	.2170	.0660	.0598	.2700	-.1429	.1196	.2320
Marital status	Currently Married	.0714	.0516	.1670	.0247	.0277	.3710	-.0961	.0785	.2210
Own education	Primary education	-.0914	.0382	.0170	-.0338	.0242	.1630	.1252	.0606	.0390
	Secondary & Above	-.1234	.0640	.0540	-.0634	.0682	.3520	.1868	.1306	.1530
Wealth Quantile	Second	-.0502	.0640	.4330	.0054	.0120	.6530	.0448	.0553	.4180
	Middle	-.0242	.0786	.7580	.0038	.0135	.779	.0204	.0654	.7550
	Fourth	-.1749	.0705	.0130	-.0419	.0258	.1040	.2168	.0756	.0040
	Highest	-.1262	.0798	.1140	-.0095	.0176	.5900	.1357	.0817	.0970
Health info access	Yes	.0965	.0556	.0830	.0460	.0472	.3300	-.1424	.1018	.1620
Participation in WHDA	Yes	-.1254	.0446	.0050	.0093	.0108	.3880	.1347	.0432	.0020
Household annual income in birr	20,000.01-45,000	.1123	.0390	.0040	.0553	.0340	.1040	-.1676	.0702	.0170
	≥ 45,000.01	.1187	.0526	.0240	.0559	.0346	.1060	-.1746	.0823	.0340
Frequency of health extension contact		-.0383	.0141	.0060	-.0071	.0042	.0860	.0455	.0165	.0060
HH size		-.0500	.0193	.0090	-.0093	.0054	.0850	.0593	.0225	.0080
Dependency ratio		.0004	.0003	.1850	.0001	.0001	.2510	-.0005	.0004	.1840

Note; dy/dx for factor levels is the discrete change from the base level.

6.1.2 Model Fit Measures

Similar to the model fit statistics used in partial proportional odds or generalized ordered logistic regression model in section 5.1.2 above, different model fit measures are used to know if the model used to estimate the association between the different independent variables and women's level of hygiene access is a good model or not. The overall goodness of fit statistics measured by using log likelihood statistics with a significant likelihood ratio chi-square test (LR chi2 (19)) of 68.80; p-value = 0.000 at the bottom of table 34 above signifies that the full model with all the

independent variables included has fitted the data significantly better than the null model with no independent variable. Similarly, the predictive power measure tested by using McFadden pseudo R^2 (0.086) (see the bottom of table 34 above) shows that the model has provided 8.9% improvement in fit over the null model indicating moderately strong predictive power of the independent variables in explaining the outcome variable hygiene access. McFadden pseudo R^2 with zero indicates a model with no predictive value further indicating that the independent and dependent variables are independent or there is no association with the outcome while Pseudo R^2 with one indicates a perfect fit (Hu, Shao & Palta, 2006).

Furthermore, the goodness of fit statistics measured by using goodness of fit indices determined by comparing a working model with other competing models fitted to the same data sets shows that partial proportional odds model (PPOM), which is the candidate model has fitted the data better than proportional odds model (POM) and multinomial logistic regression model (mlogit). How much one model is preferred over the other depends on the magnitude of the difference. Researchers have proposed benchmarks for judging whether the size of a difference in AIC or BIC between two models is practically significant (Burnham & Anderson, 2004 and Raftery, 1995). The rule of thumb is that if the difference between AICs and BICs of the different models is between 0-2, it provides substantial evidence to support the working /candidate model than the competing model. As the information criteria test result in table 32 below shows, partial proportional odds model (PPOM), which is the candidate model has the smallest AIC than the other competing models; POM and mlogit. In terms of BIC proportional odds model seems to have the smallest information criteria (858.961) compared to BIC of the PPOM (859.760) and Mlogit (937.584). However, the difference between BIC in PPOM and in POM is 0.79 providing a substantial evidence to support the working /candidate model than the competing model. Thus, based on AIC and BIC results, partial proportional odds model fits the data better than ologit and mlogit.

Table 36: Model Fit Measure (Goodness of Fit Indices)

		PPOM (Gologit2)	POM (Ologit)	Mlogit
IC	AIC	777.017	780.157	787.858
	AIC divided by N	2.045	2.053	2.073
	BIC (df=20)	(df=20)=859.760	(df=20)=858.961	(df=38)= 937.584

Source: Author's Stata computation

6.1.3. Model Specification Test

On the basis of theory and prior empirical work, the researcher has used a model that she believed will capture the essence of the subject matter under study. However, in many cases of statistical analysis, it cannot be sure if the statistical model is correctly specified or not. Thus, model specification test is necessary to check whether the model chosen is the correct model or not. Accordingly, the model specification test result in table 37 shows that the link tests go in line with what is recommended by the literature and shows that partial proportional odds model has been correctly specified and there is no model specification problem. Literature indicates that the variable *_hat* should be a statistically significant predictor, since it is the predicted value from the model while the variable *_hatsq* shouldn't have much predictive power except by chance and thus, should not be significant. The result in table 37 also shows that *__hatsq* in both low hygiene access ($P= 0.607$) and medium hygiene access ($P=0.986$) are not significant but *hat* in both low hygiene access ($p= 0.013$) and medium hygiene access ($p=0.076$) are significant.

Table 37: Model Specification Test (Link test)

Hygiene Access		Coef.	Std. Err.	P>z	[95% Conf. Interval]
Low	<i>_hat</i>	.8742026	.3501885	0.013	[.1878458, 1.560559]
	<i>_hatsq</i>	.0789189	.153224	0.607	[-.2213947,.3792325]
	<i>_cons</i>	-.0035281	.2124944	0.987	[-.4200095, .4129532]
Medium	<i>_hat</i>	.7399815	.4172626	0.076	[-.0778381,1.557801]
	<i>_hatsq</i>	.0021977	.1283843	0.986	[-.2494308,.2538263]
	<i>_cons</i>	-1.971844	.32426	0.000	[-2.607382, -1.336307]
Log likelihood = -369.38175, N=380, LR chi2 (4) =65.05, Prob > chi2 =0.0000, Pseudo R ² = 0.0809					

Source: Author's computation of Stata link test

6.2 Determinants of Women's Hygiene Utilization

The extent of women's utilization of hygiene facilities and materials is presented in chapter four above. In this section, factors that determine women's hygiene practice are examined. Women's hygiene practice is influenced by different factors, such as presence or absence of materials such as soap, water and sanitary pads and other facilities. The presence of these facilities facilitates hygiene practice while their absence hinders it (Aunger, Greenland, Ploubidis, 2016). The presence or absence of hygiene facilities is seen under the broad theme of hygiene access in the prior section. Socioeconomic status such as income and wealth enable people to access hygiene facilities and materials. Income and wealth indirectly affect hygiene behavior by limiting access to hygiene materials. Hence, income and wealth since they affect utilization indirectly through access, they are not incorporated into the model directly. Having health information access is believed to influence people's hygiene behavior by creating hygiene information and awareness. Since, this is related to the variable knowledge; the variable is dropped from the final model.

Table 35 presents the results of the generalized ordered logit model estimates. The result shows that the original three category outcome variable; hygiene utilization as low, medium and high is collapsed into two panels. In the first panel, low hygiene utilization category is contrasted with medium and high hygiene utilization categories and in the second panel, low and medium hygiene utilization categories are contrasted with high hygiene utilization category. Each panel gives the results for coefficients (β) and the odds ratio estimates (e^β). Altogether, the model has estimated 25 coefficients; 21 in the first panel, and 4 in the second panel. Confidence interval for coefficients and odds ratio was calculated at 95% level of confidence and all the independent variables with p-values of <0.05%, 0.1% and 0.01 % are considered significant.

As the result shows, climate has positive and statistically significant association with women's hygiene utilization in the second panel. The positive logit coefficient of (β) = 0.8829 for the variable indicates that a respondent who lives in Woinadega agro climate is more likely to have high hygiene utilization compared with a respondent who lives in Dega agro climate. Similarly, the variable frequency of health extension contact has positive and statistically significant association with women's hygiene utilization. The positive logit coefficient (β) = 0.1730 in the first panel indicates that as the frequency of health extension contact increases by one day from

the mean, the probability of the respondent to have either medium or high hygiene utilization increases. Similarly, the positive logit coefficient (β) = 0.1730 in the second panel indicates that as the frequency of health extension contact increases by one day from the mean, the probability of the respondent to have high hygiene utilization increases.

Respondents' self-reported knowledge of methods to treat drinking water at home has positive and statistically significant association with women's level of hygiene utilization. The logit coefficient (β) = 0.6312 indicates that a respondent who has medium knowledge about the methods of treating drinking water at home is more likely to have high hygiene utilization compared with a respondent who has poor knowledge about the methods of treating drinking water at home. Respondents' self-reported knowledge of reasons for hand washing after defecation has also positive and statistically significant association with women's level of hygiene practice. The logit coefficient (β) = 0.8409 indicates that a respondent who has high knowledge about reasons for hand washing after defecation is more likely to have high hygiene utilization compared with a respondent who has poor knowledge.

Respondents' self-reported knowledge of how food can be contaminated has positive and statistically significant association with women's level of hygiene practice. The positive logit coefficient of (β) = 1.1740 indicates that a respondent who has medium knowledge about how food can be contaminated is more likely to have high hygiene utilization compared with a respondent who has poor knowledge. Similarly, the logit coefficient (β) = 1.1566 for the same variable indicates that a respondent who has high knowledge about how food can be contaminated is more likely to have high hygiene utilization compared with a respondent who has poor knowledge.

The variable hygiene access has positive and statistically significant association with women's level of hygiene utilization. The positive logit coefficient of (β) = 1.7440 for the variable indicates that a respondent who has medium level of hygiene access is more likely to have either medium or high hygiene utilization compared with a respondent who has low level of hygiene access. Similarly, the positive logit coefficient of 3.9979 for the same variable indicates that a respondent who has high level of hygiene access is more likely to have either medium or high hygiene utilization compared with a respondent who has low level of hygiene access.

The variable woreda has negative and statistically significant association with women's level of hygiene utilization. The negative logit coefficient (β)= -1.1189 indicates that a respondent who lives in Gozamin woreda is less likely to have high hygiene utilization compared with a respondent who lives in Machakel woreda.

Similarly, age of the respondent has negative and statistically significant association with women's hygiene utilization level. The negative coefficient of -1.3769 for the variable age at middle adult category in both the first and second panel indicates that a middle adult woman is less likely to have high level of hygiene utilization compared with a young woman. Similarly, the negative coefficient of -1.8476 for the variable age at adult category in both the first and second panel indicates that an adult age woman is less likely to have high hygiene utilization compared with a young woman. Besides, the negative coefficient of -1.8649 for the variable age at old category in the first panel indicates that an old woman is less likely to have either medium or high hygiene utilization compared with a young woman. The negative coefficient of -1.0308 for the same variable in the second panel indicates that an old woman is less likely to have high hygiene utilization compared with a young woman. Respondent education has negative and statistically significant association with women's level of hygiene utilization. The negative logit coefficients of -1.5439 in both the first and second panels indicate that a respondent with secondary education and above is less likely to have high hygiene utilization compared with a respondent with no formal education.

Statistical significant association is not found between household size, occupation, knowledge about how drinking water can be contaminated and knowledge about critical times for handwashing and women's level of hygiene utilization. This finding is in disagreement with what was found by Dalila et al. (2017) where a statistically significant association was found between occupation and women's hygiene behavior.

Table 38: Determinants of Women's Hygiene Practice

Hygiene Utilization		Low Vs Medium & High				Low & Medium Vs High			
Variables		Coef.	Std. Err.	Odds Ratio	P>z	Coef.	Std. Err.	Odds Ratio	P>z
Woreda	Gozamin	-1.1189	.3992	.3266	.0050***	-1.1189	.3992	.3266	.0050***
Climate	Woinadega	-0.2953	.3547	.7443	.4050	.8829	.2826	2.4180	.0020***
Age	middle adult	-1.3769	.5048	.2524	.0060***	-1.3769	.5048	.2524	.0060***
	Adult	-1.8476	.5342	.1576	.0010***	-1.8476	.5342	.1576	.0010***
	Old	-1.8649	.5874	.1549	.0010***	-1.0308	.5259	.3567	.0500**
Education	primary	-0.1453	.3341	.8647	.6640	-.1453	.3341	.8647	.6640
	secondary & above	-1.5439	.7141	.2135	.0310**	-1.5439	.7141	.2135	.0310**
Occupation	nonfarm only or farm plus	-.5281	.3495	.5897	.1310	-.5281	.3495	.5897	.1310
KWT	Medium	.6312	.3754	1.8799	.0930*	.6312	.3754	1.8799	.0930*
	High	.4699	.3707	1.5999	.2050	.4699	.3707	1.5999	.2050
KRHWD	Medium	.2686	.3167	1.3081	.3960	.2686	.3167	1.3081	.3960
	High	.8409	.3593	2.3185	.0190**	.8409	.3593	2.3185	.0190**
KFC	Medium	1.1740	.3505	3.2350	.0010***	1.1740	.3505	3.2350	.0010***
	High	1.1566	.4240	3.1791	.0060***	1.1566	.4240	3.1791	.0060***
KWC	Medium	-.0734	.3675	.9292	.8420	-.0734	.3675	.9292	.8420
	High	-.1255	.4172	.8821	.7640	-.1255	.4172	.8821	.7640
KCTHW	Medium	-.5921	.4268	.5532	.1650	-.5921	.4268	.5532	.1650
	High	.2399	.3924	1.2712	.5410	.2399	.3924	1.2712	.5410
Hygiene access	Medium	1.7440	.3547	5.7204	.0000***	-.1405	.3235	.8689	.6640
	High	3.9979	.7832	54.4825	.0000***	-.1910	.3624	.8261	.5980
Frequency of health extension contact		.1730	.0906	1.1889	.0560*	.1730	.0906	1.1889	.0560*
Household size		.1611	.1096	1.1748	.1410	.1611	.1096	1.1748	.1410
_cons		.5645	.7052	1.7586	.4230	-1.8280	.7039	.1607	.0090

Log likelihood= -286.52433;N = 380;LR chi2(26) =185.88; Prob > chi2 =0.0000; Pseudo R2=0.2449
Note: significance at the *10%, ** 5% and *** 1% level
Abbreviations: KWT=knowledge of methods to treat drinking water at home; KRHWD= knowledge of reasons for hand washing after defecation; KFC=knowledge about how food can be contaminated; KWC=Knowledge about how drinking water can be contaminated; KCTHW=Knowledge about critical times for handwashing

6.2.1 Marginal Effects

Table 39 presents the marginal effect of a change in the independent variable on the probability of a change on the level of women's hygiene utilization. The result indicates that the marginal effect of an independent variable is not constant over the three categories of the dependent variable. For instance, the variable woreda has a significant positive effect on women's hygiene utilization at low and medium hygiene utilization categories and has a significant negative effect

on women's hygiene utilization at high hygiene utilization category. The positive marginal effect ($dy/dx=0.1044$, $p=0.004$) of the variable at low hygiene utilization indicates that a respondent who lives in Gozamin woreda is on average, 90% more likely to have low hygiene utilization compared with a respondent who lives in Machakel woreda. Similarly, the positive marginal effect of the same variable at medium hygiene category ($dy/dx=0.0919$, $p=0.013$) indicates that a respondent who lives in Gozamin woreda is on average 91% more likely to have medium hygiene utilization than a respondent in Machakel woreda. On the contrary, the average marginal effect for the variable woreda ($dy/dx= -0.1963$) at high hygiene utilization category shows that a respondent who lives in Gozamin woreda is on average, 80% less likely to have high hygiene utilization.

The variable climate has statistically significant negative effect on women's hygiene utilization at medium hygiene utilization category and significant positive effect at high hygiene utilization category. The negative marginal effect of ($dy/dx= -0.1716$, $p=0.000$) for the variable indicates that a respondent who lives in woinadega agro climate is on average, 1.7 % less likely to have medium hygiene utilization compared with a respondent living in dega agro climate. The significant positive marginal effect of the variable ($dy/dx= 0.1438$, $p=0.001$) on the other hand indicates that a respondent who lives in woinadega agro climate is on average, 14.4% more likely to have high hygiene utilization compared with a respondent living in dega agro climate. This might be explained by the fact that the biological environment in which people live and the associated dust and dirty environment (consisting of disease threats) has a significant effect on hygiene practice. The nature of soil in dega and woinadega and the associated debris are different. Dusts were more observed in woinadega than in dega and this might made people in woina dega to practice hygiene more than people living in dega areas. Variations in temperature between dega and woinadega could also be another reason for the difference in hygiene practice. Dega climate zone has an average temperature of 16°C with elevation of 2300-3200m and woinadega has an average temperature of 22°C and an elevation of 1500 to 2500 m. (Ministry of Agriculture, 2000). Warm climate is suitable for parasite survival thus Woinadega or subtropical climate is more exposed to tropical/ infectious diseases such as malaria, diarrhea and trachoma. Thus, the fact that people living in woina dega/subtropical climate practice more hygiene than people in dega/cool may be related with the prevalence of tropical diseases in woinadega and the protection thereof. Dega/cool climate on the other hand, is mountainous and creates barrier to

easily get infrastructures such as drinking water which is key for hygiene practice. Dega is not also prone to tropical diseases. During rainy season, woinadega is more prone to flooding and water is logged everywhere and it is muddy which serves as a cue for hygiene behavior. This finding is in harmony with the findings of Aunger et al. (2016) who found a statistically significant association between a dirty environment and people's engagement in hygiene behaviors such as handwashing and surface cleaning. This study is also in agreement with a hypothesis of Aunger & Curtis (2016) behavior centered design which explicitly stated that factors in the physical or built environment including climate and geography determines people's hygiene behavior.

Age has significant positive effect on women's level of hygiene utilization at low category and has significant negative effect at high hygiene utilization category. The positive marginal effect for the variable age ($dy/dx=0.0945$) at low hygiene utilization indicates that middle adult women are on average, 9.5 % more likely to have low hygiene utilization than a young woman. The average marginal effect for the variable age ($dy/dx=0.1545$) at medium hygiene utilization category indicates that middle adult women are on average, 15.5% more likely to have medium hygiene utilization than young women. Conversely, the average marginal effect for the variable age ($dy/dx=-0.2490$) at high hygiene utilization category indicates that middle adult women are on average, 25% less likely to have high hygiene utilization than young women. Similarly, the average marginal effect for the variable age ($dy/dx=0.1423$) at low hygiene utilization category indicates that the probability of having low hygiene utilization increases on average by 14% for adult women than young women. The average marginal effect for the variable age ($dy/dx=0.1801$) at medium hygiene utilization category indicates that the probability of having medium hygiene utilization increases on average by 18% for adult woman than a young woman. The average marginal effect for the variable age ($dy/dx= -0.3224$) at high hygiene utilization category indicates that the probability of having high hygiene utilization decreases on average by 32% for adult woman than young woman. The average marginal effect for the variable age ($dy/dx=0.1442$) at low hygiene utilization category indicates that the probability of having low hygiene utilization increases on average by 14.4% for old age respondents compared with young age respondents. The average marginal effect for the variable age ($dy/dx= -0.1892$) at high hygiene utilization category indicates that the probability of having high hygiene utilization decreases on average by 19% for old age respondents than young age respondents. In sum, the

result indicates that as the age of women increases, the probability of having high hygiene utilization decreases. This could be explained by the fact that as the age of women increases, the physical capacity to undertake hygiene practice may deteriorate. On the other hand, young women have less family responsibility and they are also energetic to undertake hygiene activities as far as they have got access. The finding of this study is in agreement with Sultana, Mahumud, Sarker & Hossain (2016) study which demonstrated that older individuals had lower handwashing practice scores compared to younger ones. The finding is however in disagreement with Aunger et al. (2016) study where older individuals were found to be more likely to wash their hands with soap. On the other hand, Dalila et al. (2017) did not found statistically significant association between women's age and their hygiene behavior.

Education has significant positive effect on women's level of hygiene utilization at low category and has significant negative effect at high hygiene utilization category. The average marginal effect for the variable education ($dy/dx=0.1796$) indicates that the probability of having low hygiene utilization increases on average by 18% for a respondent with secondary and above education than a respondents with no formal education. The average marginal effect for the variable education ($dy/dx=-0.2011$) at high hygiene utilization category indicates that the probability of having high hygiene utilization decreases on average by 20% for a respondent with secondary and above secondary education than respondents with no formal education. In other words the study indicates that a woman with no formal education is more likely to have better hygiene utilization than a woman with better education status. Though education is a necessary component for behavior change, not all education supports behavioral change. Academic education can make people to have general awareness but according to Arlinghaus (2018), education to increase general knowledge is rarely needed with regard to health behavior change. On the contrary, health education programme such as menstrual education, hygiene education are reported to have positive association with hygiene practice. The study is in disharmony with a finding by Dalila et al. (2017) in Malaysia where significant positive association was found between women's education level and their hygiene behavior.

Occupation has significant positive effect on women's hygiene utilization level. The average marginal effect for the variable occupation ($dy/dx=0.0320$) at medium hygiene utilization category indicates that the probability of having medium hygiene utilization increases on average

by 3.2% for a respondent whose occupation is nonfarm only or farm plus compared with a respondent whose occupation is farm only. Occupation was also found to have a positive significant association with women's hygiene behavior in Malaysia by Dalila et al. (2017).

Frequency of health extension contact has significant negative effect at low and medium hygiene utilization category and has significant positive effect at high hygiene utilization category. The average marginal effect for the variable frequency of health extension contact ($dy/dx = -0.0166$) at low hygiene utilization category indicates that the probability of having low hygiene utilization decreases on average by 1.7% for every one day increase in the frequency of health extension contact from the mean $\bar{x} = 3.11$. The average marginal effect for the variable frequency of health extension contact ($dy/dx = -0.0121$) at medium hygiene utilization category indicates that the probability of having medium hygiene utilization decreases on average by 1.2% for every one day increase in the frequency of health extension from the mean. On the other hand, the average marginal effect for the variable frequency of health extension contact ($dy/dx = 0.0287$) at high hygiene utilization category indicates that the probability of having high hygiene utilization increases on average by 2.9% for every one day increase in the frequency of health extension contact. This can be explained by increased information, knowledge and skill that would be obtainable from increased contact with health extension agents in terms of meetings, home visits, demonstrations as well as health post visits. Besides, as extension contact increases, households will be influenced to practice hygiene. This finding also goes in line with the idea of Andersen (1995) behavioral model of health services use. In Andersen (1995) behavioral model of health services, one of the variables identified as a determinant of health service use is enabling factors which includes the availability of resources such as extension workers and the amount of contact between health personnel and beneficiaries. Health personnel's which are considered significant in the community will influence individual's health behavior. Thus, as frequency of health extension contact increases, it creates motivation to comply with health personnel opinion and hence, practice of hygiene. A similar finding was reported by Akter (2015) in Bangladesh where respondents who participated in Bangladesh rural advancement committee cluster meetings and home visits were found to have improved hygiene behavior.

The average marginal effect for the variable knowledge of drinking water treatment ($dy/dx = -0.0382$) at medium hygiene utilization category indicates that the probability of having medium hygiene utilization decreases on average by 4% for respondents who have medium knowledge about drinking water treatment methods at home compared to respondents who have low knowledge about the issue. On the contrary, the average marginal effect for the variable knowledge of drinking water treatment at home at high hygiene utilization category ($dy/dx = 0.1017$) indicates that the probability of having high hygiene utilization increases on average by 10% for respondents who have medium knowledge about drinking water treatment methods at home compared with respondents who have low knowledge about the issue.

The average marginal effect for the variable knowledge of reasons for hand washing after defecation ($dy/dx = -0.0737$) at low hygiene utilization category indicates that the probability of having low hygiene utilization decreases on average by 7.4% for respondents who have high knowledge of reasons for hand washing after defecation compared with respondents who have low knowledge about the same issue. Similarly, the average marginal effect for the same variable ($dy/dx = -0.0756$) at medium hygiene utilization category indicates that the probability of having medium hygiene utilization decreases on average by 7.5% for respondents who have high knowledge about reasons for hand washing after defecation than respondents who have low knowledge about the same issue. The average marginal effect for the variable knowledge of reasons for hand washing after defecation ($dy/dx = 0.1492$) at high hygiene utilization category indicates that the probability of having high hygiene utilization increases on average by 14.9 % for respondents who have high knowledge about reasons for hand washing after defecation compared with respondents who have low knowledge about the same issue.

The average marginal effect for the variable knowledge of how food can be contaminated ($dy/dx = 0.1268$) at low hygiene utilization category indicates that the probability of having low hygiene utilization decreases on average by 12.7% for respondents who have medium knowledge about how food can be contaminated compared with respondents who have low knowledge about the same issue. Similarly, the average marginal effect for the same variable at medium hygiene utilization category ($dy/dx = -0.0539$) indicates that the probability of having medium hygiene utilization decreases on average by 5.4% for respondents who have medium knowledge about how food can be contaminated compared with respondents who have low knowledge about

the same issue. On the other hand, the average marginal effect for the variable knowledge about how food can be contaminated ($dy/dx = 0.1807$) at high hygiene utilization category indicates that the probability of having high hygiene utilization increases on average by 18% for respondents who have medium knowledge about how food can be contaminated compared with respondents who have low knowledge about the same issue. Likewise, the average marginal effect for the variable knowledge of how food can be contaminated ($dy/dx = -0.1253$) at low hygiene utilization category indicates that the probability of having low hygiene utilization decreases on average by 12.5% for respondents who have high knowledge about how food can be contaminated compared with respondents who have low knowledge about the same issue. The average marginal effect for the variable knowledge of how food can be contaminated ($dy/dx = -0.0521$) at medium hygiene utilization category indicates that the probability of having medium hygiene utilization decreases on average by 5.2% for respondents who have high knowledge about how food can be contaminated compared with respondents who have low knowledge about it. The average marginal effect for the variable knowledge about how food can be contaminated ($dy/dx = 0.1775$) at high hygiene utilization category indicates that the probability of having high hygiene utilization increases on average by 17.8% for respondents who have high knowledge about how food can be contaminated compared with respondents who have low knowledge about it. The result is in agreement with a finding by Mulubirhan & Abera (2014) study in Tigray where knowledge on hand washing, water handling matters and hand washing practice were significantly associated to respondents' hygiene behavior status. As expected, respondents who are more aware of the health impact of hygiene are more likely to practice it. This study is in agreement with a hypothesis of Aunger & Curtis (2016) behavior centered design which explicitly stated that knowledge of handwashing behavior and its benefits affects handwashing behavior. The study is also in agreement with Faye et al. (2011) observation that there is significant association between knowing about the existence of household water treatment products and their application (cited in Ibrahim et al., 2017).

The average marginal effect for the variable hygiene access ($dy/dx = -0.2589$) at low hygiene utilization category indicates that the probability of having low hygiene utilization decreases on average by 25.9% for a respondent who has medium hygiene access compared with a respondent who has low hygiene access. The average marginal effect for the variable hygiene access ($dy/dx = 0.2825$) at medium hygiene utilization category indicates that the probability of having

medium hygiene utilization increases on average by 28.3% for a respondent who has medium hygiene access level compared with a respondent who has low hygiene access level. The average marginal effect for the variable hygiene access ($dy/dx = -0.3809$) at low hygiene utilization category indicates that the probability of having low hygiene utilization decreases on average by 38% for a respondent who has high hygiene access compared with a respondent who has low hygiene access level. The average marginal effect for the variable hygiene access ($dy/dx = 0.4129$) at medium hygiene utilization category indicates that the probability of having medium hygiene utilization increases on average by 41.3% for a respondent who has high hygiene access level compared with a respondent who has low level of hygiene access. This finding is in agreement with numerous studies which reported that lack of access to hygiene materials and equipment are barrier or reasons for why people do not perform hygiene more frequently. The availability of infrastructures such as protected water sources and other hygiene technologies encourage people's utilization of the technologies. This finding is in agreement with the finding of Aunger et al. (2016) who discovered that people with the necessary materials in place such as soap and water in their homes were more likely to practice hygiene or handwashing. The result here goes in line with the hypothesis of Sen (1999) and Nussbaum (2000) capability approach. Capability approach states that capability failures such as lack of resources inhibit women's ability to function.

Table 39: Marginal Effect of Independent Variables on Women's Hygiene Utilization

Hygiene utilization		Low			Medium			High		
Variables		dy/dx	Std. Err.	P>z	dy/dx	Std. Err.	P>z	dy/dx	Std. Err.	P>z
Woreda	Gozamin	.1044	.0360	.0040***	.0919	.0368	.0130**	-.1963	.0704	.0050***
Climate	Woinadega	.0278	.0328	.3970	-.1716	.0471	.0000***	.1438	.0434	.0010***
Age	Middle adult	.0945	.0309	.0020***	.1545	.0602	.0100**	-.2490	.0872	.0040***
	Adult	.1423	.0347	.0000***	.1801	.0598	.0030***	-.3224	.0888	.0000***
	Old	.1442	.0456	.0020***	.0450	.0728	.5370	-.1892	.0928	.0410**
Own education	Primary	.0138	.0322	.6690	.0106	.0232	.6470	-.0244	.0553	.6600
	Secondary & above	.1796	.0944	.0570*	.0215	.0344	.5320	-.2011	.0654	.0020***
Own occupation	Non-farm only or farm plus	.0518	.0349	.1380	.0320	.0184	.0820*	-.0837	.0524	.1100
knowledge of methods to treat drinking water at home	Medium	-.0635	.0394	.1070	-.0382	.0219	.0810*	.1017	.0586	.0830*
	High	-.0487	.0400	.2240	-.0253	.0172	.1410	.0739	.0560	.1870
knowledge of reasons for hand washing after defecation	Medium	-.0264	.0304	.3840	-.0181	.0235	.4400	.0446	.0536	.4060
	High	-.0737	.0287	.0100**	-.0756	.0389	.0520*	.1492	.0662	.0240**
knowledge about how food can be contaminated	Medium	-.1268	.0407	.0002***	-.0539	.0178	.0020***	.1807	.0488	.0000***
	High	-.1253	.0459	.0060***	-.0521	.0284	.0670*	.1775	.0653	.0070***
Knowledge about how drinking water can be contaminated	Medium	.0069	.0347	.8420	.0053	.0265	.8410	-.0122	.0612	.8410
	High	.0119	.0396	.7630	.0088	.0294	0.7640	-.0208	.0689	.7630
Knowledge about critical times for handwashing	Medium	.0646	.0486	.1840	.0240	.0167	.1500	-.0886	.0604	.1430
	High	-.0225	.0370	.5430	-.0183	.0300	.5420	.0408	.0669	.5420
Hygiene Access	Medium	-.2589	.0540	.0000***	.2825	.0568	.0000***	-.0237	.0548	.6660
	High	-.3809	.0507	.0000***	.4129	.0599	.0000***	.0320	.0608	.5990
Frequency of health extension contact		-.0166	.0086	.0560*	-.0121	.0065	.0640*	.0287	.0149	.0540*
Household size		-.0154	.0105	.1410	-.0113	.0077	.1450	.0267	.0180	.1380

Note: dy/dx for factor levels is the discrete change from the base level. Significance at the *10%, ** 5% and *** 1% level.

6.2.2 Model Fit Measures

Lee (2013) stated that all regression models for categorical response variables should be evaluated for fit and their adherence to model assumptions. Literature provides two kinds of model fit measures; goodness of fit test and predictive power (Allison, 2014). The distinctions between these two types of model fit measures are explained in section 5.1.2 above. This section only provides the result of the model fit tests.

The results of goodness of fit and predictive power tests are presented in table 40 below. The overall goodness of fit statistics shows the log likelihood value for the intercept only model (-379.465) and full model (-286.524) for the partial proportional odds model. A significant likelihood ratio chi-square test (LR χ^2 (26)) of 185.881; p-value = 0.000 signifies that the full model with all the variables included fits the data significantly better than the null model. The predictive power test result of the model (McFadden $R^2=0.245$) indicates that the partial proportional odds model used to analyze the data has a strong predictive power of the independent variables in explaining the outcome variable hygiene utilization. According to McFadden (1974) and Louviere et al. (2000), McFadden values between 0.2 and 0.4 should be taken to represent a very good fit of the model (cited in Smith & McKenna, 2013). Thus, McFadden R^2 value of 0.245 indicates that the model provides 25 % improvement in fit over the null model and it further indicates that the model has a good fit. Count $R^2 = 0.661$ also known as proportion of correct prediction indicates that the model has predicted around 66% of the observed data. 66% of correct prediction gives the impression that the model is predicting the changes in different hygiene utilization levels very well. An observation is positive if its predicted response is ≥ 0.5 (<http://www.stata.com/manual13/reclassification.pdf>).

Goodness of fit indices, on the other hand, compare partial proportional odds model, which is used to analyze the data with other models that are deemed appropriate to analyze categorical data. Literature recommends using the model with the smallest information criteria test as the best fitting model. However there is also a rule of thumb how high the difference between AIC and BIC of the different models should be to determine the best fitting model. If the difference between AICs and BICs of the different models is between 0-2, it provides substantial evidence to support the working /candidate model than the competing model (Burnham & Anderson, 2004 and Raftery, 1995). Thus, the information criteria test result in table 40 below shows that partial

proportional odds model (PPOM), which is the candidate model has the smallest AIC than the other competing models; POM and mlogit. Partial proportional odds model has also the smallest BIC compared to POM and Mlogit. Therefore, based on AIC and BIC results, partial proportional odds model has fitted the data better than POM (ologit) and mlogit.

Table 40: Model Fit Measures

Model			PPOM	POM	Mlogit
Overall goodness of fit	Log-likelihood	Model	-286.524		
		Intercept-only	-379.465		
	Chi-square	Deviance	(df=352)= 573.049		
		LR	(df=26)=185.881		
		p-value	0.000		
Predictive power	R ²	McFadden	0.245		
		McFadden (adjusted)	0.171		
		Cox-Snell/ML	0.387		
		Cragg-Uhler/Nagelkerke	0.448		
		Count	0.661		
		Count (adjusted)	0.275		
Goodness of fit indices	IC	AIC	629.049	685.886	630.284
		AIC divided by N	1.655	1.805	1.659
		BIC	(df=28)=739.373	(df=24)=780.4	(df=46)=811.532
			50		

Source: Author's Stata GOF test and fitstat estimation

6.2.3 Model Specification Test

Link test is used to check whether the partial proportional odds model is correctly specified and there is no model specification error. The result in table 41 shows that hat in both low hygiene utilization (p= 0.000) and medium hygiene utilization (p=0.007) is significant while hatsq is not significant. As the literature indicates, the variable hat should be a statistically significant predictor, since it is the predicted value from the model while the variable hatsq should not have much predictive power except by chance. Related to this, Mohd & Malik (2016) stated that non-significant hatsq tells the absence of any additional independent variables that are significant and the equation is free from specification error. Link test uses predicted independent variable (_hat) and linear predicted independent variable value squared (_hatsq) as the predictors to rebuild the

model. Hat square is the square of the independent variables in the regression. The model is re-estimated using these two variables as independent variable and significant hat and nonsignificant hatsq indicates the absence of model specification error (<http://www.stata.com/manuals13/rlinktest.pdf>).

Table 41: Model Specification test (link test)

Low		Coef.	Std. Err.	P>z	[95% Conf. Interval]
Hygiene Utilization	_hat	.88909	.1806326	0.000	[.5350566,1.243123]
	_hatsq	.0635003	.0673028	0.345	[-.0684107, .1954113]
	_cons	-.0543333	.2077607	0.794	[-.4615368, .3528702]
Medium Hygiene Utilization	_hat	.4979012	.1842639	0.007	[.1367506, .8590518]
	_hatsq	-.0474087	.0301945	0.116	[-.1065889, .0117715]
	_cons	-1.699625	.2723509	0.000	[-2.233423, -1.165827]
Log likelihood= -318.22179; N= 380; LR chi2 (4)=122.51, Prob > chi2= 0.0000;pseudo R² = 0.1614					

Source: Author's computation of Stata link test

6.3 Discussion

This section discusses the results of the study presented in this specific chapter. The chapter is intended to examine factors associated with women's level of hygiene access and utilization. The result shows that the variables woreda, age, participation in women health development team, education, wealth and income, frequency of health extension contact and household size are found to have statistically significant association with women's level of hygiene access while statistically significant association is not found between marital status, health information access, dependency ratio and women's level of hygiene access. Similarly, the variables woreda, climate age and education of the respondent, availability of hygiene facilities (hygiene access), frequency of health extension contact, knowledge of methods to treat drinking water at home, knowledge of reasons for hand washing after defecation and knowledge of how food can be contaminated are found to be determinants of women's hygiene utilization(practice).

The variable woreda has positive and statistically significant association with women's level of hygiene access. A respondent living in Gozamin woreda is 21.3% less likely to have low hygiene access and 10.7% more likely to have high hygiene access than a respondent living in Machakel woreda. In terms of hygiene utilization, however, a respondent who lives in Gozamin woreda is

on average, 80 % less likely to have high hygiene utilization and 90% more likely to have low hygiene utilization compared with a respondent who lives in Machakel woreda. The result signifies that there is inter woreda variation in terms of women's level of hygiene access and there is also a mismatch between women's hygiene access and utilization level which further implies that hygiene access is not always a guarantee for utilization. Though access to hygiene facilities is one determinant of women's hygiene utilization, it is not the only factor. Women's hygiene utilization is affected by different factors such as education, climate, location of residence (woreda), age and knowledge about specific hygiene and health related issues.

Participation in women health development team has positive and statistically significant association with women's level of hygiene access. A woman who participates in women health development team is on average 12.5% less likely to have low hygiene access and 13.5 % more likely to have high hygiene access compared with a woman who does not participate. Belonging to a social group increases social capital, idea and information exchange. Women who are member of health development team will learn from each other about the benefits and usage of new hygiene technologies and hence influenced to have the facilities in their household. The variables participation in women health development team and having health information access are believed to influence people's hygiene behavior by creating hygiene information and awareness. Since, this is related to the variable knowledge; they were dropped from the final model in analyzing women's hygiene utilization.

Education has positive and statistically significant association with women's level of hygiene access. A respondent with primary education is on average 9.1 % less likely to have low hygiene access and 12.5 % more likely to have high hygiene access than a respondent with no formal education. A respondent with secondary and above education is 12.3 % less likely to have low hygiene access than a respondent with no formal education. Education has significant negative effect on women's level of hygiene utilization. The result indicates that a respondent with secondary and above education is on average 18 % more likely to have low hygiene utilization and 20 % less likely to have high hygiene utilization than a respondent with no formal education. The result further shows that although education has positive effect on women's adoption of hygiene facilities, it has negative effect in terms of using the available hygiene facilities and materials. Education level of a woman is assumed to increase her ability to obtain process and

use hygiene information and practice better hygiene. However, the result indicates that formal education does not always bring a change in behavior and attitude. Empirical evidences show mixed results on the effect of education on the adoption of new hygiene technology and practices. A study by Dalila et al. (2017) reported that women with higher education level were found to have more hygiene behavior practice. Similarly, a study by Okunlola et al. (2011) on adoption of new technologies by fish farmers and Ajewole (2010) on adoption of organic fertilizers found a positive and significant influence of education on technology adoption. On the other hand, Uematsu and Mishra (2010) reported a negative influence of formal education towards adopting genetically modified crops (cited in Mwangi & Kariuki, 2015).

Age is found to have negative and statistically significant association with women's level of hygiene access and utilization. As the age of women increases, the probability of them having high hygiene access and utilization decreases. The result shows that middle adult women are on average, 12.4 % more likely to have low hygiene access and 20.5 % less likely to have high hygiene access compared with young women. Middle adult women are on average, 9.5 % more likely to have low hygiene utilization, 15.5 % more likely to have medium hygiene utilization and 25 % less likely to have high hygiene utilization compared with young women. Adult women are 17 % more likely to have low hygiene access and 25.5 % less likely/lower to have high hygiene access compared with young women. Adult women are 14 % more likely to have low hygiene utilization, 18 % more likely to have medium hygiene utilization and 32 % less likely to have high hygiene utilization. Old women are on average, 19 % less likely to have high hygiene utilization compared with young women. This could be explained by lack of labor and knowledge on the available health extension packages by old women, suggesting that older women need to be mentored about the available health extension technologies. The result here lend some empirical support to Armah et al. (2018) finding that revealed that households with middle aged adult and older aged adult were less likely to have access to improved water sources than households with young adult heads. Improved water sources are important means of improved hygiene.

Frequency of health extension contact is positively related with respondent's level of hygiene access and utilization. As frequency of health extension contact increases, the probability of the respondent to have high hygiene access and utilization also increases. More specifically, the

result indicates that as frequency of health extension contact increases by one day from the mean ($\bar{x} = 3.11$), the probability of having low hygiene access decreases on average by 3.8 %, and the probability of having medium hygiene access decreases on average by 0.71 % but the probability of having high hygiene access increases on average by 4.6 %. Similarly, as frequency of health extension contact increases by one day from the mean or for every one day increase in the frequency of health extension contact from the mean, the probability of having low hygiene utilization decreases on average by 1.7 %, the probability of having medium hygiene utilization decreases on average by 1.2 % and the probability of having high hygiene utilization increases on average by 2.9 %. Women are usually informed about the existence, effective use and benefit of hygiene technologies by health extension agents. Extension agents connect health technology researchers with users of that technology and thus expose women to information which later influence adoption. People will adopt technology which they are aware of or have heard about it and for enabling people to have information health extension agents and their rate of contact with users play a paramount role.

The variables knowledge of how water can be treated at home (OR=1.984, $P < 0.006$), knowledge of reasons for hand washing after defecation (OR=2.345, $P < 0.017$), and knowledge of how food can be contaminated at home (OR=3.194, $P < 0.006$), have positive significant effect on respondent's level of hygiene utilization. There are many plausible reasons to explain why specific hygiene related knowledge has statistically positive significant effect on respondents' level of hygiene utilization. One explanation could be that when people know about the cause of disease and preventive mechanism, their likelihood of hygiene utilization increases. On the contrary, when, people have low knowledge about the mechanisms of health prevention and risks of diseases, their likelihood of hygiene utilization decreases. The result here is in agreement with Hochbaum et al. (1950) health belief model. In their health belief model, Hochbaum & his colleagues claim that an individual is ready to use health services, if he/she believes that he/she will acquire diseases. The more susceptible a person feels, the greater the likelihood of her/him taking preventive measures. Specific knowledge about what, how and why of health issues is important in determining people's behavior. The issue of knowledge as a determinant factor for women's hygiene practice was also mentioned by many interview participants during the qualitative data collection. The quote transcribed below was captured from one of the interview

participants and it shows how lack of knowledge about the contamination of water contributes for lack of proper water hygiene practice.

We do not know if water can be contaminated. What will contaminate it? We have no clue if water can harm us. Once we checked that the water looks clean, then we use it. We only boil water to wash our feet at the evening or to wash our body to remove its cold character (interview participant 17, age 38 at yetjanshebalema kebele, Gozamin woreda, Feb, 2019).

Though occupation is not found to have statistical significant association with respondents' level of hygiene utilization, it was one of the most widely mentioned reasons for women's lack of hygiene practice in the study areas. Being in agricultural fields and being busy with the field work, women do not think of practicing hygiene. A direct quote from one of the interview participant at Debrekelemu kebele, Machakel woreda can be a good example in this context.

Hygiene belongs to the urban people not for us. If you wash now, you will get dirty back in a moment/ “tatbo cheka”. Washing hands while eating is unthinkable while we are in the field. First, we do not get water to wash our hand. Second we do not think of washing. All our thoughts are on our work. If we are hungry or in a hurry, we eat with dirty hands by simply rubbing and removing soil (interview participant 8, age 43, Debrekelemu kebele, Machakel woreda, March, 2019).

CHAPTER SEVEN: THE EFFECT OF SANITATION AND HYGIENE ACCESS AND UTILIZATION ON WOMEN EMPOWERMENT

Introduction

The previous chapters have examined women's level of sanitation and hygiene access and utilization and determinant factors. This chapter, on the other hand, discusses the empowering role of sanitation and hygiene access and utilization. Resources are preconditions for empowerment (Kabeer, 1999). For women to be empowered, the preconditions for empowerment in this case, sanitation and hygiene access and utilization are important. This chapter is, therefore, aimed to assess the effect of sanitation and hygiene access and utilization on women empowerment in terms of self-esteem, participation in rural health extension activities and household decision making. The dependent variable in the chapter is, thus, the cumulative/composite empowerment index composed of these three empowerment dimensions while the independent variables are access to and utilization of sanitation and hygiene facilities. The control variables are respondent's own age, education, occupation, income, wealth, household size, home plot ownership, participation in women health development team, access to health extension information and husband's education and occupation.

Women empowerment is ordinal in nature. Women are not at equal level of empowerment. Some are less empowered, others are moderately empowered and still more others are highly empowered. Thus, in order to evaluate the effect of sanitation and hygiene access and utilization on the likelihood of women's different level of empowerment, ordered logistic regression was run. Ordered logistic regression however evaluates results by testing proportionality assumption also known as parallel lines assumption. Brant test is the most widely used test of the proportional odds/ parallel lines assumption and the test has become significant in the primary analysis. According to Williams (2019), if brant test becomes significant, it shows that the model assumption is violated and the researcher has to use another model. Accordingly, generalized ordered logistic regression or partial proportional odds model is used to estimate the association between women's access to and utilization of sanitation and hygiene facilities and their empowerment level.

The analysis is made based on data collected from 325 currently married women using questionnaire. Marital status is one of the most important factors which influence women's empowerment. The analysis has, thus, excluded widowed and divorced women because it is believed that widowed and divorced women are more empowered than married women. Related to this, Rezapour & Ansari (2014) as cited in Grace (2018) argued that widowed and divorced women are more likely to be empowered than their married counterparts due to increase in decision making power on their resources as well as increase in freedom of movement.

7.1 The Empowerment Effect of Sanitation and Hygiene Access and Utilization

Table 43 presents the results of the generalized ordered logit estimates. Given that there are three ordinal empowerment categories; not empowered, relatively empowered and empowered, the model has provided a series of binary logistic regressions where categories of empowerment are collapsed into two panels. In the first panel, not empowered category is contrasted with relatively empowered and empowered categories. In the second panel, not empowered and relatively empowered categories are contrasted with empowered category. Each panel gives the results for coefficients (β) and the odds ratio estimates (e^{β}). Altogether, the model has estimated 8 coefficients; 7 in the first panel, and 1 in the second panel. The result indicates that the variables sanitation and hygiene utilization have positive and statistically significant association with women's level of empowerment while statistical significant association is not found between sanitation and hygiene access and women's level of empowerment.

Knowing that women's level of sanitation and hygiene utilization is predicted by their level of access to the required sanitation and hygiene materials, multicollinearity/correlation among the independent variables was suspected. Accordingly, multicollinearity test was conducted among the independent variables using Kendall's tau-b correlation coefficient. The result shows that there is no perfect correlation among the independent variables. Kendall's tau_b correlation coefficient (τ) is less than one for all the independent variables. Kendall's tau_b correlation coefficient between the variable sanitation access and sanitation utilization is $\tau = 0.724$; $p = 0.000$; indicating that the variables are not perfectly correlated as their correlation coefficient is less than 1. Kendall's tau_b correlation coefficient between the variable hygiene access and hygiene

utilization is $\tau = 0.154$; $p = 0.001$, also indicating absence of perfect correlation. According to Voorhees (1998) Kendall's Tau (τ) ≥ 0.9 indicates the presence of strong correlation between the two variables and 0.9 is considered as the threshold (cited in Sanderson & Soboroff, 2007). Based on this reference, the multicollinearity among the independent variables is not found to be severe and hence all the variables were included in the model.

The positive coefficient for sanitation utilization ($\beta = 0.6123$, $p = 0.0690$) in the first panel indicates that a woman who has medium level of sanitation utilization is more likely to be relatively empowered or empowered than a woman who has low level of sanitation utilization. On the other hand, the positive coefficient for sanitation utilization ($\beta = 0.6123$, $p = 0.0690$) in the second panel indicates that a woman who has medium level of sanitation utilization is more likely to be empowered than being relatively empowered or not empowered compared with a woman who has low level of sanitation utilization. Similarly, the positive coefficient for the variable sanitation utilization ($\beta = 1.1061$, $p = 0.0140$) in the first panel indicates that a woman who has high level of sanitation utilization is more likely to be relatively empowered and empowered than a woman who has low level of sanitation utilization. On the other hand, the positive coefficient for the variable sanitation utilization ($\beta = 1.8979$, $p = 0.0000$) in the second panel indicates that a woman who has high level of sanitation utilization is more likely to be empowered than being relatively empowered and not empowered compared with a woman who has low level of sanitation utilization.

Hygiene utilization has also positive and statistically significant association with women's level of empowerment. The positive coefficient for hygiene utilization ($\beta = 0.9164$, $p = 0.0150$) in the first panel indicates that a woman who has high level of hygiene utilization is more likely to be relatively empowered and empowered compared with a woman who has low level of hygiene utilization. On the other hand, the positive coefficient for hygiene utilization ($\beta = 0.9164$, $p = 0.0150$) in the second panel indicates that a woman who has high level of hygiene utilization is more likely to be empowered than being relatively empowered and not empowered compared with a woman who has low level of hygiene utilization.

Table 42: The Effect of Sanitation and Hygiene Access and Utilization on Women Empowerment

Empowerment		Not empowered VS Relatively empowered & Empowered				Not empowered & Relatively empowered VS Empowered			
Variables	Category	Coeff	Std.Err	OR	P>z	Coeff	Std.Err	OR	P>z
Sanitation access	High	-0.5054	.3664	0.6033	0.1680	-0.5054	.3664	.6033	0.1680
Sanitation utilization	Medium	.6123	.3368	1.8447	0.0690*	0.6123	.3368	1.8447	0.0690*
	High	1.1061	.4480	3.0227	0.0140**	1.8979	.4501	6.6717	0.0000***
Hygiene access	Medium	-.3541	0.3093	.7018	0.2520	-0.3541	.3093	.7018	0.2520
	High	-.5747	0.3561	.5628	0.1060	-0.5747	.3561	.5628	0.1060
Hygiene utilization	Medium	0.2412	0.344	1.2729	0.4830	0.2413	.3440	1.2729	0.4830
	High	0.9164	0.375	2.5003	0.0150**	0.9164	.3751	2.5003	0.0150**
_cons		-0.3156	0.7295	.7294	0.6650	-2.1485	.7373	.1167	0.0040

Log likelihood = -305.92689; N= 325; LR chi2 (20) = 101.83; Prob > chi2 = 0.0000; Pseudo R² = 0.1427

Note; Significance at the *10%, ** 5% and * 1% level. OR= Odds ratio**

Each estimated coefficient shows the effect of the observable category relative to the base/reference category. The base values are not shown here

Source: Author's own computation

7.1.1 Marginal Effects of independent variables on women empowerment

Table 44 below presents the marginal effect of each independent variable on the ordinal dependent variable; women empowerment. The result indicates that sanitation utilization has significant negative effect on women's level of empowerment at not empowered category and it has significant positive effect at empowered category. The average marginal effect for the variable ($dy/dx = -0.1196$) indicates that the probability of not being empowered decreases on average by 12% for a woman who has medium sanitation utilization compared with a woman who has low sanitation utilization, holding all others variables in the model constant. In other words, a respondent who has medium level of sanitation utilization is on average, 12 % less likely to be not empowered compared with a woman who has low sanitation utilization. Conversely, a woman who has medium level of sanitation utilization is on average, 9.8% more likely to be empowered compared with a woman who has low sanitation utilization. Put another way, the probability of being empowered increases on average by 9.8 % for a woman who has medium sanitation utilization compared with a woman who has low sanitation utilization.

Similarly, the average marginal effect for the variable sanitation utilization ($dy/dx = -0.2018$) indicates that the probability of not being empowered decreases on average by 20.2 % for a woman who has high sanitation utilization compared with a woman who has low sanitation utilization. The average marginal effect for the variable sanitation utilization ($dy/dx = -0.1548$) indicates that, the probability of being relatively empowered decreases on average by 15.5 % for a woman who has high sanitation utilization compared with a woman who has low sanitation utilization. On the other hand, the average marginal effect for the variable sanitation utilization ($dy/dx = 0.3566$) indicates that the probability of being empowered increases on average by 36% for a woman who has high sanitation utilization compared with a woman who has low sanitation utilization, holding all others variables in the model constant.

The average marginal effect for the variable hygiene utilization ($dy/dx = -0.1673$) indicates that the probability of not being empowered decreases on average by 17% for a woman who has high hygiene utilization compared with a woman who has low hygiene utilization. The average marginal effect for the variable hygiene utilization ($dy/dx = .1600$) indicates that the probability of being empowered increases on average by 16% for a woman who has high hygiene utilization compared with a respondent who has low hygiene utilization. In other words, a woman who has

high level of hygiene utilization is 16 % more likely to be empowered than a woman who has low level of hygiene utilization.

In sum the result indicates that, women who have better sanitation and hygiene utilization are more empowered than those who have low sanitation and hygiene utilization. This finding indicates that availability of material resources in this context sanitation and hygiene facilities does not automatically bring empowerment. Yet, utilization of available facilities does bring empowerment leading to the conclusion that utilization not access is a determinant factor for women empowerment. This could be explained by the fact that if there is latrine in the household and a woman is not using the latrine, there is still an issue of privacy, dignity and harassment and hence disempowerment. Conversely, if the woman is using the latrine, it provides her safety, security, privacy and dignity and hence empowerment. Additionally, if there is a protected private water source in the premises of a household and the woman is allowed to use it for drinking purpose only and do not use it for washing clothes, watering vegetables and for nourishing animals, the time spend to collect water is not yet reduced for her and she does not still get opportunity to empower herself.

In conclusion, the outcomes of the present study are not comparable with the existing literature as there is no scholarly work that has tried to measure the association between sanitation and hygiene access and utilization and women empowerment. The existing literatures are either qualitative in nature or they have focused only on a single indicator such as either latrine or water if quantitative. In this study, however, sanitation and hygiene are not measured with a single indicator making it difficult to compare the result with other prior studies. But, some non-composite studies show that latrine utilization has reduced violence against women which is one aspect of women empowerment. For instance, a study by Jadhav, Weitzman & Smith-Greenaway (2016) found that women who primarily defecate in the open field were 2.14 times more likely to face the risk of non-partner sexual violence than women who use latrine. Conversely, open defecation is found to have a statistically significant association with women's preterm birth and low birth rate (Padhi et al., 2015 cited in Saleem, Burdett & Heaslip, 2019). Some non-empirical assertions in the literature also indicated that investments in water, sanitation and hygiene have reduced the burden of unpaid work on women and girls, and facilitate participation in education, employment, leisure activities and decision making. Sanitation improvements at household level

are also reported to bring improved health and thus avoid costs due to sickness (disease treatment, transportation for having treatment and productive time loss) (World Bank, 2011). In fact, interview participants in this study have also mentioned different benefits they have got from using sanitation facilities. As an illustration, one of the interview participants explains how latrine utilization has improved her life as;

Previously, when we do not have latrine, we have to wait until dark to defecate. It was not good for us. ሴት ልጅ በቀን አትፀዳዳም በባህላችን ነፃ ስራ : ቢመጣብሽ እንኳ ቋጥረሽ መዋል ነው። /literary to mean culturally a woman cannot defecate at day time. Even if it persists and we have strong urge to defecate, we have to bear it and wait until late evening. A woman could only excrete twice a day; after sunset and before sunrise in the dark. When defecating in the dark, we were so much concerned about animal biting and ghost attack. Fearing of this, we will defecate just near to the backyard and this was not good for sight. Flies also breed there and flee all over the house. Next time when we could not get clean space in the backyard, we had to go far looking for space. Then, we have to see in every direction thinking what will come. Sometimes, if highly frightened, we will go home even before finishing. Sometimes we go to the field together with other family members. One will see the overall environment while the other defecates and vice versa. If we both have the urge to expel simultaneously, we will turn each other's back and excrete. This was done to monitor our environment. But now thanks to the health extension workers, they made us utilize latrine and we do not worry as before! All that has passed! Now, we can empty ourselves anytime we need. There is no worry or feeling of shame and insecurity like before. We do not even need others accompany even at night. We just have hand lantern and go there. When we are in menstruation, we can go and wash without being concerned about who has seen us. Our life is changed a lot (Interview participant in Amanuel Zuria kebel; Machekele woreda, age 40, 2019).

Besides the security, privacy and comfort women have got by using latrine as can be seen from the direct quote, the introduction of sanitation and hygiene technologies has brought a change in gender division of labor. The introduction of jerican as water collection tool has made men to fetch water more than ever before. Several women during the qualitative interview spoke that their husbands have changed a lot in terms of helping them in domestic tasks such as fetching water.

Table 43: Marginal Effect of Sanitation and Hygiene Access and Utilization on Women
Empowerment

Empowerment		Not empowered			Relatively Empowered			Empowered		
Variables		dy/dx	Delta- method SE	P>z	dy/dx	Delta- method SE	P>z	dy/dx	Delta- method SE	P>z
San access	High	.0917	.0647	.1560	-.0097	.0103	.3460	-.0821	.0562	.1440
San use	Medium	-.1196	.0647	.0650*	.0217	.0145	.1340	.0979	.0546	.0730*
	High	-.2018	.0767	.0080***	-.1548	.0521	.0030***	.3566	.0800	.000***
Hygiene Access	Medium	.0630	.0535	.2400	-.0092	.0052	.9830	-.0628	.0555	.258
	High	.1051	.0641	.1010	-.0058	.0090	.5160	-.0993	.0620	.1090
Hygiene Use	Medium	-.0478	.0686	.4870	.0092	.0152	.5450	.0386	.0538	.4740
	High	-.1673	.0699	.0170**	.0073	.0163	.6550	.1600	.0627	.0110**
Dy/dx for factor levels is the discrete change from the base level. Note: Significance at the *10%, ** 5% and *** 1% level.										

7.1.2 Model Fit measures

Model fit measures for the partial proportional odds model used in this section includes overall goodness of fit, predictive power measure and goodness of fit indices. Overall goodness of fit is measured by log likelihood ratio chi square test statistics and likelihood ratio chi square result (LR chi2 (20) = 101.829) with a significant p-value = 0.0000 in table 45 below indicates that the partial proportional odds model as a whole is statistically significant compared to the null model with no independent variables/predictors. That is, the full model with all the independent variables included has provided a better overall model fit than the null model with no independent variable. Similarly, the predictive power measure which indicates how well the dependent variable can be explained by the independent variables in the model is tested using McFadden R² also known as pseudo R². McFadden R² value of 0.143 as shown in the table below indicates that partial proportional odds model has a moderately strong predictive power of the independent variables in explaining the outcome variable. The model provides 14 % improvement in fit over the null model. According to McFadden (1974) and Louviere et al. (2000) as cited in Smith & McKenna (2013), McFadden values of between 0.2 and 0.4 should be taken to represent a very good fit of the model. Count R² also known as proportion of correct prediction with R² value of 0.572 indicates that the model has predicted around 57% of the

observed data. 57% of correct prediction gives the impression that the model is predicting the changes in different women empowerment levels very well. An observation is positive if its predicted response is ≥ 0.5 .

AIC and BIC goodness of fit indices are used to compare alternative models that could be applied to analyze the same data set. All else being equal, a model with a lower information criterion is considered as the better fitting model (Williams, 2019; Fabozzi, Focard, Rachev & Arshanapalli, 2014; Dziak, Coffman, Lanza & Li, 2012). Thus, as can be seen from the table below, partial proportional odds model has the smallest IC in both AIC and BIC than the other two competent models which are believed to analyze the categorical dependent variable; women empowerment. Both AIC and BIC tests provide substantial evidence that partial proportional odds model has fitted the data better than multinomial and ordered logistic regression models.

Table 44: Model fit measure

	Model		gologit2	ologit	mlogit
Overall model fit	Log-likelihood	Model	-305.927		
		Intercept-only	-356.841		
		Deviance (df=303)	611.854		
		LR (df=20)	101.829		
		p-value	0.000		
Predictive power measures (pseudo R²)	McFadden	0.143			
	McFadden (adjusted)	0.081			
	Cox-Snell/ML	0.269			
	Cragg-Uhler/Nagelkerke	0.303			
	Count	0.572			
	Count (adjusted)	0.347			
Goodness of fit indices	IC	AIC	655.854	665.913	668.927
		AIC divided by N	2.018	2.049	2.058
		BIC (df=22)	739.098	741.590	812.713

Source: Stata test

7.1.3 Model Specification Test

Like the predecessor chapters, this chapter has used link test for model specification test. The result presented in table 45 below shows that the partial proportional odds model used to analyze the data has been correctly specified and there is no model specification problem because _hatsq in both not empowered (P= 0.503) and relatively empowered (P=0.885) is not significant but hat in both not empowered (p= 0.000) and relatively empowered (p=0.001) categories is significant. Literature suggests that the variable _hat should be a statistically significant predictor while the variable _hatsq should not have much predictive power (Mohd & Malik,2017).

Table 45: Model Specification test (Link test)

Empowerment		Coef.	Std. Err.	P>z
Not empowered	_hat	.882383	.1966189	0.000
	_hatsq	.092399	.1378317	0.503
	_cons	-.042526	.1699035	0.802
Relatively empowered	_hat	1.07805	.3205988	0.001
	_hatsq	.021218	.1464729	0.885
	_cons	-.868767	.2316015	0.000
Log likelihood = -316.47331; N= 325; LR chi2 (4) = 80.74, Pseudo R² = 0.113; Prob > chi2 = 0.0000				

Source: stata link test

CHAPTER EIGHT: CONCLUSION AND RECOMMENDATION

8.1 Conclusion

Women have specific sanitation and hygiene needs as an individual for themselves and as care takers of their families. Menstruation, pregnancy, childbirth and associated roles all create women specific sanitation and hygiene necessities. Traditional gender divisions of labor also make women to be responsible for the sanitation and hygiene needs of their families. With this in mind, the rural health extension program of Ethiopia gives greater emphasis to women and targeted them as both service providers and beneficiaries. Given the important link women have with sanitation and hygiene, empirical studies on their access to and utilization of the said facilities are limited. There are few qualitative studies that have paid attention to the gender variations in access and utilization of sanitation and hygiene facilities while many quantitative studies are made at household level where sanitation and hygiene access and utilization are assumed to be equal for all household members. Yet, different factors play against women's equitable access and utilization of sanitation and hygiene facilities. Access to and utilization of sanitation and hygiene facilities are also claimed to empower women but there are limited empirical evidences that can prove this. Impact evaluations of sanitation and hygiene interventions have focused on direct health benefits and non-health benefits such as women empowerment did not get enough attention. Additionally, the role of women empowerment in achieving better sanitation and hygiene access is researched well while how better sanitation and hygiene access and utilization has contributed for women empowerment is under researched area. On the contrary, empowerment has become one of the goals of sanitation and hygiene interventions. Literature also shows that resources are preconditions for women empowerment. This study is, therefore, aimed at assessing the level of women's access to and utilization of sanitation and hygiene facilities identify their determinant factors, and determine the effect of sanitation and hygiene access and utilization on women empowerment. In doing so, the study contributes knowledge to the field, and fills the gap in literature. The study is carried out in two woredas of East Gojjam zone, Amhara region using mixed methods research approach. Based on the quantitative and qualitative results obtained from the study, the following conclusions are made:

First, there is a mismatch between sanitation access at household level and women's utilization status. Some women who have the sanitation facilities in their household do not use the available facilities. This could be seen as women's freedom or choice and hence empowerment, because the individual has opted for not to use the available facilities. However, there are different explanations for women's non utilization of the available sanitation facilities and the explanations are different depending on the sanitation technology. Unpleasant smell of latrine, presence of flies and distance from the house were some of the factors for women's non-utilization of latrine while lack of durability on the part of liquid waste disposal pits, their small size nature and filling of easily, and presence of enough open space in their compound were reasons for the non-utilization of liquid waste disposal pits even if the pits were physically available in the household. Besides, the non-utilization of available facilities, there are also households who do not have the sanitation facilities at all and lack of financial and non-financial resources such as time, labor, and technical skill were appealed to be among the factors that influence sanitation access. Lack of demand for the low-cost sanitary technologies and related drawbacks and aspiration for better sanitation facilities such as large waste pits that would not fill easily, and a latrine made from cement have also inhibited some respondents not to have the sanitation facilities. In brief, technological and economic factors have influenced women's access to and utilization of sanitation facilities.

Second, a large majority of respondents have medium hygiene access and utilization level and the result is expected as the study areas are rural and there is low hygiene practice in rural areas overall. Therefore, there is still a need to strengthen the rural health extension program and its associated sanitation and hygiene related promotion and communication services. Psychological factors such as being familiar with the water source and the belief that it has not caused any health related problem, not liking the color and test of water treated via boiling and attributes of hygiene facilities themselves specifically clean looking water based on its color and physical appearance were found to be among the factors for the non- treatment of drinking water at home. The water warming character of narrow neck water container namely, jerrican and the difficulty to clean its inside were also reasons for some women's non-utilization of narrow neck water container which is highly promoted by the health extension program. Lack of access to hygiene products and chemicals, such as ceramic filters and wuha agar to treat drinking water at home has inhibited women's practice of hygiene. Unavailability of modern menstrual hygiene

management materials in rural areas, lack of information and knowledge about the available materials and how to use them were also found to be factors that impede women's access to and utilization of menstrual hygiene management materials.

Third, women's level of sanitation and hygiene access is determined by place of residence (woreda), income, wealth, household size, frequency of health extension contact, and participation in women health development team. Conversely, marital status, occupation and dependency ratio are found to have statistical significant association with women's level of sanitation access but have no significant effect on women's level of hygiene access. Similarly, education and age of women have statistically significant effect on women's level of hygiene access but no significant effect on their sanitation access.

The variable woreda, climate, age, education and frequency of health extension contact are found to have statistically significant association with women level of hygiene utilization but are not significant determinants of women's level of sanitation practice. In sum, some variables have mixed effect on women's level of sanitation and hygiene access and utilization. For instance, the variable education has statistically significant association with women's level of hygiene access and utilization but it is insignificant with women's level of sanitation access and utilization. Therefore, appropriate emphasis should be given for such variables accordingly when promoting sanitation and hygiene technologies. Education is believed to have a significant influence on women's behavior particularly of practicing safe sanitation activities. As women's educational status increases, their knowledge on the cause of diseases, their transmission and prevention mechanisms are believed to increase. And, an increase in knowledge is supposed to motivate women to adopt and practice better sanitation behaviors. This, however; is not the case when it comes to women's level of sanitation access and utilization in the present study. Educational status of women is not found to have a statistically significant association with their level of sanitation access and utilization. Conversely, a behavioral factor such as knowledge about the benefit of latrine utilization is found to have a statistically significant association with women sanitation practice indicating how formal schooling does not always bring a change in behavior while knowledge about the health benefit of safe sanitation practice has significant effect on women's sanitation utilization.

Fourth, the mere presence of sanitation and hygiene facilities does not empower women but the actual utilization of the facilities do so. To put it more simply, a woman who has high level of sanitation utilization is more likely to be empowered than a woman who has low level of sanitation utilization. Statistical significant association is not found between sanitation and hygiene access and women's level of empowerment. This implies that access is an opportunity for women to use sanitation and hygiene facilities while utilization enables them to actually exercise their rights and hence become empowered.

8.2 Recommendations

Massive sanitation and hygiene facility coverage supported by knowledge creation on the benefit of sanitation and hygiene facility utilization and the adverse health impact of non-utilization need to be strengthened and the rural health extension program should sustain. Increasing people's awareness about perceived risk or vulnerability to disease if they do not practice sanitation is one way to make people practice proper sanitation behaviors. The more susceptible a person feels, the greater the likelihood of taking preventive measures. Thus, the government should strengthen its work towards increasing individual's understanding and awareness of the health risk of not practicing the appropriate sanitation and hygiene behavior. Utilization of sanitation and hygiene facilities should also be monitored not only facilities built. Besides, the health extension workers and women health development teams, the government can initiate sanitation and hygiene behavior change campaigns using community-level activities, mobile voice messages and community radio. In order to increase latrine ownership in rural India, the Indian government in 2005 has used the slogan "No Toilet, No Bride" as a social marketing campaign. The campaign has encouraged women and their families to demand latrine as a prerequisite for marriage. The campaign has increased latrine ownership by 21% from 2004-2008 (Stopnitzky, 2017). A similar strategy can be used in Ethiopia and sanitation and hygiene issues can be incorporated as one precondition for undertaking marriage in rural areas. Marriage proposers should show certificates verifying their ownership of basic sanitation and hygiene facilities such as latrine, protected drinking water source, separate housing for people and domestic animals and bathing facilities. This will make sanitation and hygiene a social norm in the long run.

The inability to pay for sanitation and hygiene infrastructures particularly latrine and private protected water sources was commonly reported among some participants as a cause for their

lack of the facilities. The government should, thus, subsidize selected sanitation and hygiene facilities, materials and infrastructures such as providing corrugate and cement slabs for latrine, providing drinking water disinfection chemicals such as water guard (wuha agar) for water treatment at home and drinking water filtration materials such as ceramic filters, assisting households with the development of protected private water wells and hand pumps including identification of ground water sources, and provision of menstrual hygiene management materials for women in rural areas. Besides, subsidizing, the government should also strengthen households' income and wealth creation capacity through different rural livelihood schemes. Safe sanitation and hygiene decreases the overall public health burden and reduces health sector costs. Poor sanitation and hygiene, on the other hand, is associated with poor health and wellbeing. Poor health brings reduction in productivity and high health care cost. For this reason, subsidizing sanitation and hygiene infrastructures together with diversification of income sources is a viable option. The government can organize the rural unemployed youth to engage in sanitation marketing where the youth can produce cement slabs for latrines, dig and install latrines as well as dig drinking water wells. In doing so, households who can afford to pay but have no enough labor and skill to do so can benefit.

The government can provide incentives for better sanitation and hygiene performers and disincentives for bad performance. Though the experience is there, it needs to be strengthened and provided together with behavior change communications intended to change in mindset and make better sanitation and hygiene a social norm. Women health development team should also be strengthened and sustained.

Further policy research as well as intervention is also required on the quality of sanitation and hygiene technologies promoted and their acceptability by the people should be assessed rigorously as demand for better sanitation and hygiene technologies was identified as one determinant of women's sanitation and hygiene access and utilization.

The characteristics of sanitation and hygiene technologies in influencing utilization outcomes were not considered in the inferential statistics used in this study. Thus, further research is required on the association between technology related factors and women's level of sanitation and hygiene access and utilization.

Mismatches between people's expectation and the services actually delivered are important determinants of health service utilization. Safe drinking water and land may be a priority for women and the extension workers telling them to adopt latrine and use narrow neck water container may not be acceptable. Therefore, further research can be done to identify the prior needs of the community, and device interventions accordingly by working together with other concerned sectors.

Future studies can widen the range of variables such as perception and attitude, household decision making power, social norms, traditional gender division of labor and see their association with women's level of sanitation and hygiene access and utilization.

The effect of sanitation and hygiene access and utilization on women empowerment can be studied by incorporating other empowerment indicators such as economic and political empowerment. When women get better sanitation and hygiene access, they will have time to engage in other income earning activities, and their participation in local politics will also improve and this could be studied inferentially.

Although questionnaire surveys have been the most commonly used instruments to measure hygiene behaviors, the use of extended observations might be more helpful to understand people's sanitation and hygiene behavior. There is disagreement in some of the observed hygiene behaviors and what was reported by participants. For instance, a respondent who reported as washing her hand always before serving food was observed serving food with no hand washing indicating that there might be evidence of over-reporting of desired hygiene behaviors than what is actually practiced. Therefore, further studies on whether to use questionnaire or observation to better understand people's hygiene and sanitation behavior may be necessary.

References

- Abate Bekele, Mesele Abrha, Zinau Gebrezgi, Dejen Yemane (2018). Availability and utilization of sanitation facilities in Enderta district, Tigray, Ethiopia. *Journal of preventive medicine and hygiene*, 59(3), doi: 10.15167/2421-4248/jpmh2018.59.3.826
- Abu, T., Bisung, E., & Elliott, S. (2019). What if your husband doesn't feel the pressure? an exploration of women's involvement in wash decision making in Nyanchwa, Kenya. *International Journal of Environmental Research and Public Health*, 16(10), 1763. doi: 10.3390/ijerph16101763
- Adane Nigusie, Resom Berhe & Molla Gedefaw (2015). Prevalence and associated factors of active trachoma among children aged 1–9 years in rural communities of Gonji Kulella district, West Gojjam Zone, North West Ethiopia. *BMC Research Notes*, 8(1). doi: 10.1186/s13104-015-1529-6.
- Aday LA, Andersen R. (1974). A framework for the study of access to medical care. *Health Service Research*, 9 (3), 208–220.
- Aday, L.A, and Shortell, S.N (1988). Indicators and predictors of health services utilization. In Williams and Torrey (ed), *Introduction to Health Services*, 3rd Edition. New York. John Wiley & Sons.
- African Union (2011). African Women's decade. Retrieved from <http://au.int/en/documents-43>.
- Agresti, A. & Tarantol, C. (2018). Simple ways to interpret effects in modeling ordinal categorical data. *Statistica Neerlandica*, 72(3), 210-223. <https://doi.org/10.1111/stan.12130>
- Agresti, A. (2007). *An Introduction to Categorical Data Analysis (2nd ed)*. John Wiley & Sons, Inc., Hoboken, New Jersey.
- Aiemjoy, K., Stoller, N. E., Sintayehu Gebresillasie, Ayelew Shiferaw, Zerihun Tadesse, Tegene Sewent ... 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
- Akpakli, D., Manyeh, A., Akpakli, J., Kukula, V., & Gyapong, M. (2018). Determinants of access to improved sanitation facilities in rural districts of southern Ghana: evidence from Dodowa health and demographic surveillance site. *BMC Research Notes*, 11(1). doi: 10.1186/s13104-018-3572-6
- Akter, T., Jhohura, F., Chowdhury, T., Akter, F., Mistry, SK., Rahman, A. (2015). Measuring the status of household water, sanitation and hygiene behaviors in rural Bangladesh: An application of qualitative information system. *Journal of Tropical Medicine & International Health*, 20(1), 1-147.
- Allendorf, K. (2007). Do women's land right promote empowerment and child health in Nepal? *Journal of World Development*, 35(11), 1975-1988. doi:10.1016/j.worlddev.2006.12.005.
- Allison, P. D. (2014). Measures of fit for logistic regression. *Global Forum Paper 1485-2014 Statistical Horizons LLC and the University of Pennsylvania*.

- Alula Seyum, Dejene Ermias , Terefe Markos , Abinet Arega & Bazie Mekonnen (2018). Knowledge, attitude and practice on hand washing and associated factors among public primary schools children in Hosanna town, Southern Ethiopia. *Journal of Public Health and Epidemiology*, 10(6), 205-214. doi: 10.5897/jpche2017.0987.
- Amhara National Region State Bureau of Finance and Economic Development, Annual statistical bulletin, 2009/2010. Bahir Dar, Ethiopia.
- Anthonj, C., Rechenburg, A., & Kistemann, T. (2016). Water, sanitation and hygiene in wetlands. A case study from the Ewaso Narok Swamp, Kenya. *International Journal of Hygiene and Environmental Health*, 219(7), 606-616. doi: 10.1016/j.ijheh.2016.06.006.
- Antrobus, P. (2004). *The global women's movement : issues and strategies for the next century*. Zed Books Ltd.
- Armah, F., Ekumah, B., Yawson, D., Odoi, J., Afitiri, A., & Nyieku, F. (2018). Access to improved water and sanitation in sub-Saharan Africa in a quarter century. *Heliyon*, 4(11), doi:10.1016/j.heliyon.2018.e00931.
- Aunger, R., Greenland, K., Ploubidis, G., Schmidt, W., Oxford, J., & Curtis, V. (2016). The determinants of reported personal and household hygiene behavior: a multi-country study. *PLOS ONE*, 11(8). doi: 10.1371/journal.pone.0159551.
- Awunyo-Akaba, Y., Awunyo-Akaba, J., Gyapong, M., Senah, K., Konradsen, F., & Rheinländer, T. (2016). Sanitation investments in Ghana: An ethnographic investigation of the role of tenure security, land ownership and livelihoods. *BMC Public Health*, 16(1). doi: 10.1186/s12889-016-3283-7.
- Babitsch, B., Gohl, D., & von Lengerke, T. (2012). Re-revisiting Andersen's behavioral model of health services use: A systematic review of studies from 1998-2011. *Psycho-social medicine*. 9. <https://doi.org/10.3205/psm000089>
- Barron, M. (2014). Econometric Tools 2: Marginal Effects in Stata. University of California, Retrieved from <https://www.ocf.berkeley.edu/~manuelb/week7/LectureNotes07.pdf>.
- Berhanu Nega, Berhanu Adenew, Gebre-Selassie (2013). Current land policy issues in Ethiopia. *Ethiopian Economic Policy Research Institute, Addis Ababa, Ethiopia*. Accessed from <http://www.fao.org/3/y5026e/y5026e08.htm>
- Beselam Tadesse, Alemayehu Worku, Abera Kumie, & Solomon Abebe (2017). Effect of water, sanitation and hygiene interventions on active trachoma in North and South Wollo zones of Amhara Region, Ethiopia: A quasi-experimental study. *PLOS Neglected Tropical Diseases*, 11(11), e0006080. Doi: 10.1371/journal.pntd.0006080.
- Bilal, N., Herbst, C. H., Zhao, F., Soucat, A., & Lemiere, C., (2011). Health extension workers in Ethiopia: Improved access and coverage for the rural poor. In M. Angwafo & P. Chuhan-Pole (Eds.), *Yes Africa can: success stories from a dynamic continent*. The World Bank, Washington DC.
- Billig, P., Bendahmane, D. & Swindale, A. (1999). Water and Sanitation Indicators Measurement Guide. Title 2 Indicator Guides: USAID Food and Nutrition Technical Assistance Project. Impact indicators for measuring water and sanitation-related program performance. Retrieved from https://ec.europa.eu/echo/files/evaluation/watsan2005/annex_files/USAID/USAID1%20-%20Water%20and%20sanitation%20indicators%20measurement.pdf.

- Bisung, E., & Elliott, S. (2016). Psychosocial impacts of the lack of access to water and sanitation in low- and middle-income countries: a scoping review. *Journal of Water and Health*, 15(1), 17-30. Doi: 10.2166/wh.2016.158.
- Biswas, T., & Kabir, M. (2004). Measuring women's empowerment: Indicators and measurement techniques. *Social Change*, 34(3), 64-77. doi: 10.1177/004908570403400305.
- Bizuayehu Alemu (2014). *Practices, challenges and prospects of agricultural land management in Machakel woreda, East Gojjam Zone, Ethiopia* (Master's thesis). Addis Ababa University, Addis Ababa, Ethiopia.
- Brant, R. (1990). Assessing proportionality in the proportional odds model for ordinal logistic regression. *Biometrics*, 46(4), 1171. doi: 10.2307/2532457
- Budhathoki, S.S, Shrestha, G., Bhattachan, M., Singh ,S.B, Jha, N.& Pokharel, P.K. (2017). Latrine coverage and its utilization in a rural village of Eastern Nepal: a community-based cross sectional study. *BMC Research Notes* 10(209). <https://doi.org/10.1186/s13104-017-2539-3>.
- Canavan, M., Linnander, E., Ahmed, S., Mohammed, H., & Bradley, E. (2017). Unit costing of health extension worker activities in Ethiopia: A model for managers at the district and health facility level. *International Journal of Health Policy and Management*, 7(5), 394-401. doi: 10.15171/ijhpm.2017.102.
- Canberra Group Handbook (2011). *Handbook on Household Income Statistics (2nded.)*. [e-book].Retrievedfrom <https://www.unece.org/fileadmin/DAM/stats/documents/ece/ces/2011/3.add.1.e.pdf>.
- Carrard, N., Crawford, J., Halcrow, G., Rowland, C., & Willetts, J. (2013). A framework for exploring gender equality outcomes from WASH programmes. *Waterlines*, 32(4), 315–333. <https://doi.org/10.3362/1756-3488.2013.033>.
- Castro, F., Kellison, J., Boyd, S., & Kopak, A. (2010). A methodology for conducting integrative mixed methods research and data analyses. *Journal of Mixed Methods Research*, 4(4), 342-360. <http://dx.doi.org/10.1177/1558689810382916>
- Central Statistical Agency (CSA) (2013). “Population Projection of Ethiopia for All Regions at Woreda Level from 2014 - 2017,” Addis Ababa.
- Central Statistical Agency (CSA) [Ethiopia] and ICF (2016). Ethiopia Demographic and Health Survey. Addis Ababa, Ethiopia, and Rockville, Maryland, USA.
- Chakraborty, N., Fry, K., Behl, R., & Longfield, K. (2016). Simplified asset indices to measure wealth and equity in health programs: A reliability and validity analysis using survey data from 16 countries. *Global Health Science and Practice*, 4(1), 141-154.Doi: 10.9745/ghsp-d-15-00384.
- Chidziwisano, K., Slekiene, J., Kumwenda,S., Mosler, HJ., & Morse, T. (2019). Toward complementary food hygiene practices among child caregivers in rural Malawi. *The American Society of Tropical Medicine and Hygiene*,101(2),294–303 doi: 10.4269/ajtmh.
- Cohen, J., Cohen, P., West, S. G., & Aiken, L. S. (2003). *Applied Multiple Regression/Correlation Analysis for the Behavioral Sciences (3rded.)*. Mahwah, NJ: Erlbaum.
- Coombes, Y., & Devine, J. (2010). Introducing FOAM: A framework to analyze handwashing behaviors to design effective handwashing programs. Washington DC: The World Bank, Water and Sanitation Program.

- Cooten, M., Selamawit Bilal, Samson Gebremedhin, & Spigt, M. (2018). The Association between acute malnutrition and water, sanitation, and hygiene among children aged 6–59 months in Rural Ethiopia. *Maternal & Child Nutrition*, 15(1). Doi: 10.1111/mcn.12631.
- Córdova, A. (2009). Methodological note: Measuring relative wealth using household asset indicators. *Americas Barometer Insights*, 6. Retrieved from <https://www.vanderbilt.edu/lapop/insights/I0806en.pdf>.
- Cornelißen, T. (2005). Standard errors of marginal effects in the heteroskedastic probit model. Retrieved from http://diskussionspapiere.wiwi.uni-hannover.de/pdf_bib/dp-320.pdf.
- Creswell, J.W, and Plano Clark, V. (2007). *Designing and conducting mixed methods research*. Thousand Oaks, CA: Sage
- Creswell, J.W. (2006). Choosing a mixed methods design. Retrieved from https://www.sagepub.com/sites/default/files/upm-binaries/10982_Chapter_4.pdf.
- Creswell, J.W., Plano Clark, VL. Gutmann, ML. & Hanson, WE (2003). Advances in mixed methods research designs. In A., Tashakkori & C. Teddlie (Eds.), *Handbook of mixed methods in social and behavioral research*. SAGE; Thousand Oaks, CA: 209-240.
- Cueto, M.(2004). The Origins of primary health care and selective primary health care. *American Journal of Public Health*, 94(11). doi: 10.2105/ajph.94.11.1864.
- Cumberland, P., Girum Hailu, G., & Todd, J. (2005). Active trachoma in children aged three to nine years in rural communities in Ethiopia: prevalence, indicators and risk factors. *Transactions of the Royal Society of Tropical Medicine and Hygiene*, 99(2), 120–127. <https://doi.org/10.1016/j.trstmh.2004.03.011>.
- Daniel Weldegebriel (2012). Land rights in Ethiopia: Ownership, equity, and liberty in land use rights. FIG working week 2012 knowing to manage the territory, protect the environment, evaluate the cultural heritage Rome, Italy, May 6-10, 2012.
- Dasuki, S., Abbott, P., & Azerikatoa, D. (2013). ICT and empowerment to participate. *Information Development*, 30(4), 321-331. doi: 10.1177/02666666913485259.
- Davidson, R. & MacKinnon, JG. (1984). Convenient specification tests for logit and probit models. *Journal of Econometrics*, 25:241–262.
- Deb, B. C., Sircar, B. K., Sengupta, P. G., Mondal, S. K., Gupta et al (1986). Studies on interventions to prevent eltor cholera transmission in urban slums. *Bulletin of the World Health Organization*, 64 (1): 127-131.
- Dereje Gorfu & Eshetu Ahmed (n.d). Crops and Agro-ecological Zones of Ethiopia. Ethiopian Institute of Agricultural Research, Addis Ababa.
- Dery, F., Bisung, E., Dickin, S., & Dyer, M. (2019). Understanding empowerment in water, sanitation, and hygiene (WASH): a scoping review. *Journal of Water, Sanitation and Hygiene for Development*. <https://doi.org/10.2166/washdev.2019.077>
- Desalegn Amenu, Sissay Menkir & Tesfaye Gobena (2013). Assessment of Water Handling Practices among Rural Communities of Dire Dawa Administrative Council, Dire Dawa, Ethiopia. *Science, Technology and Arts Research Journal*, 2(2), 75. Doi: 10.4314/star.v2i2.98891
- Devine, J. (2009). Introducing SaniFOAM: A Framework to Analyze Sanitation Behaviors to Design Effective Sanitation Programs. Washington DC: The World Bank, Water and Sanitation Program.
- Dreibelbis, R., Winch, P., Leontsini, E., Hulland, K., Ram, P., Unicomb, L., & Luby, S. (2013). The Integrated Behavioral Model for Water, Sanitation, and Hygiene: a systematic

- review of behavioral 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.
- Dziak, J.J, Coffman, D. L., Lanza, S.T, Li, R. (2012). Sensitivity and specificity of information criteria. The Methodology Center and Department of Statistics. The Pennsylvania State University. Retrieved from <https://www.methodology.psu.edu/files/2019/03/12-119-2e90hc6.pdf>.
- Evans, B. (2005). “Securing sanitation”--The compelling case to address the crisis, in report by the Stockholm International Water Institute (SIWI) to the Norwegian Government. Stockholm, Sweden. Retrieved from <https://www.siwi.org/publications/securing...>
- Fabozzi, F.J, Focardi, S. M., Rachev,T., Arshanapalli, B. (2014). Model selection criterion: AIC and BIC. *The basics of Financial Econometrics*, 399-403. <https://doi.org/10.1002/9781118856406.app5>.
- Fagerland, M. W., & Hosmer, D. W. (2012). A goodness-of-fit test for the proportional odds regression model. *Statistics in Medicine*, 32(13).<https://doi.org/10.1002/sim.5645>.
- Farouque M. G. and Sarker M. A. (2018). Farmers’ knowledge and practice of organic vegetable cultivation: A field level study of two villages from Bangladesh. *Journal of Agricultural Extension and Rural Development*, 10(5), 99-107. doi: 10.5897/JAERD2018.0948.
- Fiedler, J. L. 1981. A review of the literature on access and utilization of medical care with special emphasis on rural primary care. *Medical Economics* 15(3):129–42.
- Fikralem Alemu, Abera Kumie, Girmay Medhin, Teshome Gebre & Phoebe Godfrey (2017). A socio-ecological analysis of barriers to the adoption, sustainability and consistent use of sanitation facilities in rural Ethiopia. *BMC Public Health*,17(706), <https://doi.org/10.1186/s12889-017-4717-6>.
- Flores, Ó., Jiménez, A. & Pérez-Foguet, A. (2013). Monitoring access to water in rural areas based on the human right to water framework: a local level case study in Nicaragua. *International Journal of Water Resources Development*, 29(4), 605-621. doi: 10.1080/07900627.2012.757017.
- Flores Baquero, O., Jiménez Fdez. de Palencia, A., & Pérez Foguet, A. (2015). Measuring disparities in access to water based on the normative content of the human right. *Social Indicators Research*, 127(2), 741-759. doi: 10.1007/s11205-015-0976-8
- FMOH (2016). National Hygiene and Environmental Health Strategy (2016-2020). Accessed from https://www.cmpethiopia.org/media/hygiene_and_environmental_health_strategy_2
- Fukuda-Parr, S. (2011). Theory and Policy in International Development: Human development and capability approach and the Millennium Development Goals. *International Studies Review*, 13(1), 122–132. doi:10.1111/j.1468-2486.2010.01003.
- Gedamu Kassie, G. (2017). Assessment of water handling and sanitation practices among rural communities of Farta woreda, Northwest Ethiopia. *American Journal of Health Research*, 5(5), 119. <https://doi.org/10.11648/j.ajhr.20170505.11>
- Geere, J.L., Hunter, P.R. & Jagals, P (2010). Domestic water carrying and its implications for health: A review and mixed methods pilot study in Limpopo Province, South Africa. *Environmental Health*, 9 (52). doi.org/10.1186/1476-069X-9-52
- Gehlert, S., & Browne, TA. (2019). *Handbook of health social work* (3rded.). John Wiley & Sons, Inc.

- Getachew Tadesse (1990). Ethiopia: The course is charted. In E. Tarimo & A. Creese (Eds.), *Achieving health for all by the year 2000: Midway reports of country experiences* (pp.80-97). World Health Organization.
- Génevaux, C., Mateus, A., Le Jallé, C., Allély, D., Dussaux, V., Aubourg, G., ...Gabrielle (2018). The Sustainable Development Goals for Water and Sanitation Services Interpreting the Targets and Indicators. Retrieved from https://www.pseau.org/outils/ouvrages/ps_eau_the_sustainable_development_goals_for_wash_services.pdf
- Gozamen Woreda Agricultural and Rural Development Office Annual Report (2014). Debre markos.
- Giné Garriga, R., Pérez Foguet, A., (2013a). Unravelling the linkages between water, sanitation, hygiene and rural poverty: The WASH poverty index. *Water Resource Management*, 27(5),1501-1515.
- Giné Garriga, R., Pérez Foguet, A., (2013b) Water, sanitation, hygiene and rural poverty: issues of sector planning and the role of aggregated indicators. *Water Policy*, 15(6),1018-1045.
- Graham, JP., Hirai, M., Kim, S-S (2016). An analysis of water collection labor among women and children in 24 Sub-Saharan African Countries. *PLoS ONE*, 11(6): e0155981. <https://doi.org/10.1371/journal.pone.0155981>.
- Gray, A. (2001). Definitions of crowding and the effects of crowding on health: A literature review. Retrieved from <https://msd.govt.nz/.../2001-definitions-of-crowding.pdf>.
- Greco, S., Ishizaka, A., Tasiou, M., & Torrissi, G. (2018). On the Methodological Framework of Composite Indices: A Review of the Issues of Weighting, Aggregation, and Robustness. *Social Indicators Research*, 141(1), 61-94. doi: 10.1007/s11205-017-1832-9
- Greene, W., & Hensher, D. (2008). Modeling ordered Choices: A primer and recent developments. *SSRN Electronic Journal*. Doi: 10.2139/ssrn.1213093.
- Gross, E., & Günther, I. (2014). Why do households invest in sanitation in rural Benin: Health, wealth, or prestige? *Water Resources Research*, 50(10), 8314–8329. <https://doi.org/10.1002/2014wr015899>.
- Guffey, D. (2012). Hosmer-Lemeshow goodness-of-fit test: Translations to the cox proportional hazards model (Master's thesis). University of Washington.
- Gujarati, D.N. (2004). *Basic Econometrics* (4th ed.). McGraw-Hill, New York.
- Guna, S., Nithiya & Karupiah, Premalatha & Parthiban, S.G. (2015). The capability approach: comparing Amartya Sen and Martha Nussbaum: USM international social sciences conference 2015, at Penang. Retrieved from <https://www.w.academia.edu/21483549>.
- Hadley, C., Tefera Belachew, Lindstrom, D., & Fasil Tessema (2011). The Shape of things to come? Household dependency ratio and adolescent nutritional status in rural and urban Ethiopia. *American Journal of physical anthropology*, 144(4), 643–652. <https://doi.org/10.1002/ajpa.21463>.
- Hair, J. F. Jr., Anderson, R. E., Tatham, R. L. & Black, W. C. (1995). *Multivariate Data Analysis* (3rd ed.). New York: Macmillan.
- Hall, R., Van Koppen, B., & Van Houweling, E. (2013). The human right to water: The importance of domestic and productive water rights. *Science and Engineering Ethics*, 20(4), 849-868. doi: 10.1007/s11948-013-9499-3.

- Hashemi, S. M., Schuler, S. R., & Riley, A. P. (1996). Rural credit program and women's empowerment in Bangladesh. *World Development*, 24(4), 635-653.
[https://doi.org/10.1016/0305-750x\(95\)00159-a](https://doi.org/10.1016/0305-750x(95)00159-a).
- Hirai, M., Graham, J., & Sandberg, J. (2016). Understanding women's decision making power and its link to improved household sanitation: the case of Kenya. *Journal of Water, Sanitation and Hygiene for Development*, 6(1), 151-160. doi: 10.2166/washdev.2016.128.
- Hoek, W., Evans, B., Bjerre, J., Calopietro, M. & Konradsen, F. (2010). Measuring progress in sanitation-reaching the MDG target for sanitation in Africa - a call for realism. Retrieved from <https://www.researchgate.net/publication/284885043>.
<https://policy-practice.oxfam.org.uk/publications/...>
- Hu, h., Shao, J. & Palta, M. (2006). Pseudo-R² in Logistic Regression Model. *Statistica Sinica* 16,847-860. University of Wisconsin-Madison.
- Hulland, K., Leontsini, E., Dreibelbis, R., Unicomb, L., Afroz, A., & Dutta, N. et al. (2013). Designing a handwashing station for infrastructure-restricted communities in Bangladesh using the integrated behavioral model for water, sanitation and hygiene interventions (IBM-WASH). *BMC Public Health*, 13(1). doi: 10.1186/1471-2458-13-877
- Howard G., Bartram J. (2003). Domestic Water Quantity, Service Level and Health. World Health Organization; Geneva, Switzerland. Retrieved from https://apps.who.int/iris/bitstream/handle/10665/67884/WHO_SDE_WSH_03.02.pdf.
- Ibrahim, JM., Sufiyan, BM., Oloruko-oba, AA., Gobir. AA., Adam, H. & Amadu, L. (2017). Knowledge, attitudes, and practices of household water purification among caregivers of under-five children in Biye community, Kaduna State. *Arch Med Surg*, 1, XX-XX.
- Ibrahim, S. & Alkire, S. (2007). Agency and Empowerment: A proposal for internationally comparable indicators. Retrieved from <http://www.ophi.org.uk/wp-content/uploads/OPHI-wp04.pdf>.
- Imtiaz, K., Begum, K., Begum, N., Naureen, S., Barua, J., Faruque, J., & Khalid, A. (2015). Practice of personal hygiene among rural women of a selected community in Bangladesh. *Northern International Medical College Journal*, 6(1), 29-31. doi: 10.3329/nimcj.v6i1.23158
- Irianti, S., Prasetyoputra, P., & Sasimartoyo, T. (2016). Determinants of household drinking-water source in Indonesia: An analysis of the 2007 Indonesian family life survey. *Cogent Medicine*, 3: 1151143. <http://dx.doi.org/10.1080/2331205X.2016.1151143>.
- Israel, G.D (1992). Determining sample size; the Evidence of Extension Program Impact. Program Evaluation and Organizational Development, IFAS, University of Florida. PEOD-6.
- Ivens, S. (2008). Does increased water access empower women? *Development*, 51(1), 63-67. doi: 10.1057/palgrave.development.1100458
- Jabbar, M.A., Saleem, M., Solomon Gebreselassie & Hailu Beyene (2003). Role of knowledge in the adoption of new agricultural technologies: an approach and an application. *International Journal of Agricultural Resources, Governance and Ecology*, 2(3/4), 312. <https://doi.org/10.1504/ijarge.2003.003974>.
- Jadhav, A., Weitzman, A., & Smith-Greenaway, E. (2016). Household sanitation facilities and women's risk of non-partner sexual violence in India. *BMC public health*, 16(1), 1139. <https://doi.org/10.1186/s12889-016-3797-z>.
- Jejeebhoy, S. J. (2000). Women's autonomy in rural India: Its dimensions, determinants, and the influence of context. In H. Presser & G. Sen, (Eds.) *Women's Empowerment and Demographic Processes: Moving beyond Cairo*. New York: Oxford University Press.

- Jones, O. (2015). Monitoring sanitation and hygiene in rural Ethiopia: A diagnostic analysis of systems, tools and capacity. The World Bank: Water and sanitation program technical paper.
- Jung, S., Doh, Y. A., Bizuneh, D. B., Beyene, H., Seong, J., Kwon, H., Kim, Y., Habteyes, G. N., Tefera, Y., & Cha, S. (2016). The effects of improved sanitation on diarrheal prevalence, incidence, and duration in children under five in the SNNPR State, Ethiopia: study protocol for a randomized controlled trial. *Trials*, 17(1),204. <https://doi.org/10.1186/s13063-016-1319-z>
- Kabeer, N. (1999). Resources, agency, and achievements: Reflections on the measurement of women's empowerment. *Development and Change*, 30, 435-464. doi:10.1111/1467-7660.00125
- Kabeer, N. (2005). Gender equality and women's empowerment: A critical analysis of the third Millennium Development Goal. *Gender & Development*,13(1),13-24.doi: 10.1080/13552070512331332273.
- Kabudula, C., Houle, B., Collinson, M., Kahn, K., Tollman, S., & Clark, S. (2016). Assessing changes in household socioeconomic status in rural South Africa, 2001–2013: A distributional analysis using household asset indicators. *Social Indicators Research*, 133(3), 1047-1073. doi: 10.1007/s11205-016-1397-z.
- Kare Chawicha, Mengistu Asnake, Girma Kassie, Tariku Nigatu, Mehari Belachew & Habtamu Zerihun (2012).The status of hygiene and sanitation practice among rural model families of the health extension program (HEP) in Wolayta and Kembata Tembaro Zones of Southern Nations, Nationalities and Peoples' Region of Ethiopia. *Ethiopian Journal of Health Development*, 26(2).
- Karimi, M., Brazier, J., & Basarir, H. (2016). The capability approach: A critical review of its application in Health Economics. *Value in Health*, 19(6), 795-799. doi: 10.1016/j.jval.2016.05.006
- Kayser, G. L, Rao, N. Jose, R. & Raj, A. (2019). Water, sanitation and hygiene: measuring gender equality and empowerment. *Bulletin of the World Health Organization*, 97, pp 438-440. doi: <http://dx.doi.org/10.2471/BLT.18.223305>
- Keleher, L. W., (2007). Empowerment and International Development (Doctoral dissertation. The University of Maryland). Retrieved from [Microsoft Word - 92847-1188241951-LWKeleher Dissertation \(umd.edu\)](#).
- Kilsby, D. (2012). “Now we feel like respected adults; Positive change in gender roles and relations in a Timor-Leste WASH program. ACFID Research in Development Series, 6. Retrieved from <https://iwda.org.au/resource/now-we-feel-like>.
- Kirui, O. K., & Mirzabaev, A. (2019). Determinants of choice, number and simultaneous adoption of sustainable land management practices in Eastern Africa. *International Journal of Agriculture and Forestry*, 9(1), 1-15. doi: 10.5923/j.ijaf.20190901.01.
- Kirschner, A.J. (2011). The human right to water and Sanitation. *Max Planck Yearbook of United Nations Law*, 15, 445-487.
- Kishor, S. & Subaiya, L. (2008). Understanding women's empowerment: A comparative analysis of demographic and health surveys (DHS) data. DHS comparative reports. 20. Calverton, Maryland, USA: Macro International.
- Kivunja, C., & Kuyini, A. (2017). Understanding and applying research paradigms in educational contexts. *International Journal of Higher Education*, 6(5),26. doi: 10.5430/ijhe.v6n5p26.

- Kloos, H. (1998). Primary health care in Ethiopia: From Haile Sellassie to Meles Zenawi. *Northeast African Studies*, 5(1), 83-113. doi: 10.1353/nas.1998.0016.
- Kowal, P., & Peachey, K. (2001). Indicators for the minimum data set project on ageing: A critical review in sub-Saharan Africa. Retrieved from https://www.who.int/healthinfo/survey/ageing_mds_report_en_daressalaam.pdf.
- Kumie, A. (2002). Crowding in a traditional rural housing (“Tukul”) in Ethiopia. *Ethiopian Journal of Health Development*, 16(3). <https://doi.org/10.4314/ejhd.v16i3.9798>
- Kumwenda, S. (2019). Challenges to Hygiene Improvement in Developing Countries. In N. Potgieter & A.N.Traore (Eds.), *the relevance of hygiene to health in developing countries*. University of Venda, South Africa. <https://doi.org/10.5772/intechopen.80355>
- Kunwar, L.B., Kunwar, B.B., Jain, V. & Subedi, S., (2014). Hygiene practices in rural area of Doti District, Nepal. *International Journal of Health Sciences & Research* 4(3).
- Kwami, C., Godfrey, S., Gavilan, H., Lakhanpaul, M., & Parikh, P. (2019). Water, sanitation, and hygiene: Linkages with stunting in rural Ethiopia. *International Journal of Environmental Research and Public Health*, 16(20), 3793. doi: 10.3390/ijerph16203793.
- Lanjouw, P., & Feder, G. (2001). Rural non-farm activities and rural development, from experience towards strategy. *The Rural Development Strategy Background Paper Series#4*.
- Leahy, C., Winterford, K., Nghiem, T., Kelleher, J., Leong, L., & Willetts, J. (2017). Transforming gender relations through water, sanitation, and hygiene programming and monitoring in Vietnam. *Gender and Development*, 25(2), 283-301. doi: 10.1080/13552074.2017.133153.
- Lee, H. Y. (2013). Goodness-of-fit tests for Proportional odds model. *Journal of the Korean Data and Information Science Society*, 24(6), 1465–1475. <https://doi.org/10.7465/jkdi.2013.24.6.1465>.
- Leech, N., & Onwuegbuzie, A. (2007). A typology of mixed methods research designs. *Quality & Quantity*, 43(2), 265-275. doi: 10.1007/s11135-007-9105-3.
- Leeper, T.J. (2018). An Introduction to Margins. Retrieved from <https://thomasleeper.com/margins/articles/Introduction.html>.
- Levesque, J., Harris, M., & Russell, G. (2013). Patient-centered access to health care: conceptualizing access at the interface of health systems and populations. *International Journal for Equity in Health*, 12(1), 18. doi: 10.1186/1475-9276-12-18
- Liu, X. (2016). *Applied Ordinal Logistic Regression Using Stata*. Eastern Connecticut State University.
- Lombardini, S., Bowman, K. & Garwood, R. (2017). A 'How to' Guide to Measuring Women's Empowerment: Sharing experience from Oxfam's impact evaluations. Oxfam guidelines and toolkits. Retrieved from <https://gdnonline.org/resources/gt-measuring-women...> · PDF file.
- Long, J. S., & Freese, J. (2001). *Regression Models for Categorical Dependent Variables using Stata*. College Station, TX: Stata Press.
- Lopez, V., Berrocal, V., Corozo A., Ram, P., Trostle, J., & Eisenberg, J. (2019). Determinants of latrine use behavior: The psychosocial proxies of individual-level defecation practices in rural Coastal Ecuador. *The American Journal of Tropical Medicine and Hygiene*, 100(3), 733-741. doi: 10.4269/ajtmh.18-0144.

- Lui, S.M. & Hui, W. (2011). The effects of knowledge on security technology adoption: Results from a quasi-experiment. The 5th International Conference on New Trends in Information and Service Science (pp. 328-333). Macao.
- Maes, K., Closser, S., Vorel, E., & Yihenew Tesfaye (2015). A women's development army: Narratives of community health worker investment and empowerment in rural Ethiopia. *Studies in Comparative International Development*, 50(4), 455-478. doi: 10.1007/s12116-015-9197-z.
- Maguire, M.S., & Delahunt, B. (2017). Doing a thematic analysis: A practical, step-by-step guide for learning and teaching scholars. Dundalk Institute of Technology. Retrieved from <https://ojs.aishe.org/index.php/aishe-j/article/viewFile/335/553>.
- Mahasneh, S. (2001). Health perceptions and health behaviors of poor urban Jordanian women. *Journal of Advanced Nursing*, 36(1), 58-68. doi: 10.1046/j.1365-2648.2001.01943.
- Mahmud, S., Shah, N. M., & Becker, S. (2012). Measurement of women's empowerment in rural Bangladesh. *World Development*, 40(3), 610-619. <https://doi.org/10.1016/j.worlddev.2011.08.003>
- Malhotra, A., & Schuler, S. (2005). Women's empowerment as a variable in international development. Psyceextra dataset. doi: 10.1037/e597202012-004.
- Mason, K. & Smith, H.L. (2000). Husbands' versus wives fertility goals and use of contraception: The influence of gender context in five Asian countries. *Demography* 37(3):299-311.
- Mason, N., Mosello, B., (2017).How to reduce inequalities in access to WASH Synthesis report. Overseas Development Institute, London. Retrieved from <https://www.odi.org/sites/odi.org.uk/files/resource-documents/11604.pdf>
- Mcintyre, D., Thiede, M., & Birch, S. (2009). Access as a policy-relevant concept in low- and middle-income countries. *Health Economics, Policy and Law*, 4(2), 179-193. Doi: 10.1017/s1744133109004836
- Megersa Olumana (2018). Safe drinking water: Concepts, benefits, principles and standards. In M. Glavan (Eds.), *Water challenges of an urbanizing world*. University of Ljubljana, Slovenia. doi: 10.5772/intechopen.71352.
- Mehra, R. (1997). Women, empowerment, and economic development. *The ANNALS of the American Academy of Political and Social Science*, 554(1), 136-149. <https://doi.org/10.1177/0002716297554001009>
- Meleko, A. (2018). Assessment of magnitude of hand washing practice and its determinant factors among mothers/ caretakers in Aman sub-city, Bench Maji zone, Southwest Ethiopia. *Global Journal of Reproductive Medicine*, 3(4). <https://doi.org/10.19080/gjorm.2018.03.555617>.
- Menard, S. (1995). *Applied Logistic Regression Analysis*. Sage University Paper Series on Qualitative Applications in the Social Sciences, 07-106, Thousand Oaks, CA: Sage.
- Bizatu Mengistie & Negga Baraki, N. (2010). Community based assessment on household management of waste and hygiene practices in Kersa woreda, Eastern Ethiopia. *Ethiopian Journal of Health Development*, 24(2). doi: 10.4314/ejhd.v24i2.62958.
- Mize, T. (2019). Best practices for estimating, interpreting, and presenting nonlinear interaction effects. *Sociological Science*, 6, 81-117. <https://doi.org/10.15195/v6.a4>.
- Ministry of Health [MOH] (2011). Hygiene and sanitation strategic action plan for rural, per-urban & informal settlements in Ethiopia, Addis Ababa, Ethiopia.

- Mohd, R., & Malik, I. (2017). Sanitation and hygiene knowledge, attitude and practices in urban setting of Bangalore: A cross-sectional study. *Journal of Community Medicine & Health Education*, 07(04). <https://doi.org/10.4172/2161-0711.1000540>.
- Montaño, D. & Kasprzyk, D.D. (2015). Theory of reasoned action, theory of planned behavior, and the integrated behavioral model. In K.Glanz, K. Barbara & K.V.Viswanath (Eds.), *Health behavior: Theory, research, and practice* (95–124). Jossey-Bass.
- Montoute, M. C. & Cashman, A. (2015). A knowledge, attitudes and practices study on water, sanitation and hygiene in Anse La Raye village, Saint Lucia. CERMES Technical Report No78. Retrieved from <https://www.cavehill.uwi.edu/cermes/getdoc/2ed8b81...> · PDF file.
- Moser, C. O. N. (1993). *Gender Planning and Development : Theory, Practice, and Training*. Routledge.
- Mosler,H-J. (2012). A systematic approach to behavior change interventions for the water and sanitation sector in developing countries: a conceptual model, a review, and a guideline. *International Journal of Environmental Health Research*, 22, 431-449. doi:10.1080/09603123.2011.650156.
- Mostofa,G., Tareque, I., Haque, M., & Mahfuza, T.I. (2008). Mathematical modeling of women empowerment in Bangladesh. *Research Journal of Applied Sciences* 3(6):416-420.
- Mosseye, Tibebe & Belay, Mehretie (2018). One-into five labor grouping for watershed management in Northwest Ethiopia: Farmer’s acceptable participation and influencing. *Ethiopian Journal of Social Sciences*, 4(2).
- Mulubirhan Assefa & Abera Kumie (2014). Assessment of factors influencing hygiene behavior among school children in Mereb-Leke district, Northern Ethiopia: A cross-sectional study. *BMC Public Health*, 14, (1000). <https://doi.org/10.1186/1471-2458-14-1000>.
- Mwangi, M. & Kariuki, S. (2015). Factors determining adoption of new agricultural technology by smallholder farmers in developing countries. *Journal of economics and sustainable development*, 6(5).
- Nigatu Regassa, Sundaraa, R. & Kalkidan Ketsela (2017). Access to and utilization of information on sanitation and hygiene by rural households in Alaba special district, Southern Ethiopia. *Journal of Human Ecology*, 33(2),101–112. <https://doi.org/10.1080/09709274.2011.11906352>.
- Niguse Debesay, Lalit Tukaram, Azeb G.selassie, Huruye Belay & Dejen Yemane (2015). Latrine utilization and associated factors in the rural communities of Gulomekada district, Tigray Region, North Ethiopia: A community based cross-sectional study. *Journal of Community Med Health Educ*, 5, 338. doi:10.4172/21610711.1000338.
- Nigussie Amsalu, Yilkal Bezie, Mulugeta Fentahun, Addisu Alemayehu & Gashaw Amsalu (2018). Use and conservation of medicinal plants by indigenous people of Gozamin wereda, East Gojjam Zone of Amhara Region, Ethiopia: An ethnobotanical approach. *Evidence-based complementary and alternative medicine*, Vol, 2018, pp, 1-23. doi: 10.1155/2018/2973513.
- Niketha, L., Sankhala, G., Prasad, K., & Kumar, S. (2017). Empowerment of Women through Dairy Cooperatives in Karnataka, India. *International Journal of Current Microbiology and Applied Sciences*, 6(7), 1292-1304. doi: 10.20546/ijcmas.2017.607.156.
- Norton, E. C., Wang, H., & Ai, C. (2004). Computing interaction effects and standard errors in logit and probit models. *The Stata Journal: Promoting Communications on Statistics and Stata*, 4(2), 154–167. <https://doi.org/10.1177/1536867x0400400206>.

- Norwood, C. (2014). Women's empowerment and microcredit: A case study from rural Ghana. *Journal of International Studies and Development*. 4, 1-22. PMID: 26213637; PMCID: PMC4513662.
- Nussbaum, M. (2000). *Women and human development*. Cambridge: Cambridge University Press.
- Nwakile, T., Celestina, E. & Arinzechukwu, O. (2017). Sanitation practices on students' health: A case study of students of vocational and technical education in the University of Nigeria, Nsukka. *International Journal of Multidisciplinary and Current Research*. 5.
- Nyanza, E.C., Jahanpour, O., Hatfield, J., Van der Meer, F., Allen-Scott, L., Orsel, K., & Bastien, S. (2018). Access and utilization of water and sanitation facilities and their determinants among pastoralists in the rural areas of northern Tanzania. *Tanzania Journal of Health Research*, 20(1). <https://doi.org/10.4314/thrb.v20i1>.
- Ohwo, O., (2019). Dimensions of inequality in urban and rural water, sanitation and hygiene services in Sub-Saharan Africa. *European Scientific Journal*. 15 (8); 1857 – 7881.
- O.Sintondji, L.(2017). Socio-demographic characteristics of households as determinants of access to water, hygiene and sanitation in So-Ava, Benin. *Journal of Environmental Science and Public Health*, 253-267. Doi: 10.26502/jesph.96120023.
- O'brien, R. (2007). A caution regarding rules of thumb for variance inflation factors. *Quality & Quantity*, 41(5), 673-690. doi: 10.1007/s11135-006-9018-6.
- O'Connell, A. A. (2006). *Logistic Regression Models for Ordinal Response Variables*. Sage Publications. Thousand Oaks, London.
- O'Loughlin, R., Gashu Fentie, Flannery, B., & Emerson, P. M. (2006). Follow-up of a low cost latrine promotion programme in one district of Amhara, Ethiopia: characteristics of early adopters and non-adopters. *Tropical Medicine and International Health*, 11(9), 1406–1415. <https://doi.org/10.1111/j.1365-3156.2006.01689>.
- Ofuoku, A.,Olele, N., & Emah, G. (2008). Determinants of adoption of improved fish production technologies among fish farmers in delta state, Nigeria. *The Journal of Agricultural Education and Extension*, 14(4), 297-306. doi: 10.1080/13892240802416186.
- Oliver, A. & Mossialos, E. (2004). Equity of Access to Health Care: Outlining the Foundations for Action. *Journal of Epidemiol Community Health*, 58:655–658.doi: 10.1136/jech.2003.017731.
- Onwuegbuzie, A. J., & Collins, K. M. (2007). A typology of mixed methods sampling designs in social science research. *The Qualitative Report*, 12(2), 281-316.
- O'Reilly, K. (2010). Combining sanitation and women's participation in water supply: An example from Rajasthan. *Development in Practice*, 20(1),45-56.doi: 10.1080/09614520903436976.
- Osumanu, I., Kosoe, E., & Ategeeng, F. (2019). Determinants of open defecation in the Wa municipality of Ghana: Empirical findings highlighting sociocultural and economic dynamics among households. *Journal of Environmental and Public Health*, 1-10. doi: 10.1155/2019/3075840.
- Oswald, W., Stewart, A., Flanders, W., Kramer, M., Tekola Endeshaw, Mulat Zerihun & et.al (2016). Prediction of Low Community Sanitation Coverage Using Environmental and Sociodemographic Factors in Amhara Region, Ethiopia. *The American Journal of Tropical Medicine and Hygiene*, 95(3), 709-719. doi: 10.4269/ajtmh.15-0895.

- Ousmane, D., & Nafiou, M. (2019). Determinants of agricultural technology adoption: Farm households evidence from Niger. *Journal of Development and Agricultural Economics*, 11(1), 15-23. Doi: 10.5897/jdae2018.0998.
- Ozoya, M. I., Edewor, P. A., Iruonagbe, C. T., Idowu, A. E., Chiazor, I. A.; George, T. O.; Egharevba, M. E. (2018). A chronological overview of women empowerment initiatives in Nigeria. *Ife PsychologiA. An International Journal of Psychology in Africa*, 25(1), 304-317.
- Paul, P., & Meena, B.S. (2016). A study on access to and control over resources; gender perspective. *International Journal of Science, Environment and Technology*. 5 (5), 2982 – 2988.
- Penchansky, R. & Thomas, J. W. (1981). The Concept of Access: Definition and Relationship to Consumer Satisfaction. *Medical Care*. 19 (2), 127-140.
- Peterson, B., & Harrell, F. (1990). Partial proportional odds models for ordinal response variables. *Applied Statistics*, 39(2), 205-217. Doi: 10.2307/2347760.
- Petry, NM. (2002). A comparison of young, middle-aged, and older adult treatment-seeking pathological gamblers. *The Gerontologist*, 42, (1), 92–99, <https://doi.org/10.1093/geront/42.1.92>.
- Pinzón, E. (2016). Dealing with and understanding endogeneity. StataCorp LP Barcelona. Retrieved from <https://www.stata.com/meeting/spain16/slides/pinzon-spain16.pdf>.
- Pregibon, D. (1980). Goodness of link tests for generalized linear models. *Journal of the Royal Statistical Society. Series C (Applied Statistics)*, 29 (1).15-24. doi: 10.2307/2346405.
- Pulkstenis, E., & Robinson, T. J. (2004). Goodness-of-fit tests for ordinal response regression models. *Statistics in Medicine*, 23(6), 999–1014. <https://doi.org/10.1002/sim.1659>.
- Potgieter, N. (2007). Water storage in rural households: intervention strategies to prevent waterborne diseases (Doctoral dissertation. University of Pretoria, South Africa).
- Qizilbash, M. (1997). A weakness of the capability approach with respect to gender justice. *Journal of International Development*, 9(2), 251-262. doi: 10.1002/(sici)1099-1328(199703)9:2<251::aid-jid437>3.0.co;2-q.
- Raftery, A. (1995). Bayesian model selection in social research. *Sociological Methodology*, 25(111). Doi: 10.2307/271063.
- Rahman, S.A. (2001). Utilization of primary health care services in rural Bangladesh: The population and provider perspectives (Doctoral dissertation, London School of Hygiene & Tropical Medicine). doi: 10.17037/PUBS.00682288.
- Rajanbir, K., Kanwaljit, K. & Rajinder, K., (2018). Menstrual hygiene, management, and waste disposal: Practices and challenges faced by girls/women of developing countries. *Journal of Environmental and Public Health*. Doi: 10.1155/2018/1730964.
- Ramsey (1969). Tests for specification errors in classical linear least squares analysis. *Journal of the Royal Statistical Association, Series B*, 7(1), 350–371.
- Rathgeber, E. (2015). WID, WAD, GAD: Trends in Research and Practice. *The Journal of Developing Areas*, 24(4), 489-502.
- Rehman, A., Alharthi, K. (2016). An Introduction to Research Paradigms. *International Journal of Educational Investigations*, 3 (8), 51-59.
- Rheingans, R., Anderson, J., Luyendijk, R., & Cumming, O. (2013). Measuring disparities in sanitation access: Does the measure matter? *Tropical Medicine & International Health*, 19(1), 2-13. Doi: 10.1111/tmi.12220.

- Rimer, B.K. and Glanz, K. (2005). *Theory at a Glance: A Guide for Health Promotion Practice* (2nded). U.S. Department of Health and Human Services. National Institutes of Health.
- Roche, R., Bain, R., & Cumming, O. (2017). Correction: A long way to go - Estimates of combined water, sanitation and hygiene coverage for 25 sub-Saharan African countries. *PLOS ONE*, 12(3), e0173702. Doi: 10.1371/journal.pone.0173702
- Routray, P., Schmidt, W., Boisson, S., Clasen, T., & Jenkins, M. (2015). Socio-cultural and behavioral factors constraining latrine adoption in rural Coastal Odisha: An exploratory qualitative study. *BMC Public Health*, 15(1). doi: 10.1186/s12889-015-2206-3.
- Routray, P., Torondel, B., Clasen, T., & Schmidt, W. (2017). Women's role in sanitation decision making in rural coastal Odisha, India. *PLOS ONE*, 12(5), e0178042. Doi: 10.1371/journal.pone.0178042.
- Rowlands, J. (1995). Empowerment Examined. *Development in Practice*, 5(2), 101-107. <https://doi.org/10.1080/0961452951000157074>.
- Salahuddin, T., & Ahmad, A. (2017). Women Empowerment: A Quantitative Exploration. *Journal of Socialomics*, 06(04). <https://doi.org/10.4172/2167-0358.1000218>.
- Saleem, M., Burdett, T., & Heaslip, V. (2019). Health and social impacts of open defecation on women: A systematic review. *BMC Public Health*, 19(1). Doi: 10.1186/s12889-019-6423-z.
- Sanderson, M., & Soboroff, I. (2007). Problems with Kendall's tau. In: SIGIR '07: Proceedings of the 30th annual international ACM SIGIR conference on research and development in information retrieval. Pp 839–840. <https://doi.org/10.1145/1277741.1277935>.
- Saurman, E. (2015). Improving access: modifying Penchansky and Thomas's Theory of Access. *Journal of Health Services Research & Policy*, 21(1), 36–39.
- Sbrana, G., (2009). Technical note on the determinants of water and sanitation in Yemen. Department of Economic and Social Affairs, United Nations, New York. Retrieved from https://www.un.org/en/development/desa/policy/capacity/country_documents/yemen_tech_note_water_jun2009.pdf.
- Schoonenboom, J., Johnson, R.B. (2017). How to construct a mixed methods research design. *Koln Z Soziol*, 69,107-131. <http://doi.org/10.1007/s11577-017-0454-1>.
- Schreiber-Gregory, D. (2017). Is my model the best? Methods for exploring model fit? MWSUG – Conference Paper AA19. Retrieved from <https://mwsug.org/proceedings/2016/AA/MWSUG-2016-AA19.pdf>.
- Sen, G., & Grown, C. & Era. (1988). *Development, crises and alternative visions : Third World women's perspectives*. Earth scan.
- Shahida, P., Azam, K., & Mahmud, H.S (2014). Household-level analysis of women's power practice in old Dhaka city, Bangladesh, *Journal of Comparative Asian Development*, 13 (1), 174-203. doi: 10.1080/ 15339114.2014.899070.
- Sharma, M. & Romas, J. A (2012). *Theoretical foundations of health education and health promotion* (2nded.); Jones & Bartlett: Sudbury, MA, USA.
- Sharpe, A. & Andrews, B. (2012). "An Assessment of Weighting Methodologies for Composite Indicators: The case of the Index of Economic Well-being," CSLS Research Reports 2012-10, Centre for the Study of Living Standards.
- SIDA. (2015). Women, water, sanitation and hygiene / the gender tool box. Retrieved from <https://www.sida.se/English/publications/159436/>.
- Sinha, A., Nagel,C., Schmidt, W.P., Torondel, B., Boisson, S., Routray, P., & Clasen T. et.al (2017). Assessing patterns and determinants of latrine use in rural settings: A longitudinal

- study in Odisha, India. *International Journal of Hygiene and Environmental Health*, 220, 906–915. <http://dx.doi.org/10.1016/j.ijheh.2017.05.004>.
- Smith, T. J. & McKenna, C.M. (2013). A comparison of logistic regression pseudo R^2 indices. *Multiple linear regression viewpoints*, 39(2). Retrieved from http://www.glmj.org/archives/articles/Smith_v39n2.pdf.
- Soon, J.(2010). The determinants of students' return intentions: A partial proportional odds model. *Journal of Choice Modelling*, 3(2),89-112.[https://doi.org/10.1016/S1755-5345\(13\)70037-X](https://doi.org/10.1016/S1755-5345(13)70037-X).
- Sørensen, L. (2012). Wound healing and infection in surgery. *Archives of Surgery*, 147(4), 373. Doi: 10.1001/archsurg.2012.5
- Ssemugabo, C., Wafula, S., Ndejjo, R., Oporia, F., Osuret, J., Musoke, D., & Halage, A. (2019). Knowledge and practices of households on safe water chain maintenance in a slum community in Kampala City, Uganda. *Environmental Health and Preventive Medicine*, 24(1). doi: 10.1186/s12199-019-0799-
- Staal, S., Baltenweck, I., Waithaka, M., DeWolff, T., & Njoroge, L. (2002). Location and uptake: Integrated household and GIS analysis of technology adoption and land use, with application to smallholder dairy farms in Kenya. *Agricultural Economics*, 27(3), 295-315.
- Strandberg, N. (2001). Empowerment as a transformative strategy for poverty eradication and the implications for measuring progress. United Nations Division for the Advancement of Women (DAW) Expert Group Meeting on “Empowerment of women throughout the life cycle as a transformative strategy for poverty eradication” 26 – 29 November 2001 New Delhi, India.
- Subedi, D. (2016). Explanatory sequential mixed method design as the third research community of knowledge claim. *American Journal of Educational Research*, 4(7), 570-577. doi: 10.12691/education-4-7-10.
- Sultana M., Mahumud, A., Sarker, R.A., Hossain, M.S., (2016). Hand hygiene knowledge and practice among university students: Evidence from private universities of Bangladesh. *Risk Manag Healthc Policy*, 2016(9),13-20. <https://doi.org/10.2147/RMHP.S98311>.
- Sultana, A., & Sharafat, Sk. (2013). Role of employment in women empowerment: Evidence from Khulna city of Bangladesh. *International Journal of Social Science & Interdisciplinary Research*, 2 (7).
- Sultana, F. (2011). Suffering for water, suffering from water: emotional geographies of resource access, control and conflict. *Geoforum*,42(2),163-172.doi: 10.1016/j.geoforum.2010.12.002.
- Sweetman, C., & Medland, L. (2017). Introduction: Gender and water, sanitation and hygiene. *Gender & Development*, 25(2), 153–166. doi:10.1080/13552074.2017.1349867.
- Tandon, T. (2016). Women Empowerment: Perspectives and views. *The International Journal of Indian Psychology*, 3(8).
- Tashakkori, A., & Teddlie, C. (1998). Mixed methodology:Combining qualitative and quantitative approaches. In L. Bickman & D. J. Rog (Series Eds.), *Applied Social Sciences Research Methods Series (Vol. 46)*. Thousand Oaks, CA: Sage.
- Teddlie, C., & Yu, F. (2007). Mixed methods sampling: A typology with examples. *Journal of Mixed Methods Research*, 1(77). doi: 10.1177/2345678906292430

- Terefe Degefa & Djamba, Y.K. (2015). Overcrowding of residential houses in Ethiopia: A study of selected demographic and socio-economic correlates. *Ethiopian Journal of the Social Sciences and Humanities*, 11 (1).
- Terza, J. V., Basu, A., & Rathouz, P. J. (2008). Two-stage residual inclusion estimation: Addressing endogeneity in health econometric modeling. *Journal of Health Economics*, 27(3), 531–543. <https://doi.org/10.1016/j.jhealeco.2007.09.009>.
- Tesfamichael Wossen, Tahirou Abdoulaye, Arega Alene, Mekbib Haile, Shiferaw Feleke, Adetunji Olanrewaju, Victor Manyong (2017). Impacts of extension access and cooperative membership on technology adoption and household welfare. *Journal of Rural Studies*, 54, 223–233. <https://doi.org/10.1016/j.jrurstud.2017.06.022>.
- The Open University (n.d.). Hygiene and environmental health part 1-Ethiopia. Retrieved from <https://moodle.digital-campus.org/course/view.php?id=193>.
- The Capability Approach (Stanford Encyclopedia of Philosophy/Spring 2019 Edition). (2019). Retrieved 16 December 2019, from <https://stanford.library.usyd.edu.au/archives/spr2019/entries/capability-approach/>.
- Todaro, M. P. & Smith, S. C. (2012). Economic Development (11thed.) (The Pearson Series in Economics), Prentice Hall. UK.
- Topp, S., & Abimbola, S. (2018). Call for papers—the Alma Ata Declaration at 40: Reflections on primary healthcare in a new era. *BMJ Global Health*, 3. doi: 10.1136/bmjgh-2018-000791.
- Turman-Bryant, N., Clasen, T., Fankhauser, K., & Thomas, E. (2018). Measuring progress towards sanitation and hygiene targets: A critical review of monitoring methodologies and technologies. *Waterlines*, 37(3), 229-247. doi: 10.3362/1756-3488.18-00008.
- Ucal, M., & Günay, S. (2019). Perceived happiness, perceived trust and perceived income levels: The case of the reunified Germany. *Panaeconomicus*, 66(2), 219-239. doi: 10.2298/pan160721031u.
- Waterkeyn, J., & Cairncross, S. (2005). Creating demand for sanitation and hygiene through community health clubs: A cost-effective intervention in two districts in Zimbabwe. *Social Science & Medicine*, 61(9), 1958-1970. doi: 10.1016/j.socscimed.2005.04.012.
- Webb, A., Stein, A., Ramakrishnan, U., Hertzberg, V., Urizar, M., & Martorell, R. (2006). A simple index to measure hygiene behaviors. *International Journal of Epidemiology*, 35(6), 1469-1477. doi: 10.1093/ije/dyl165.
- Weiss, A. (1997). Specification tests in ordered logit and probit models. *Econometric Reviews*, 16 (4), 361-391. DOI: 10.1080/07474939708800394.
- WHO / UNICEF Joint Monitoring Programme for Water Supply and Sanitation (2015). WASH post-2015 proposed indicators for drinking water, sanitation and hygiene. Retrieved from https://www.who.int/water_sanitation_health/monitoring/coverage/wash-post-2015-rev.pdf.
- WHO/UNICEF Joint Monitoring Program for Water Supply, Sanitation and Hygiene (JMP) (2019). Progress on household drinking water, sanitation and hygiene 2000-2017. Retrieved from <https://www.unwater.org/publications/whounicef-joint-monitoring-program-for-water-supply-sanitation-and-hygiene-jmp-progress-on-household-drinking-water-sanitation-and-hygiene-2000-2017/>.
- Williams, R. (2005). Gologit2: A program for generalized logistic regression/partial proportional odds models for ordinal dependent variables. Retrieved from <https://www.stata.com/meeting/4nasug/gologit2.pdf>.

- Williams, R. (2006). Generalized ordered logit/partial proportional odds models for ordinal dependent variables. *Stata Journal*, 6(1), 58-82. doi: 10.1177/1536867X0600600104
- Williams, R. (2008). Ordinal regression models: Problems, solutions, and problems with the solutions. Retrieved from <https://www.stata.com/meeting/germany08/GSUG2008.pdf>.
- Williams, R. (2012). Using the margins command to estimate and interpret adjusted predictions and marginal effects. *The Stata Journal*. 12 (2), 308–331
- Williams, R. (2016). Understanding and interpreting generalized ordered logit models. *The Journal of Mathematical Sociology*, 40(1), 7-20. doi: 10.1080/0022250x.2015.1112384
- Williams, R. (2019). Scalar measures of fit: Pseudo R² and information measures (AIC & BIC), Retrieved from <https://www3.nd.edu/~rwilliam>.
- Worku Awoke & Semahegn Muche (2013). A cross sectional study: Latrine coverage and associated factors among rural communities in the district of Bahir Dar Zuria, Ethiopia. *BMC Public Health*, 13-99.
- WHO (2011)-“*Guidelines for drinking-water quality (3rded.)*.”World Health Organization, Geneva.
- World Health Organization (2006). Guidelines for drinking-water quality [electronic resource]: incorporating first addendum. Vol. 1, Recommendations. – 3rd ed. Accessed from https://www.who.int/water_sanitation_health/dwq/gdwq0506.pdf.
- World Health Organization & UNICEF (2006). Meeting the MDG drinking water and sanitation the urban and rural challenge of the decade. Accessed from https://www.who.int/water_sanitation_health/monitoring/jmpfinal.pdf.
- World Health Organization. Regional Office for Europe & Ranson, Ray P. (1988). Guidelines for healthy housing. WHO Regional Office for Europe. Retrieved from <https://apps.who.int/iris/handle/10665/191555>.
- World Health Organization (2016, November). Drinking-water fact sheet. News and Press Release. Retrieved from <https://reliefweb.int/report/world/drinking-water-fact-sheet-reviewed-november-2016>.
- World Health Organization (WHO) & the United Nations Children’s Fund (2017). Progress on Drinking Water, Sanitation and Hygiene: 2017 Update and SDG Baselines. Geneva.
- World Bank (2011). Economic Assessment of Sanitation Interventions in Indonesia. Water and sanitation program technical paper. Washington DC. <https://openknowledge.worldbank.org/handle/10986/17351>
- Yamane, T. (1967). *Statistics: An Introductory Analysis (2nd ed.)*, Harper and Row, New York.
- Yared Alazar (2019). The status and determinants of solar photovoltaic technology utilization by rural households in Gozamin woreda, Amhara region, Ethiopia. *International Journal of Energy and Environmental Science*. 4(2), 27-34. doi: 10.11648/j.ijees.20190402.11.
- Yitayh Leul (2011). Assessment of problems to sustainability of rural water supply and management systems in Machakel woreda, Amhara Region (Master’s thesis), AAU.
- Yvonne Feilzer, M. (2009). Doing mixed methods research pragmatically: Implications for the rediscovery of pragmatism as a research paradigm. *Journal of Mixed Methods Research*, 4(1), 6-16. doi: 10.1177/1558689809349691.

Annexes

Appendix 1: Self -esteem

Appendix 1A: Self-esteem Scenarios

Self-esteem with regard to decision making	Self-esteem with regard to acceptance or rejection of gender based violence
She thinks she should have a say in decisions on:	She thinks a wife's beating is justified:
Buying household furniture	If there is no water in the household
Spending family income/ savings	She comes home late while fetching water
Taking a loan	If the house is not clean?
Latrine adoption	If she asks him to wash dish? Or ask her husband to help her in household chores?
Latrine site identification	If she does not complete her domestic work to his satisfaction
Materials used for latrine construction	If she spends money without permission
Sanitation and hygiene related activities	If she accepts women development team membership without his permission?
Drinking water interventions	If she goes to toilet during day time?
Women's development team structure and function	If she attends community meeting outside of church without his permission

Appendix 1B: Cumulative Self-esteem Index (CSEI)

Index values		Frequency	Square root of frequency	Cumulative Square root frequency	Classes
Valid	.07	2	1.4	1.4	1
	.14	10	3.2	4.6	1
	.21	14	3.7	8.3	1
	.29	23	4.8	13.1	1
	.36	14	3.7	16.9	1
	.36	1	1.0	17.9	1
	.43	22	4.7	22.5	1
	.50	23	4.8	27.3	2
	.57	29	5.4	32.7	2
	.64	23	4.8	37.5	2
	.71	12	3.5	41.0	2
	.71	17	4.1	45.1	2
	.79	32	5.7	50.8	3
	.86	13	3.6	54.4	3
	.86	23	4.8	59.2	3
	.93	30	5.5	64.6	3
	1.00	37	6.1	70.7	3
	Total	325	70.7		

Appendix 2: Women's Empowerment in Decision Making Index

Index value		Frequency	Square root of frequency	Cumulative Square root frequency	Classification
Valid	.0000	1	1.0	1.0	1
	.0370	2	1.4	2.4	1
	.0741	1	1.0	3.4	1
	.1111	2	1.4	4.8	1
	.1481	5	2.2	7.1	1
	.1852	3	1.7	8.8	1
	.2222	5	2.2	11.0	1
	.2593	8	2.8	13.9	1
	.2963	14	3.7	17.6	1
	.3333	15	3.9	21.5	1
	.3704	34	5.8	27.3	1
	.4074	28	5.3	32.6	2
	.4444	34	5.8	38.4	2
	.4815	31	5.6	44.0	2
	.5185	30	5.5	49.5	2
	.5556	20	4.5	53.9	2
	.5926	17	4.1	58.1	3
	.6296	10	3.2	61.2	3
	.6667	6	2.4	63.7	3
	.7037	10	3.2	66.8	3
	.7407	8	2.8	69.7	3
	.7778	6	2.4	72.1	3
	.8148	7	2.6	74.8	3
	.8519	5	2.2	77.0	3
	.8889	7	2.6	79.6	3
	.9259	7	2.6	82.3	3
	.9630	4	2.0	84.3	3
	1.0000	5	2.2	86.5	3
	Total	325	86.5		

Appendix 3: Women Empowerment in Participation in Rural Health Extension Activity Index

Participation Index		Frequency	Square Root of Frequency	Cumulative Square Root Frequency	Classes
Valid	.0	78	8.8	8.8	1
	.2	127	11.3	20.1	2
	.4	21	4.6	24.7	2
	.6	3	1.7	26.4	2
	.8	42	6.5	32.9	3
	1.0	54	7.3	40.2	3
	Total	325	40.2		

Appendix 4: Composite Empowerment Index

CEI	Frequency	Square root of frequency	Cumulative Square root frequency	Classification
0.00-0.15	2	1.414214	1.414214	1
0.16-0.29	49	7	8.414214	1
0.30-0.40	54	7.348469	15.76268	1
0.41-0.49	61	7.81025	23.57293	2
0.50-0.58	54	7.348469	30.9214	2
0.59-0.70	41	6.403124	37.32453	3
0.71-0.80	41	6.403124	43.72765	3
0.80-1.00	23	4.795832	48.52348	3
Total	325	48.52348		

Appendix 5: Descriptive Statistics for the Asset Variables

Asset Type		Frequency	Percent
Physical Capital	Housing Structure		
	Flooring material of the House	Earth	379
		Cement	0
		Tiles	0
		Others Such As Plastic	1
	Wall material of the house	Earth	379
		Wood	0
		Cement	1
		Others	0
	Roofing material	Grass	9
		Iron Sheet	371
		Tiles	0
		Others	0
	Place for cooking	no kitchen	79
		a room used for traditional kitchen inside the house	27
		a room used for traditional kitchen outside the house	274
	Number of rooms in the house	1-2	248
		3+	132
	Domestic Assets		
	Sickle	No	108
		Yes	272
	Pick axe	No	155
		Yes	225
	Axe	No	107
		Yes	273
	Shovel	No	181
		Yes	199
	Wardrobe	No	217
		Yes	163
	Bed with cotton/spring mattress	No	215
		Yes	165
	Smokeless stove	No	168
		Yes	212
	Mosquito net	No	315
		Yes	65
	Radio	No	308
		Yes	72
	TV	No	376
		Yes	4
	Mobile	No	253
		Yes	127
	Bajaj	No	372

		Yes	8	2.1%
	Cart, hand pushing	No	356	93.7%
		Yes	24	6.3%
	Weaving equipment	No	374	98.4%
		Yes	6	1.6%
Natural Capital	Type of Cooking Fuel			
	Firewood	No	17	4.5%
		Yes	363	95.5%
	Charcoal	No	337	88.7%
		Yes	43	11.3%
	Crop residue	No	226	59.5%
		Yes	154	40.5%
	Dung	No	103	27.1%
		Yes	277	72.9%
	Livestock			
	Do you or your household own livestock	No	18	4.7%
		Yes	362	95.3%
	Total Livestock Owned			
	Cow, Ox, calf	1- 4	139	36.6%
		5 – 9	207	54.5%
		10+	34	8.9%
	Horse, Donkey, Mules	1	297	78.2%
		2	51	13.4%
		3+	32	8.4%
	Sheep, Goat	1-4	286	75.3%
		5-9	43	11.3%
		10+	51	13.4%
	Possession of Agricultural land	No	94	24.7%
		Yes	286	75.3%
	Land ownership status	Without title deed	94	24.7%
		With Title Deed	286	75.3%
	Land size in hectare	<= 1.00	181	47.6%
		1.01+	199	52.4%
Financial Capital	Did you or your household received any credit during the last 12 months	No	332	87.4%
		Yes	48	12.6%

Appendix 6: Distribution of Respondents According to their profile and sanitation access and utilization: Categorical variables

Variables		Sanitation Access				Sanitation Utilization			
		Low	Medium	High	Total	Low	Medium	High	Total
		Freq	Freq.	Freq.	Freq.	Freq.	Freq.	Freq.	Freq.
Woreda	Machakel	10 (11.6%)	40 (30.3%)	100(61.7%)	150 (39.5)	53 (27.5%)	35 (44.9%)	62 (56.9%)	150(39.5%)
	Gozamin	76 (88.4%)	92 (69.7%)	62 (38.3%)	230(60.5%)	140(72.5%)	43 (55%)	47(43%)	230(60.5%)
Climate	Dega	28 (32.6%)	47(35.6%)	70(43.2%)	145 (38%)	62 (32%)	39(50%)	44(40.4%)	145(38%)
	Woinadega	58 (67.4%)	85(64.4%)	92 (56.8%)	235(61.8%)	131(67.9%)	39(50%)	65 (59.6%)	235(61.8%)
Age	young	17(19.8%)	11(34.4%)	15(9.3%)	43 (11.3%)	29 (15%)	4 (5%)	10(9.2%)	43 (11.3)
	middle adult	22 (25.6%)	22 (16.7%)	40 (24.7%)	84 (22%)	38 (19.7%)	19(24.4%)	27 (24.8%)	84 (22%)
	Adult	36 (41.9%)	75 (56.8%)	72 (44.4%)	183 (48%)	93 (48.2%)	35 (44.9%)	55(50.5%)	183 (48%)
	Old	11(12.8%)	24 (18.2%)	35 (21.6%)	70 (18.4%)	33(17.1%)	20 (25.6%)	17 (15.6%)	70 (18.4)
Education	no education	61(70.9%)	116(87.9%)	123 (75.9%)	300(79%)	147(76.2%)	65(83.3%)	88(80.7%)	300 (79%)
	primary	16(18.6%)	16 (12.1%)	31 (19%)	63(16.6%)	37 (19%)	13(16.7%)	13(11.9%)	63(16.6%)
	Secondary & above	9 (10.5%)	0 (0%)	8 (4.9%)	17(4.5%)	9 (4.7%)	0	8 (7.3%)	17 (4.5%)
Occupation	Farm only	67(77.9%)	109(82.6%)	74 (45.7%)	250(65.8%)	152(78.8%)	50 (64%)	48(44%)	250(65.8%)
	non-farm only or farm plus	19 (22.1%)	23 (17.4%)	88 (54.3%)	130(34%)	41 (21%)	28(35.9%)	61(56%)	130 (34%)
Marital status	currently married	62 (72.1%)	119(90.1%)	144 (88.9%)	325(85.5)	160(82.9%)	72 (92%)	93(85%)	325(85.5%)
	currently not married	24(27.9%)	13 (9.8%)	18 (11%)	55 (14.5%)	33 (17%)	6 (7.7%)	16 (14.7%)	55(14.5%)
Access to extension information	Yes	72 (83.7%)	123(93.1%)	157 (97%)	352(92.6%)	173(89.6%)	74(94.9%)	105(96.3%)	352(92.6%)
	No	14 (16.3%)	9 (6.8%)	5 (3%)	28 (7.4%)	20(10.4%)	4(5%)	4(3.7%)	28 (7.4%)
Participation in WHDA	Yes	12 (14%)	44(33.3%)	64 (39.5%)	120(31.6%)	40 (20.7%)	21(26.9%)	59(54%)	120(31.6%)
	No	74 (86%)	88(66.7%)	98 (60.5%)	260(68.4%)	153(79.3%)	57(73%)	50(45.9%)	260(68.4%)
Home plot ownership	Owned	47(54.7%)	99 (75%)	121 (74.7%)	267(70.3%)	123(63.7%)	58(74.4%)	86 (78.9 %)	267(70.3%)
	Not owned	39(45.3%)	33 (25 %)	41 (25.3 %)	113(29.7%)	70% (36%)	20(25.6%)	23 (21%)	113(29.7%)
Household Crowding	Crowded	82 (95.3%)	121(91.7%)	149 (92%)	352(92.6%)	179(92.8%)	72(92%)	101(92.7%)	325(85.5%)
	Not crowded	4 (4.7%)	11(8.3%)	13 (8%)	28(7.4%)	14(7.3%)	6(7.7%)	8(7.3%)	28 (7.4%)
Income	≤ 20000.00	26 (30.2%)	17 (12.9%)	12 (7.4%)	55(14.5%)	37 (19.2%)	7(9%)	11(10%)	55 (14.5%)
	20000.01 - 45000.00	47(54.7%)	75 (56.8%)	103 (63.6%)	225(59%)	110(57%)	40(51.3%)	75(68.8%)	225(59%)
	≥45,000.01	13 (15.1%)	40 (30.3%)	47 (29%)	100(26.3%)	46(23.8%)	31(39.7%)	23(21%)	100 (263%)
Wealth	Lowest	35 (40.7%)	11(8.3%)	30 (18.5%)	76 (20%)	45(23.3%)	9 (11.5%)	22 (20.2%)	76 (20%)
	Second	19 (22.1%)	25 (18.9%)	32 (19.8%)	76(20%)	39 (20.2%)	18(23%)	19 (17.4%)	76(20%)
	Middle	7 (8.1%)	40 (30.3%)	29 (17.9%)	76(20%)	36 (18.7%)	20(25.6%)	20(18.4%)	76(20%)
	Fourth	10 (11.6%)	29 (22%)	37 (22.8%)	76 (20%)	34(17.6%)	15 (19%)	27(24.8%)	76(20%)
	Highest	15(17.4%)	27 (20.5%)	34(21%)	76(20%)	39(20.2%)	16(20.5%)	21(19.3%)	76(20%)
Total		86 (22.6%)	132(34.7%)	162 (42.6%)	380	193(50.8)	78 (20.5%)	109(28.7%)	380

Appendix 7: Distribution of Respondents According to their profile and Hygiene access and utilization: categorical variables

Variables		Hygiene Access				Hygiene Utilization			
		Low	Medium	High	Total	Low	Medium	High	Total
		Freq.	Freq.	Freq.		Freq.	Freq.	Freq.	
Woreda	Machakel	54 (60%)	61 (34.5%)	35 (30.9%)	150(39.5%)	18(27.7%)	66 (32.7%)	66 (58.4%)	150(39.5%)
	Gozamin	36(40%)	116 (65.5%)	78 (69%)	230(60.5%)	47(72%)	136 67.3%)	47 (41.6%)	230(60.5%)
	Dega	29 (32%)	73 (41%)	43 (38%)	145(38.2%)	22(33.9%)	93 (46%)	30(26.6%)	145(38.2%)
	Woinadega	61 (67.8%)	104 (58.8%)	70 61.9%)	235(61.8%)	43 (66%)	109 (54%)	83 (73.5%)	235(61.8%)
	Young	5 (5.6%)	20 (11.3%)	18 (15.9%)	43(11.3%)	2 (3%)	27 (13.4%)	14 (12.4%)	43(11.3%)
	middle adult	25 (27.8%)	36 (20%)	23 (20.3%)	84(22%)	16(24.6%)	43 (21.3%)	25 (22%)	84(22%)
	Adult	45 (50%)	87 (49%)	51 (45%)	183(48.2%)	32 (49%)	102(50.5%)	49(43.4%)	183 48.2%)
	Old	15 (16.7%)	34 (19%)	21 (18.6%)	70(18.4%)	15 (23%)	30(14.9%)	25(22%)	70(18.4%)
marital status	not currently married	18 (20%)	20 (11.3%)	17(15%)	55(14.5%)	13 (20%)	24(11.9%)	18(15.9%)	55(14.5%)
	currently married	72 (80%)	157 (88.7%)	96 (84.9%)	325(85.5%)	52 (80%)	178(88%)	95(84%)	325(85.5%)
Household Crowding	Crowded	85 (94.4%)	166 (93.8%)	101(89.4%)	352(92.6%)	59(90.8%)	186(92%)	107(94.7%)	352(92.6%)
	Not crowded	5 (5.6%)	11 (6%)	12 (10.6%)	28(7.4%)	6(9%)	16(7.9%)	6(5.3%)	28(7.4%)
access to information from health extension agents	No	2 (2.2%)	16 (9%)	10 (8.8%)	28 (28.4%)	4 (6%)	21(10.4%)	3 (2.7%)	28 (28.4%)
	Yes	88 (97.8%)	161 (90.9%)	103 (91%)	352(92.6%)	61(93.9%)	181(89.6%)	110(97.4%)	352(92.6%)
participation in WHDA	No	52 (57.8%)	120 (67.8%)	88 (77.9%)	260(68.4%)	50(76.9%)	144(71.3%)	66(58.4%)	260(68.4%)
	Yes	38 (42.2%)	57 (32%)	25 (22%)	120(31.6%)	15 (23%)	58 (28.7%)	47(41.6%)	120(31.6%)
Education	no education	78 (86.6%)	143 (80.8%)	79 (69.9%)	300(78.9%)	59(90.8%)	142(70.3%)	99(87.6%)	300(78.9%)
	primary education	11(12%)	27(15%)	25 (22%)	63(16.6%)	6 (9%)	44(21.8%)	13(11.5%)	63(16.6%)
	secondary education and above	1 (1%)	7 (3.9%)	9 (7.9%)	17(4.5%)	0	16(7.9%)	1(0.9%)	17(4.5%)
Occupation	Farm only	46 (51%)	125 (70.6%)	79 (69.9%)	250(65.8%)	45 (69%)	140(69%)	65(57.5%)	250(65.8%)
	non-farm only or farm plus	44 (48.9%)	52 (29.4%)	34 (30%)	130(34.2%)	20(30.8%)	62(30.7%)	48(42.5%)	130(34.2%)
gross annual household income	≤20000.00	11 (12%)	20 (11%)	24 (21%)	55(14.5%)	7(10.8%)	27(13.4%)	21(18.6%)	55(14.5%)
	20000.01 - 45000.00	61 (67.8%)	102 (57.6%)	62 (54.9%)	225(59.2%)	42(64.6%)	116(57.4%)	67(59.3%)	225(59.2%)
	≥45000.01+	18 (20%)	55 (31%)	27 (23.9%)	100(26.3%)	16(24.6%)	59(29.2%)	25(22%)	100 (26.3%)
Wealth	Lowest	18 (20%)	36 (20%)	22 (19.5%)	76(20%)	13(20%)	43(21.3%)	20(17.7%)	76(20%)
	Second	19 (21%)	35 (19.7%)	22 (19.5%)	76 (20%)	12(18.5%)	37(18.3%)	27(23.9%)	76 (20%)
	Middle	26 (28.9%)	34 (19%)	16 (14.2%)	76(20%)	18(27.7%)	42(20.8%)	16(14.2)	76(20%)
	Fourth	12 (13.3%)	37 (20.9%)	27 (35.5%)	76 (20%)	7(10.8%)	42(20.8%)	27(23.9%)	76 (20%)
	Highest	15 (16.7%)	35 (19.8%)	26 (34.2%)	76 (20%)	15(23%)	38(18.8%)	23(20.4%)	76 (20%)
Home plot ownership	Owned	65 (72%)	125 (70.6%)	77 (28.8%)	267(70.3%)	47 (72%)	143(70.8%)	77 (68%)	267 (70.3%)
	Not own	25 (27.8%)	52 (29.4%)	36 (31.9%)	113(29.7%)	18(27.7%)	59 (29%)	36(31.9%)	113(29.7%)
Total		90(23.7%)	177(46.6%)	113(29.7%)	380	65(17.1%)	202 (53.2%)	113 (29.7)	380

Appendix 8: Survey Questionnaire

Addis Ababa University College of Development Studies Centre for Rural Development

Introduction: Hello! I am a PhD student at Addis Ababa University College of Development studies. Currently, I am conducting a research about sanitation and hygiene and other topics in East Gojjam zone as part of the PhD study requirement. Data will be collected from randomly selected households in six Kebeles of East Gojjam Zone. Thus, you have been asked to participate in this study because your personal views are important for the success of this study. I would like to ask you some questions about yourself, the presence of sanitation and hygiene facilities in your household and your utilization of the facilities such as latrine, liquid and solid waste disposal pits and handwashing stations among others. The questionnaire will take 40-45 minutes to complete. All the information you will give me will be kept confidential and will be used only for the purpose of this research. Participation in this study is voluntary. Some of the questions may also be quite personal and I hope this will be OK with you. If you do not feel comfort answering any questions, please feel free to say so, and you can choose not to answer any individual question or all of the questions. You can stop the questionnaire at any time. However, I hope that you will participate in this survey since your views are important. Are you willing to fill this questionnaire? Yes___ No_____

I would like to thank you in advance for your kind cooperation!

I. Respondent Characteristics (*Interview is administered to a female head of the household)

1. Woreda_____ Kebele_____ Date_____
2. Age of the respondent in years_____?
3. Marital status of the respondent A. single B. married C. Divorced D. Widowed
E. Separated
4. What is the highest level of education you have completed_____.
5. What is your main occupation?
 - A. Agriculture /crop production and livestock raising
 - B. Off- farm-, selling of wood, charcoal and dung cake, local drinks, (petty trade such as selling of fruits, vegetables and grain)
 - C. Non-farm-pottery and handicrafts, cotton weaving, stone mining, daily labourer in construction sites, carpenter, cementing, masonry etc.
 - D. Student
 - E. Retired
 - F. Others _____

II. Household Characteristics

6. Total number of household members/family size_____
7. Total Number of household members whose age is less than 15 years old_____
8. Total Number of household members whose age is b/n 15-64_____
9. Total number of household members whose age is 65 and above_____

10. What is the highest level of education your husband has completed? _____

11. Occupation of the husband

A. Farm/crop and livestock production alone

B. Off- farm-, selling of wood, charcoal and dung cake, local drinks, (petty trade such as selling of fruits, vegetables and grain)

C. Non-farm-pottery and handicrafts, stone mining, daily laborer in construction sites, carpenter, cementing, masonry etc.

D. Student

E. Retired

G. Others _____

12. **Total household Annual income from different sources**

No	Source of income	Total HH income in birr in (2010/2011 e.c) from this source
12.1	Income from sale of livestock	
12.2	Income from sale of livestock products such as milk, butter, egg, honey, skin	
12.3	Income from sale of vegetables and fruits	
12.4	Income from wage	
12.5	Income from sale of local drink	
12.6	Income from remittance	
12.7	Income from employment	
12.8	Others	

13. **Crop production/** How much quintals of cereals or fruits and vegetables did you/your household has produced in this production year (from 2010 to Feb 2011 E.C)

Crop category	Amount produced in (quintal)	Local market Value in birr
13.1 Cereals		
Teff		
Wheat		
Barley		
Maize		
Peas		
Bean		
Oat		
Millet		

14. **Household Wealth Status/ Asset endowment**

14.1 Land Asset

14.1.1. Do you or your household have land? A. Yes B. No

14.1.2 If yes, what is your land size/ _____

14.1.3 If yes, type of ownership/ownership status/ tenure system

A. Owned/ has title deed/certified by the officials

B. Inherited

C. Rental/ sharecrop

D. Communal land

E. Others such as gifted but no title

15. Housing

15.1 Home plot ownership/ what is your ownership status of your home plot?

- A. Construction on own land/have title deed
- B. Inherited
- C. Family gifted/ free of rent/ borrowed
- D. Rental house

15.2 How many rooms are there in your house? A. One B. Two C. Three and more

15.3 Floor material of the house A. Earth B. Cement C. Tiles/ceramic D. Others, specify _____

15.4 Wall material of the house? A. Earth/mud B. Wood/bamboo/iron sheet C. Cement, bricks D. if others, please specify _____

15.5 Roofing material A. Grass B. Iron sheet/ corrugated iron C. Tiles D. if others, please specify _____

15.6 Place for cooking/kitchen

- A. No kitchen/open space
- B. A room used for traditional kitchen inside the house
- C. A room used for traditional kitchen outside the house

15.7 Source of fuel for cooking A. Fire wood B. Charcoal C. Crop residue / leaves

D. Dung / manure E. if others please specify _____

16. Livestock

16.1 Do you or your household have any livestock A. Yes; _____ B. No _____

16.2. If yes, do you have separate house for animals? A. Yes B. No

16.3 If yes, please indicate the numbers of animals owned by the household

No	Livestock type	Number currently Owned	Tropical Livestock Units for Sub-Saharan Africa	Total livestock Unit
1.	Ox		0.5	
2.	Cow		0.5	
3.	Calf		0.5	
4.	Donkey		0.8	
5.	Horse		0.50	
6	Mule		0.60	
7	Sheep		0.10	
8	Goat		0.10	
9	Poultry/chicken		0.01	
10	beehives		0.01	
Total number of livestock				

17 Household/domestic Assets

	Yes (coded 1)	No (coded 0)
Implements for sanitation facilities		
Sickle (machid)		
Pick axe (Doma)		
Axe (misar)		
Shovel/ Spade/Akafa		

Furniture		
Wardrobe/closet		
Bed		
Smokeless stove		
Biogas stove		
Mosquito net		
ICT		
Radio		
TV		
Mobile		
Other Assets		
Bajaj		
Cart (hand pushed)		
Weaving equipment		

- 18 Did you or your household receive any credit during the last 12 months? A. yes B. No

Section One: Questions about Sanitation

- 19 Do you or your household have ever heard any information from health extension agents
A. yes B. No
- 20 If yes, what sanitation related message/s do you recall that the extension agent has told you? (Check all that apply).
A. Latrine construction and usage
C. Adoption and utilization of liquid waste disposal facility
D. Adoption and utilization of solid waste disposal facility
E. Shelf construction and usage
F. Smokeless stove construction and usage
- 21 If yes! how many time did the extension agent contacted you in the last one year? _____
- 22 Does your household own a latrine? A. Yes B. No
- 23 If yes, do you personally use the latrine? A. Yes B. No
- 24 What motivates you or your household to adopt latrine? (Check all that apply).
A. I/we have got awareness about the benefits of latrine
B. Regular push from health extension workers and HAD to adopt and use latrine
C. Neighbours adoption of latrine/ modelling
D. Discussions in village meetings
E. Presence of educated and school going children
- 25 If others please specify _____
- 26 If No Latrine, what could be the **main reason** why you cannot construct or adopt a latrine? (Check yes or no to all that apply).
A. Lack of labor/busy with other activities
B. Lack of space to construct latrine
C. Risk of damage/collapse from flooding and wearing down of soil
D. A lot of space to defecate/defecation is not an issue/Easier to head to the bush
E. If others please specify _____

- 27 Do you have household liquid waste disposal facility? A. Yes B. No
- 28 How do you usually dispose your household liquid waste such as used water from washing household utensils?
A. disposes into liquid waste disposal facility B. Pouring into any place/ surface and gardens
- 29 How do you usually dispose your household solid waste? (Check all that apply).
A. Burning B. Burying C. Use it for compost making D. Throwing into the field/open drain

Section TWO: - Questions on Access to Safe Drinking Water

- 30 What is the **main** source of drinking water for your household?
A. Protected hand pump B. Protected spring C. Borehole/protected dug well D. River E. Unprotected spring
- 31 How long does it take you to go to the nearest drinking water source, get water and come back? (Physical Accessibility)
A. Water source is in the premise B. Less than 30 minutes C. Within 30 minutes D. 30 minutes- 60 minutes E. More than 60 minutes.
- 32 Is drinking water available to you at all time you need and in every season? A. Yes B. No
- 33 If your answer is **No** what is the cause for not getting water/ or water unavailability at a particular time or season
A. Overcrowding at water source
B. Sporadic failure of the water source
C. Water shortage
D. Distance from the house
E. Not clean
F. If others, please specify
- 34 Do you have separate drinking water collection/transportation container? A. Yes B. No
- 35 What specific kind of water container do you use most in collecting drinking water?
A. Clay Pot B. Jerry Can C. bucket/ Baldi or rotto D. Others_____
- 36 Does the water collection/transportation container has its own lid /cover? A. Yes B. No
- 37 Do you have separate drinking water storage container? A. Yes B. No

- 38 If yes which specific water container do you usually use to store your drinking water? (quality and safety issues) A. Clay pots B. Jerry Can C. Bucket/Rotto D. Others please specify_____
- 39 Does the drinking water storage container has its own lid /cover? A.Yes B. No
- 40 Do you treat your drinking water at home? A. Yes B. No
- 41 If your answer is **No**, why do not you treat drinking water at home?
A. The water is treated at the source B. Lack of time C. I do not know if water is treated
D. Water is drunk mixed with other drinks E. If others please specify_____
- 42 How do you **usually** withdraw (get) drinking water from the container/storage?
A. Tilt & pour into a water serving utensil
B. Dip the hand with the water serving utensil
- 43 Do you have shelf/cupboard to keep your kitchen and drinking utensils up the floor?
A. Yes B. No
- 44 Does your household have Shawor facility? A. Yes B. No

Section Four: Questions about Personal Hygiene

- 45 Do you have hand washing facility near latrine? A. Yes B. No C. Not applicable
- 46 If your answer is **yes**, is water always available in the hand washing facility? A. Yes B. No
- 47 Have you used the hand washing facility today or yesterday? A. Yes B. No
- 48 Do you usually use soap to wash your hands after defecation? A. Yes B. No
- 49 If your answer is no, what is the main factor(s) that prevent you from using soap
A. Laziness/ negligence /washing with soap and ash takes time
B. Soap is expensive to buy
C. Water alone cleans the hand
D. If others, please specify_____
- 50 Do you know the times that are said to be critical for handwashing? Yes No
- 51 If yes, what are the critical times for handwashing)?
A. To wash hand after defecation
B. To wash hand before preparing food
C. To wash hand before eating
D. To wash hand after handling garbage

- 52 Do you use sanitary material for menstrual hygiene management? A. Yes B. No C. Does not apply
- 53 If your answer is **yes**, what are the materials you use for menstrual hygiene management?
- A. Commercial sanitary pad
 - B. Reusable cloth pads
 - C. Pad made from wool
 - D. If others please specify.....
- 54 If you do not use sanitary pads for menstrual hygiene management what is the cause
- A. I do not know how to use sanitary pad
 - B. I do not have money to buy sanitary pad
 - C. I am ashamed to buy sanitary pad
 - D. sanitary pad is not available in nearby
 - E. I have never heard about sanitary pads
 - F. Does not apply
- 55 What problem have you ever faced because of lack of menstrual hygiene management materials/products_____

Section Five: Women's Sanitation and Hygiene Related Knowledge

- 56 Do you know how to treat water at home and make it safe for drink? A. Yes B. No
- 57 If yes, how can water be treated at home? (knowledge of how water can be treated at home)
- A. Boiling
 - B. using sand filtering technique
 - C. Using water guard or Wuha Agar
 - D. using solar water disinfection method
- 58 Do you know why you shall wash your hands after defecation? A. Yes B. No
- 59 If yes, what is the **major reason** for hand washing after defecation?
- A.To remove diseases causing germs like bacteria or virus and prevent illnesses and spread of infections
 - B.To remove dirty and feel clean
 - C.To appear good
 - D.Because everyone does/ moral behaviour

- 60 Do you know that the food you eat can be contaminated? A. Yes B. No
- 61 If yes how can food be contaminated
- A. Preparing food with unhygienic hand
 - B. Preparing food inside unhygienic kitchens
 - C. Leaving food uncovered and expose it to flies
- 62 Do you know that drinking water can be contaminated at home? A. Yes B. No
- 63 If yes, how can water be contaminated at home?
- A. When using unhygienic water serving utensils
 - B. When transporting water with unhygienic facilities
 - C. When storing water with unhygienic facilities
 - D. Leaving water without cover/lid

Section Six: Women Household Decision Making

- 64 Who in your household usually decides about how to use land?
- A. The respondent alone
 - B. The husband alone (the woman did not participate
 - C. The respondent and husband jointly
 - D. Others such as, family members, extension workers etc both the woman and man did not participate
 - E. Not applicable
- 65 Who in your household usually decides about household financial administration? How much to save, where to save, how much to utilize and for what to use?
- A. The respondent alone
 - B. Husband alone
 - C. The respondent and husband jointly
 - D. Others such as family members
 - E. Not applicable
- 66 Who in your household makes the final decision on spending your own money
- A. The respondent alone
 - B. Husband alone
 - C. The respondent and husband jointly

- D. Decision was made by others such as the husband alone, family members /the woman did not participate
 - E. Not applicable
- 67 Who in your household makes the final decision on spending your husband's money
- A. The respondent alone
 - B. Husband alone
 - C. The respondent and husband jointly
 - D. Decision was made by others such as family members /the woman did not participate
 - E. Not applicable
- 68 Who in your household makes the final decision on making purchase for your clothe
- A. The respondent alone
 - B. Husband alone
 - C. The respondent and husband jointly
 - D. Decision was made by others such as family
 - E. Not applicable
- 69 Who in your household makes the final decision on making purchase for your husband clothe
- A. The respondent alone
 - B. Husband alone
 - C. The respondent and husband jointly
 - D. Decision was made by others such as family members
 - E. Not applicable
- 70 Who in your household makes the final decision on crop selling or buying in large quantity/ quintal
- A. The respondent alone
 - B. Husband alone
 - C. The respondent and husband jointly
 - D. Decision was made by others such as family members
 - E. Not applicable

- 71 Who in your household makes the final decision on crop selling or buying in small quantity/ carrying on back
- A. The respondent alone
 - B. Husband alone
 - C. The respondent and husband jointly
 - D. Decision was made by others such as family members
 - E. Not applicable
- 72 Who in your household makes the final decision on cattle selling or buying such as oxen, cow, donkey, sheep etc?
- A. The respondent alone
 - B. Husband alone
 - C. The respondent and husband jointly
 - D. Decision was made by others such as family members
 - E. Not applicable
- 73 Who in your household makes the final decision to borrow money from microfinance institutions?
- A. The respondent alone
 - B. Husband alone
 - C. The respondent and husband jointly
 - C. Decision was made by others
 - E. Not applicable
- 74 Who made the final decision on where to collect water/choice of water sources for various purposes?
- A. The respondent alone
 - B. Husband alone
 - C. The respondent and husband jointly
 - D. Decision was made by others such as family members
 - E. Not applicable
- 75 Who made the final decision on the construction and use of latrine
- A. The respondent alone
 - B. Husband alone

- C. The respondent and husband jointly
 - D. Decision was made by others such as the health extension workers
 - E. Not applicable
- 76 Who in the household made the final decision on raw material types of latrines?
- A. The respondent alone
 - B. Husband alone
 - C. The respondent and husband jointly
 - D. Decision was made by others
 - E. Not applicable
- 77 Who in the household made the final decision to have a hand washing facility near latrine?
- A. The respondent alone
 - B. Husband alone
 - C. The respondent and husband jointly
 - D. Decision was made by others such as the health extension workers
 - E. Not applicable
- 78 Who in your household makes the final decision in your participation in community health development teams
- A. The respondent alone
 - B. Husband alone
 - C. The respondent and husband jointly
 - D. Decision was made by others such as the health extension workers and community members
 - E. Does not apply
- 79 Who in your household makes the final decision in your visit to health post for different services?
- A. The respondent alone
 - B. husband alone
 - C. The respondent and husband jointly
 - D. Decision was made by others such as the health extension workers and community members
 - E. Does not apply

Section Seven: Questions on Women's Participation in Rural Health Extension Activities

- 80 Do you participate in women's development team in your village? A. Yes B. No
- 81 Do you participate in communicating health information between households and HEWs
A. Yes B. No
- 82 Do you participate in sensitizing and monitoring neighbors' adoption of healthy behaviors
such as the use of latrine, smokeless stove and bed net etc. A. Yes B. No
- 83 Do you participate in making households' become member of community based health
insurance scheme? A. Yes B. No
- 84 Do you participate in supporting women in your village to deal with administrative matters?
A. Yes B. No
- 85 Do you participate in child immunization campaign and service use A. Yes B. No

Section Eight: Questions about Women's self esteem

I. Self-esteem- women's gender equality attitude

- 86 In your opinion, is a husband justified in beating his wife if there is no water in the
household? A. Yes B. No C. Do not know
- 87 In your opinion, is a husband justified in beating his wife, if she comes home late while
fetching water? A. Yes B. No C. Do not know
- 88 In your opinion, is a husband justified in hitting or beating his wife if the house is not
clean? A. Yes B. No C. Do not know
- 89 In your opinion, is a husband justified in hitting or beating his wife if she asks him to wash
dish? A. Yes B. No C. Do not know
- 90 In your opinion, is a husband justified in hitting or beating his wife if she does not complete
her domestic work to his satisfaction? A. Yes B. No C. Don't know
- 91 In your opinion, is a husband justified in hitting or beating his wife if she spends money
without permission? A. Yes B. No C. Don't know
- 92 In your opinion, is a husband justified in hitting or beating his wife if she accepts women
development team membership without his permission? A. Yes B. No C. Do not know
- 93 In your opinion, is a husband justified in hitting or beating his wife if she goes to toilet
during day time? A. Yes B. No C. Do not know

- 94 In your opinion, is a husband justified in hitting or beating his wife if she attends community meeting outside of church without his permission? A. Yes B. No C. Do not know

II Self Esteem: If the woman wants to have decision input

- 95 Do you want to have decision input in buying household furniture such as bed, cupboard and wardrobe? A. yes B. No C. Do not know
- 96 Do you want to have decision input in spending family income? A. Yes B. No C. Do not know
- 97 Do you want to have decision input in taking a loan? A. Yes B. No C. Do not know
- 98 Do you want to have decision input in latrine adoption? A. Yes B. No C. Do not know
- 99 Do you want to have decision input in latrine site identification? A. Yes B. No C. Do not know
- 100 Do you want to have decision input on materials used for latrine construction? A. Yes B. No C. Does not know
- 101 Do you want to have decision input in sanitation and hygiene related activities in your kebele? A. Yes B. No C. Do not know
- 102 Do you want to have decision input in drinking water interventions? A. Yes B. No C. Do not know
- 103 Do you want to have decision input on women's development team structure and function A. Yes B. No C. Do not know

Appendix 9: Interview Guide

1. Place of interview -----Age ----- 2. Education -----3. Marital Status-----
2. Where do you get your drinking water? Is there any protected water source in your locality? Is the source reliable to get water at all time of the day you need and in different seasons? If not why? (probe)
3. What benefit does access to a nearby water source brought to you? What do you think you have lost because you do not have protected water source in nearby?
4. What kind of facilities do you use to collect, transport and store your drinking water? Do you have separate water collection and storage facility? What is the advantage and disadvantage of using these kinds of facilities?

5. What is the traditional custom regarding sanitation and hygiene in your village? Do you have latrine in your household? If yes, do you use the latrine yourself? If you do not use latrine, why not? What factors influence you or your household to adopt and use sanitation facilities like latrine, solid and liquid waste disposal facilities? Can we talk about these issues in detail please? What benefits have you got by using latrine and other waste disposal pits?
6. Do you always wash your hands after defecation and before food preparation and serving? If yes, do you usually use soap to wash your hands? If no, what is the main factor(s) that prevent you from using soap?
7. How do you keep your personal hygiene during menstrual period? Do you use sanitary pads? If not what do you use? (probe),
8. Are there any sanctions or motivations to adopt sanitation and hygiene facilities in your area?

Appendix 10: Key informant interview Guide

1. Would you tell me about the sanitation related extension services available to households and women here, the extent they have been adapted and used?
2. Would you tell me about hygiene related extension services available to households and women here, the extent they have been adapted and used?
3. Would you tell me your perception towards the main constraints in the area with regards to adoption and utilization of sanitation and hygiene facilities?
4. How do you describe the trend of sanitation and hygiene facility adoption and utilization in your working area? Have there been changes? If yes, would you tell me the nature of changes and the effects they brought in the area: (positive and negative effects)?
5. Have you witnessed changes in the lives of women in your working area that can be associated with sanitation and hygiene technology adoption and utilization?

Observation guideline

1. Observe the kind of toilet facility available
2. Observe the hand washing station
3. Observe the presence of water in the hand washing facility
4. Observe the sanitation and hygiene practices made by women

List and Status of Articles Produced from the Monograph

Women's Sanitation Access and Utilization Level and Their Determinant Factors in East Gojjam Zone, North West Ethiopia. Submitted to Ethiopian Journal of the Social Sciences and Humanities (EJOSSAH). Under review and waiting for reviewers comment.

The Effect of Sanitation and Hygiene Access and Utilization on Women Empowerment: The Case of East Gojjam Zone, Northwest Ethiopia. Submitted to International Journal of Environmental Research & Public Health

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The Effect of Sanitation and Hygiene Access and Utilization on Women Empowerment: The Case of East Gojjam Zone, Northwest Ethiopia

Abstract

The goal of empowerment has become a common component of water, sanitation, and hygiene interventions in developing countries. Yet, there is limited empirical evidence on how access to and utilization of such services have contributed for women's empowerment. Many studies related to sanitation and hygiene are conducted on the basis of how empowerment of women is linked with the achievement of better sanitation and hygiene access and utilization. This study was, therefore, intended to fill this gap in the literature. The study is part of a larger cross-sectional research that examined women's access to and utilization of rural health extension service and its empowerment effect in East Gojjam Zone, Amhara region, Ethiopia, and the analysis is made from a total of 325 currently married women. Partial proportional odds model (PPOM) is used to estimate the association between women's sanitation and hygiene access and utilization level and their empowerment status. The PPOM estimation has identified sanitation and hygiene utilization to have a statistically significant association with women empowerment. A woman who has high level of sanitation utilization is 6.67 times more likely to be empowered than a woman who has low level of sanitation utilization. Similarly, a woman who has a high level of hygiene utilization is 2.5 times more likely to be empowered than a woman who has a low level of hygiene utilization. A statistical significant association is not found between sanitation and hygiene access and women empowerment; signifying that the mere presence of sanitation and hygiene facilities has no effect on women empowerment unless it is actually utilized. It is, therefore, recommended that the government should strengthen its work towards promoting and monitoring not only the sanitation and hygiene facilities to be built but also their utilization.

Keywords access, hygiene, sanitation, utilization, women empowerment