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LIST OF ABBREVIATIONS

CI	Confidence interval
CHC	Community health club
CLUES	Community-led urban environmental sanitation
CLTS	Community-led total sanitation
CSA	Central Statistical Agency of Ethiopia
DHS	Demographic and Health Survey
EHP	Environmental Health Project
ETB	Ethiopian Birr
HCES	Household-centred environmental sanitation
HSDP	Health Sector Development Programme
HEP	Health extension programme
HIF	Hygiene improvement framework
IRC	International Water and Sanitation Centre
LCD	Litres per capita per day
MoH	Ministry of Health of Ethiopia
NGOs	Non-governmental organizations
OR	Crude odds ratio
PHAST	Participatory hygiene and sanitation transformation
PRA	Participatory Rural Appraisal
PHCU	Primary health care unit
SPSS	Statistical Package for the Social Sciences
UNICEF	United Nations Children's Fund
USAID	United States Agency for International Development
VIP latrine	Ventilated improved pit latrine
WHO	World Health Organization
WSP	Water and Sanitation Programme of the World Bank
WSSCC	Water Supply and Sanitation Collaborative Council

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CHAPTER 1

ORIENTATION TO THE STUDY

1.1 INTRODUCTION

Diarrhoeal disease is a major public health problem, especially with children in developing countries (Scrimgeoura & Lukask 2008:711). Globally, diarrhoea remains the second most common cause of death among children under-five and is followed closely by pneumonia as the leading killer of young children. Both pneumonia and diarrhoea account for an estimated 40% of all child deaths around the world each year (World Health Organization & United Nations Children's Fund 2009:5). There are an estimated 1.7 billion cases of diarrhoea, or on average 2.9 episodes/child/year, and an estimated 1.87 million deaths among children under 5 years of age (Brown, Cairncross & Ensink 2013:1).

More than 40% of the global burden of disease attributed to environmental factors falls on children below five years of age, who account for only about 10% of the world's population (World Bank 2008:1). An estimated 94% of the diarrhoeal diseases burden is attributable to the environment, and associated with risk factors such as unsafe drinking-water and poor sanitation and hygiene (Prüss-Üstün & Corvalán 2006:9). Lack of safe water, sanitation and hygiene may account for as much as 88% of the disease burden due to diarrhoea (Kleinau, Post & Rosensweig 2004:1). It is well known, for example, that most of the cases of diarrhoea worldwide are the result of faecal-oral contamination. Water supply, sanitation and hygiene are some of the top ten proven preventive interventions for deaths of children under-five. Indeed, it is estimated that up to two thirds of all the incidents of diarrhoea in children could be avoided through readily available and inexpensive hygiene improvement interventions in developing countries (Environmental Health Project 2004:1). However, more than 780 million people are still without access to improved sources of drinking water and 2.5 billion lack improved sanitation (World Health Organization & United Nations Children's Fund 2012:2). Water, sanitation and hygiene measures remain critically important to global public health, especially among children in developing countries (Brown et al 2013:1).

According to an Ethiopian Demographic and Health Survey Report of 2011, conducted by Central Statistical Agency (CSA) and ICF International (2012:146) with regard to the prevalence of diarrhoea, within two weeks preceding the survey among under-five children, a national statistic of 13% of the children under the age of five were reported to have had diarrhoea. The report also indicated that over 46% of households in Ethiopia lacked access to an improved source of drinking water and the large majority of households, 82%, use non-improved toilet facilities.

This research explored the association between household environmental health factors and the prevalence of diarrhoea among under-five children in an urban setting of Sebeta town in Ethiopia. The study gives an insight into the environmental health and hygiene status in relation to childhood diarrhoea at household level and assists to optimise actions to be prioritised and recommends environmental health strategies for the prevention of childhood diarrhoea based on the study findings.

1.2 BACKGROUND INFORMATION ABOUT THE RESEARCH PROBLEM

1.2.1 The source of the research problem

Diarrhoea is a major cause of morbidity and mortality among children under the age of five years in sub-Saharan Africa. Nearly half of the global deaths from diarrhoea among young children occur in Africa where diarrhoea is the single largest cause of death among under 5-year-olds and a major cause of childhood illness (O'Reilly, Jaron, Ochieng et al 2012:2). Africa and South Asia are home to more than 80% of child deaths due to diarrhoea (World Health Organization & United Nations Children's Fund 2009:5).

According to Prüss-Üstün and Corvalán (2006:34), the World Health Organization (WHO) estimated that 88% of all global cases of diarrhoea were attributable to water, sanitation and hygiene. The risk factor was defined as "drinking-water, sanitation and hygiene behaviour", as well as aspects of food safety that are related to water, sanitation and hygiene (i.e. food contamination by unsafe water, or the lack of domestic hygiene). A limited disease transmission was facilitated through pathways other than those associated with water, sanitation and hygiene, or food (e.g. airborne transmission), and about 94% (84 - 98%) of all cases of diarrhoea around the world were attributable

to the environment, resulting in more than 1.5 million deaths annually, mainly in children (Prüss-Üstün & Corvalán 2006:34).

Environmental health interventions for the prevention of diarrhoeal disease include steps to improve proper disposal of human faeces (basic sanitation), improving water quality, water quantity and access, and promoting hand-washing and other hygiene practices (Clasen, Bostoen, Schmidt, Boisson, Fung, Jenkins, Scott, Sugden & Cairncross 2010:5). Improved sanitation, better hygiene and safe water can be considered as three separate, but complementary, interventions for the prevention of the transmission of faecal-borne pathogens (Van Wijk & Murre 1995:6).

The government of Ethiopia has formulated a number of strategies that provide a framework for improving child health. One of the priorities in the Health Sector Development Plan (HSDP IV) is improving children's health (Central Statistical Agency & ICF International 2012:135). The government has also developed a national strategy for child survival. The objective of the strategy is to reduce under-five mortality (Ministry of Health of Ethiopia 2005c:39). Furthermore, the Ethiopian National Health Policy puts emphasis on the preventive aspect of health services (Ministry of Health of Ethiopia 1993:28). The country has no separate environmental health and sanitation policy of its own, but has a National Hygiene and Sanitation Strategy that emanated from the health policy. The National Hygiene and Sanitation Strategy was developed to enable 100% adoption of improved sanitation and hygiene practice (Water Supply and Sanitation Collaborative Council 2009:3).

According to the Ministry of Health (MoH) of Ethiopia (2005b:15), the overwhelming communicable disease burden in the country is attributable to poor sanitation. As a result, three-fourths of the country's health problems are due to communicable diseases attributable to unsafe/inadequate water supply, and unhygienic/unsanitary waste management, particularly excreta. Diarrhoeal disease that is caused by improper management of water and sanitation is among the major causes of infant and child morbidity and mortality (Ministry of Water Resources of Ethiopia 2004:19). On the basis of available information, it is estimated that diarrhoea contributes 20% of the cause-specific proportions for under-five mortality (Ministry of Health of Ethiopia 2005c:17). Therefore, the increased magnitude of environmental health problems in Ethiopia's urban settings demands community-based studies that will facilitate a better

understanding of the issues and influence policy and decision-making at the community, town, regional and national level. With this context, Sebeta town was selected to study the situation of water, sanitation, hygiene and waste handling practices in relation to childhood diarrhoea at household level.

1.2.2 Background to the research problem

Diarrhoeal diseases remain a leading cause of preventable death, especially among children under-five in developing countries. Diarrhoea is caused by infectious organisms, including viruses, bacteria, protozoa, and helminths that are transmitted from the stool of one individual to the mouth of another, termed faecal-oral transmission. Human faeces are the primary source of diarrhoeal pathogens (Keusch, Fontaine, Bhargava et al 2006:371). Infection is more common when there is a shortage of clean water for drinking, cooking and cleaning. Water contaminated with human faeces, for example, from sewage, septic tanks and latrines, is of particular concern. Animal faeces also contain microorganisms that can cause diarrhoea. Diarrhoeal disease can also spread from person-to-person, aggravated by poor personal hygiene. Food is another major cause of diarrhoea when it is prepared or stored in unhygienic conditions (World Health Organization 2009).

Sanitation, through a safe disposal of human excreta, is the primary barrier in preventing excreta-related transmission of diarrhoeal diseases. Without removing excreta from potential contact with humans, animals and insects, pathogens (disease causing agents) may be carried on unwashed hands, in contaminated water or food, or via flies and other insects on to human hosts. The secondary barriers to excreta-related disease transmission are based on hygienic practices, such as washing hands following defecation and handling children's faeces, and before storing and preparing water and food. Children's excreta in particular are known to be especially infective, but there is widespread belief that they are relatively harmless, so that they are also most likely not to be safely disposed of (Hunt 2006:3).

The most successful efforts to prevent diarrhoea involve interventions to improve sanitation, improve water quality, increase water quantity, and increase hand washing. These efforts have been conclusively shown to reduce diarrhoeal disease incidence in developing countries. In addition, access to clean water and sanitation is important for

the prevention of diarrhoeal diseases and other water-related diseases, such as ascariasis, hookworm, helminth infection, schistosomiasis, trachoma and guinea worm (Environmental Health Project 2004:7).

The effects of each of the four interventions are summarised below:

1. *Improved basic sanitation* (safe disposal of faeces) blocks the paths between faeces and fluids, between faeces and fields, and between faeces and food. A simple latrine that is minimally maintained can also block the pathway between faeces and flies, by either keeping flies away from faeces or keeping flies that have had contact with faeces away from people.
2. *Improved water quality* (through water supply improvements, household water treatment, and safe storage of drinking water) makes water safe to drink and to use in all aspects of food preparation. The safety of the water is ensured only if that water stays clean and is not contaminated via other pathways.
3. *Increased water quantity* allows the household to wash food more thoroughly during preparation, wash food preparation surfaces and utensils more thoroughly and frequently, and to use for personal hygiene such as to wash hands more thoroughly. These activities can block a number of the paths to contamination, including most of those involving fingers and flies and having to do with food.
4. *Increased hand-washing,* if done correctly at critical times, blocks all the pathways that directly or indirectly involve the fingers (Environmental Health Project 2004:7).

All of these interventions – whether of the "hardware" (the infrastructure inputs related to appropriate equipment and construction, such as sanitation facilities, community water systems, and the provision of facilities to dispose of human excreta in ways that safeguard the environment and public health); or "software" programmes (hygiene promotion such as community education and participation, training, social marketing, hygiene education, health education materials, and other non-technology aspects in order to ensure that water and sanitation systems) have been shown to considerably reduce the prevalence of diarrhoea (Environmental Health Project 2004:8; International Federation of Red Cross and Red Crescent Societies 2007:2; Kleinau & Pyle 2004:28). In addition, while each of these approaches is effective on its own, in combination they can deliver even greater results (Environmental Health Project 2004:8).

Water and sanitation improvements, in association with hygiene behaviour change, can have significant effects on population and health by reducing a variety of disease conditions such as diarrhoea, intestinal helminths, guinea worm, and skin diseases. These improvements in health can, in turn, lead to reduced morbidity and mortality and an improved nutritional status (Billig, Bendahmane & Swindale 1999:6).

A 2005 systematic review carried out on diarrhoeal disease by Fewtrell and colleagues estimated that the risk reduction associated with provision of improved sanitation was 32%. The review also revealed that diarrhoeal episodes can be reduced by 25% through improving water supply and by 31% via water quality. The overall results of the review are summarised in Table 1.1 (Bloomfield, Exner, Fara, Nath, Scott & Van der Voorden 2009:42; Prüss-Üstün, Bos, Gore & Bartram 2008:17).

Table 1.1 Estimated relative reductions in risk of diarrhoeal disease associated with water and sanitation interventions

Intervention area	Reduction in diarrhoea
Sanitation	32%
Water supply	25%
Water quality	31%

(Prüss-Üstün et al 2008:17)

The strong causal relationship between hand hygiene and gastrointestinal disease risk has also been demonstrated by meta-analysis studies of community-based interventions (Bloomfield et al 2009:44). A 2003 systematic review by Curtis and Cairncross estimated a 42–47% reduction in diarrhoeal diseases associated with hand-washing (Curtis & Cairncross 2003:275). The Fewtrell and colleagues (2005) showed a 44% reduction in diarrhoeal illness associated with hand washing (Bloomfield et al 2009:44). A Cochrane systematic review in 2008 by Ejemot and colleagues examined 18 randomised trials of hand-washing on diarrhoea and found that interventions promoting hand-washing resulted in a 32% reduction in diarrhoeal episodes among children living in low-income or middle-income countries, a conclusion also supported by other reviews (Fana & Mahalb 2011:341). In a 2008 study, Aiello and colleagues estimated that hand washing with soap and combined with education could produce a 39% reduction in gastrointestinal illness (Bloomfield et al 2009:44).

Almost all the water-borne, water-based and water-washed diseases are spread through exposure of food and drinking water to human faeces. The rate of infection may thus be reduced by improving human waste disposal practices and better home hygiene practices, water quality and food hygiene. Supply of safe water provides little advantage if water becomes contaminated because of unhygienic practices at home. On the one hand, the storage and handling of food and drinking water should be an important component of any programme for promoting domestic hygiene. On the other hand, an improvement in the hygienic behaviour of a community cannot be sustained without concurrent improvement in the quality of environmental sanitation and drinking water (Beumer, Bloomfield, Exner, Fara, Scott & Nath 2002:9).

A growing concern over environmental health risks from the country's towns makes it essential to carry out community-based studies that will support a better understanding of the problems in relation to childhood diarrhoea. Based on these contexts, this study was conducted with regard to household environmental health factors associated with the occurrence of diarrhoea in the under-five children of Sebeta town in Ethiopia.

1.3 STATEMENT OF THE RESEARCH PROBLEM

According to the 2011 Ethiopian Demographic and Health Survey data (Central Statistical Agency & ICF International 2012:111), the infant mortality rate was 59 per 1,000 live births, the child mortality rate was 31 per 1,000 children surviving to age 1 year, and the under-five mortality rate was 88 per 1,000 live births. This implies that one in 17 Ethiopian children dies before their first birthday and one in 11 Ethiopian children dies before their fifth birthday.

Children in Ethiopia suffer from poor health conditions (Ministry of Health of Ethiopia 2005c:17). More than 90% of child deaths are due to pneumonia, diarrhoea, malaria, neonatal problems, malnutrition and HIV/AIDS, and often a combination of these conditions (Ministry of Health of Ethiopia 2010:3). The levels of mortality are also worsened particularly by poverty, inadequate maternal education, lack of potable water and sanitation and high fertility (Ministry of Health of Ethiopia 2005c:17).

The 2005 Ethiopian Demographic and Health Survey showed that the prevalence of under-five childhood diarrhoea in the two-week period was 18% in Ethiopia (Central

Statistical Agency & ORC Macro 2006:136). A 2011 Demographic and Health Survey also showed that 13% of children under the age of 5 had diarrhoea, in the two-week period before the survey. Diarrhoea was most common among children age 6–23 months (23-25% percent). Furthermore, the prevalence of diarrhoea is highest among children residing in households that drink from unprotected wells (18%) (Central Statistical Agency & ICF International 2012:146).

According to data sources from the World Health Organization and United Nations Children's Fund Joint Monitoring Programme for Water Supply and Sanitation, only 44% of the general population in Ethiopia has access to safe drinking water supplies. A further 79% of the population do not have access to improved sanitation facilities (World Health Organization & United Nations Children's Fund 2012:42). There is ample evidence that access to adequate and safe water and sanitation can influence child mortality and, therefore, these major determinants must be addressed in developing sustainable preventive interventions (Ministry of Health of Ethiopia 2005c:18).

To effectively prevent childhood diarrhoea, it is imperative that the important risk factors associated with diarrhoea in communities be identified through research. However, there are limited studies conducted on local environmental health risk factors in relation to childhood diarrhoea in Ethiopia. Thus, with these situations, this study was carried out on the household environmental health risk factors in relation to childhood diarrhoea in an urban setting of Ethiopia.

1.4 AIM OF THE STUDY

1.4.1 Research purpose

The purpose of the study was to assess and explore the household environmental health factors associated with the occurrence of diarrhoea in children under-five years in Sebeta town of Ethiopia, in order to develop environmental health strategies to optimise actions to be prioritised in the prevention of childhood diarrhoea.

1.4.2 Research objectives

The objectives for this study were to:

- Identify the demographics and other related factors for childhood diarrhoea.
- Assess the environmental risk factors of childhood diarrhoea with regard to water, environmental sanitation and hygiene practices of the households in Sebeta town of Ethiopia.
- Determine the prevalence of diarrhoea among children under-five years among households in Sebeta town of Ethiopia.
- Explore the relationship between households' environmental health factors on the occurrence of diarrhoea among children under-five years.

1.4.3 Research questions

The main research questions were:

- What environmental risk factors are associated with diarrhoea among children under-five years in Sebeta town of Ethiopia?
- What environmental health strategies could be implemented for effective prevention of childhood diarrhoea?

1.5 SIGNIFICANCE OF THE STUDY

As this study aimed to identify the most common environmental health risk factors associated with diarrhoeal illnesses among children under-five years, the study will help to inform the status of the community environmental health and child health programmes in relation to childhood diarrhoea, and assist in the establishment of a better understanding and distinguishing of priorities in environmental health programmes in relation to childhood diarrhoea. This will assist health professionals to best achieve their goal of improved environmental health conditions and contribute to the prevention of childhood diarrhoea in the study area in particular and in the country in general.

This study will also contribute to the growing body of knowledge and research on the household environmental health risk factors in relation to childhood diarrhoea. The research's findings will specifically contribute knowledge to existing health professionals, which will enhance urban environmental health programmes for the prevention of childhood diarrhoea and develop further health strategies. This will also result in an improvement of the urban environmental health conditions and child health in the study area, which in turn contributes to the improvement of the health of the general population.

1.6 DEFINITION OF KEY CONCEPTS

1.6.1 Conceptual definitions

A conceptual definition refers to the general meaning of a concept (LoBiondo-Wood & Haber 2010:58). In this study, the following key concepts were used as defined below:

- ***Diarrhoea***: is the passage of 3 or more loose or liquid stools per day, or more frequently than is normal for the individual (World Health Organization 2009). In this study, ***a case of childhood diarrhoea*** is defined as a child up to the age of 60 months (an under-five child) in the study household having passed three or more loose or watery stool in a 24-hour period (a day) within a two weeks period preceding the date of interview, as reported by the mother/caregiver of the child.

- ***Environmental health factors***: There are many environmental sanitation interventions that can help to prevent diarrhoeal and other infectious diseases. The environmental interventions for the prevention of diarrhoeal disease include measures such as excreta containment and treatment, food safety and hygiene, water source protection and handling (improving water quality and water quantity and access), and personal and domestic hygiene (promoting hand washing and other hygiene practices) (Clasen et al 2010:5; Murphy, Stanton & Galbraith 1997:11). In this study, environmental health factors include domestic water supply, environmental sanitation (excreta disposal, solid waste and liquid waste disposal) and hygiene practices at household level.

- ***Strategy***: refers to a systematic, well-planned series of actions, combining different methods, techniques and tools, to achieve an intended change or objective utilising the available resources within a specific time frame (Mefalipulos & Kamlongera 2004:8). In this study, indicating general methodology using various techniques, tools and approaches to be used to achieve the desired objectives.

- ***Prevention***: It is estimated that 90% of the child diarrhoeal disease burden is the result of poor sanitation conditions and inadequate personal, household and community hygiene behaviours. Therefore, understanding environmental and behavioural risk factors and their interactions is a prerequisite for devising effective preventive approaches. Primary preventive interventions reduce environmental risk factors and high-risk behaviours for whole communities by interrupting the disease transmission cycle. For diarrhoeal disease this means promoting changes in hygiene behavior to protect people from ingesting diarrhoeal disease pathogens and providing sanitation solutions to protect the environment from faecal contamination. The environmental health prevention strategies for diarrhoea include: good personal and domestic hygiene (effective hand-washing with a cleansing agent at critical times /after defecation, after handling children's faeces, before feeding and eating, and before preparing food/; proper disposal of faeces by using latrine and toilet and adequate food hygiene, such as hygienic preparation and safe storage of foods); use of safe water (use of drinking water from the safest source and protection of drinking water from contamination at the source and in the home) (Hung 2006:21). A full-scale programme to improve environmental health for prevention of diarrhoea would need to address the management of excreta, sullage, drainage and solid waste at households (Water Supply and Sanitation Collaborative Council & World Health Organization 2005:10). In this study, prevention of diarrhoea in relation to household environmental health factors include interventions in the areas of domestic water supply, environmental sanitation (excreta disposal, solid waste and liquid waste disposal) and household hygiene practices.

1.6.2 Operational definitions

The process of translating a concept into a measurable variable for data collection requires the development of an operational definition. An operational definition is how

the researcher will measure each variable (LoBiondo-Wood & Haber 2010:576). In this study, the following operational terms were used as defined below:

- ***Prevalence of diarrhoea***: refers to the proportion of children in a given sample who have had diarrhoea in the preceding two weeks, which includes diarrhoea at the time data are collected (Kleinau & Pyle 2004:37). Diarrhoea prevalence in children is as measured as two-week recall by the mother. In this study, it is the total number of diarrhoea cases of children under the age of 5 years in the two weeks prior to the day of interview divided by the total number of under-five children in the samples of the study area.

- ***Index child***: According to Demographic and Health Surveys (DHS), the child health variables are generally obtained for all surviving children born in an interval of time before the survey, usually five years and this is referred to as "index" children (Pullum 2008:1). According to an operational definition, cited in a study by Danquah, Awuah, Mensah and Agyemang (2014:120), an index child refers to one child less than or equal to 5 years (60 months) whose health data has been captured exclusively for study in a household. In this study, an index child refers to a child under-five years of age that was enrolled in the study from a household. In a household where there was more than one child, the youngest child was selected so as to collect information on the child's socio-demographic and health data. Furthermore, in this study, ***under-five children*** refer to children under the age of five years or children less than 60 months of age living in a household of the study town at the time data collection.

- ***Environmental sanitation***: refers to a range of interventions designed to improve the management of excreta, sullage, drainage and solid waste (Water Supply and Sanitation Collaborative Council & World Health Organization 2005:VI). In this study, environmental sanitation is concerned with excreta disposal, solid waste disposal and liquid waste disposal facilities, services or practices.

- ***Basic sanitation***: refers to the management of human faeces at the household level (Ministry of Health of Ethiopia 2011a:3). In this study, basic sanitation refers to household toilet facilities.

- ***Hygiene or hygiene practices***: refers to personal and household practices such as hand-washing, bathing and management of stored water in the home, all aimed at preserving cleanliness and health (WaterAid 2011:2). In this study, hygienic practices mainly include washing hands at critical times (before eating, before preparing food, after defecation, after a clean-up of child's faeces or cleaning a child's bottom and before feeding a child).

- ***Type of toilet facility***: is classified as improved and unimproved sanitation facility.

  - ***Improved sanitation facilities***: A sanitation facility is considered adequate if it hygienically separates human excreta from human contact. The types of technology that are likely to meet this criterion are: flush to piped sewer system; flush to septic tank; flush/pour flush to pit; composting toilet; ventilated improved pit latrine (VIP latrine); and pit latrine with a slab (World Health Organization & United Nations Children's Fund 2006:12). In this study, improved sanitation facilities refers to flush or pour flush toilet (flush to piped sewer system, flush to septic tank (holding tank), flush to pit latrine) and pit latrine (ventilated improved pit latrine (VIP), and pit latrine with slab).

  - ***Unimproved sanitation facilities***: types of sanitation facilities that are not likely to meet the criterion are: flush/pour flush elsewhere; pit latrine without a slab/open pit; bucket; and a hanging toilet (World Health Organization & United Nations Children's Fund 2006:12). In this study, unimproved sanitation facility includes flush toilet – flush to river/stream, flush toilet - flush to elsewhere, pit latrine without slab/open pit, communal latrine, public toilet and no facilities or open field defecation anywhere.

- ***Type of source of water supply***: this is classified into improved and unimproved drinking water supply.

  - ***Improved drinking water source***: the water sources likely to be of suitable quality, or "improved", are: a piped water supply into the dwelling; piped water to a yard/plot; a public tap/standpipe; a tube well/borehole; a protected dug well; a protected spring; and rainwater (World Health Organization & United Nations Children's Fund 2006:8). In this study, improved water source refers to piped

water into dwelling, piped water to yard, public tap/standpipe, protected dug well, protected spring and rainwater.

- ***Unimproved drinking water source***: water sources that are "unimproved" are: an unprotected dug well; an unprotected spring; a cart with a small tank/drum; a water tanker-truck; and surface water (World Health Organization & United Nations Children's Fund 2006:8). In this study, unimproved water sources include surface water (river, stream or pond), unprotected dug well; unprotected spring and cart with a small tank/drum.

1.7 THEORETICAL FOUNDATIONS OF THE STUDY

The F-diagram model of faecal-oral disease transmission is a useful model to describe the principal routes of transmission of infectious diarrhoeal disease (Hunt 2001:5; UN-Water 2008). This model has provided the conceptual framework for this study. According to Curtis, Cairncross and Yonli (2000:24), the F-diagram, described by Wagner and Lanoix in 1958 has been widely used as a model of faecal-oral disease transmission and it schematises the routes that faecal pathogens get through the environment to reach a new host. Most diarrhoeal diseases are a consequence of an oral exposure to an enteric pathogen emanating from faeces eliminated by an infected individual in a susceptible host. Enteropathogens from contaminated faeces (mostly from humans, but in the case of some enteropathogens, also some animals) will be transmitted to a new susceptible host through contaminated water, fingers, soil and flies, either directly or by contaminating food that is ingested (Gil, Lanata, Kleinau & Penny 2004:3).

The F-diagram also indicates the primary and secondary measures that prevent the spread of diarrhoeal pathogens in the environment. The primary barriers include: the disposal of stool in such a way that it is isolated from human contact (by the use of latrines, sewers, burying, etc.) and the removal of traces of faecal material from hands after contact with excreta (i.e. hand-washing after going to the toilet) (Curtis et al 2000:25). The secondary barriers are hygiene practices that stop faecal pathogens that have got into the environment in stool or on hands, from multiplying and reaching new hosts. Secondary barriers thus include washing hands before preparing food or eating, and preparing, cooking, storing and re-heating food in a way that avoids pathogen

survival and multiplication. They also include protecting water supplies from faecal contaminants and water treatments such as boiling or chlorination. Other secondary barriers include keeping play spaces free of faecal material, preventing children from eating earth, and controlling flies (Curtis et al 2000:25). The details on the F-diagram model of faecal-oral disease transmission which provided the conceptual framework for the study are presented in Chapter 3.

1.8 RESEARCH DESIGN AND METHOD

1.8.1 Research design

According to Grove, Burns and Gray (2013:195), a research design is the blueprint for conducting a study. A quantitative, descriptive, contextual and cross-sectional research design was used to conduct this study on the environmental health factors in relation to the occurrence of childhood diarrhoea among the households of Sebeta town.

1.8.2 Study setting

According to Grove et al (2013:709), a setting refers to location for conducting research. The setting for this study, Sebeta town, is located in Oromiya region in Ethiopia.

1.8.3 Study population

Grove et al (2013:351) describes a target population as the entire set of individuals or elements who meet the sampling criteria. In this study, the target population (source population) compromises all households' mothers or caregivers with under-five children living in Sebeta town of Ethiopia. An accessible population is the portion of the target population to which the researchers have reasonable access (Grove et al 2013:351). In this study, the accessible population includes a sample of randomly selected households' mothers/caregivers with under-five children in Sebeta town.

1.8.4 Sampling method

A sample is a subset of a population selected to participate in a study. Sampling refers to the process of selecting a portion of the population to represent the entire population

(Polit & Beck 2010:307). A two-stage stratified random sampling method was utilised for selection of the study households. The sample size of the study was 477 households with mothers/caregivers of under-five children (mother-child pairs), which was determined using a statistical formula for the single population proportion.

1.8.5 Data collection

Data collection is a systematic gathering of information relevant to the research purpose or the specific objectives, questions or hypotheses of a study (Grove et al 2013:691). Two types of structured data collection methods were used in the study. These were structured interview and structured observational methods. The data collection tool which was employed for household interview and observation methods is the structured interview schedule. Structured data collection is an approach to collecting data from participants in which response categories are specified in advance (Polit & Beck 2010:569).

1.8.6 Data analysis

Data analysis refers to techniques used to reduce, organise and give meaning to data (Grove et al 2013:691). After completion of fieldwork, the interview schedules were collected, reviewed and thereafter each interview schedule was coded numerically. Data was then entered and verified in the computer database created in EPI Info 7.0 (United States Centres for Disease Control and Prevention, Atlanta, Georgia, USA) and analyzed using the Statistical Package for the Social Sciences (SPSS) version 20.0 statistical software (SPSS Inc. Chicago, Illinois, USA). Descriptive statistics were used to describe the variables by means of frequency distributions, percentages, measures of central tendency and standard deviations and the summary results of the statistics were presented using tables and graphs. In analyzing data, both bivariate and multivariate analyses were employed in this study using SPSS software programme to identify the determinants of childhood diarrhoea. Bivariate analysis was conducted using chi-square test of independence or Fisher's exact test. Multivariate analyses were performed using the binary logistic regression to estimate the association between the dependent variable and independent variables. All the independent variables that were found significant at *p*-value less than 0.25 in bivariate analysis were entered into the regression model and a backward stepwise (likelihood ratio) method was used for the

multivariate analysis. The results of the multivariate analysis were presented with adjusted odds ratio (AOR) with 95% confidence intervals (CI) and *p*-values. In all the analysis, the test was two-sided and *p*-value less than or equal 0.05 was considered as statistically significant.

1.8.7 Validity and reliability

The validity of a study, according to Grove et al (2013:197), is a measure of the truth or accuracy of a claim and is an important concern throughout the research process. Reliability is the ability of an instrument to measure the attributes of a concept or construct consistently (LoBiondo-Wood & Haber 2010:286). In this research, external validity was addressed in the sampling strategies and sample selection procedures of the study households. The interview schedule of the study was developed after conducting a detailed literature review and by adapting from the publications of international organisations and relevant studies to ensure content validity. Furthermore, standardised, pre-tested, and a structured data collection tool (interview schedule) was used to ensure the reliability of the data collection tool and to enhance the accuracy of measurements.

1.8.8 Ethical considerations

Ethical principles refer to the principles of respect for persons, beneficence, and justice relevant to the conduct of research (Grove et al 2013:693). The ethical issues considered in this study are protecting the rights of the participants, protecting the rights of institutions and scientific integrity on the part of the researcher. The details of the ethical principles for this research are provided in Chapter 4.

1.9 SCOPE OF THE STUDY

This study was conducted among households in Sebeta town which is located in Finfinne surrounding special zone of the Oromiya region in Ethiopia. Though the focus was on one urban setting regarding the environmental health determinants in relation to childhood diarrhoea, the study investigated a wide range of environmental health issues affecting children within households including water supply, sanitation facilities, disposal of solid waste and wastewater and hygiene practices in relation to childhood diarrhoea.

The study assessed and examined the role that water supply, sanitation, waste management and hygienic practices of households had in the occurrence of diarrhoea in children under-five years living with the study area. The aim was to develop urban environmental health strategies to improve actions to be prioritised in the prevention of childhood diarrhoea.

1.10 STRUCTURE OF THE THESIS

This thesis is divided into seven chapters and each chapter is briefly described below:

- **CHAPTER 1: ORIENTATION OF THE STUDY** – This chapter gives the background information and overview of the whole study.
- **CHAPTER 2: LITERATURE REVIEW** – This chapter provides an in-depth review of the literature related to the major environmental health determinants in relation to childhood diarrhoea.
- **CHAPTER 3: THEORETICAL FRAMEWORK OF THE RESEARCH** – This chapter presents the paradigms, the paradigmatic assumptions and the conceptual framework of the study.
- **CHAPTER 4: RESEARCH DESIGN AND METHOD** – The chapter presents the detailed description of the research design, research method, study setting, study population, sampling, data collection, ethical considerations, data analysis and validity and reliability.
- **CHAPTER 5: ANALYSIS, PRESENTATION AND DISCUSSION OF RESEARCH FINDINGS** – This chapter presents the data analysis procedures that were used and the details of the findings of the research.
- **CHAPTER 6: SUMMARY, CONCLUSIONS, RECOMMENDATIONS, CONTRIBUTIONS AND LIMITATIONS OF THE STUDY** – This chapter presents the summary of the study with the major findings, conclusions drawn from the main research findings, contributions of the study, its limitations, the study recommendations and concluding remarks.
- **CHAPTER 7: DEVELOPMENT OF ENVIRONMENTAL HEALTH STRATEGIES FOR PREVENTION OF CHILDHOOD DIARRHOEA** – This chapter presents the urban environmental health strategies for the prevention of childhood diarrhoea based on the study findings and the literature review.

1.11 CONCLUSION

This chapter presented the background information and overview of the study. The study was conducted regarding household environmental health factors in relation to the occurrence of diarrhoea among children under-five years in Sebeta town in Ethiopia. Sebeta town was selected for this study which is one of the urban settings in Ethiopia. This chapter discussed background information about the research problem, statement of the research problem, aim of the study and the research questions, significance of the study, definitions of key concepts, and the theoretical foundations of the study. It further highlighted the aspects of the research design, which include the type of research design, research method, study setting and population, sampling, data collection and data analysis. Measures to ensure validity and reliability as well as the ethical considerations of the study were also briefly described. It is noted and explained that a descriptive, quantitative, contextual cross-sectional study using stratified random sampling method was used to conduct the research.

The following chapter presents the literature review of the research.

CHAPTER 2

LITERATURE REVIEW

2.1 INTRODUCTION

This chapter discusses the literature that was reviewed for the study. The literature review starts with the basic concepts of environmental health, child health and diarrhoea. It also covers the global burden of diarrhoeal diseases among children; public health significance of diarrhoeal diseases; and environmental health factors for childhood diarrhoea. The chapter also discusses the review carried out on topics on major environmental health determinants in relation to childhood diarrhoea, which are water supply, basic sanitation (excreta disposal), hand-washing, wastewater disposal, and solid waste disposal. Finally, the chapter includes literature reviewed on the health system of Ethiopia.

2.2 ENVIRONMENTAL HEALTH, CHILD HEALTH AND DIARRHOEA

According to a World Health Organization (WHO) Expert Committee on National Environmental Health Programmes: Their Planning, Organization, and Administration, environmental health “refers to the ecological balance that must exist between man and his environment in order to ensure his well-being” (World Health Organization 1970:6). Within the field of environmental health, environmental sanitation was defined by a World Health Organization Expert Committee in 1950 as "the control of those factors in man's environment which exercise or may exercise a deleterious effect on his physical, mental, or social well-being" (World Health Organization 1977:2). In particular, it refers to the control of community water supplies, excreta and wastewater disposal, refuse disposal, vectors of disease, housing conditions, food supplies and handling, atmospheric conditions, and the safety of the working environment (Franceys, Pickford & Reed 1992:3). The World Health Organization in 1993 defines “environmental health comprises of those aspects of human health, including quality of life, that are determined by physical, chemical, biological, social and psychosocial factors in the environment. It also refers to the theory and practice of assessing, correcting, controlling and preventing those factors in the environment that can potentially affect

adversely the health of the present and future generations" (Gosselin, Furgal & Ruiz 2001:2).

According to the International Water and Sanitation Centre (IRC), the word hygiene comes from the Greek word *hygieinos*, which translates literally as "healthful". The term has, however, come to mean "the practice of keeping oneself and one's surroundings clean, especially to prevent illness or the spread of diseases" (Appleton & van Wijk 2003:65). The word sanitation is derived from the Latin word *sanitas* meaning health (Navaratne 2006:510). However, the terms "hygiene" and "sanitation" can mean different things to different people (Peal, Evans & Van der Voorden 2010:2). Nevertheless, the problems of excreta and wastewater disposal have received less attention because of a considerable awareness of community water supply needs. In order to focus attention on these problems, "sanitation" became used and understood by people worldwide to refer only to excreta and wastewater disposal. A World Health Organization Study Group in 1986 formally adopted this meaning by defining sanitation as "the means of collecting and disposing of excreta and community liquid wastes in a hygienic way so as not to endanger the health of individuals and the community as a whole" (Franceys et al 1992:3; World Health Organization 1987:12). Finally, added to this is environmental sanitation, which comprises both a change in behaviour and facilities to form a hygienic environment (Mmom & Mmom 2011:116).

Environmental health relates to human activity or environmental factors that have an impact on socioeconomic and environmental conditions with the potential to reduce human disease, injury, and death, especially among vulnerable groups — mainly the poor, women, and children under-five. The top killers of children under-five are acute respiratory infections (from indoor air pollution); diarrhoeal diseases (mostly from poor water, sanitation, and hygiene); and malaria (from inadequate environmental management and vector control) (World Bank 2008:5).

Disease or ill-health is often a result of the interplay between the environment, agent, and host factors. The environment is defined as all the physical, chemical and biological factors external to a person, and all the related behaviours (Narain 2012:185). It has been estimated that 25 to 33% of the global burden of disease can be attributed to environmental risk factors (Kahlmeier 2003:18). Human exposure to these factors present in the environment can have a profound influence on public health. Since many

of these factors are manmade, protecting the environment is in man's best interest and a good investment from a health point of view (Narain 2012:185).

Children in the developing world continue to face an onslaught of disease and death from largely preventable factors. These children are especially susceptible to these environmental factors, which put them at risk of developing illness at an early life. More than 40 percent of the global burden of disease attributed to environmental factors falls on children below five years of age, who account for about 10 percent of the world's population (World Bank 2008:1).

2.3 THE GLOBAL PROBLEM OF DIARRHOEAL DISEASE AMONG CHILDREN

Diarrhoea is one of the principal causes of morbidity and mortality among children in the developing world. In 1982, on the basis of a review of active surveillance data from studies conducted in the 1950s, 1960s and 1970s, it was estimated that 4.6 million children died annually from diarrhoea. In 1992, a review of studies conducted in the 1980s suggested that diarrhoeal mortality had declined to approximately 3.3 million annually. Both reviews estimated that children in the developing world experienced a median of between two and three episodes of diarrhoea every year (Kosek, Bern & Guerrant 2003:197). In 2003, Kosek et al (2003:197) provided another updated estimation of diarrhoea morbidity concluding that children have 3.2 episodes of diarrhoea per year.

Although great strides have been made in reducing diarrhoea mortality, especially as a result of the increased use of oral rehydration therapy, diarrhoea remains the second leading cause of death in children under 5 years of age, after pneumonia. It is responsible for an estimated 1.7 billion cases of diarrhoea, or on average 2.9 episodes/child/year, and an estimated 1.87 million deaths among children under 5 years of age. The highest burden of disease is in children in the age range of 6–11 months with 4.5 episodes/child/year. It has been estimated that 50% of diarrhoea deaths can be attributed to persistent diarrhoea and that while oral rehydration therapy can prevent many deaths from acute diarrhoeal diseases, access to appropriate treatment is often limited in resource-poor settings (Brown et al 2013:1).

2.4 PUBLIC HEALTH SIGNIFICANCE OF DIARRHOEAL DISEASES AMONG CHILDREN

As defined by the World Health Organization (2005:4), diarrhoea is the passage of unusually loose or watery stool, usually at least three times in a 24 hour period. A loose stool being one that would take the shape of a container. However, mothers may use a variety of terms to describe diarrhoea, depending, for example, upon whether the stool is loose, watery, bloody or mucoid, or there is vomiting (World Health Organization 1992:10).

Diarrhoeal diseases come from excreta (Curtis 2003:74). It is transmitted through the faecal-oral route and is spread through contaminated food and drinking water or from person to person as a result of poor hygiene and sanitation. It is caused by at least 20 viral, bacterial, protozoan enteric pathogens and parasitic organisms and is usually a symptom of gastrointestinal infection (Curtis 2003:74; PATH 2009:6). In developing countries 50–60% of cases are of bacterial origin (Enteropathogenic *E. Coli* 25%, *Campylobacter jejuni* 10–18%, *Shigella* spp and *Salmonella* spp 5% each), while 35% are of viral (15–25% rotavirus) origin, and in many the cause is unidentified or mixed. In developing countries the prevalence of diarrhoea also varies widely by country. For instance, in Africa rotavirus has been shown to be the causative agent in 28-49% of cases in Ethiopia but accounts for only 14% of cases in Tanzania (Cooke 2010:43).

The diarrhoea-causing enteric pathogens provoke the shedding of liquids from the gut, leading to dehydration, loss of nutrients, complications and sometimes death. This shedding of liquids used to be seen as a defence mechanism allowing the body to get rid of microbes, but might better be thought of as a way in which the parasitic organisms manipulate their hosts to enable the parasite progeny to reach new hosts more easily. Hygiene is hard to maintain when large volumes of liquid stool are being pumped out of a sick child. One gram of faeces can contain as many as 100 million viruses and 10 million bacteria (Curtis 2003:74).

Furthermore, there are three main forms of acute childhood diarrhoea, all of which are potentially life-threatening and require different treatment courses:

- **Acute watery diarrhoea** includes cholera and is associated with significant fluid loss and rapid dehydration in an infected individual. It usually lasts for several hours or days. The pathogens that generally cause acute watery diarrhoea include *Vibrio cholerae* or *Escherichia coli* bacteria, as well as rotavirus.
- **Dysentery** is marked by visible blood in the stool. It is associated with intestinal damage and nutrient losses in an infected individual. The most common cause of bloody diarrhoea is Shigella, a bacterial agent that is also the most common cause of severe cases.
- **Persistent diarrhoea** is an episode of diarrhoea, with or without blood, which lasts at least 14 days. Undernourished children and those with other illnesses, such as AIDS, are more likely to develop persistent diarrhoea. Diarrhoea, in turn, tends to worsen their condition (World Health Organization & United Nations Children's Fund 2009:10).

A number of specific behaviours promote the transmission of enteric pathogens and thus increase the risk of diarrhoea. These include: using infant feeding bottles; storing cooked food at room temperature; using drinking-water contaminated with faecal bacteria; failing to wash hands after defecation, after disposing faeces or before handling food and failing to dispose of faeces (including infant faeces) hygienically. Several host factors are associated with increased incidence, severity or duration of diarrhoea. They include malnutrition, measles and immunodeficiency or immunosuppression (World Health Organization 1992:11).

The youngest children are most vulnerable to diarrhoea: incidence is highest in the first two years of life and declines as a child grows older (World Health Organization & United Nations Children's Fund 2009:5). Incidence is highest in the age group 6-11 months, when weaning often occurs. This pattern reflects the combined effects of declining levels of maternally acquired antibodies, the lack of active immunity in the infant, the introduction of food that may be contaminated with faecal bacteria and direct contact with human or animal faeces when the infant starts to crawl. Most enteric pathogens stimulate at least partial immunity against repeated infection or illness, which helps to explain the declining incidence of disease in older children and adults (World Health Organization 1992:12).

The incidence of diarrhoeal diseases varies greatly with the seasons (Cooke 2010:43). Distinct seasonal patterns of diarrhoea occur in many geographical areas. In temperate climates, bacterial diarrhoeas tend to occur more frequently during the warm season, whereas viral diarrhoeas, particularly disease caused by rotavirus, peak during the winter. In tropical areas, rotavirus diarrhoea tends to occur throughout the year, increasing in frequency during the drier, cool months, whereas bacterial diarrhoeas tend to peak during the warmer and rainy season. The incidence of persistent diarrhoea follows the same seasonal pattern as that of acute watery diarrhoea (World Health Organization 1992:12).

The fight against diarrhoea in under-five children has played an important part of child survival programmes since their inception several decades ago. Efforts are typically concentrated on three types of intervention: managing the disease, improving resistance to the disease, and preventing the disease. The first approach, case management of diarrhoea, has been extremely successful in reducing child mortality. The primary means of achieving impact has been through the introduction and implementation of oral rehydration therapy and continued feeding. In addition, health experts have emphasised the need for caretakers to detect the danger signs early in children under their care and to seek timely, appropriate care to prevent severe dehydration and death (Kleinau & Pyle 2004:23).

The second approach, increasing host resistance to diarrhoea, has also had some success with the improvement of a child's nutritional status and vaccination against measles, a common cause of diarrhoea. In addition, nutrition interventions, including growth monitoring programmes and behaviour change and communication efforts that increase birth weight, promote exclusive breastfeeding and the introduction of quality complimentary foods, promote frequent feedings, and ensure that children intake an adequate amount of micronutrients (especially vitamin A), have helped improve resistance to the disease (Kleinau & Pyle 2004.24).

The third element is prevention through hygiene improvement (Kleinau & Pyle 2004.24). The various infectious agents that cause diarrhoea are all transmitted by common faecal-oral pathways, such as contaminated water, food, and hands. Measures taken to interrupt the transmission of the causative agents should focus on these pathways. Important measures of proven efficacy include: avoiding the use of infant feeding

bottles; improving practices related to the preparation and storage of weaning foods (to minimise microbial contamination and growth); using clean water for drinking; washing hands (after defecation or disposing of faeces, and before preparing food or eating); and safely disposing of faeces, including those of infants (World Health Organization 1992:11).

2.5 ENVIRONMENTAL HEALTH FACTORS FOR CHILDHOOD DIARRHOEA

Of the many diseases and hazards that fall within the purview of environmental health, a major one related to child mortality and morbidity is diarrhoeal disease (Kleinau et al 2004:1). The World Health Organization (WHO) estimated that 88% of all cases of diarrhoea globally were attributable to water, sanitation (excreta disposal) and hygiene (Prüss-Üstün & Corvalán 2006:34). A great proportion of the diarrhoeal infections are caused by faecal-oral pathogens. Pathogens transferred through inadequate sewage systems may contaminate surface or ground water. Poor hygiene, such as not observing hand-washing, can lead to contamination of food, and ingestion of contaminated food and water, thus causing diarrhoea (Goland 2009:7).

Children are more exposed to contamination than adults, due to behavioural factors (Goland 2009:7). Children under the age five are in the dynamic stage of growth. Their immune, respiratory, and digestive systems are still developing. The impact of an unhealthy environment is felt among the under-fives because they are always close to the ground, where many contaminants settle. Unlike more developed countries, where health hazards from the child's household environment constitute little risk and hence cause little childhood mortality, developing countries still experience high childhood mortality due to diseases associated with poor water supply, sanitation, and personal and household hygiene. Studies in some developing countries have found a significant incidence of diarrhoeal diseases because of water shortage and contamination, as well as exposure to measles infections because of household crowding and high risks of accidents or injury because of poor housing (Fayehun 2010:3).

2.6 MAJOR ENVIRONMENTAL HEALTH DETERMINANTS OF CHILDHOOD DIARRHOEA

This section reviews the major environmental health determinants in relation to childhood diarrhoea, namely water supply, basic sanitation (excreta disposal), hand-washing, wastewater disposal, and solid waste disposal.

2.6.1 Water supply

2.6.1.1 Water and health

Water may have multiple impacts on human health. It can work as a medium of transmission for pathogens. Contaminated water can cause a range of water-borne diseases, such as cholera and typhoid. Lack of sufficient amounts of water will also affect health as it impacts on hygiene standards, and increases the risk of water-washed diseases, such as trachoma and diarrhoeal infections. The impact on health is therefore related both to the quality of the water and the quantity (Goland 2009:7).

The great majority of water-related health problems are the result of microbial (bacteriological, viral, protozoan or other biological) contamination (Ministry of Health of Ethiopia 2011b:1). Classifying diseases by causative agent, such as microbe type for infectious disease, has value in terms of understanding aetiology of infection. However, a more effective way to inform decision-making is to categorise pathogens/diseases in relation to the broad mode of transmission. Bradley in 1977 suggests that there are four principal categories that relate to water and which are not mutually exclusive (Howard & Bartram 2003:10).

- ***Water-borne*** – caused through consumption of contaminated water (e.g. diarrhoea, dysentery, typhoid fever);
- ***Water-washed*** – caused due to lack of water for personal hygiene practices (e.g. diarrhoea, dysentery, typhoid fever, scabies, and trachoma);
- ***Water-based*** – caused by aquatic invertebrate host (e.g. dracunculiasis, schistosomiasis); and,

- ***Water-related vector*** – spread by insect vectors that depend on water (e.g. trypanosomiasis, dengue fever, malaria) (Howard & Bartram 2003:10; World Bank 2008:18).

2.6.1.2 Water access

According to the United States Agency for International Development (USAID) Food and Nutrition Technical Assistance Project's "*water and sanitation indicators measurement guide"*, access to an improved water source means that the home or compound is connected directly to a piped system or that a public fountain, well, or standpost is located within 200 metres of the home. No particular level of water quality is implied, but access must be to water used for drinking, cooking, cleaning and bathing (Billig et al 1999:17).

The proportion of population with access to improved water sources is defined by the World Health Organization (WHO) and United Nations Children's Fund (UNICEF) Joint Monitoring Programme for Water Supply and Sanitation. Access to safe drinking water is measured by the percentage of the population using improved drinking-water sources. An improved drinking water source is a source that, by nature of its construction, adequately protects the water from outside contamination, in particular from faecal matter (Cheng, Schuster-Wallace, Watt, Newbold & Mente 2012:3). Improved water sources include:

- a piped water supply into the dwelling
- a piped water to a yard/plot
- a public tap/standpipe
- a tube well/borehole
- a protected dug well
- a protected spring
- rainwater (World Health Organization & United Nations Children's Fund 2006:8).

An unimproved drinking water source refers to water sources that are "unimproved" such as:

- an unprotected dug well

- an unprotected spring
- a cart with a small tank/drum
- a water tanker-truck
- surface water (World Health Organization & United Nations Children's Fund 2006:8).

According to a report of the World Health Organization (WHO) and United Nations Children's Fund (UNICEF) (2012:61), an estimated 89% of the global population uses improved drinking water sources. The report states further that despite this enormous accomplishment, 780 million people remain underserved. Four out of 10 people without access to improved drinking water live in sub-Saharan Africa. Furthermore, coverage of improved water supply sources is 90% or more in Latin America and the Caribbean, Northern Africa and large parts of Asia, while it is only 61% in sub-Saharan Africa (World Health Organization & United Nations Children's Fund 2012:61).

2.6.1.3 Water quantity

There are four types of uses of water that could be defined in relation to normal domestic supply: consumption (drinking and cooking); hygiene (including basic needs for personal and domestic cleanliness); amenity use (for instance car washing, lawn watering); and productive use (animal watering, construction and small-scale horticulture). Many uses of water occur largely at the household (for instance drinking, eating and hand-washing), while others may occur away from the home (laundry and in some cases bathing). Therefore, these uses need to be borne in mind when ensuring that adequate quantities of domestic supply are available for these purposes and in interpreting and applying minimum values (Howard & Bartram 2003:2).

The World Health Organization (WHO) and United Nations Children's Fund (UNICEF) Joint Monitoring Programme describes reasonable access as being *'the availability of at least 20 litres per person per day from a source within one kilometre of the users dwelling'* (Howard & Bartram 2003:1). Although 20 litres per person, per day is the World Health Organization and United Nations Children's Fund standard for household water consumption, it has been estimated that at least 30–40 litres a day are needed per person if drinking, cooking, laundry and basic hygiene. Water becomes a prohibitive quantity when it is accessible from a distance and needs to be carried (or when it needs to be purchased from vendors), as a result, many households with young children who

use such hard to access water make do on far less than they really need. Hands, food, utensils, floors, cooking surfaces and children are all less likely to be kept clean when water has to be carried for a given distance (Bartlett 2003:63).

According to the guidance manual of the Department for International Development, a minimum criterion for water supply should be 20 litres per capita per day, whilst noting the importance of reducing distance and encouraging household connection. A similar figure has been suggested by other researchers. Gleick in 1996 suggested that the international community adopt a figure of 50 litres per capita per day as a basic water requirement for domestic water supplies (Howard & Bartram 2003:1).

2.6.1.4 Water collection

The collection time of water is a good indicator of water availability as it takes into account distance, waiting times, and to a certain extent the effort needed to obtain water. Studies have shown that people will not really restrict their water use if collection times are less than three minutes, or a distance of about 100 metres in easy terrain with no waiting times. Longer collection times will result in a restriction on the use of water (Rottier & Ince 2003:57).

The amount of time spent fetching water will have implications for the amount of water that a household makes available to its members. The longer the time invested in fetching water, the less chance a family has to acquire enough water to satisfy household water per capita needs. The World Health Organization (WHO) and United Nations Children's Fund (UNICEF) suggest that when the time invested in going to the source, collecting water and returning to the household is between three and 30 minutes, the amount of water collected may vary between 15 and 25 litres per capita per day. This range is considered suitable for a person to meet basic needs. If the time invested in fetching water is longer than 30 minutes, the satisfaction of basic water needs is compromised. Yet, the less time families take to fetch water, the better (Hygiene Improvement Project 2010:17).

2.6.1.5 Household water quality, handling and storage

Over 780 million people lack access to an 'improved' water source (Brown et al 2013:3) which means that they are relying on unimproved water sources for drinking and for other domestic activities. These sources can include unprotected wells, ponds and rivers. Even where water sources are considered to be improved, the water may not meet the microbiological standards set by World Health Organization (Ahs, Tao, Löfgren & Forsberg 2010:116).

Many households in less developed countries do not have individual connections to treated, piped water, or 24 hours access to water. Such households typically store water in the home, and this water is vulnerable to contamination (primarily from handling) during transport and storage, even if it is clean at the source (Fewtrell, Kaufmann, Kay, Enanoria, Haller & Colford 2005:47). This provides a number of opportunities for contamination. It is a particular problem in households with young children, who may dip dirty hands into a storage bucket or leave water scoops on the floor, contributing to contamination (Bartlett 2003:64).

While access to safe water is important, it is also necessary for the household to store its water properly so that it remains safe. That means water should not be contaminated by exposure to dirt or dust (hence it should be covered), the instrument used for transferring water to/from storage container is clean, and the container itself is periodically cleaned to eliminate sources of infection (Kleinau & Pyle 2004:46).

Protected water sources do not ensure that water used for drinking and cooking in the home is safe. Household water storage – a practice common in developing countries – contributes to drinking-water contamination. Water stored in homes is often faecally contaminated at levels far above the contamination level at the source. Studies show that water stored in homes routinely have faecal coliform levels hundreds of times higher than is present in the source – some studies have documented thousand-fold increases in faecal coliforms (United Nations Children's Fund 2008:75).

There are three reasons why water quality deteriorates during the storage and transport of water. These reasons are: poor hygiene which knowledge prevents people from taking basic steps to minimise contamination; inadequate household latrines, hand-

washing facilities and poor community environmental sanitation that results in more faeces in and around households; and commonly used transport and storage containers that are easily contaminated (United Nations Children's Fund 2008:76).

Many types of vessels are used to store and transport water in developing countries, including traditional clay pots, metal containers, mortar jars, plastic and metal buckets, jerry cans, collapsible containers, ferrocement tanks, beverage bottles, barrels, and plastic vessels or tanks (Rottier & Ince 2003:57; United Nations Children's Fund 2008:76). It is important that water containers should be clean, especially inside. It is always best to clean the insides of storage containers with either detergent or chlorine. The top of the water container should be covered to prevent dust and other contaminants falling into the drinking-water. It is best for water to be poured from the container to prevent contact with dirty fingers and hands. When scoops are used to take water out of the storage container they should be clean and kept inside the water storage jar. They should never be placed on the floor (Howard, Bogh, Goldstein, Morgan, Prüss, Shaw & Teuton 2002:32).

Household-level water treatment has been proposed as an interim solution to provide safer drinking water at the point of use because of the fact that universal safe, reliable, on-plot water supply remains an elusive goal for the majority of the world's population (Brown et al 2013:3). When a water source cannot be considered safe, households should treat their drinking water to remove pathogens (Kleinau & Pyle 2004:46). According to Fewtrell et al (2005:47) review suggests that a water quality intervention at the point of use should be considered for any water supply programme that does not provide 24 hours access to a safe source of water. This calls for water treatment at the household level. Water treatment at the household is also referred to as "point-of-use" treatment (Kleinau & Pyle 2004:46). Household treatment can be performed by heat or ultraviolet radiation, chemical treatment (e.g., chlorine tablets), physical removal (e.g., filtering or sedimentation) or a combination of these approaches, immediately prior to consumption (Ahs et al 2010:116).

Improving water quality at the point of consumption can protect children from waterborne disease. The findings of meta-analyses show a much stronger protective effect for water quality interventions at the household level (rather than at source level) on diarrhoeal disease outcomes (up to 40%). A review by Cairncross et al estimated

diarrhoea risk reductions of 17% arising from improved water quality, which is consistent with earlier reviews by Esrey et al (Brown et al 2013:3).

2.6.2 Basic sanitation (excreta disposal)

2.6.2.1 Excreta and disease

Human waste is mainly composed of faeces and urine, which together are known as excreta (Ministry of Health of Ethiopia 2011b:68). Human excreta and the lack of adequate personal and domestic hygiene have been implicated in the transmission of many infectious diseases. Human excreta-transmitted diseases predominantly affect children and the poor. Most of the deaths due to diarrhoea occur in children and in developing countries. Proper excreta disposal and minimum levels of personal and domestic hygiene are essential for protecting public health (Carr 2001:90). Human excreta contain germs, eggs and other living things (organisms). Some organisms cause disease and are called pathogens. There are four main groups of organisms in fresh faeces that are of concern to humans: bacteria, viruses, protozoa and helminths. These organisms once excreted: may be immediately infectious; may require a period of time outside of the body to become infectious; or may require an intermediate host before becoming infectious (Esrey, Gough, Rapaport, Sawyer, Simpson-Hébert, Vargas & Winblad 1998:8).

When a person excretes a pathogen which is not contained or destroyed, the environment becomes contaminated. Once human excreta gain access to the larger environment (see Figure 3.1), they can contaminate fingers (hands, clothes and utensils), fluids (e.g. drinking and cooking water, beverages and other water bodies), fields (e.g. vegetables and household yards) and flies (e.g. houseflies and blowflies, domestic animals and snails). People may be exposed to pathogens and parasites directly through these routes or via food. A contaminated environment puts people at risk of exposure to the pathogens, leading to infection and disease. Newly infected people then excrete into the environment and there is a repeated cycle of infection, contamination and infection (Esrey et al 1998:9).

There are five categories of excreta-related diseases:

1) ***Faecal-oral diseases*** represent the largest health burden associated with water supply, sanitation and hygiene.
2) ***Soil-transmitted helminths*** include roundworm, whipworm and hookworm. These parasitic worm infections are transmitted when eggs are passed in human faeces (eggs often need time in moist soil to mature and become infective).
3) ***Beef and pork tapeworms*** live in animal hosts and humans are infected when eating animal meat that is not sufficiently cooked. The cycle continues when animals eat food contaminated with faeces.
4) ***Water-based helminths*** where an aquatic intermediate hosts are required. Aquatic organisms such as snails act as hosts to parasites, which then infect humans either through swallowing or contact in water (for example through entering the skin). Examples of diseases in this category are guinea worm and schistosomiasis.
5) ***Excreta-related insect vectors***, include mosquitoes, flies and cockroaches. The *culex* mosquito, which transmits filariasis, breeds in septic tanks and flooded latrines. Flies and cockroaches are responsible for causing some transmission of faecal-oral disease (Hunt 2001:3).

Sanitation is one of the most effective barriers against the transmission and spread of disease. Knowledge of these diseases is essential to the design of sanitation systems targeted at interrupting their transmission as well as protection of human health (Ilesanmi 2002:11).

2.6.2.2 Prevention of diarrhoea through improved sanitation

An unsanitary environment contributes to the spread of diarrhoeal agents. The fact that the pathogens that cause diarrhoea are excreted in the stool of an infected person or animal means that proper disposal of faeces can assist in stopping the spread of infection. Faecal matter can contaminate water where children play, where mothers wash clothes, and where they collect water for home use (World Health Organization 2005:28). With exposure to faeces being a primary source of diarrhoeal disease, it is essential for hygiene improvement that households safely dispose of both adult and child faecal matter (Kleinau & Pyle 2004:42).

Human faeces should be disposed of in a way that prevents them from coming into contact with hands or contaminating a water source. This is best achieved through regular use of a well-maintained latrine. The proper use of latrines can reduce the risk of diarrhoea to almost the same extent as improved water supplies, but the greatest benefit occurs when improvements in sanitation and water supply are combined and education is given on hygienic practices (World Health Organization 1992:119).

In many communities the stools of infants and young children are considered harmless. However, young children are frequently infected with enteric pathogens and their stools are actually an important source of infection for others. This is true both for children with diarrhoea and for those with asymptomatic infections (World Health Organization 1992:120). Where infants and small children are concerned, the only safe sanitation methods are those that eliminate all possibility of contact with excreta. Safe stool disposal is far more effective as a safeguard against disease (Bartlett 2003:64). Therefore, hygienic disposal of the faeces of all young children is an important aspect of diarrhoea prevention. Education is needed to advise families of the dangerous nature of young children's stool and to stress the importance of disposing of them properly (World Health Organization 1992:120). Child-friendly toilets, and the development of effective school sanitation programmes, are important and popular strategies in promoting the demand for sanitation facilities and enhancing their impact (World Health Organization & United Nations Children’s Fund 2000:3).

2.6.2.3 Methods for proper excreta disposal

There are numerous technical options for excreta management, many of which, if properly designed, constructed, operated and maintained will provide adequate and safe service as well as health benefits. It is necessary to choose technically, economically and financially feasible options for sustainable excreta management (Carr 2001:99). Whether a flush toilet is installed with a sewage system, a ventilated improved pit latrine, or a simple hole in the ground, faecal material has to be removed from the home, which is, after all, the place where the susceptible child spends most of his or her time (Curtis 2003:74).

The first priority of excreta disposal programmes for urban areas in developing countries should be the protection of human health. This health objective can be achieved by

sanitation technologies that are much less costly than waterborne sewerage. For disposal of excreta and sullage, Kalbermatten et al in 1982 and Mara in 1982 offer a variety of approaches shown in Table 2.1. The selection of the most appropriate approach is affected, among other factors, by the water supply service and water consumption (Geiger 1990:127).

Table 2.1 Water supply service levels and options for excreta and sullage disposal in urban areas

Water supply level	Typical water consumption litres/capita/day	Options for excreta disposal	Options for sullage disposal
Stand-pipes	20-40	Pit latrines Pour-flush toilets Vault toilets	Soakage pits
Yard taps	50-100	Pit latrines Pour-flush toilets Vault toilets Sewer-pour-flush toilet Septic tanks	Soakage pits Stormwater drains Sewer-pour-flush toilet Septic tanks
Multiple tap in-house connections	>100	Sewer-pour-flush toilet Septic tanks Conventional sewerage	Sewer-pour-flush toilet Septic tanks Conventional sewerage

(Source: Geiger 1990:127)

2.6.2.4 Access to sanitation

The proportion of population with access to improved sanitation is defined by the World Health Organization (WHO) and United Nations Children's Fund (UNICEF) Joint Monitoring Programme. Access to sanitation is measured by the percentage of the population using improved sanitation facilities. Improved sanitation includes toilet facilities that hygienically separate human excreta from human contact (Cheng et al 2012:3). The types of technology that are likely to meet this criterion are: flush to piped sewer system; flush to septic tank; flush/pour flush to pit; composting toilet; ventilated improved pit latrine (VIP latrine); and pit latrine with a slab. Unimproved sanitation facilities include: flush/pour flush elsewhere; pit latrine without a slab/open pit; bucket latrine; and hanging toilet (World Health Organization & United Nations Children's Fund 2006:12).

Access to adequate excreta disposal facilities is an important requirement if adverse health effects of poor sanitation are to be avoided. This indicator thus provides a measure of both the potential exposure of the population to infectious agents associated with poor sanitation, and that of the action taken to improve domestic sanitation (Briggs 1999:50).

According to the 2012 report of World Health Organization and United Nations Children's Fund (UNICEF) (2012:61), 63% of the global population uses improved sanitation facilities. This report also indicated that since 1990, 1.8 billion people have gained access to improved sanitation. However, an estimated 2.5 billion people are still without improved sanitation. The number of people resorting to open defecation globally has decreased by 271 million since 1990. According to this 2012 report, open defection is practised by 1.1 billion people – 15% of the global population (World Health Organization & United Nations Children's Fund 2012:61).

Research focusing at the benefits of partial sanitation coverage has produced mixed findings. Research work in urban Africa found that improved provision to a small number of households in an area may not protect even those families from infection when the overall level of faecal contamination in the environment is high. Other research shows that even partial coverage reduces overall faecal contamination and also contact between children and opportunities for infection. Clearly, it is important for provision to reach some critical "tipping point" for things to change substantially (Bartlett 2003:66). Studies showed that community coverage of improved sanitation (excreta disposal) at the 75% level is associated with improved health and less than 75% still places those with improved sanitation in their homes at risk because of the poor environmental conditions surrounding them (Bateman, Jahan, Brahman, Zeitlyn & Laston 1995:47; Bateman, Smith & Roark 1993:96). However, a major challenge in this regard is scaling up sanitation facilities to the point where they are used by an entire community ('total sanitation'). Use of such facilities by all community members is necessary to significantly reduce diarrhoeal disease transmission (World Health Organization & United Nations Children's Fund 2009:11).

2.6.3 Hand-washing

2.6.3.1 Hand-washing with soap

Hands are an important pathway for faecal-oral transmission. The contamination points are contact with faeces during defecation, handling children's faeces, touching other contaminated hands, preparing or consuming foods with contaminated hands, and placing soiled hands in the mouth. Hand-washing with soap or other abrasives at critical times — after defecation, after handling children's faeces, before preparing meals, and before consuming foods — can significantly decrease transmission of diarrhoeal diseases (Murphy et al 1997:14).

Hand-washing interrupts the transmission of disease agents and so can significantly reduce diarrhoea and respiratory infections, as well as skin infections and trachoma. A review of the literature on hand hygiene suggests that hand-washing with soap can reduce microorganism levels close to zero, mainly through the mechanical action of rubbing and rinsing (Brown et al 2013:3). A review made by Curtis and Cairncross in 2003 suggests that hand-washing with soap, particularly after contact with faeces (post-defecation and after handling a child's stool), can reduce diarrhoeal incidence by 42-47%, while a study by Rabie et al suggests a 30% reduction in respiratory infections is possible through hand-washing (World Bank 2005:9).

2.6.3.2 Hand-washing practices

Providing improved drinking water and sanitation services, and adopting good hygiene behaviours are of the utmost importance in reducing diarrhoeal disease. Mothers should dispose of their babies' faeces in a safe way; wash their hands after defecation, after handling babies' faeces, after cleaning their babies' bottoms and before preparing food in order to break the disease chain. The full benefits of improved drinking water and sanitation services will be accrued only with effective and sustainable behaviour change (World Health Organization & United Nations Children's Fund 2005:30).

Hand-washing decontaminates the hands and prevents cross transmission. Washing with soap and water removes pathogens mechanically and through chemical microbicidal action. Hand-washing may require infrastructural, cultural, and behavioural

changes, which take time to develop, as well as substantial resources (e.g. trained personnel, community organization, provision of water supply and soap) (Shah, Chouldhury, Gupta, Mathew, Gera, Gogia, Mohan, Panda & Menon 2012:631).

Appropriate hand-washing involves three elements: (1) hand-washing supplies (2) hand-washing technique and (3) hand-washing at critical moments (Kleinau & Pyle 2004:40).

(a) Hand-washing technique

A typical description of the recommended hand-washing process is: wet the hands, rub both hands thoroughly with an agent (soap, ash or mud) for 20 seconds and rinse completely and (air) dry. Air drying hands was preferred to prevent the recontamination of clean hands (Shordt 2006:4).

(b) Critical moments for hand-washing

Surprisingly, studies that reported a significant reduction in disease have promoted different critical times for hand-washing. Khan's study of 1982 promoted hand-washing with soap after defecation and before eating. In addition to these two instances, Shahid added hand-washing before handling food/cooking. In addition to these times, Pinfold and Luby's studies of 1996 and 2005 promoted hand-washing before feeding the baby and after cleaning a baby's bottom as 'crucial times' which are also supported by United States Agency for International Development (USAID), World Health Organization (WHO) and United Nations Children's Fund (UNICEF) (Shordt 2006:5).

According to the United States Agency for International Development Food and Nutrition Technical Assistance Project "*water and sanitation indicators measurement guide"*, the critical times for hand-washing are after defecation, after cleaning babies' bottoms, before food preparation, before eating and before feeding children (Billig et al 1999:14). Critical moments that World Health Organization lists as the instances for maximum effect on diarrhoeal disease reduction include the following: after defecation, after handling child's faeces or cleaning a child's bottom, before preparing food, before feeding a child and before eating (Kleinau & Pyle 2004.41).

(c) Places and materials for hand-washing

Hand-washing behaviour is strongly influenced by the presence or absence of a convenient source of water and soap. Studies have shown that, because they facilitate hand-washing and other important hygiene behaviours, in-house water supplies are associated with reduced rates of diarrhoea (Billig et al 1999:14).

A review of formative research in 11 countries conducted by Curtis and colleagues of the London School of Hygiene and Tropical Medicine in 2009 found that some type of soap was available in almost every household, as was water. However, it is not sufficient for soap and water to be present in the home; both must be readily accessible in the right places and at the right times to enable household members to wash their hands. In terms of critical times for hand washing, this means that soap and water must be conveniently placed next to the toilet or food preparation area. If a caretaker needs to fetch the soap from another part of the family compound or from a locked cupboard after using the toilet, then she or he is less likely to wash his or her hands (Devine 2010:2).

2.6.4 Wastewater disposal

2.6.4.1 Health problems caused by poor drainage

Waste can be categorised as liquid waste or solid waste depending on its physical state. Liquid waste includes human waste, runoff (storm water or flood water), sullage, industrial wastewater and other forms of wastewater from different sources. The mixture of human waste with wastewater is known as sewage. Stormwater runoff is simply rainwater that collects on the ground and runs off into channels, ditches and rivers (Ministry of Health of Ethiopia 2011b:67). Sullage consists of domestic water exclusive of toilet waste, but this does not mean that it is safe; water used for cleaning clothes and nappies can be heavily contaminated with the same disease-causing organisms that sanitation is intended to control (Department for International Development 1998:72).

Proper disposal of stormwater and household wastewater (sullage) is an important environmental health intervention for reducing diseases. Poorly drained stormwater forms stagnant pools that provide breeding sites for disease vectors; as a result, some

diseases are more common in the wet season than the dry season. Household wastewater may also contain pathogens that can pollute groundwater sources and increase the risk of diseases such as lymphatic filariasis. In addition, poor drainage can lead to flooding, damage water supply infrastructure and contaminate domestic water sources (Howard et al 2002:48).

No sanitation system can be considered ‘safe’ if the area it serves is poorly drained (Department for International Development 1998:71). If sullage or stormwater is discharged into fresh surface water (e.g. streams, rivers, lakes), the surface water will be polluted with excreta. This will result in risks of faecal-oral infections and beef and pork tapeworm if people and animals use this water as drinking-water (Rottier & Ince 2003:92).

Problems with sanitation are intensified when there is inadequate drainage and waste removal. Where sanitation is poor, many people defecate in the open, or throw away their stool with the household garbage. Excreta can accumulate rapidly in open areas and on garbage piles. Uncollected garbage is also frequently dumped in drainage ways, which quickly become clogged. When wastewater and storm water cannot be easily drained, flooding spreads waste and excreta widely throughout the surrounding area (Bartlett 2003:66).

Inadequate drainage and waste collection pose particular problems for children, who tend to play wherever there are interesting opportunities for exploration and who may be drawn to play in standing water and drainage ditches or to scavenge in piles of garbage. In many communities, it is impossible for children to play outdoors and avoid these hazards. Children between 5 and 14, for instance, are disproportionately affected by helminths and by such water-based diseases as bilharzia (Bartlett 2003:66).

2.6.4.2 Managing wastewater

The development of an effective service for domestic waste collection is one of the primary ways of improving living conditions in urban areas, reducing pollution of surface and ground water, and of reducing exposure (especially of children) to hazardous substances and pathogens in waste materials (Briggs 1999:84). Regardless of the technical option chosen for sanitation, both runoff and sullage need to be disposed of

safely if a sanitation system is to be considered complete (Department for International Development 1998:72).

2.6.5 Solid waste disposal

2.6.5.1 Health risks of solid waste

Solid waste from general housekeeping can be described as residential waste, household waste or domestic waste (Ministry of Health of Ethiopia 2011b:70). It also refers to all household refuse in nonliquid form (Kleinau & Pyle 2004:62). The solid waste that is produced as a result of food preparation, or any foodstuff leftover after eating, is called kitchen waste or garbage (Ministry of Health of Ethiopia 2011b:70).

Rapid urbanisation, population growth and changes in lifestyles in low- and middle-income countries contribute to an increase in the per capita domestic waste generation. This trend leads to deplorable environmental and public health conditions, especially in rapidly expanding cities of low- and middle-income countries lacking appropriate waste management systems. Inappropriate waste handling, storage, collection and disposal practices pose environmental and public health risks (Mosler, Drescher, Zurbrügg, Rodríguez & Miranda 2006:850). In cities, when municipal services are deficient, waste piles up in empty lots and street sides, thus leading to soil, air, and water pollution. This pollution might increase the prevalence of diarrhoeal and intestinal parasitic infections (Alirol, Getaz, Stoll, Chappuis & Loutan 2011:133).

2.6.5.2 Managing solid waste

Solid waste (refuse) should be disposed of properly in order to keep the household and surrounding environment clean as well as reduce health risks (Howard et al 2002:52). Waste management refers to the many methods and processes of dealing with waste at every stage from generation and collection through to final disposal. Waste needs to be managed in order to prevent contact with humans or their immediate environment. Therefore, the main purpose of waste management is to isolate waste from humans and the environment, and consequently, safeguard individual, family and community health. Solid waste management can be classified into five main stages. These stages are also referred to as the functional elements of solid waste management. These are onsite

handling, storage and processing; collection; transfer and transport; resource recovery and processing; and disposal (Ministry of Health of Ethiopia 2011b:74).

2.7 THE HEALTH SYSTEM OF ETHIOPIA

2.7.1 Health status in Ethiopia

The major health problems of the country are largely preventable communicable diseases and nutritional deficiencies. There is a high rate of morbidity and mortality and the health status remains relatively poor (Ministry of Health of Ethiopia 2010:3). Widespread poverty along with general low income levels of the population, low education levels, inadequate access to clean water and sanitation facilities and poor access to health services have contributed to the high burden of ill-health in the country (Ministry of Health of Ethiopia 2005a:4). According to reports from Ethiopia Demographic and Health Surveys (DHSs), there are improvements in some health sector indicators. For instance, according to the 2011 Ethiopia Demographic and Health Survey (DHS) report, under-five child mortality is 88 deaths per 1,000 live births (67% of which occur before the age of one), down from 123 deaths per 1,000 live births in 2005. Approximately 44% of children under-five years old are stunted (low height-for-age), while 10% of children are wasted (low weight-for-height) (Nganwa 2013:17).

2.7.2 The health service delivery system of Ethiopia

The National Health Policy of Ethiopia was issued by the Government of Ethiopia in 1993 (Central Statistical Agency & ICF International 2012:5). The core elements of the health policy are decentralisation of the health care system, development of the preventive, promotive and curative components of health care, assurance of the accessibility of health care for all segments of the population, and the promotion of private sector and non-governmental organisations (NGOs) participation in the health sector (Ministry of Health of Ethiopia 2010:4). The policy focuses on a comprehensive health service delivery system to address mainly communicable diseases, malnutrition and improve maternal and child health (Ministry of Health of Ethiopia 2005c:9). In 1996, the government launched a Health Sector Development Programme, which incorporates a health development strategy consisting of a series of 5-years investment

programmes (Ministry of Health of Ethiopia 2010:4; Ministry of Water Resources of Ethiopia 2004:113).

The report of the Ministry of Health of Ethiopia (2010:4) shows that the health service system of the country is organised in accordance with a three-tier system. The first level of the health service delivery system is a *woreda* (district) health system comprising of a primary hospital (with population coverage of 60,000 to 100,000 people), health centres (1 per 15,000 to 25,000 people) and their satellite health posts (1 per 3,000 to 5,000 people) that are connected to each other by a referral system. A primary hospital, health centres and health posts form a primary health care unit (PHCU) with each health centre having five satellite health posts. The second level in the tier is a general hospital with population coverage of 1 to 1.5 million people; and the third level is a specialised hospital that covers a population of 3.5 to 5 million. The Ethiopian health care system has been enhanced by the private sector and non-governmental organisation participation which play significant roles in improving the health service coverage and delivery of health care services in the country (Ministry of Health of Ethiopia 2010:4).

The government's decentralisation policy has introduced three prominent levels of health offices: the Federal Ministry of Health, Regional Health Bureaus, and *Woreda* (district) Health Offices. The Federal Ministry of Health and Regional Health Bureaus focus more on policy matters and technical support, whereas the *Woreda* Health Offices focus on managing and coordinating the operations of the district health system (Ministry of Health of Ethiopia 2010:4).

The government of Ethiopia in 2004 launched a community-based initiative called Health Extension Programme (HEP) with an emphasis to establish reflective and responsive health delivery systems to the people living in rural areas. This was accompanied by accelerated health post construction in each *kebele* (village/community). Health Extension Programme focuses on promoting health and providing preventive and selected curative services to ensure equitable access to the community focusing on disease prevention and control, family health service, hygiene and environmental health and health education, and communication. Health extension workers, who are assigned health posts, spend about three-fourths of their time on outreach activities in the communities, the *kebele* in particular. Each health extension worker is responsible for 500 - 1000 households in each *kebele* (Datiko 2011:9).

2.7.3 Child health strategies in Ethiopia

The government of Ethiopia has formulated a number of strategies that provide a framework for improving child health. One of the priorities in the Health Sector Development Plan (HSDP IV) is improving child health (Central Statistical Agency & ICF International 2012:135). The government has also developed a national strategy for child survival. The objective of the Strategy is to reduce under-five mortality (Ministry of Health of Ethiopia 2005c:39). The Health Extension Programme is the main pillar of the Child Survival Strategy seeking to increase access to promotive, preventive and basic essential curative health services to the majority of the underserved population (Ministry of Health of Ethiopia 2005c:vi).

2.7.4 Environmental health status and strategies in Ethiopia

It is reported that the overwhelming communicable disease burden in Ethiopia is attributable to poor sanitation (Ministry of Health of Ethiopia 2005b:15). Lack of clean/potable water supply and sanitation services in the country has been a serious problem and statistics show that more than 60% of health related deaths are caused by water-borne diseases (Government of Ethiopia 2007:35). On the basis of available information, it is estimated that diarrhoea contributes 20% of the cause-specific proportions for under-five mortality (Ministry of Health of Ethiopia 2005c:17). According to the 2011 Ethiopia Demographic and Health Survey by the Central Statistical Agency and ICF International (2012:15), over 46% of households in Ethiopia lacked access to an improved source of drinking water and the large majority of households, 82 percent, use non-improved toilet facilities.

The health policy of the government of Ethiopia emphasises on the preventive aspect of health services. Strategies adopted to meet environmental health service include: accelerating the provision of safe and adequate water supply for urban and rural populations; developing safe disposal of human, household, agricultural and industrial wastes, and encouraging recycling; developing measures to improve the quality of housing and work premises for health; encouraging the awareness and development of health promotive life-style and attention to personal hygiene and healthy environment (Ministry of Health of Ethiopia 1993:28).

Ethiopia has no separate environmental health and sanitation policy of its own but has a National Hygiene and Sanitation Strategy that emanated from the Health Policy. The Health Sector Strategy emphasises on the preventive aspect of health care without neglecting essential curative services with a focus on communicable diseases, common nutritional disorders and on environmental health and hygiene (Water Supply and Sanitation Collaborative Council 2009:9).

2.8 CONCLUSION

This chapter presented the findings of the literature review. The chapter described the concepts of environmental health, child health and diarrhoea; as well as presented the global burden of diarrhoeal diseases among children; public health significance of diarrhoeal diseases; and environmental health factors for childhood diarrhoea. The chapter reviewed relevant studies and publications on the most important environmental health factors for childhood diarrhoea focusing on household drinking water, sanitation, liquid waste disposal, solid waste disposal and hygiene practices. It also reviewed the health status and service delivery system in Ethiopia. The following chapter presents the theoretical framework of the research.

CHAPTER 3

THEORETICAL FRAMEWORK OF THE RESEARCH

3.1 INTRODUCTION

This chapter presents the concept of paradigm and the paradigmatic assumptions of the study. The chapter discusses the ontological, epistemological and methodological assumptions which are explained from a positivist approach. The chapter also gives detail on the F-diagram model of faecal-oral disease transmission which provides the conceptual framework of the study.

3.2 PARADIGM

A paradigm is defined by Polit and Beck (2010:14) as a worldview, a general perspective on the complexities of the real world. According to Grove et al (2013:702), paradigm refers to a particular way of viewing a phenomenon in the world. It is a way of looking at natural phenomena that encompasses a set of philosophical assumptions and guides one's approach to inquiry (Polit & Beck 2010:562).

Quantitative research methodology was employed in this research and the outcomes obtained from the quantitative data are numeric and quantifiable. Polit and Beck (2010:565) define quantitative research as the investigation of phenomena that lend themselves to precise measurement and quantification, often involving a rigorous and controlled design. Quantitative research is associated with the positivist paradigm (Polit & Beck 2010:564). This study is, therefore, opted to use quantitative research within a positivistic paradigm with the aim of explaining the relationship between the household environmental health factors associated with the occurrence of diarrhoea in children under-five years.

The quantitative paradigm is based on positivism, which takes scientific explanation to be nomothetic (i.e. based on universal laws). Its main aims are to measure the social world objectively, test hypotheses and predict and control human behaviour (De Vos, Strydom, Fouche & Delport 2002:79). Positivism emphasises scientific method.

Scientific method is a set of orderly, systematic, controlled procedures for acquiring dependable, empirical – and typically quantitative–information; which is the methodological approach associated with positivist approach (Polit & Beck 2010:567).

According to Polit and Beck (2010:14), positivists believe that reality exists and can therefore be studied. In the positivist paradigm, the researcher is independent from those being researched. Positivism maintains that values and biases are to be held in check. Objectivity is sought and has utmost importance. The best methods for obtaining evidence in the positivist-directed research are deductive processes; emphasis on discrete, specific concepts; focus on objective and quantifiable; fixed, pre-specified design; outsider knowledge – the researcher as external; control over context; measured, quantitative information; statistical analysis and seeks generalisations (Polit & Beck 2010:15).

Evidence that this study was rooted in the positivist paradigm includes:

- The use of a quantitative research design (see section 4.2.1)
- The fact that the research process used was systematic and followed a logical step-wise approach (see section 4.3)
- The use of mechanisms to control the study so that biases are minimised (see section 4.4)
- The researcher took the position of an interested outsider in that the information given by respondents was all treated with utmost respect (see section 4.3.4.6)
- Careful construction and pre-testing of the interview schedule ensured objectivity (see section 4.3.4.2 and section 4.3.4.4)
- The gathering of empirical evidence through data collection processes (see section 4.3.4.5)
- The evidence were measured and analysed statistically (see section 4.3.5)

3.3 PARADIGMATIC ASSUMPTIONS

Assumption is a principle that is believed to be true without proof or verification (Polit & Beck 2010:14). According to Grove et al (2013:41), assumptions are statements that are taken for granted or are considered true, even though they have not been

scientifically tested. Sources of assumptions include universally accepted truths, theories and previous research (Grove et al 2013:41).

Assumptions of the positivist paradigm will apply to this study since the reality to be described is environmental health factors at household level in relation to childhood diarrhoea. This reality can be observed and measured by means of a fixed design that will provide quantitative information. The quantitative approach to scientific inquiry emerged from a branch of philosophy called logical positivism, which operates on strict rules of logic, truth, laws, axioms, and predictions. Quantitative researchers hold the position that truth is absolute and that there is a single reality that one could define by careful measurement (Grove et al 2013:24).

According to Polit and Beck (2010:14), a fundamental assumption of positivists is that reality exists. In the positivist paradigm, nature is basically ordered and regular and an objective reality exists independent of human observation. The related assumption of determinism refers to the positivists' belief that phenomena (observable facts and events) are not haphazard or random, but rather have antecedent causes. Thus, positivists seek to be objective because of their belief in an objective reality. Their approach involves the use of orderly and disciplined procedures with tight controls over the research situation to test hunches about the nature of phenomena being studied and relationships among them (Polit & Beck 2010:15).

According to Creswell (2007:74), a research paradigm is based on assumptions that relate to the nature of reality or existence (ontology), the relationship between the researcher and what is being researched or how knowledge is developed (epistemology) and the manner or process of best obtaining research evidence (methodology).

The ontological, epistemological and methodological assumptions used in the present study in assessing and exploring the relationship between the environmental health factors associated with childhood diarrhoea among the households of Sebeta town in Ethiopia are listed below.

Ontological assumptions

The ontological assumptions regarding reality underlying this study are as follows:

- People take health related actions on the basis of information on the identified environmental health risk factors of childhood diarrhoea from the study communities and the study can be used to educate the community about good environmental health practices for prevention of childhood diarrhoea.
- Adequate knowledge and understanding of the magnitude of environmental health risks from the study contributes to the prevention and control of childhood diarrhoea.
- There are many environmental sanitation interventions that can help to prevent diarrhoeal and other infectious diseases. The environmental health interventions dealing to control diarrhoeal diseases involve measures that communities and households can implement (Murphy et al 1997:11).

Epistemological assumptions

The epistemological assumptions underlying this study are as follows:

- The F-diagram model of faecal-oral disease transmission can provide the conceptual structure through which the empirical data of the study can be organised.
- Strategies recommended from this study would provide insight into the prevention of household environmental health factors associated with the occurrence of childhood diarrhoea and would also provide useful input that will enhance the effective implementation of environmental health programmes in order to prevent and reduce the prevalence of morbidity due to childhood diarrhoea.

Methodological assumptions

The methodological assumptions of this study are that:

- The emphasis is on discrete, specific concepts as delineated in the structured interview schedule which was used to collect data (see Annexure B).

- The focus is on the objective and quantifiable data which is obtained from the data collection tool (interview schedule) (see Chapter 5).
- A quantitative research design ensured that empirical data were used, statistical analyses were performed and the study results can be generalised to the study population (see Chapter 4).

3.4 THE CONCEPTUAL FRAMEWORK: THE F-DIAGRAM MODEL OF FAECAL-ORAL DISEASE TRANSMISSION

According to LoBiondo-Wood and Haber (2010:57), a research's conceptual framework or theoretical framework is a structure of concepts and/or theories pulled together as a map for the study that provides rationale for the development of research questions or hypotheses. This study was based on the F-diagram model of faecal-oral disease transmission which provides the conceptual framework of the research.

The F-diagram model of faecal-oral disease transmission (Figure 3.1) described by Wagner and Lanoix in 1958 is a useful model to explain the principal routes of transmission of infectious diarrhoeal disease (Hunt 2001:5; UN-Water 2008). Accordingly, this model provided the conceptual framework for this study. Diarrhoeal diseases are mostly spread by disease-causing organisms (pathogens) which are found in human and/or animal excreta. Most common transmission mechanism of these pathogens from excreta to a susceptible host is through faecal-oral transmission (WaterAid 2012:15).

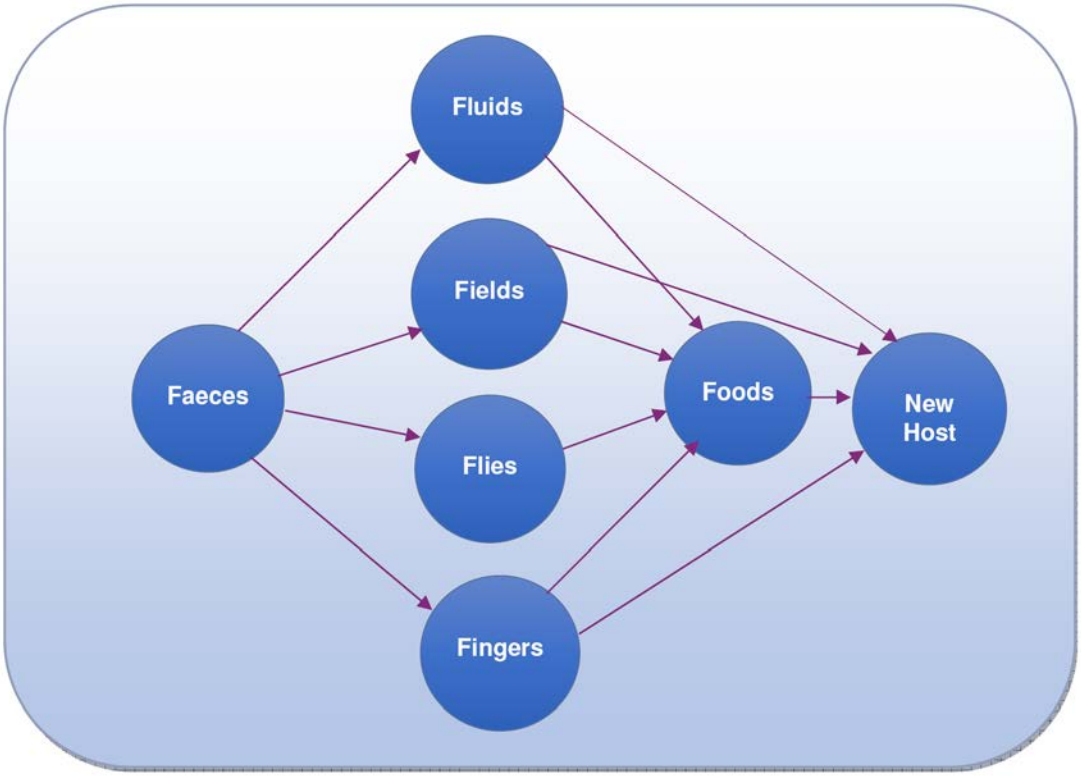

Figure 3.1 The F-diagram model for faecal-oral disease transmission

(Curtis et al 2000:25)

The major transmission routes are through 'the five Fs' (Figure 3.1): fingers, fluids (e.g. water), flies, fields and food. Excreta pathogens can spread to a new 'susceptible host' and be ingested through any of these transmission routes. For instance, they can contaminate a water supply and contaminated water can be used for drinking or in food preparation. Flies that have had contact with human waste matter can carry pathogens to places where food is being prepared and/or eaten. Soil with excreta material can be transmitted into the home by humans or animals and unknowingly carried to places where food is prepared or children play (WaterAid 2012:15).

Diarrhoeal disease can spread through the following five paths ('the five Fs') (Kleinau & Pyle 2004:25; Environmental Health Project 2004:6):

1. Fluids — carry disease through contaminated water
2. Fields — become contaminated by outdoor defecation
3. Flies — carry and transmit diseases
4. Fingers — become contaminated by bacteria that transmit disease
5. Food — becomes infected by fluids, flies, or fingers and then ingested (Kleinau & Pyle 2004:25).

The exposure of children to diarrhoeal disease pathogens is effectively reduced by blocking several of these paths (Environmental Health Project 2004:7). All of the transmission routes shown in the F-diagram (Figure 3.1) can be blocked by changes in domestic hygiene practice. Improved infrastructure, such as water and excreta disposal facilities, can also contribute to the prevention of transmission. However, public infrastructure can only be fully effective if employed in conjunction with safe hygiene practices in the home (Curtis et al 2000:25).

The F-diagram of disease transmission prevention and control shown in Figure 3.2 allows in differentiating between primary barriers and secondary barriers that prevent and control the spread of diarrhoeal disease causing pathogens in the environment (Curtis et al 2000:25). The most effective method of reducing disease transmission is by implementing 'primary barriers' and 'secondary barriers' that prevent the spread of pathogens in the environment or being carried onto susceptible hosts (WaterAid 2012:15).

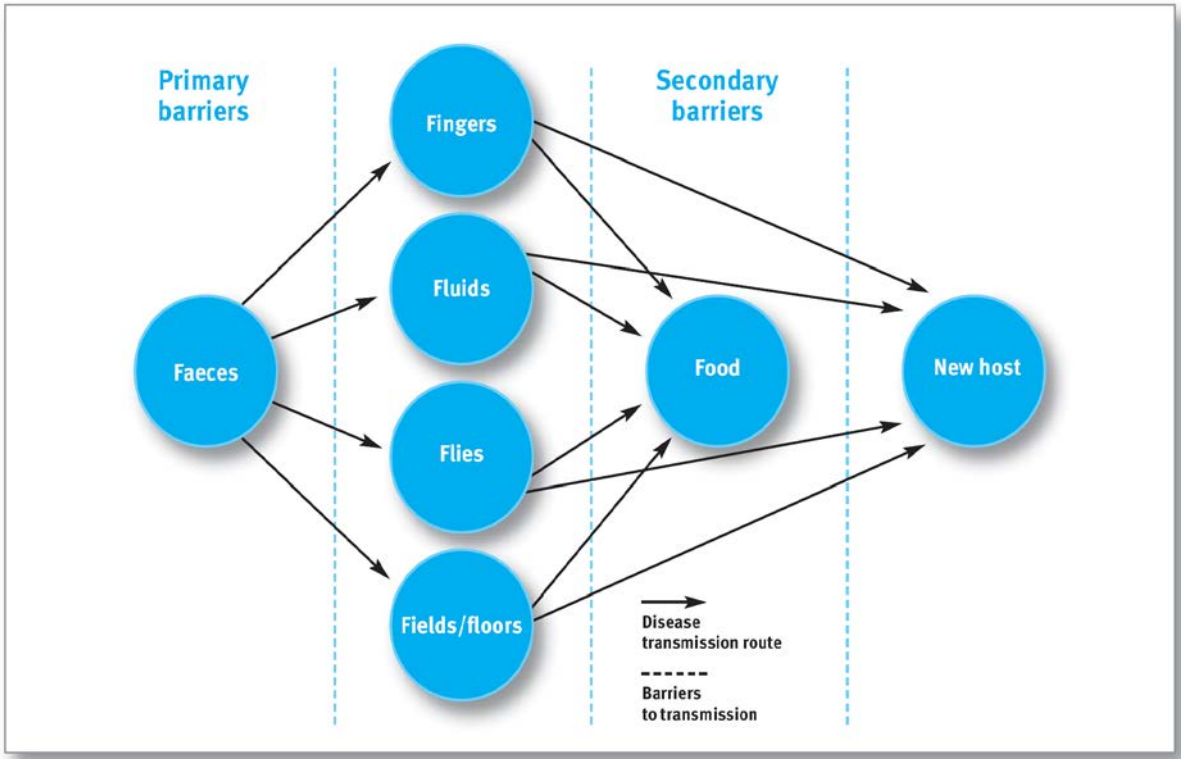

Figure 3.2 The F-diagram of disease transmission and control through primary and secondary barriers

(WaterAid 2012:15)

The primary barriers prevent infectious disease-causing organisms found in excreta from entering the environment, by using the following methods:

- The containment and disposal of human excreta in such a way that it gets isolated or separated from human contact (by the use of latrines, septic tank, sewers, etc.).
- The removal of traces of faecal matter from hands after contact with excreta (i.e. washing hands with soap after defecation or after cleaning up children post-defecation) (WaterAid 2012:15).

Secondary barriers are hygiene practices that stop excreta pathogens that would have spread into the environment in stool or on hands from multiplying and reaching new susceptible hosts. The secondary barriers include:

- Hand-washing before preparing food or eating.
- Preparing, cooking, storing and re-heating food in such a way as to prevent pathogen survival and multiplication.
- Protecting water supplies from faecal contamination, and utilising water treatments such as boiling or chlorination.
- Keeping domestic environment free of faecal matters (WaterAid 2012:16).

The F-diagram indicates useful implications. Firstly, it indicates that diarrhoeal pathogens originate in stool. Secondly, it suggests that if primary barriers to the transmission of faecal pathogens are in place, then secondary barriers will be less important. Interventions to encourage the safe disposal of stool and adequate hand-washing after stool contact should thus pay greater advantage than those that concentrate on the secondary barriers (Curtis et al 2000:25).

The following points review the specific practices related to the primary and secondary barriers, such as safe stool disposal, hand-washing, protecting water, fly control and food hygiene in the light of this hypothesis.

i) Safe stool disposal

The association between stool disposal and child diarrhoea has been investigated in a number of epidemiological studies. Indiscriminate defecation near the home or in living

areas was found to be associated with an increased incidence of diarrhoea. A further source of evidence for the importance of safe stool disposal is the literature on the impact of sanitation programmes in developing countries. If the construction of latrines reduces diarrhoeal disease then the effect is presumably due to the safe disposal of stools. Thus, the studies indicates that human stool in the domestic environment are a source of diarrhoeal infection for small children, and evidence shows that the safe disposal of stool should be one of the key measures to prevent diarrhoeal diseases (Curtis et al 2000:26). Sanitation facilities that are not properly working can set up further potential disease transmission pathways and these conditions can lead to the pollution of the environment. Selection of the right technologies, good design, appropriate use and proper management are required to protect against these additional risks (Water Supply and Sanitation Collaborative Council & World Health Organization 2005:10).

ii) Hand washing

Hand washing can interrupt several of the transmission routes in the F-diagram (Figure 3.2). Hand washing can interrupt pathogen transmission as a primary barrier (removing faecal matter after contact with stools) and hand-washing as a secondary barrier (before preparing food, handling fluids, feeding and eating). To prevent stool pathogens from gaining access to the domestic environment, efforts should concentrate on hand-washing after stool contact, especially after defecation or after cleaning up a child (Curtis et al 2000:26).

iii) Preventing transmission through water

The F-diagram shows how diarrhoeal pathogens use water as a route to reach new hosts. Primary barriers to this transmission route include preventing contamination of water by faecal material, both at source and in transit. Secondary barriers remove pathogens once get into water supplies, and include methods of purification both at source and in the home. Fluids can also become contaminated by a failure of other barriers, via unwashed fingers, for example. Preventing transmission through water thus requires action in both the public domain and in the sphere of domestic hygiene. Keeping water supplies free of faecal contamination at source and in transit is important for preventing diarrhoeal disease. However, the best way to do this may be to ensure

that faecal material is not released into the environment and so does not get into water. This again requires safe stool disposal and effective hand-washing after stool contact (Curtis et al 2000:27).

iv) Flies

Flies are commonly thought of as a source of diarrhoeal disease. Flies have been shown to carry pathogens on their feet, in their faeces and in the digestive juices which they regurgitate onto foods. A number of studies have linked flies to diarrhoea incidence. Though fly control might be desirable in settings where flies form a major nuisance and where there is substantial faecal contamination of the environment, it is not yet achievable. The logic of the F-diagram again leads to the conclusion that the primary need is to prevent flies gaining access to stools in the first place. Safe stool disposal in latrines, sewers, or by burying thus has two benefits. It reduces opportunities for flies to breed and it removes the source of fly transported pathogens (Curtis et al 2000:28).

v) Food-borne transmission of diarrhoeal diseases

The F-diagram shows food as a possible link in the chain of transmission of diarrhoeal pathogens from stool to new host. Potential interventions to break this chain include the secondary barriers of hand-washing before food preparation and handling, safe food storage, avoidance of contaminated foods, adequate cooking and reheating, cleaning kitchens, surfaces and utensils, and hand washing before eating or feeding children. Food is potentially important for disease transmission because pathogens on food have an easy route into the digestive system, and some gastro-enteric pathogens can multiply in food and thereby increase the dose ingested. The risk practices that should be targeted in the efforts to prevent diarrhoeal disease are: first, in the public domain foods should be protected from contamination before they come into the home, especially from food handlers' stools. Second, since food contamination with diarrhoeal pathogens in the domestic domain can only result from an inadequate disposal of stool, or if hands are inadequately washed after stool contact, then hand washing and stool disposal are key to diarrhoea prevention (Curtis et al 2000:28).

Multiple routes of infection

A number of studies have concluded that several interventions at a time are more effective than one alone. Alam and colleagues in 1989 demonstrated that a combination of clean water, absence of faeces in the yard and hand-washing resulted in 40% less diarrhoea than when one practice alone was observed. Haggerty and colleagues in 1994 reported an 11% reduction in diarrhoea reporting in villages where hand washing and the disposal of human and animal faeces were promoted. Thus, the source of the diarrhoeal pathogens is removed by a correct disposal of human stool from the domestic environment and hand-washing after stool contact. Households may still be at risk from contaminated materials that are brought into the household from outside and need to adopt a variety of hygiene practices (Curtis et al 2000:29).

To achieve full health benefits and in the interest of human dignity, other sources of contamination and disease also need to be managed. These include:

- Sullage (dirty water that has been used for washing people, cloths, pots, pans, etc)
- Drainage (natural water that falls as rain or snow)
- Solid waste (also called garbage, refuse or rubbish) (Water Supply and Sanitation Collaborative Council & World Health Organization 2005:10)

Although several factors are responsible for the survival of children under the age of five in developing countries, studies reveal that some childhood diseases that often result in mortality can be explained by well-known health hazards within the child's household environment. Indeed, environmental health hazards are threats to the health of millions of people in the settings where they live. Studies have shown that sanitation, water supply, and hygiene are generally poor in developing countries (Fayehun 2010:2).

According to several studies priority environmental health interventions for prevention of diarrhoeal disease typically includes:

- Disposing of human excreta appropriately through improved sanitation
- Improving water quality
- Providing sufficient water quantity and access
- Promoting hand-washing with soap (Clasen et al 2010:5; Kleinau & Pyle 2004:25)

All these sources of contamination and disease must be managed in all the locations where they are produced. Thus, a full-scale programme to improve hygiene would need to address the management of excreta, wastewater (sullage and drainage) and solid waste handling at households (both formal and informal); schools; semi-public places; and public places (such as markets, and other areas) (Water Supply and Sanitation Collaborative Council & World Health Organization 2005:11).

Though the research focus was on the F-diagram model of faecal-oral disease transmission for the study of the environmental health determinants in relation to childhood diarrhoea, the study included other sources of contamination based on the aforementioned premises. Thus, the environmental risk factors included in the study are: water supply, sanitation facilities, disposal of solid waste and wastewater and hygiene practices as well as the study gathered data on household characteristics. Within this context, the concept of faecal-oral transmission of diarrhoeal pathogens provides the conceptual framework for this research's focus regarding the environmental health risk factors for childhood diarrhoea at household level.

3.5 CONCLUSION

The chapter presented the concept of paradigm and the paradigmatic assumptions. It discussed the ontological, epistemological and methodological assumptions underpinning the study from a positivist approach. The chapter also described the F-diagram model of faecal-oral disease transmission which provided the conceptual framework of the study within which to focus on the consideration of environmental health risk factors for childhood diarrhoea.

The following chapter will present the research design and methods used in the current study.

CHAPTER 4

RESEARCH DESIGN AND METHOD

4.1 INTRODUCTION

This chapter describes the research design and methodology that was followed when conducting the current study. The research design and method discussed in this chapter includes the type of research design, description of the study area, population and sampling method, data collection, data analysis, ethical considerations and measures taken to ensure validity and reliability. A descriptive, quantitative, contextual and cross-sectional study, using stratified random sampling method, was used to conduct the research and is discussed in detail below.

4.2 RESEARCH DESIGN

According to Grove et al (2013:195), a research design is the blueprint to conducting a study. Polit and Beck (2010:567) define research design as the overall plan to addressing a research question and strategies that will enhance the study's integrity. In this study, a quantitative, descriptive, contextual and cross-sectional research design was employed to conduct the study with the aim of assessing and exploring the relationship between household environmental health factors associated with the occurrence of diarrhoea in children under-five years among the households of Sebeta town. The study design approaches are described below.

4.2.1 Quantitative research

Quantitative research is a formal, objective, systematic process implemented to obtain numerical data in order to understand aspects of the world (Grove et al 2013:23). According to Grove et al (2013:25), quantitative research describes and examines relationships and determines casualty among variables. It incorporates logistic and deductive reasoning as the researcher examines particulars to make generalisations about the universe. It is characterised by the use of structured interviews, questionnaires or observations; scales; and physiological measures that generate

numerical data. Statistical analyses are conducted to reduce and organise data, describe variables, examine relationships and determine differences among groups. Control, precise measurement methods, and statistical analyses are used to ensure that the research findings accurately reflect reality so that the study findings can be generalised (Grove et al 2013:25).

Quantitative research is chosen for this study as the outcomes obtained from the collected data from the households in the study area are numeric and quantifiable. The collected data was also analysed using statistical software programmes for data analysis. The data was measured objectively using the structured data collection tool.

The following characteristics of quantitative research, as described by Grove et al (2013:24) are of importance in this study:

- Quantitative research uses structured interviews, questions and observations. In this study a structured data collection tool in the form of an interview schedule was used to gather information from the study households.
- Quantitative research uses numbers and statistics. In this study, data analysis was carried out numerically using statistical procedures (descriptive and inferential statistics).

4.2.2 Descriptive study

According to Polit and Beck (2010:236), the purpose of descriptive studies is to observe, describe, and document aspects of a situation. A descriptive study involves the identification of a phenomenon of interest and the variables that contribute to the phenomenon. A descriptive study provides more information about characteristics within a particular field of study. It provides a picture of situations as they naturally happen, and may also be used to develop theory, identify problems with current practice, justify current practice, make judgements, or determine what others in similar situations are doing (Grove et al 2013:215). In this research, the descriptive design approach was, therefore, used to describe the environmental health factors in relation to the childhood diarrhoea.

4.2.3 Contextual

The study is contextual in nature in that data was collected within the natural settings of the household environment. A natural setting refers to uncontrolled, real-life setting where a study is conducted (Grove et al 2013:37).

4.2.4 Cross-sectional study

According to Grove et al (2013:220), cross-sectional study designs examine groups of subjects in various stages of development, trends, patterns, and changes with the intent to describe changes in phenomenon across stages. It is a study design in which data are collected at one point in time from a cross-section of the population (Polit & Beck 2010:551; World Health Organization 2001:17). All phenomena under study are captured during one data collection period (Polit & Beck 2010:239). In this study, data was collected from sample households of the study town (from a section of the population) using a structured interview schedule during one data collection period; i.e., the data were collected only in the month of November 2013.

4.3 RESEARCH METHOD

Research methodology refers to a process or plan for conducting the specific steps of the study (Grove et al 2013:707). According to Polit and Beck (2010:567), a research method is defined as the technique used to structure a study, gather and analyse information in a systematic fashion. The methodology used in this study is described below.

4.3.1 Study setting

According to Grove et al (2013:709), a setting refers to location for conducting research. Polit and Beck (2010:568) defined it as the physical location and conditions in which data collection takes place in a study. The setting for this study was Sebeta town which is located in Finfinne surrounding special zone of Oromiya region in Ethiopia (Figure 4.1). Sebeta town was selected for this study with purposive sampling as there were no previous studies conducted in the town with regard to environmental factors of childhood diarrhoea. The town is 25 kilometres to the Southwest of Addis Ababa.

Sebeta town is administratively divided into eight *kebeles* (*kebele* is the smallest government administrative unit) (Sebeta Town Administration 2012:6). The town has a population of more than a hundred thousand people (Sebeta Town Health Office 2012:2).

The elevation of the area ranges between 2,194 metres and 2,302 metres above sea level which borders with Addis Ababa in the north, northeast and east, Burayu town in the north, and rural villages of Sebeta Hawas District in the south and west (Hailu 2008:16). The total land area of the town is 9,645.3 hectares (Sebeta Town Administration 2012:8).

With respect to available health institutions, there are three government health centres, fifty one private clinics and twenty one private drug vendors in the town in 2012 (Sebeta Town Health Office 2012:2). According to the town's administration report, the health service coverage of the town in 2012 was 72.4% and access to piped water sources was 65% (Sebeta Town Administration 2012:8).

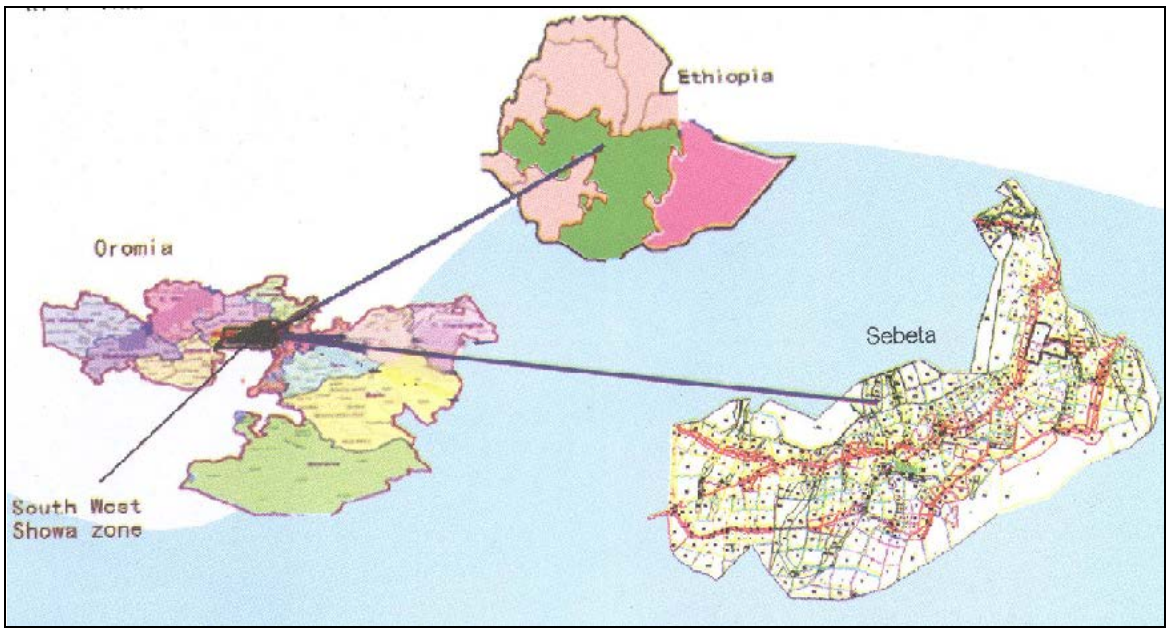

Figure 4.1 Location map of Sebeta town in Oromiya region of Ethiopia
(Sebeta Town Administration 2012:7)

4.3.2 Study population

According to Grove et al (2013:44), a population is all the elements (individuals, objects) that meet certain criteria for inclusion in a given universe. In research, two populations are described, the target population and the accessible population. Grove et al (2013:351) describe a target population as the entire set of individuals or elements who meet the sampling criteria. In this study, the target population (source population) compromised all household mothers or caregivers of under-five children in Sebeta town of Ethiopia. Accessible population is composed of cases from the target population that are accessible as study participants (Polit & Beck 2010:307). Grove et al (2013:351) define it as the portion of the target population to which the researchers have reasonable access. In this study, the accessible population includes a sample of randomly selected households' mothers/caregivers with under-five children (mother-child pairs) in Sebeta town.

4.3.3 Sample and sampling

4.3.3.1 Sampling procedure

A sample is a subset of a population selected to participate in a study. Sampling refers to the process of selecting a portion of the population to represent the entire population (Polit & Beck 2010:307). Probability sampling approach was used in this study to select households' mothers/caregivers with under-five children from the town. Probability sampling is a procedure that uses some form of random selection when the sample units are chosen. This type of sample enables the researcher to estimate the probability that each element of the population will be included in the sample. Probability sampling is a more rigorous type of sampling strategy and is more likely to result in a representative sample (LoBiondo-Wood & Haber 2010:225). Probability sampling is, therefore, chosen as it is more appropriate and useful for quantitative research which aims to measure variables distributed in the population.

A two-stage stratified random sampling method was used to select the samples in which the population was first divided into relevant strata (subgroups). Stratified random sampling is defined by Polit and Beck (2010:569) as the random selection of study participants from two or more strata of the population independently. According to

LoBiondo-Wood and Haber (2010:231), stratified random sampling requires the population be divided into strata or subgroups. An appropriate number of elements from each subset are randomly selected on the basis of their proportion in the population. The goal of this strategy is to achieve a greater degree of representativeness (LoBiondo-Wood & Haber 2010:231). Therefore, the subjects were selected using the stratified random sampling method to improve the likelihood of the sample being representative.

In this study, firstly, *kebeles* was considered as strata and all the eight *kebeles* of the town were included in the study. Then, all the lists of households with under-five children (mother-child pairs) in each *kebele* (community) which were registered by urban health extension workers (data collectors) at each *kebele* health post was used as the sampling frame for the random selection of sampling units. Polit and Beck (2010:567) define a sampling frame as a list of all the elements in the population, from which a sample is drawn.

A proportional to size allocation method was employed to determine the number of study subjects in each *kebele*. In proportional to size (proportionate sampling), subjects are selected in proportion to their occurrence in the population (Grove et al 2013:360). This means that study participants per stratum were randomly selected and the number per stratum (i.e. *kebele*) was determined by the percentage contribution of households with under-five children in each *kebele* to the total registered households with under-five children in the entire town.

In the second stage of the stratified random sampling method, from each stratum, households with under-five children were selected using the simple random sampling technique. Thus, in order to ensure that all samples were adequately represented, the simple random sampling method was employed in each stratum (*kebele*). Accordingly, as per the simple random sampling method, households with under-five children in Sebeta town were selected randomly by means of the table of random numbers from the registered list of households with under-five children in each of the *kebele*. For the implementation of random selection, a number was assigned to each household head name on the list, and then the households were selected from the registered sampling frame using a table of random numbers.

4.3.3.2 Inclusion and exclusion sampling criteria for household selection

An inclusion sampling criteria is defined by Grove et al (2013::696) as sampling requirements identified by the researcher that must be present for the element or subject to be included in the sample. In this study, the inclusion sampling criteria were:

- Household's mother/caregiver having a child who had not yet completed his or her 60th month (a child under-five years of age). In cases, where there were more than one under-five child in the same household, the youngest child was selected as an index child to collect information on the child's demographic and health characteristics.
- Households that were registered as having under-five children by the *kebele* health post.

An exclusion criterion is defined by Polit and Beck (2010:554) as the criteria specifying characteristics that a study population does not have. In this study, the exclusion sampling criteria were:

- Institutions (such as offices, hotels, etc.) other than households.
- Households that did not have child/children of under-five years and were not registered as having under-five children by the *kebele* health post.

4.3.3.3 Eligibility criteria for being a household respondent for interview

Households that were selected based on random sampling procedure were made to participate in the study. The eligibility criteria for being a household respondent for interview were being (i) a mother of an under-five child; or (ii) where the mother was not be available, a female caregiver person of at least 18 years of age, who is most familiar and knowledgeable concerning the health status of the under-five child and the environmental sanitation condition of the household. Accordingly, respondents from the randomly selected households that were willing to participate in the study and were available at the time of data collection were interviewed, following informed consent.

4.3.3.4 Sample size

A sample size is the number of study subjects recruited to be included in a specific study (Grove et al 2013:708). The aim of the calculation for a study estimating population prevalence is to determine an adequate sample size to estimate the population prevalence with a good precision. The sample size for this study was determined using a statistical formula for estimation of single population proportion in prevalence study (Naing, Winn & Rusli 2006:9).

Accordingly, the sample size was calculated by employing the single population proportion formula of $n = Z^2P\ (1\text{-}P)/d^2 * D$.

Where:

- n = the required sample size,
- P = the proportion of diarrhoea (assumed prevalence of diarrhoea of 17%),
- Z = the standard score corresponding to 95% confidence level (and is thus equal to 1.96),
- d = the margin of error (estimated at 5%) and
- D = a design effect of 2 for multistage nature of stratified sampling method.
- This gave a sample size of 434. Ten percent of the sample size was added to the calculated sample for non-response rate.

Thus, the calculated total sample size for this study was 477 households' mothers/caregivers with under-five children (mother-child pairs).

4.3.4 Data collection

4.3.4.1 Data collection approach

Research data is information obtained during a study (Polit & Beck 2010:552). Data collection is a systematic gathering of information relevant to the research purpose or the specific objectives, questions or hypotheses of a study (Grove et al 2013:691). In this study, the data collection approach employed was a structured data collection tool. Structured data collection is an approach of collecting data from participants, either

through self report (interview or questionnaire) or observations, in which response categories are specified in advance (Polit & Beck 2010:569).

The data collection for this study was conducted at household level using the quantitative research technique. Quantitative research is characterised by the use of structured interviews, questionnaires, observations, scales, or physiological measures (Grove et al 2013:24). In this study, two types of structured data collection methods were used. These were:

i) **Structured interviews (household interview)**: According to LoBiondo-Wood and Haber (2010:580), an interview is a method of data collection in which a data collector questions a subject verbally. In this study, household interviews were conducted by directly interviewing the mothers or caregivers of children in the randomly selected households using a structured data collection tool (interview schedule).
ii) **Structured observations**: a structured observation involves specifying in advance what behaviours or events are to be observed (LoBiondo-Wood and Haber 2010:272). In this study, information on sanitation facilities and environmental health conditions of the study households was collected using the observational method utilising a structured data collection tool.

Data collected from the households constituted primary data. Secondary data sources were also used by conducting a detailed literature review. Review of literature, such as policy documents, books, journals, articles, electronic sources, theses, reports and plans from government institutions and other relevant documents and publications that were sourced from libraries, institutions and online materials were used as the secondary sources. The process for developing the urban environmental health strategies for prevention of childhood diarrhoea (see chapter 7) was based on the main findings of the study and these were complemented with the related literature review. The literature review for the development of strategies were focused on the assessment of the country's status on environmental health, sanitation and hygiene promotion programmes, review of factors affecting the progress of environmental health implementation with emphasis in prevention of diarrhoea, institutional and policy issues, finance and human resources.

4.3.4.2 Data collection tool

In this study, the data collection tool used for household interview and observation was the structured interview schedule. According to Polit and Beck (2010:343), structured interview data is usually collected by means of a formal, written document (instrument) known as interview schedule in which questions are asked orally in a face-to-face interview. In this study, the interview questions answered by respondents and the observational questions which were checked by observations by data collectors were developed as one data collection tool in the structured interview schedule.

The interview schedule of the study (see Annexure B) was developed according to the study's objectives, research questions and the theoretical framework (F-diagram model of faecal-oral disease transmission). Accordingly, the interview schedule was developed after carrying out a detailed literature review and it was mainly adapted from the publications of World Health Organization and United Nations Children's Fund (2006:8), Environmental Health Project (Kleinau & Pyle 2004:121), Hygiene Improvement Project (2010:12) and United Nations Children's Fund (2012).

Two items were attached to the front pages of the data collection tool. These were: (i) instructions for interviewers for the completion of the interview schedule (Annexure D); and (ii) participants' informed consent letter (see Annexure C), which contains the purpose of the research and ethical aspects of confidentiality and serves as an introduction to the interview. The questions of the structured interview schedule were focused on socio-demographic data, household environmental health conditions and childhood diarrhoea. The main contents of the interview schedule are described below:

- SECTION I: Socio-demographic data

    i. Household socio-demographic data
    ii. Mother/caregivers' socio-demographic data
    iii. Childrens' demographic data (index child)
    iv. House characteristics

- SECTION II: Environmental health conditions

    i. Water
    ii. Excreta disposal
    iii. Wastewater disposal
    iv. Solid waste disposal
    v. Hygienic practices

- SECTION III: Childhood diarrhoea

The type of question in the interview schedule was based on the two types of variables of the study, namely dependent (outcome) and independent (explanatory) variables. The occurrence of childhood diarrhoea in an under-five child within the last two weeks preceding the study interview was considered to be the dependent variable and environmental health factors were considered to be the independent variables.

Questions regarding dependent variable

- The study has one dependent variable which is the occurrence of diarrhoea in an under-five child within the last two weeks preceding the study interview.

The outcome measure, diarrhoea in under-five children, was based on mothers' response (yes or no) to a question on whether a particular child under 60 months of age had experienced diarrhoea during the previous two weeks before the interview. It was measured by asking mothers with children under the age of 5 years to provide information about the history of diarrhoea for the two weeks prior to the interview. This indicator is the period prevalence of diarrhoea based on a two-week recall of the child's mother or caregiver. Diarrhoea is defined as three or more loose or liquid stool passed in a 24-hour period (Kleinau & Pyle 2004:37). There are several advantages of using diarrhoea prevalence as an indicator of health status. There is a direct relationship between improved water and sanitation and diarrhoea prevention. Diarrhoea is an acute disorder reflecting environmental risks at the time of the diarrhoeal episode (Bateman, Smith & Roark 1993:7). It is an indication of the magnitude of the problem of diarrhoea and the potential health effects from exposure to the environmental problems of poor quality of sanitation, water and food (Briggs 1999:52).

Questions regarding independent variables

- ***Socio-economic and demographic characteristics****:* these include household socio-demographic factors (age of household head, gender of household head, place of residence, education level of household head, type of job of household head, number of household members, number of under-five children, household income and type of house ownership and housing characteristics); maternal/caregivers' socio-demographic factors (age, education level, type of job and marital status); and the childs' demographic factors (age and gender).

- ***Environmental health conditions***: the interview schedule questions contained a list of issues pertaining to household environmental health-specific issues such as drinking water (type of water source, distance to the water source, time spent to-and-from the source, amount of daily water consumption, water storage and treatment); environmental sanitation (availability and type of toilet facility, disposal of child's stool, latrine cleanliness, solid waste disposal, liquid waste disposal and compound cleanliness); and hygiene practices such as hand-washing (at critical times).

The observational questions in the data collection tool were focused on the type of construction materials of the housing wall, floor and roof; domestic water storage container type, cover and cleanliness; toilet type and cleanliness; solid waste storage container type and cover; house compound cleanliness; and the presence of soap, place for hand-washing, hand-washing device, availability of water and soap for hand-washing practices.

The structured interview schedule consists of mainly closed-ended questions and also includes some open-ended questions. Most of the questions have instructions for interviewers which were put together in each question. The instructions in each question as well as the general instructions for interviewers for the completion of the interview schedule were developed in order to enhance clarity and understanding.

The data collection tool (interview schedule) was initially developed in English language and then it was translated to the Afan Oromo which is the local language of the study area. To ensure the validity and reliability of data, during the training of data collectors,

discussion was made with the data collectors of the study (urban health extension workers of the *kebele* health posts) on the translated interview schedule. Consequently, the feedback provided from data collectors were used as input to refine the data collection tool. The data collection from the randomly selected households were conducted using the translated interview schedule, and the data collectors speak the local language (Afan Oromo) of the study area.

The average time taken to complete the household data collection tool per household was recorded during the data collection. The analysis of the collected data shows that the average time taken to complete the interview schedule per household was 60 minutes.

4.3.4.3 Training

The data collectors were trained by the researcher for one day on data collection methods and the interview/observation methodology. The training was conducted at the training hall of Sebeta town Health Centre. During the training, the data collectors were provided with an explanation on the purpose of the study, the sampling method, interviewing techniques, content of the data collection tool, tasks to be accomplished during data collection, issues of data quality, and the ethical conduct to the research. A hand-out on the research methodology and data collection procedures was given to data collectors during the training session.

The training was focused on reading and familiarising the data collectors with each question of the interview schedule which was translated in the local language (Afan Oromo). In the elucidation of the questions, the purpose of each question was made clear. Then an explanation on how to fill out the questions was provided by familiarising the data collectors in differentiating and understanding of the format structure of the interview schedule, closed-ended questions, open-ended questions, skip patterns, interview questions, observation questions, one response and multiple response questions, as well as on how to record and write responses of respondents. Emphasis was also given on how to establish mutual trust with respondents before asking questions. Questions that need attention such as estimation for measurement and observations were also discussed. During the training, discussion was made regarding the completeness of response sets; flow of questions; the identification of unclear terms,

phrases or questions; and understanding of instructions by data collectors and feedback provided from the data collectors were used to refine the data collection tool.

4.3.4.4 Pre-testing

According to Polit and Beck (2010:345), a pre-test is a small-scale trial of the data collection instrument to determine whether the instrument is useful in generating desired information. In this study, the structured interview schedule was pre-tested in the same study area where the main data collection was performed. The purpose of the pre-test was to determine the level of understanding and relevance of the questions and assess the suitability of the data collection tool with regards to wording appropriateness and questions clarity. The pre-test was carried out in 10% (47 households) of the total sample size of the study. The pre-test at selected households was carried out in the month of October 2013 by data collectors who are urban health extension workers. Households' mothers/caregivers with under-five children were selected for the pre-test study of the data collection tool through convenience sampling. In convenience sampling, the sample elements are included into the study according to the availability of subjects (Grove et al 2013:686).

The interview schedule was revised before embarking on full data collection in this study, on the basis of the responses obtained from the pre-test. This strategy was used to improve the reliability of the data collection tool. The results of the pre-test were used to provide feedback to data collectors as well as to revise the data collection tool with respect to the completeness of response sets; flow of questions; the identification of unclear terms, phrases or questions; understanding of instructions by data collectors; and the time required to complete the data collection tool. The data collected from the pre-test were not included in the main data collection of the study.

4.3.4.5 Data collection process

The data collection from the randomly selected households of Sebeta town was conducted from November 6 to 28, 2013 by field data collection team which consisted of the researcher and the field data collectors. The field data collectors were urban health extension workers of the *kebele* health posts in Sebeta town. The data collection from the study households was carried out by interviewing household respondents using

interview schedules through house-to-house visits by data collectors. Twenty nine data collectors were grouped into eight teams as per the eight *kebeles* of Sebeta town to gather data from the households. The data collectors speak the local language (Afan Oromo) of the study area and had previous experience in community health data collection fieldworks.

The researcher was responsible for overall coordination of the whole data collection process and checking of the data quality during the field data collection period. All data collected was validated by checking the filled data collection tool to see if all information needed was actually collected and to assess for consistency in recording. Where the filled interview schedules were found to be inconsistent, incomplete or having missing information, the data collectors were made to re-check the filled data or made to re-interview the households based on the type of problems identified.

The role of data collector was to correctly identify the randomly selected households with their respondents as per the provided name of the household head; obtain informed consent prior to each interview; conduct the data collection using the structured data collection tool (interview schedule) by interviewing a mother or guardian of the child; maintain respondent confidentiality and keep an ongoing record of each household assigned to them. The data collectors were also responsible for keeping records of the progresses of the data collection process on the interview schedules for the assigned households and report on the problems encountered to the researcher.

During the data collection period, the data collectors visited each assigned household which had been randomly selected. Interviews were performed at each household with the mother of the under-five child when she was present and when the mother was not available, interviews were performed with female caregivers of at least 18 years of age. When both the mother and caregiver were not available in the house for the interview, data collectors made return visits to the households for at least three times.

4.3.4.6 Ethical considerations related to data collection

Ethical principles refer to the values of respect for persons, beneficence and justice relevant to the conduct of research (Grove et al 2013:693). The ethical issues considered in this study are protecting the rights of both the participants and institutions

and upholding scientific integrity on the part of the researcher. The details of the ethical principles for this research are described below.

4.3.4.6.1 Protecting the rights of participants

The human rights that require protection in research are the right to self-determination; the right to privacy; the right to anonymity and confidentiality; the right to justice; and the right to protection from discomfort and harm (Grove et al 2013:164). This study involved human subjects as household respondents in which mothers or caregivers from households were interviewed regarding the environmental health conditions of households and children's demographic data and the occurrence of diarrhoea. Thus, the following were done to protect their rights:

Informed consent

Informed consent means the study participants have adequate information regarding the research, comprehend the information, and have the power of free choice, enabling them to consent to or decline participation voluntarily (Polit & Beck 2010:127). In this study, the respondent of the interview was a mother of an under-five child and where the mother was not available; a female caregiver of at least 18 years of age was interviewed. The household respondents were therefore informed about the purpose and procedures of the study and were allowed to ask questions, before they were requested to give written consent. At the beginning of each interview schedule, a "participant informed consent letter" (Annexure C) which requests the permission from the household respondent was attached. The consent letter was translated to the local language so as to make the respondents understood the purpose and procedures of the study. Written informed consent was obtained after a respondent's agreement to participate, however, those who cannot read nor write, provided their thumbs as signatures.

Autonomy

According to Grove et al (2013:164), prospective subjects should be treated as autonomous agents by informing them about a proposed study and allowing them to voluntarily choose to participate or not. In this study, it was explained to the household

respondents that the interview will be conducted voluntarily after their agreement to participate and that the rights of the respondents not to participate would be respected at anytime if they refused to participate or choose to withdraw from their participation during the interview. This is referred to as the right to self-determination, which is based on the ethical principle of respect for persons (Grove et al 2013:164).

Confidentiality and anonymity

Researchers have a responsibility to protect the anonymity of subjects and to maintain the confidentiality of data collected during a study. Confidentiality is defined as the management of private data so that subjects' identities are not linked to their responses and data provided is never publicly divulged (Grove et al 2013:686; Polit & Beck 2010:550); whereas anonymity is protection of participants' confidentiality such that even the researcher cannot link individuals with data provided (Polit & Beck 2010:547). Respondents were informed that the collected data would be kept confidential as no names and address of any of the respondents (personally identifiable information) will be used in the event of a publication or presentation resulting from the research. Hence, the anonymity of respondents was protected during data compilation and analysis, by assigning a number (coded numerically) to each interview schedule.

Beneficence

Polit and Beck (2010:548) describe beneficence as a fundamental ethical principle that seeks to maximise benefits for study participants, and prevent harm. Protection from discomfort and harm is based on the ethical principle of beneficence which holds that one should do well, and above all, do no harm (Grove et al 2013:174). The data collection for this study from the household respondents had no known risks which would expose them to harm. The data collection was conducted at the natural settings of the household environment. However, any kind of discomfort to respondents due to temporary interruption at their household works was minimised by conducting the data collection when the eligible respondents were available at their houses and by taking a reasonable time to complete the interview schedule. Moreover, to minimise any problems during interviewing, the data collectors were trained on interviewing skills, methods to establish mutual trust with respondents before asking questions and use of proper introduction by utilising the participants' informed consent form. Benefits from

this study include increased awareness about household environmental health risk factors associated with the occurrence of diarrhoea in children under-five years as well as the fact that the study may contribute to the refinement and development of urban environmental health strategies for the prevention of childhood diarrhoea.

Justice

This is based on the ethical principle of justice which holds that human subjects should be treated fairly (LoBiondo-Wood & Haber 2010:250). In this study, this was ensured by randomly selecting study subjects with an equal chance to participate in the study from the households of the study area on the basis of an appropriate scientific research methodology.

4.3.4.6.2 Protecting the rights of institutions

The Health Studies Higher Degrees Committee of the College of Human Sciences at the University of South Africa (UNISA) granted the ethical clearance certificate to conduct the research (Annexure A). Institutional consent was also sought from the government institution in Ethiopia. The researcher presented a request for permission to carry out the research in Sebeta town of Ethiopia to the Oromiya Regional Health Bureau (Annexure E). Accordingly permission was obtained from the Oromiya Regional Health Bureau to conduct the study in Sebeta town of Ethiopia (Annexure F).

4.3.4.6.3 Scientific integrity

The conduct of this study contributes to the growing body of knowledge and research regarding environmental health and diarrhoea through honest accomplishment, reporting and publication of a research report. Accordingly, scientific integrity was maintained in this research by protecting the intellectual property of the authors of the publications which were consulted in the study by giving proper attribution and citation in the list of references. Data was collected, analysed, interpreted and reported basing on appropriate scientific procedures and evidence in an ethical manner.

4.3.5 Data analysis

According to Polit and Beck (2010:552), data analysis is the systematic organisation and synthesis of research data. The purpose is to reduce, organise, and give meaning to data (Grove et al 2013:691). As quantitative data was collected in this study, the emergent data was consequently analysed using quantitative data analysis methods. Descriptive, bivariate, and multivariate statistics were used in the data analyses of the study.

After completion of the field data collection, the interview schedules were collected, and all responses to the questions of the interview schedule (data collection tool) were initially assessed and reviewed, and thereafter each interview schedule was coded numerically. Data entry and verification were then performed using the EPI Info 7.0 software programme (United States Centres for Disease Control and Prevention, Atlanta, Georgia, USA). Statistical analyses were conducted using the Statistical Package for the Social Sciences (SPSS) version 20.0 statistical software (SPSS Inc. Chicago, Illinois, USA).

According to Grove et al (2013:692), descriptive statistics refer to summary statistics that allow the researcher to organise data in ways that give meaning and facilitate insight, such as frequency distributions and measures of central tendency and dispersion. In this study, descriptive statistics were used to describe the variables by means of frequency distributions, percentages, measures of central tendency and standard deviations and the summary results of the statistics were presented using tables and graphs.

In analysing data, both bivariate and multivariate analyses were employed in this study using the SPSS software programme to identify the determinants of childhood diarrhoea. Binary analysis was used as the method of analysis for this study, due to the dichotomous nature of the dependent variable. According to Grove et al (2013:687), bivariate analysis is a statistical procedure that involves comparison from two variables. In this study, bivariate analysis was used to ascertain the association between under-five childhood diarrhoea by independent variables using Pearson's chi-squared test of independence or Fisher's exact test. Both the chi-squared test and Fisher's exact test

are a statistical procedure used to assess the significance of the differences in proportions (Polit & Beck 2010:549).

Multivariate analysis was conducted using the binary logistic regression method. Multivariate analysis is a statistical procedure designed to analyse the relationships among three or more variables. Logistic regression is a multivariate regression procedure that analyses relationships between one or more independent variables and categorical dependent variables and yields an odds ratio (Polit & Beck 2010:559). In this study, the purpose of conducting the binary logistic regression was to estimate the association between the dependent variable and independent variables. All independent variables which were significant at *p*-value less than 0.25 in the bivariate analysis using Chi-square tests or Fisher's exact tests were included in the binary logistic regression analyses. Accordingly a backward stepwise method with a likelihood ratio approach was used for multivariate analysis using the SPSS software programme. Before data were entered for the multivariate analysis, the variables were converted to dichotomous variables. The results of the multivariate analysis were presented with adjusted odds ratio (AOR) with 95% confidence intervals (CI) and *p*-values. In all the analysis, the test was two-sided and *p*-value $\leq$ 0.05 was considered as statistically significant.

4.4 VALIDITY AND RELIABILITY

The validity and reliability of the research design and data collection tool for this study are discussed below:

4.4.1 Validity and reliability of the study

The validity of a study according to Grove et al (2013:197) is a measure of the truth or accuracy of a claim and is an important concern throughout the research process. In conducting descriptive research, control is exercised by applying the principles of external validity. External validity is concerned with the extent to which study findings can be generalised beyond the sample used in the study (Grove et al 2013:202). The factors that may affect external validity are related to the selection of subjects, study conditions and types of observations (LoBiondo-Wood & Haber 2010:170). In this research, external validity was addressed in the sampling strategies and sample selection procedures of the study households. To enhance external validity of the

research, a probability sampling approach using stratified random sampling was used so that the selected household respondents were representative of the study population.

4.4.2 Validity of the research instrument

Grove et al (2013:45) describe the validity of an instrument as a determination of the extent to which the instrument actually reflects the abstract construct being examined. The types of validity of research instrument are content validity, predictive validity, criterion validity and construct validity (Grove et al 2013:393). However, for the purpose of this study, content validity and construct validity were considered important as discussed below.

4.4.2.1 Content validity

The validity of the data collection tool of this study was considered in the development of the data collection tool and the construction of individual questions in the interview schedule. Grove et al (2013:394) define content validity as the extent to which the method of measurement includes all the major elements relevant to the construct being measured. According to Polit and Beck (2010:550), it refers to the degree to which the items in an instrument adequately represent the universe of content for the concept measured. Content validity of the data collection tool for this study was assured mainly by adapting from the questionnaires in the publications of international organizations and relevant studies as base (see section 4.3.4.2) and expanding them by structuring questions from the literature. Hence, the interview schedule was made to contain the major elements relevant to the study's objectives, research questions and the conceptual framework of the research. To ensure the validity of data, feedback offered by data collectors of the study on the translated interview schedule during training of data collectors as well as the responses obtained from the pre-test of data collection tool on sampled households were used as input to refine the data collection tool.

4.4.2.2 Construct validity

Construct validity examines the fit between the conceptual definitions and operational definitions of variables. Theoretical constructs or concepts are defined within the framework (conceptual definitions). These conceptual definitions provide the basis for

the development of operational definitions of the variables. Operational definitions (methods of measurement) must validly reflect the theoretical constructs (Burns & Grove 2005:217). In this study, construct validity was ensured by conducting an extensive literature review and consulting a variety of publications to define all the key concepts of the study. Thus the key concepts of the study were operationally defined based on detailed literature review conducted (see chapter 1, section 1.6). For example, in this study diarrhoea as a research concept is defined using the number of loose or liquid stools per day that is passed by an individual. The World Health Organization (2009) recommended the passage of 3 or more loose or liquid stools per day, or more frequently than is normal for the individual to be considered to have diarrhoea.

4.4.3 Reliability of the research instrument

Reliability is the ability of an instrument to measure the attributes of a concept or construct consistently (LoBiondo-Wood & Haber 2010:286). Grove et al (2013:389) define the reliability of an instrument as the consistency of measures of an attribute, item, or situation obtained in a study.

To ensure the reliability of the data collection tool and to enhance the accuracy of measurements, the following main activities were performed:

- Standardised and structured data collection, using the same questions in the interview schedule, was carried out for all household respondents.
- Closed-ended questions were used in most items of the data collection tool which reduces the introduction of bias.
- The data collection tool was pre-tested in the study area and discussion was also made with the data collectors of the study on the translated interview schedule and the feedback obtained from the results of the pre-test study and the feedback of the data collectors were used as input to refine the interview schedule.
- Data collectors were trained on the objective of the study; sampling method and sources of bias; data collection and interview/observation methodology; and provided with standardised instructions in the interview schedule.
- The data collectors speak the local language of the study area and accordingly the interview was conducted using the interview schedule translated in the Afan Oromo

language and the interviewers also had previous experience in community health data collection fieldworks.

- The researcher had conducted close monitoring and daily follow-ups on the data collectors during the data collection process and the filled interview schedules were checked during the field data collection for completeness and consistency.

4.5 CONCLUSION

The research design and method used in this study were described in this chapter. A descriptive, quantitative, contextual, cross-sectional study using a stratified random sampling method was used to conduct the research in Sebeta town of Ethiopia. The sampling procedure, data collection method, data collection tool and data analysis used for the study were also discussed. Furthermore, the chapter presented the ethical considerations, validity and reliability of the study. The following chapter focuses on the data analysis and presentation as well as the discussion of the research findings.

CHAPTER 5

ANALYSIS, PRESENTATION AND DISCUSSION OF THE RESEARCH FINDINGS

5.1 INTRODUCTION

This chapter presents the results of the analysis of data obtained among the study households and details of the findings of the research. The analysis, presentation and description of the research findings are illustrated by means of tables and graphs with frequencies, percentages and statistical analysis data. The presentation of the socio-economic, demographics and other related characteristics of the study households is also provided. Further presented are the results of the data analysis pertaining to water, environmental sanitation and hygiene practices of the households. The prevalence of diarrhoea among under-five children is described. Finally, the results of bivariate and multivariate analysis regarding the association between socio-economic and demographic characteristics and environmental health factors on the occurrence of diarrhoea among under-five children are presented in detail in this chapter.

5.2 DATA COLLECTION, RESPONSE RATE AND RESPONDENTS

Data was collected from November 6 to 28, 2013 from the selected study households using a pre-tested and structured interview schedule that was administered to the respondents in their homes by data collectors. All the household respondents, from a total of 477 households that were randomly selected for the study in Sebeta town of Ethiopia, participated in the interview, thus resulting in a response rate of 100%. All the household respondents, from a total of 477 households that were randomly selected for the study in Sebeta town of Ethiopia, participated in the interview, thus resulting in a response rate of 100%. The largest proportion (445, 93.3%) of the interview respondents comprised of mothers of the under-five children and 32 (6.7%) respondents were female caregivers of at least 18 years.

The majority of the respondents (443, 92.9%) were from urban areas, while 34 (7.1%) were from rural areas (town peripheral areas within town boundary but with rural

characteristics). The 477 respondents of the households that participated in the study were from all the eight *Kebeles (Kebele* is the lowest administrative unit in government structure) of the town and the distribution of the households by *kebeles* were as follows: seventy five respondents (15.7%) were from Sebeta town *kebele* 01, eighty one respondents (17%) were from *kebele* 02, sixty six respondents (13.8%) were from *kebele* 03, seventy six respondents (15.9%) were from *kebele* 04, fifty six respondents (11.7%) were from *kebele* 05, seventy respondents (14.7%) were from *kebele* 06, twenty four respondents (5%) were from *kebele* 07 and twenty nine respondents (6.1%) were from *kebele* 08.

5.3 DATA MANAGEMENT AND ANALYSIS

Quality control measures and good practices including, use of a standardised and structured data collection tool, training of data collectors, pre-testing of data collection tool and field monitoring of data collection were made before and during data collection period. The researcher closely monitored the day-to-day data collection process and ensured completeness and consistency of interview schedules gathered on each day. During the data collection process, the interview schedules filled by the data collectors which were found to contain incomplete information, errors or inconsistencies were checked for their appropriateness or the data collectors were asked to re-do the interviews in order to rectify the type of problems identified.

During the data entry process, raw data in the interview schedules was initially reviewed for completeness and consistency. The data was then checked for missing values and errors and thereafter verified against the source. Then the interview schedules were coded numerically and the data entered into the Epi Info 7.0 software programme (United States Centres for Disease Control and Prevention, Atlanta, Georgia, USA). A statistician assisted with data entry and statistical analysis using the Epi Info and SPSS software programmes.

Descriptive, bivariate, and multivariate statistics were used in the data analyses of the study. The statistical analysis was performed using the SPSS software programme. Descriptive statistics were used to describe the variables which include frequency distributions, percentages, measures of central tendency and standard deviations and the summary results of the statistics were presented using tables and graphs.

Both bivariate and multivariate analyses were employed to identify the determinants of childhood diarrhoea. Bivariate analysis was conducted using Chi-square tests or Fisher's exact tests. Multivariate analyses were performed using the binary logistic regression with the backward stepwise regression technique in order to identify the risk factors that are independently associated with diarrhoea, while controlling for confounding variables. Explanatory (independent) variables with *p*-value less than 0.25 in the bivariate analysis were included in the multivariable analysis. The crude odds ratio (OR), regression coefficient, adjusted odds ratio (logistic regression odds ratio/AOR) with 95% confidence interval (CI) and *p*-value of the variables were calculated in the logistic regression analysis. In all the analysis, the test was two-sided and a *p*-value less than or equal 0.05 was considered as statistically significant.

5.4 RESEARCH RESULTS

The results of the study are presented below:

5.4.1 General characteristics

5.4.1.1 Socio-economic and demographic characteristics of the study households

5.4.1.1.1 Household socio-economic and demographic characteristics

The mean age of household heads was 36.8 (standard deviation ±6.5). The majority of the household heads were in the age group of 30-39 years (260, 54.5%), followed by those within the 40-49 years of age (144, 30.2%). Household heads who belonged to the age group of 20-29 years amounted to 56 (11.7%) and those within 50-59 years were 17 (3.6%). The majority of households (459, 96.2%) were headed by males and 3.8% (18) of the household heads were females.

The majority of household heads (322, 67.6%) had formal education (literate), 88 (18.4%) could read and write and 67 (14%) could not read and write (illiterate). Over one-third of the household heads (166, 34.8%) were engaged in private trade, followed by daily wage workers (88, 18.4%). The type of jobs for the other household heads were

farmer (83, 17.4%), government employee (68, 14.3%), private establishment employed (57, 11.9%) and 15 (3.1%) were engaged in other type of jobs.

The mean household family size of the study population was 4.7 (standard deviation ±1.4). The majority of the households (342, 71.7%) had household members of 4 to 6, followed by 1 to 3 family size (90, 18.9%). Households which had 7 to 11 household members were 45 (9.4%). The results of the study show that the majority of households (172, 36.1%) had a family monthly income of 501 to 1,000 Ethiopian Birr (ETB), followed by those less than 500 at 140 (29.4%). Households which earned a family monthly income of 1,001 to 2,000 were 86 (18%). Households that belonged to the income group of more than 2,000 were 79 (16.6%).

As a proxy measure of household socioeconomic status, a household asset index was defined basing on household ownership of consumer durables (commodities), housing characteristics and access to drinking water and improved sanitation as reported by the respondents in order to examine whether the prevalence of diarrhoea varied across the households. This index is based on the ownership and use of the items listed below. Each item in the asset index was assigned with a weighted value (shown in brackets) based on the estimated market value of each item. Radio (4), tape/cassette player (10), television (17), video deck (14), cable/satellite dish (10), camera (10), bed (10), refrigerator (20), wood furniture (cupboard or cabinet) (12), iron (5), chair and table (10), sofa (17), computer (25), mobile telephone (5), regular telephone (8), sewing machine (8), bicycle (12), modern stove (3), electricity (10), farm or other land (33), motorcycle (25), kerosene lamp (3), farm animals (20), car/truck (50), private owned house (50), house wall made from cement with block, brick or stone (30), housing floor (tile or cement) (20), ownership of private piped water (15) and private toilet (14). The scores of each household were summed and households were ranked into two categories, i.e. poor and well-off. The items asked in the questions gave an expected total score of 470; however, according to items responded for their availability the total sum of scores was 310. Based on this system, households scoring 0 – 150 have been designated poor and those scoring 151 – 310 have been designated well-off. Accordingly, more than two-thirds of the households (315, 66%) were found to be in the poor category and 162 (34%) households were in the well-off category. Table 5.1 displays the descriptive statistics of the households' socio-economic and demographic characteristics.

Table 5.1 Household socio-economic and demographic characteristics (N=477)

Characteristic	No.	%
Area of residence (N=477)		
Urban	443	92.9
Rural	34	7.1
Gender of head of the household (N=477)		
Male	459	96.2
Female	18	3.8
Household head age (N=477)		
20-29	56	11.7
30-39	260	54.5
40-49	144	30.2
50-59	17	3.6
Household head education (N=477)		
Illiterate	67	14.0
Read and write	88	18.4
Literate (formal schooling)	322	67.6
Main job of the household head (N=477)		
Private trade (merchant)	166	34.8
Private trade establishment employed	57	11.9
Government employees	68	14.3
Farmer	83	17.4
Daily wage workers	88	18.4
Others	15	3.1
Number of persons in households (N=477)		
1-3	90	18.9
4-6	342	71.7
7-11	45	9.4
Family monthly income in Ethiopian Birr (N=477)*		
≤500	140	29.4
501-1,000	172	36.1
1,001-2,000	86	18.0
>2,000	79	16.6
Household asset index (N=477)		
Poor	315	66
Well-off	162	34

*1 US Dollar (USD) equals 19.5 Ethiopian Birr (ETB) on February 17, 2014 (Commercial Bank of Ethiopia 2014).

5.4.1.1.2 Maternal/caregiver's socio-demographic characteristics

The results of the study show that the mean age of the mothers was 28.6 years (standard deviation ±4.7). Majority of the mothers were between the age range of 20 to 29 years (308, 64.6%), followed by those within the 30 to 39 years of age (159, 33.3%) and 10 (2.1%) mothers belonged to the age group of 40 to 49 years.

Majority of the mothers (434, 91%) were married. According to the results of the study, 126 (26.4%) mothers cannot read and write (illiterate), 96 (20.1%) reported that they can read and write and 255 (53.5%) mothers had formal education (literate). The results of the study regarding the mother's types of job show that 260 (54.5%) mothers were housewives, 80 (16.8%) were private traders, 30 (6.3%) were private trade establishment employed, 30 (6.3%) were daily wage workers, 29 (6.0%) were unemployed, 27 (5.7%) were government employees and 21 (4.4%) were engaged in other type of jobs.

Mothers who had one under-five child were 344 (72.1%), those who had two under-five child were 124 (26.0%) and only 9 (1.9%) households had three under-five child. Households that had more than one child were 133 (27.9%). The mean for the number of under-five children in the households was 1.3 (standard deviation $\pm$0.5). Table 5.2 summarises the descriptive statistics of the mothers' socio-demographic characteristics.

Table 5.2 Maternal/caregivers' socio-demographic characteristics (N=477)

Characteristic	No.	%
Mothers age (N=477)		
20-29	308	64.6
30-39	159	33.3
40-49	10	2.1
Marital status of the mother/caregiver (N=477)		
Single	14	2.9
Married	434	91
Divorced/separated	16	3.4
Widowed/widower	13	2.7
Mothers education (N=477)		
Illiterate	126	26.4
Read and write	96	20.1
Literate (formal schooling)	255	53.5
Main job of the mother (N=477)		
Private trade (merchant)	80	16.8
Private trade establishment employed	30	6.3
Government employee	27	5.7
Daily wage workers	30	6.3
Housewife	260	54.5
Unemployed	29	6
Others	21	4.4
Number of under-five children (N=477)		
1	344	72.1
2	124	26.0
3	9	1.9

5.4.1.1.3 Childs' demographic characteristics

The results of the study show that the mean age of the under-five children was 25.6 months (standard deviation ±14.5). About one-third of the children (153, 32.1%) were between the age group of 36 to 59 months, followed by those within 24-35 months of age (142, 29.8%) and children who belonged to the age group from 12 to 23 months were 102 (21.4%). Children from the age group 7 to 11 months were 45 (9.4%) and there were 35 (7.3%) children from the age group 0 to 6 months. In this study, three-fifths of the under-five children (284, 59.5%) were males, while two-fifths of the under-five children (193, 40.5%) were females. Table 5.3 summarises the descriptive statistics of the children's demographic characteristics.

Table 5.3 Children's demographic characteristics (N=477)

Characteristic	No.	%
Age of child (months) (N=477)		
0-6	35	7.3
7-11	45	9.4
12-23	102	21.4
24-35	142	29.8
36-59	153	32.1
Gender of child (N=477)		
Male	284	59.5
Female	193	40.5

5.4.1.2 House characteristics

The respondents were asked on the housing characteristics of the households. About three-fifths of the houses were privately owned (293, 61.4%) and 184 (38.6%) houses were rented from private and government. The number of rooms existing in each of the houses were also counted and observed during the interview. The mean for the number of separate house room held by the study population was 3.3 (standard deviation ±1.5). More than one-quarter (131, 27.5%) of the households had four separate rooms, followed by households that had two rooms (122, 25.6%). Households which had three rooms were 109 (22.9%), those that had more than five rooms were 78 (16.4%) and only 37 (7.8%) households had one room.

The data collectors had interviewed and made observations regarding the material of the walls, floors and roofs of the houses at the respondents' homesteads. About two-thirds (309, 64.8%) of the house walls were built from mud and wood, followed by cement with blocks, bricks or stone (106, 22.2%), cement with mud (56, 11.7%) and only 6 (1.3%) house walls were made from corrugated iron sheet. More than half (263, 55.1%) of the house floors were made of earthen floor, followed by cement (185, 38.8%), ceramic (14, 2.9%), stone (8, 1.7%) and wood (7, 1.5%). A majority of the houses (452, 94.8%) had roofs made from corrugated metal sheet. Only 15 (3.1%) and 10 (2.1%) households had roofs constructed from cement and thatch, respectively. Table 5.4 summarises the descriptive statistics of the households' housing characteristics.

Table 5.4 The households' housing characteristics (N=477)

Characteristic	No.	%
Type of house ownership (N=477)		
Private owned	293	61.4
Rented	184	38.6
Number of separate house rooms (N=477)		
1	37	7.8
2	122	25.6
3	109	22.9
4	131	27.5
>5	78	16.4
Main material of the wall of the house (N=477)		
Cement with blocks, bricks or stone	106	22.2
Cement with mud	56	11.7
Mud with wood	309	64.8
Corrugated iron sheet	6	1.3
Main material of the floor of the house (N=477)		
Ceramic or marble tiles	14	2.9
Cement	185	38.8
Wood	7	1.5
Earth	263	55.1
Stone	8	1.7
Main roofing material of the house (N=477)		
Corrugated metal sheet	452	94.8
Thatch/straw	10	2.1
Concrete/cement	15	3.1

5.4.1.3 Environmental health conditions

5.4.1.3.1 Household drinking water

Slightly more than half of the households (256, 53.7%) obtained drinking water from a public tap/standpipe, followed by households that got drinking water from piped water connected into the yard (189, 39.6%). Other households obtained drinking water from piped water connected into dwellings (13, 2.7%), protected springs (12, 2.5%), piped water outside the compound (3, 0.6%), rainwater (3, 0.6%) and protected dug well (1, 0.2%) (Table 5.5). Accordingly, households that used improved municipal piped water connection include those that used public tap/standpipe (256, 53.7%), piped water connected to the yard (189, 39.6%), piped water connected into the dwellings (13, 2.7%) and piped water outside compounds (3, 0.6%). This makes access to improved municipal piped water to be 96.6%. Other households obtained water from improved water sources such as protected springs (12, 2.5%), rainwater (3, 0.6%) and protected dug wells (1, 0.2%). Thus, when these are summed up together, 477 (100%) households had access to improved sources of drinking water, which this is high coverage because of a reasonable access to municipal piped water connections.

Table 5.5 Type of main source of drinking water (N=477)

Characteristic	No.	%
Main source of drinking water (N=477)		
Improved source		
Piped water into dwelling	13	2.7
Piped water to yard	189	39.6
Piped water outside compound	3	0.6
Public tap/standpipe	256	53.7
Protected dug well	1	0.2
Protected spring	12	2.5
Rainwater	3	0.6
Unimproved source	-	-

Table 5.6 shows that over three-fifths of the households (304, 63.7%) used shared water sources and less than two-fifths (173, 36.3%) used private water source. All the private water sources (173, 36.3%) included private piped water sources with private piped water inside the dwelling or in the yard. The results of the study also show that

the main source of water at the households were located outside the yards (280, 58.7%), in the yards (184, 38.6%) and in the dwellings (13, 2.7%).

Table 5.6 Type of ownership and location of the main source of drinking water (N=477)

Characteristic	No.	%
Ownership of main water source (N=477)		
Private water source	173	36.3
Shared water source	304	63.7
Location of main water source (N=477)		
In dwelling	13	2.7
In yard (compound)	184	38.6
Outside yard (compound)	280	58.7

Respondents were asked regarding the time taken to fetch water and the distance of the water source from dwelling. As shown in table 5.7 concerning time taken to obtain drinking water (round trip), over four-fifths of the households (391, 82%) took 30 minutes or less to fetch drinking water and 86 (18%) households took more than 30 minutes to fetch drinking water. A more disaggregated data shows that about three-fifths (178, 58.3%) of the households obtained drinking water from the main water source in less than 15 minutes, while about one-fifth of the households (21, 4.4%) obtained water in more than 1 hour. The results of the study show that the mean time for all households to go to the main water source, get water and come back was 20 minutes.

With respect to the distance of the water source from the dwelling, table 5.7 shows that about four-fifths of the households (380, 79.7%) had access to water within a 200 metre distance from their dwelling houses and 97 (20.3%) households had to walk over 200 metre to reach the nearest source of water. A more disaggregated data shows that slightly more than half of the households (246, 51.6%) had to walk less than 50 metres to obtain their main water source, while 9 (1.9%) households had to walk more than 1 kilometre. The results of the study show that the mean distance of the main water source from the dwellings was 160 metres.

Table 5.7 Time to fetch water and the distance of the water source from the dwelling (N=477)

Characteristic	No.	%
Time to obtain drinking water (round trip) (N=477)		
≤30 minutes	391	82
>30 minutes	86	18
Distance of water source from dwelling (N=477)		
≤ 200 metres	380	79.7
> 200 metres	97	20.3

Table 5.8 indicates that water collection was primarily carried out by the households' adults (406, 85.1%), out of which, in slightly more than half of the households (248, 52%), an adult woman usually collected drinking water from the main water source, followed by in 136 (28.5%) households, water was collected by both female and male adults and in 22 (4.6%) households, it was collected by adult men. In 36 (7.5%) households, water was carried by adults and children; out of which, in 32 (6.7%) households water was carried by adult women and children, and in 4 (0.8%) households carried by adult men and children. In 35 (7.3%) households, water was carried by children, out of which, in 28 (5.9%) households water was carried by both female and male children, whilst in 4 (0.8%) households it was carried by female children and in 3 (0.6%) households by male children. Overall, in over half of the households (252, 52.8%), females alone carried the water from the main water source.

Table 5.8 Persons who usually collect household drinking water (N=477)

Characteristic	No.	%
Person who fetch from the main water source (N=477)		
Adult		
Adult woman (above 15)	248	52
Adult man (above 15)	22	4.6
Mix of female and male adults	136	28.5
Children		
Female child (under 15 years)	4	0.8
Male child (under 15 years)	3	0.6
Mix of female and male children	28	5.9
Adult and children		
Adult woman and child(ren)	32	6.7
Adult man and child(ren)	4	0.8

The results of the study indicate that the average daily consumption of water per household was 62.1 litres and the mean per person per day water consumption of the

households was found to be 12.4 litres. As shown in table 5.9, the overwhelming majority of the households (462, 96.8%) had used a daily water consumption of less than or equal to the basic minimum of 20 litres per capita per day and slightly over half of the households (256, 53.7%) had used a mean daily water consumption of less than or equal to 12 litres per person per day.

The cross-tabulation of table 5.9 indicates that households that had used quantities of daily water consumption above the recommended minimum of 20 litres per capita per day and those that had private piped water were only 1.3% of the total households. In addition, households that had used mean daily water consumption of above 12 litres per person per day and those that had private piped water were 20.2% of the total households.

As table 5.9 shows, the study results indicate that there was no significant difference in water consumption from the minimum recommended 20 litres per capita per day among households that have a private piped water source compared with those households that have other water sources ($\chi^2(1, N=477) = 0.09$, $p > .76$). However, there was significant difference in water consumption from a mean daily amount of 12 litres per capita per day between households that have private piped water source and those households that have other water sources ($\chi^2(1, N=477) = 9.16$, $p < .002$).

Table 5.9 Daily amount of water used (litres) by availability of private piped water sources (N=477)

Characteristics	Availability of private piped water source		χ^2	*p*-value
	Private piped water source No. (%)	Other water source No. (%)		
Water consumption from minimum recommended 20 litres per capita per day			0.09	0.76
≤20	167 (36.1)	295 (63.9)		
>20	6 (40.0)	9 (60.0)		
Water consumption from mean daily amount of 12 litres per capita per day			9.16	0.002*
≤12	77 (30.1)	179 (69.9)		
>12	96 (43.4)	125 (56.6)		

*Statistically significant with *p*-value ≤ 0.05

The data from Figure 5.1 indicates that the per capita daily water use varies according to the household income. Households that earned a family monthly income of less than 500 Ethiopian Birr (ETB) had a mean water consumption of 11.2 litres per capita per day, which is less in 8.8 litres from the recommended minimum requirement of 20 litres per capita per day, while for households with 501-1,000 ETB monthly income the mean water consumption was 12.1 litres per capita per day, which is less by 7.9 litres from the recommended minimum requirement of 20 litres per capita per day. Households with 1,001-2,000 ETB monthly income had a mean water consumption of 13.1 litres per capita per day, which is less by 6.9 litres from the recommended minimum requirement of 20 litres per capita per day. Furthermore, households with a more than 2,000 ETB monthly income had a mean water consumption of 14.4 litres per capita per day, which is less by 5.6 litres from the recommended minimum requirement of 20 litres per capita per day. The data clearly shows that the larger the household monthly income, the higher the mean water consumption of the households in litres per capita per day, although the water consumption is generally less than the recommended minimum amount of 20 litres per capita per day.

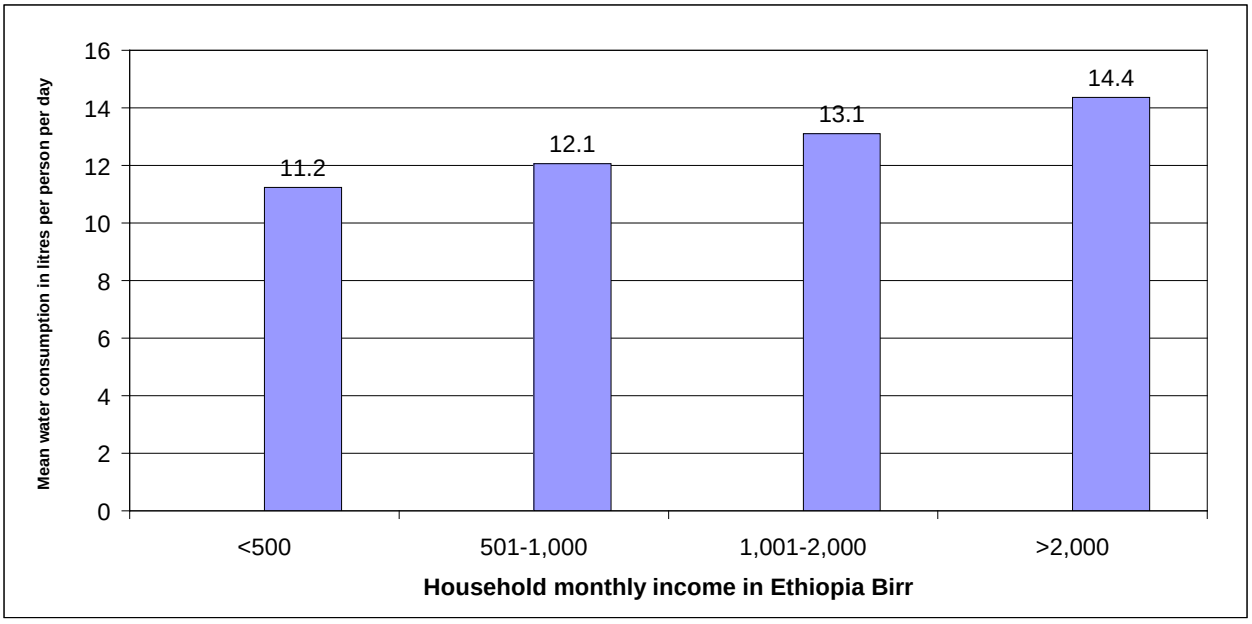

Figure 5.1 Mean daily amount of water used (litres) by household income (N=477)

Figure 5.2 shows a clear relationship between the mean water consumption per person per day and the size of the household; the larger the household, the lower the consumption per member. Households with 1 to 3 family members had used 16.2 litres

per person per day, a household size of 4-6 had used 11.8 litres per person per day and those with 7-11 household members had used 9.2 litres per person per day. It can be noted that the larger the household, then the higher the consumption per household. Households with 1 to 3 family members had used 48.1 litres per household per day, a household size of 4-6 had used 54.6 litres per household per day and those with 7-11 household members had used 70.3 litres per household per day.

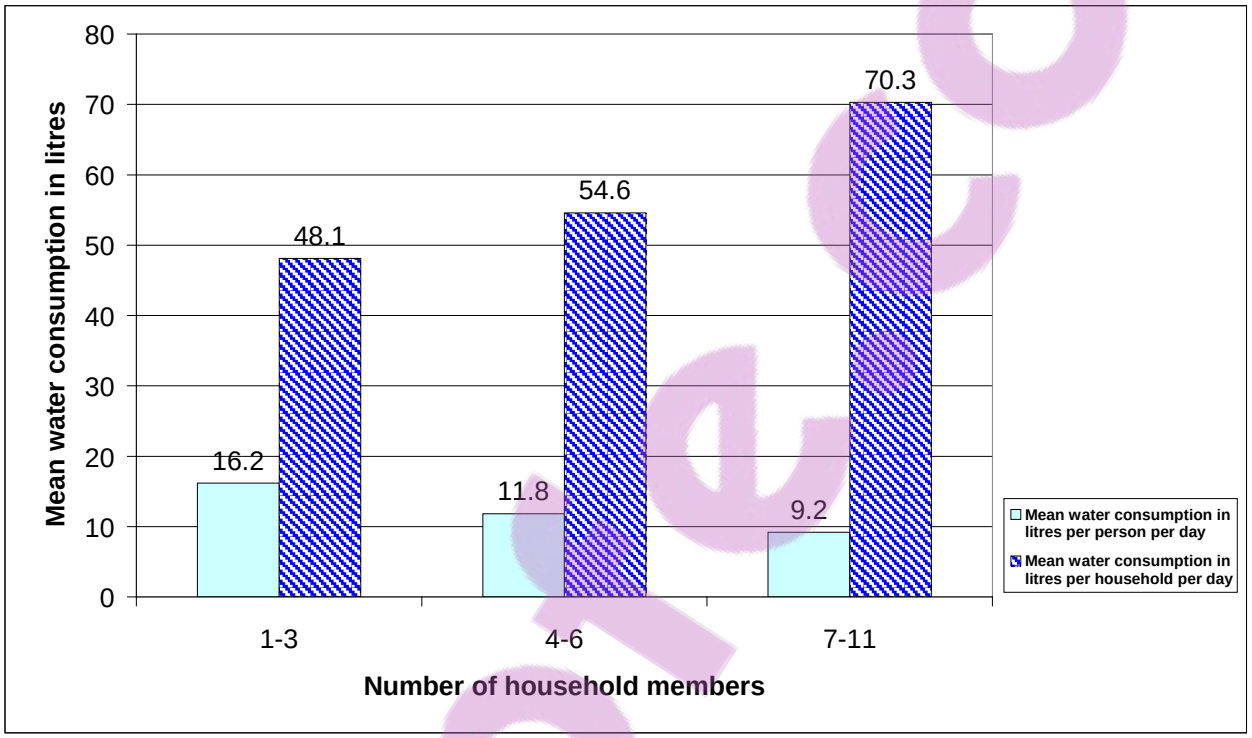

Figure 5.2 Drinking water consumption and household size relation (N=477)

Mothers/caregivers were asked whether they stored drinking water for all domestic water use in their house. As shown in table 5.10, 343 (71.9%) household respondents reported that they stored water for all purposes of domestic use at home. Of those that had stored water, 317 (92.4%) household respondents indicated that they separately stored water for drinking use only. Data collectors had observed the presence and type of a water storage container. The findings of the study for those households that stored drinking water showed that two-thirds (215, 67.8%) of the households had used plastic jerry can containers (hard plastic container with a capacity of approximately 20 – 25 litres). The other commonly used containers were plastic buckets (56, 17.7%), plastic drums/barrels (37, 11.7%) and others (9, 2.8%).

Observation was made by data collectors regarding the cover of water storage containers. The study results for those households that stored drinking water showed that the majority of households (312, 98.4%) had covered their stored drinking water and 218 (68.8%) households had used narrow-necked containers for drinking water storage.

The inside of the water storage containers were also observed to determine whether they were kept clean or not. The inside of a water storage container is defined as clean when the interior of the container is kept free of visible dirt. The study results for those households that store drinking water show that 92.4% (293) of the containers were kept clean. Mothers/caregivers were also asked on the frequency of the cleaning of the water storage containers. The study results for those households that stored drinking water in containers showed that a majority of the households (307, 96.9%) cleaned their containers at least once or more per week and only 10 (3.2%) households cleaned them after more than a week.

The study results show that over two-thirds of the respondents (220, 69.4%) mentioned that they poured out water for use from a container. Other methods of drawing water from a container as reported by the household respondents were 85 (26.8%) households used dippers with handles, 6 (1.9%) households used dippers without handles and 6 (1.9%) households used containers that had a spigot/faucet. The drawing of water from a container by pouring it out is a safe method in domestic water handling.

The findings of the study indicate that five out of nine households (259, 54.3%) had treated their drinking water at home, while four-in-nine households (218, 45.7%) did not use any form of household water treatment. Of those that treated their drinking water at home, the primary treatment methods that were used are adding chlorine (107, 22.4%), followed by boiling (101, 21.1%). The other methods that were used are settling the water after some time (let it stand and settle) (29, 6.1%), filtering it through cloth (17, 3.6%) and filtering the water with sand or other methods (5, 1.1%). Table 5.10 presents the descriptive statistics of the household drinking water storage and treatment methods.

Table 5.10 Household level drinking water storage and treatment

Characteristic	No.	%
Store water at home for all purposes of domestic water use (N=477)		
Yes	343	71.9
No	134	28.1
Store drinking water in separate container from other domestic water storage (n=343)		
Yes	317	92.4
No	26	7.6
Main type of water storage container (n=317)		
Plastic bucket	56	17.7
Plastic drum/barrel	37	11.7
Plastic jerry can	215	67.8
Others	9	2.8
Availability of narrow necked drinking water storage container (n=317)		
Yes	218	68.8
No	99	31.2
Water container cover (n=317)		
Yes	312	98.4
No	5	1.6
Cleanliness of the inside of container used for drinking water storage (n=317)		
Good	293	92.4
Poor	24	7.6
Frequency of the cleaning of the drinking water storage container (n=317)		
Cleaning at least once or more per week	307	96.9
Cleaning after more than a week	10	3.2
Method of water drawing (n=317)		
Pour water from the container	220	69.4
Use dipper without handle	6	1.9
Use dipper with handle	85	26.8
Container has spigot/faucet	6	1.9
Household water treatment practices (N=477)		
Boil	101	21.1
Add chlorine	107	22.4
Filter it through cloth	17	3.6
Water filter with sand or other method	5	1.1
Settling after sometime (let it stand and settle)	29	6.1
Nothing	218	45.7

As can be seen in Table 5.11, there were significant differences in factors related to the availability of private piped water compared to that of other water sources, including by area of residence ($\chi^2(1, N=477) = 9.51$, $p=.002$) and family monthly income ($\chi^2(3, N=477) = 80.87$, $p=.00$). However, the percentage of household respondents that used private piped water and those from other water sources did not differ by household head

education (χ^2(2, N=477) = 5.82, *p*=.055), household size (χ^2(2, N=477) = 5.77, *p*=.056) and type of house ownership (χ^2(1, N=477) = 3.29, *p*=.07).

Table 5.11 Selected socio-demographic variables by availability of private piped water sources (N=477)

Characteristics	Availability of private piped water source		χ^2	*p*-value
	Private piped water source No. (%)	Other water source No. (%)		
Area of residence (N=477)				
Urban	169 (38.1)	274 (61.9)	9.51	0.002*
Rural	4 (11.8)	30 (88.2)		
Household head education (N=477)				
Illiterate	18 (26.9)	49 (73.1)	5.82	0.055
Read and write	40 (45.5)	48 (54.5)		
Literate (formal schooling)	115 (35.7)	207 (64.3)		
Number of persons in households (N=477)				
1-3	33 (36.7)	57 (63.3)	5.77	0.056
4-6	131 (38.3)	211 (61.7)		
7-11	9 (20.0)	36 (80.0)		
Family monthly income (N=477)				
≤500	40 (28.6)	100 (71.4)	80.87	0.00*
501-1,000	40 (23.3)	132 (76.7)		
1,001-2,000	30 (34.9)	56 (65.1)		
>2,000	63 (79.7)	16 (20.3)		
Type of house ownership (N=477)				
Private owned	97 (33.1)	196 (66.9)	3.29	0.07
Rented	76 (41.3)	108 (58.7)		

*Statistically significant with *p*-value ≤ 0.05

5.4.1.3.2 Excreta disposal

The findings of this study (table 5.12) indicate that a majority of households (442, 92.7%) had toilet facilities that members of the household usually used and 35 (7.3%) households did not have toilets. Of the 477 households, more than two-thirds of the households (337, 70.6%) used improved toilets such as pit latrines with slabs (282, 59.1%), flush or pour-flush toilets (28, 5.9%) and ventilated improved pits (VIP) latrine (27, 5.7%).

The study results show that less than one-third of households (140, 29.4%) had used unimproved toilet facilities. Of those that used unimproved toilets, 105 (22%) households used pit latrines without slabs or open pits and 35 (7.3%) households did not have any kind of latrine and as a result used open field defecation.

Of those 442 households that had toilets for household members, 381 (86.2%) households had their own private toilets, whereas 61 (13.8%) households used shared latrines which include the sharing of private neighbourhood latrines (22, 5%) and that of communal latrines (39, 8.8%). Of the total of 477 households, six out of ten households (295, 61.8%) had private improved toilets. From the total of 442 households that had toilets, a majority of the toilets (415, 93.9%) were located in the yard, whereas 19 (4.3%) toilets were located in dwellings and 8 (1.8%) toilets were located outside the yard.

Information on the cleanliness of toilets was recorded by data collectors on the interview schedule after conducting observation of the household toilets. A hygienic toilet was defined as one which was not full, did not have faecal matter on the latrine floor and wall, no or few flies in or near the latrine and did not smell bad. Data collectors observed the toilets and checked them on the basis of this definition to determine if the toilets were kept clean or not. Of those 442 households that had toilets for use by household members, 380 (86%) households kept their latrines clean, whereas 62 (14%) households did not keep their latrines clean. Table 5.12 presents the descriptive statistics with regard to household toilet facilities.

Table 5.12 Toilet facility characteristics

Characteristic	No.	%
Availability of a toilet facility that members of the household usually use (N=477)		
Available	442	92.7
Not available	35	7.3
Type of toilet facility used (N=477)		
Improved		
Flush or pour flush toilet		
Flush to piped sewer system	6	1.3
Flush to septic tank (holding tank)	12	2.5
Flush to pit latrine	10	2.1
Pit latrine		
Pit latrine with slab	282	59.1
Ventilated improved pit latrine (VIP)	27	5.7
Unimproved		
Pit latrine		
Pit latrine without slab/open pit	105	22.0
No facilities or open field defecation anywhere	35	7.3
Type of toilet ownership (n=442)		
Private toilet	381	86.2
Shared toilet		
Private neighbourhood latrine	22	5.0
Communal latrine	39	8.8
Availability of private improved toilet (N=477)		
Private improved toilet	295	61.8
Others	182	38.2
Location of toilet (n=442)		
In dwelling	19	4.3
In yard (compound)	415	93.9
Outside yard (compound)	8	1.8
Cleanliness of latrine (n=442)		
Yes	380	86
No	62	14

Interview questions were asked to mothers/caregivers regarding defecation and disposal methods of the children's stools. As shown in table 5.13, with respect to child defecation methods, a majority of children (345, 72.3%) used the potty, followed by 52 (10.9%) children who used a diaper/cloth. Others went onto the house yards (44, 9.2%), used latrines (22, 4.6%) and went outside the premises (14, 2.9%).

Regarding stool disposal practices for the under-five children, from the 477 households, the majority of the households (337, 81.1%) used a contained method which includes dropping into a toilet facility by putting/rinsing into toilet (385, 80.7%) and burying (2, 0.4%). In 90 (18.8%) households, the children's stool was left uncontained and was

disposed into garbage (56, 11.7%), disposed outside premises (22, 4.6%), did nothing (6, 1.3%) or disposed in the yard (2, 0.4%).

Table 5.13 Child defecation methods and stool disposal practices (N=477)

Characteristic	No.	%
Defecation methods of under-five children (N=477)		
Used latrine	22	4.6
Used potty	345	72.3
Used diaper/cloth	52	10.9
Went in house yard/compound	44	9.2
Went outside the premises	14	2.9
Stool disposal methods (N=477)		
Contained		
Put/rinse into toilet	385	80.7
Buried	2	0.4
Uncontained		
Put/rinse into drainage	4	0.8
Disposed into garbage	56	11.7
Disposed in yard/compound	2	0.4
Disposed outside premises	22	4.6
Did nothing/left it there	6	1.3

Table 5.14 presents the study results concerning the relationship between selected socio-demographic variables by availability of an improved toilet facility. There was significant difference between the availability of an improved toilet facility and unimproved toilet by area of residence ($\chi^2(1, N=477) = 15.34$, $p=.00$), household head education ($\chi^2(2, N=477) = 28.15$, $p=.00$), household monthly income ($\chi^2(3, N=477) = 50.74$, $p=.00$) and type of house ownership ($\chi^2(1, N=477) = 12.33$, $p=.00$). However, the percentage of household respondents that used improved toilets and those that used unimproved toilets did not differ by number of persons in households, $\chi^2(2, N=477) = 0.45$, $p=.80$.

Table 5.14 Selected socio-demographic variables by availability of improved toilet facility (N=477)

Characteristics	Availability of improved toilet facility		χ^2	*p*-value
	Improved No. (%)	Unimproved No. (%)		
Area of residence (N=477)				
Urban	323 (72.9)	120 (27.1)	15.34	0.00*
Rural	14 (41.2)	20 (58.8)		
Household head education (N=477)				
Illiterate	29 (43.3)	38 (56.7)	28.15	0.00*
Read and write	66 (75.0)	22 (25.0)		
Literate (formal schooling)	242 (75.2)	80 (24.8)		
Number of persons in households (N=477)				
1-3	65 (72.2)	25 (27.8)	0.45	0.80
4-6	242 (70.8)	100 29.2)		
7-11	30 (66.7)	15 (33.3)		
Family monthly income (N=477)				
≤500	71 (50.7)	69 (49.3)	50.74	0.00*
501-1,000	127 (73.8)	45 (26.2)		
1,001-2,000	64 (74.4)	22 (25.6)		
>2,000	75 (94.9)	4 (5.1)		
Type of house ownership (N=477)				
Private owned	224 (76.5)	69 (23.5)	12.33	0.00*
Rented	113 (61.4)	71 (38.6)		

*Statistically significant with *p*-value ≤ 0.05

5.4.1.3.3 Wastewater disposal

As shown in table 5.15, the findings from this study show that two-thirds of the households (324, 67.9%) had used improper wastewater disposal methods and did not have appropriate liquid waste disposal systems. In this case, 122 (25.6%) households discharged into premises yard, 109 (22.9%) households used open ditch and 93 (19.5%) households discharged outside premises anywhere.

About one-third of the households (153, 32.1%) used proper wastewater disposal facilities. With this method, 81 (17%) households used soakage pit, 49 (10.3%) households poured or carried wastewater into a toilet facility, 15 (3.1%) households used a septic tank and 8 (1.7%) households drained into closed sewer system.

Table 5.15 Type of domestic wastewater disposal method (N=477)

Characteristic	No.	%
Type of domestic wastewater disposal method (N=477)		
Proper disposal of wastewater		
Soakage pit	81	17
Septic tank	15	3.1
Drain in closed sewer system	8	1.7
Poured or carried into toilet facility	49	10.3
Improper disposal of wastewater		
Open ditch	109	22.9
Discharge into premises yard	122	25.6
Discharge outside premises anywhere	93	19.5

Table 5.16 presents the study results concerning the relationship between selected socio-demographic variables by availability of proper wastewater disposal facilities. There was a significant difference between the availability of proper and improper wastewater disposal methods by area of residence ($\chi^2(1, N=477) = 9.09$, $p=.003$), household head education ($\chi^2(2, N=477) = 18.63$, $p=.00$) and household monthly income ($\chi^2(3, N=477) = 19.41$, $p=.00$). However, the percentage of household respondents that used proper and improper wastewater disposal methods did not differ by number of persons in households ($\chi^2(2, N=477) = 4.36$, $p=.11$) and type of house ownership ($\chi^2(1, N=477) = 0.37$, $p=.54$).

Table 5.16 Selected socio-demographic variables by availability of proper wastewater disposal facility (N=477)

Characteristics	Availability of wastewater disposal facility		X^2	*p*-value
	Proper disposal No. (%)	Improper disposal No. (%)		
Area of residence (N=477)				
Urban	150 (33.9)	293 (66.1)	9.09	0.003*
Rural	3 (8.8)	31 (91.2)		
Household head education (N=477)				
Illiterate	8 (11.9)	59 (88.1)	18.63	0.00*
Read and write	39 (44.3)	49 (55.7)		
Literate (formal schooling)	106 (32.6)	216 (67.1)		
Number of persons in households (N=477)				
1-3	34 (37.8)	56 (62.2)	4.36	0.11
4-6	110 (32.2)	232 (67.8)		
7-11	9 (20.0)	36 (80.0)		
Family monthly income (N=477)				
≤500	39 (27.9)	101 (72.1)	19.41	0.00*
501-1,000	47 (27.3)	125 (72.7)		
1,001-2,000	25 (29.1)	61 (70.9)		
>2,000	42 (53.2)	37 (46.8)		
Type of house ownership (N=477)				
Private owned	97 (33.1)	196 (66.9)	0.37	0.54
Rented	56 (30.4)	128 (69.6)		

*Statistically significant with *p*-value ≤ 0.05

5.4.1.3.4 Solid waste disposal

Three-fourths of the total households (360, 75.5%) had temporary solid waste storage containers (containers where solid waste is temporally stored before final disposal) in their compound, while 117 (24.5%) households did not have containers. As shown in table 5.17, of those that had storage container, 291 (80.8%) households used a bag or sack, 45 (12.5%) households used plastic waste containers, 12 (3.3%) households used bamboo baskets, 8 (2.2%) households used barrels and 4 (1.1%) households used metallic containers. Of those that had solid waste containers, 207 (57.5%) households covered the containers, whereas slightly more than two-fifths (153, 42.5%) of the households did not cover their solid waste containers which might expose household members to the risk of waste contamination.

As indicated in table 5.17, nearly three-fifths of the households (277, 58.1%) used a proper solid waste disposal method. Of the proper disposal methods, over one-fourth (121, 25.4%) of the households used waste collectors, 107 (22.4%) households used a private waste pit, 30 (6.3%) households used communal waste pits located outside the premises and 19 (4%) households used composting of wastes for agriculture or gardening.

The results of this study indicate that about two in five households (200, 42%) used improper solid waste disposal methods (open field disposal). With this method, one-third of the households (154, 32.3%) used burning (open field burning), 39 (8.2%) households disposed outside premises anywhere and 7 (1.5%) households disposed within premises anywhere.

With regard to the cleanliness of the home environment, data collectors made observations to check whether the houses were clean or not. A house was defined as clean if areas around the dwelling were uncontaminated by solid waste and observable faeces, kept free of animal faeces, had clear wastewater drains and if wastewater did not contaminate the surrounding environment. The study results indicate that in the overwhelming majority of households (422, 88.5%), the surrounding of the houses were kept clean, whereas 55 (11.5%) households did not keep the surroundings of their residential areas clean.

Table 5.17 Household solid waste handling and disposal practices

Characteristic	No.	%
Availability of solid waste storage container (N=477)		
Available	360	75.5
Not available	117	24.5
Type of solid waste storage container (n=360)		
Plastic waste container	45	12.5
Bag/sack	291	80.8
Small metallic container	4	1.1
Barrel	8	2.2
Bamboo basket	12	3.3
Availability of solid waste container cover (n=360)		
Yes	207	57.5
No	153	42.5
Type of household solid waste disposal method (N=477)		
Proper disposal		
Collected from home by waste collectors	121	25.4
Disposed within premises in private waste pit	107	22.4
Disposed outside premises in communal waste pit	30	6.3
Composted	19	4
Improper disposal		
Disposed within premises anywhere	7	1.5
Disposed outside premises anywhere	39	8.2
Open burning	154	32.3
Cleanliness of the surrounding of house (N=477)		
Yes	422	88.5
No	55	11.5

Table 5.18 presents the findings of the study concerning the relationship between selected socio-demographic variables by availability of a proper solid waste disposal facility. There was a significant difference between the availability of proper and improper solid waste disposal methods by household head education, $\chi^2(2, N=477) = 13.89$, $p=.001$ and type of house ownership, $\chi^2(1, N=477) = 12.91$, $p=.00$. However, the percentage of household respondents that use proper and improper solid waste disposal methods did not differ by area of residence ($\chi^2(1, N=477) = 3.59$, $p=.058$), household size ($\chi^2(2, N=477) = 1.24$, $p=.54$) and family monthly income ($\chi^2(3, N=477) = 5.08$, $p=.17$).

Table 5.18 Selected socio-demographic variables by availability of proper solid waste disposal facility (N=477)

Characteristics	Availability of solid waste disposal		χ^2	*p*-value
	Proper disposal No. (%)	Improper disposal No. (%)		
Area of residence (N=477)				
Urban	252 (56.9)	191 (43.1)	3.59	0.058
Rural	25 (73.5)	9 (26.5)		
Household head education (N=477)				
Illiterate	29 (43.3)	38 (56.7)	13.89	0.001*
Read and write	64 (72.7)	24 (27.3)		
Literate (formal schooling)	184 (57.1)	138 (42.9)		
Number of persons in households (N=477)				
1-3	55 (61.1)	35 (38.9)	1.24	0.54
4-6	199 (58.2)	143 (41.8)		
7-11	23 (51.1)	22 (48.9)		
Family monthly income (N=477)				
≤500	89 (63.6)	51 (36.4)	5.08	0.17
501-1,000	89 (51.7)	83 (48.3)		
1,001-2,000	50 (58.1)	36 (41.9)		
>2,000	49 (62.0)	30 (38.0)		
Type of house ownership (N=477)				
Private owned	189 (64.5)	104 (35.5)	12.91	0.00*
Rented	88 (47.8)	96 (52.2)		

*Statistically significant with *p*-value ≤ 0.05

5.4.1.3.5 Hygiene behaviours and knowledge

The results of this study indicate that a majority of respondents (459, 96.2%) had reported having soap in their houses on the day of interview, which indicates the availability of a higher percentage of soap in the households. Moreover, an overwhelming proportion of the respondents (454, 95.2%) reported for having used soap for washing during the previous 24 hours. The difference between the availability of soap in houses and the practical use of soap for washing was only 1%, which suggests that a small percentage of respondents did not use soap for washing, though they have soap in their houses.

The respondents who reported that they used soap for washing were asked regarding the activity or purpose they had used soap during the previous 24 hours. The activities or purpose of use mentioned by the household respondents were for washing the

mother’s hands (408, 89.9%), washing of clothes (278, 61.2%), washing of the children’s body (211, 46.5%), washing the child's bottom after defecation (196, 43.2%), washing of the mother’s body (170, 37.4%) and washing of the children’s hands (138, 30.4%).

Those respondents who mentioned that they washed their hands with soap were asked regarding the occasions of hand-washing performed during the previous 24 hours. The majority of the respondents (372, 91.2%) reported that they washed their hands before eating food, followed by 312 (76.5%) respondents who indicated that they washed their hands with soap after defecation. Over one-half of the respondents (237, 58.1%) mentioned that they washed their hands after eating food. Other responses mentioned by the respondents were before preparing food (234, 57.4%), before feeding children (216 52.9%), after cleaning a child’s bottom (186, 45.6%) and when hands are dirty (183, 44.9%).

Mother’s hand-washing practices with soap during the five critical times (before eating food, after going to toilet, before preparing food, before feeding children and after cleaning a child’s bottom) for the period of 24 hours was analysed and categorised as good or poor based on the self-report of the mothers that had mentioned that they washed their hands with soap. Mothers that could name none or only one practice were categorised as having poor practices and mothers that could name at least two or more were considered as having good practices. Accordingly, the study results indicate that one-eleventh (40, 9.8%) of the respondents had poor practices (named none or only one practice), while a majority of the mothers (368, 90.2%) had good hand-washing practices as they reported that they practiced at least two or more of the critical times of the five key practices. Thus, the percentage of mothers who reported that they had used soap for hand-washing at least at two critical times during the previous 24 hours was 90.2%. Table 5.19 displays the descriptive statistics of the mothers’ hand-washing practices.

Table 5.19 Hand-washing practices of mothers

Characteristic	No.	%
Availability of soap in houses on the day of interview (N=477)		
Yes	459	96.2
No	18	3.8
Used soap for washing during the previous 24 hours (N=477)		
Yes	454	95.2
No	23	4.8
Activities or purpose of use mentioned by mothers for having used soap for washing practices during the previous 24 hours (N=477)*		
Washing of mother's hands	408	89.9
Washing children's hand	138	30.4
Washing of clothes	278	61.2
Washing of mother's body	170	37.4
Washing of children's body	211	46.5
Washing of child's bottom after defecation	196	43.2
Mothers practices of hand-washing with soap during critical times (most important occasions for hand-washing) (n=408)*		
Before eating food	372	91.2
After eating food	237	58.1
After going to toilet	312	76.5
Before preparing food	234	57.4
Before feeding children	216	52.9
After cleaning a child's bottom	186	45.6
When hands are dirty	183	44.9
Mothers practices on hand-washing behaviour of the five critical times of hand-washing (n=408)		
Poor (practice none or only one)	40	9.8
Good (practice at least two or more)	368	90.2

*Percentages totally exceed 100% as multiple response categories were used

The study household respondents were asked on their knowledge about the most important times for washing hands. A majority of the respondents had reported that hand-washing before eating food (424, 88.9%), after defecation (363, 76.1%) and before preparing food (270, 56.6%) are important. Slightly more than one-half of the respondents (246, 51.6%) had mentioned hand-washing is important after eating food. Nearly one-half of respondents (236, 49.5%) mentioned hand-washing as important before feeding children, 225 (47.2%) respondents mentioned after cleaning a child's bottom and 201 (42.1%) respondents reported that when hands are dirty.

The mothers' hand-washing knowledge was assessed by the measure of a mother's ability to identify the five critical times at which hand-washing with soap should be practiced (before eating food, after going to toilet, before preparing food, before feeding

children and after cleaning a child's bottom) and this was categorised as good or poor on the basis of the number of the mothers' responses. Mothers who pointed out none or only one practice were categorised as having poor knowledge and mothers that stated at least two or more were categorised as having good knowledge. Accordingly, this analysis shows that a majority of the mothers (417, 87.4%) had a good knowledge, since they mentioned at least two or more critical times of the five key practices, while 60 (12.6%) mothers had poor knowledge as they named none or only one practice. Thus, the percentage of mothers who reported that they had knowledge on hand-washing with soap at least at two critical times was 87.4%. Table 5.20 describes the descriptive statistics of the hand-washing knowledge of mothers.

Table 5.20 Hand-washing knowledge of mothers (N=477)

Characteristic	No.	%
Mothers' knowledge on the most important times to wash hands with soap (N=477)*		
Before eating food	424	88.9
After eating food	246	51.6
After going to toilet	363	76.1
Before preparing food	270	56.6
Before feeding children	236	49.5
After cleaning a child's bottom	225	47.2
When hands are dirty	201	42.1
Mothers' knowledge on hand-washing behaviour of the five critical times of hand-washing with soap (N=477)		
Poor (name none or only one)	60	12.6
Good (name at least two or more)	417	87.4

*Percentages totally exceed 100% as multiple response categories were used

According to the study results there are variations between knowledge and practices on hand-washing with soap during the five critical times. Of the 477 total study household respondents, 424 (88.9%) respondents felt hand-washing before eating food was important, however, 372 (78%) respondents washed their hands practically, which is less by 10.9%. Slightly over three-quarters (363, 76.1%) of the respondents were aware that hand-washing after defecation is important, whereas about two-thirds of the respondents (312, 65.4%) washed their hands practically, which is less by 10.7%. Over one-half of the respondents (270, 56.6%) were aware that hand-washing before preparing food is important, while less than one-half of the respondents (234, 49.1%) washed their hands practically, which is less by 7.5%. Less than one-half of the respondents (236, 49.5%) were aware that hand-washing before feeding children is

important, while 45.3% (216) of the respondents carried out hand-washing practices, which is less by 4.2%. The study results show that 225 (47.2%) respondents were aware that hand-washing after cleaning a child's bottom is important, while 186 (39%) respondents performed hand-washing practices, which is less by 8.2%.

The study household respondents were asked whether they had a place for washing their hands and data collectors gathered the information by checking through observation. As shown in table 5.21, the results indicate that over one-half of the households (263, 55.1%) had specific places for hand-washing, whereas over two-fifths of the households (214, 44.9%) had no dedicated place for hand-washing, which this may prevent hand-washing at key times. Of those that had specific places for hand-washing, more than one-fifth of the households (102, 21.4%) washed their hands inside or near the kitchen or cooking place, 89 (18.7%) households used elsewhere in the compound, 54 (11.3%) households used inside or nearby toilet facilities, 10 (2.1%) households used outside the yard and 8 (1.7%) households used inside houses.

The study household respondents were asked to show if they had hand-washing facilities such as water taps or water holding receptacles, pails with dippers, kettles, jugs, basins or sinks. The findings indicate that an overwhelming majority of the households (444, 93.1%) had hand-washing devices, whereas 33 (6.9%) households did not have hand-washing devices which made it difficult for the washing of hands at critical times to prevent hand contamination from disease pathogens.

The respondents of the study households were asked whether they had water, bar soap, detergent or liquid soap for washing their hands at the specific hand-washing places and data collectors gathered the information by checking through observation. Table 5.21 shows that more than three-quarters of the households (373, 78.2%) had bar soaps, about three-fifths of the households (292, 61.2%) had water, 49 (10.3%) households had liquid soap and 48 (10.1%) households had powder detergent. In addition, respondents were asked whether they had alternative cleansing agents other than soap and detergents for washing their hands at the specific hand-washing places. The results indicate that 142 (29.8%) households had ash, 37 (7.8%) households had leaves, 17 (3.6%) households had soil/mud and 11 (2.3%) households had sand. Table 5.21 describes the availability of facilities and supplies for washing hands.

Table 5.21 Hand-washing facilities and supplies (N=477)

Characteristic	No.	%
Availability of specific place for hand-washing (N=477)		
Available		
Inside or near the toilet facility	54	11.3
Inside or near the kitchen or cooking place	102	21.4
Elsewhere in the compound	89	18.7
Outside the compound	10	2.1
Inside the house	8	1.7
Not available		
No specific place	214	44.9
Availability of hand-washing device (water tap or local water holding receptacle, pail with dipper, kettle, jug, basin or sink) (N=477)		
Available	444	93.1
Not available	33	6.9
Availability of supplies for hand-washing at the specific hand-washing place (N=477)*		
Water	292	61.2
Bar soap	373	78.2
Detergent	48	10.1
Liquid soap	49	10.3
Availability of alternative cleansing agents (other than soap or detergent) for hand-washing at the specific hand-washing place (N=477)*		
Ash	142	29.8
Soil/mud	17	3.6
Sand	11	2.3
Leaves	37	7.8

*Percentages totally exceed 100% as multiple response categories were used

Respondents were asked on their knowledge about the causes of diarrhoea in children under the age of five years. More than three-quarters of the respondents (368, 77.1%) cited dirty/contaminated food, followed by 355 (74.4%) respondents who mentioned dirty/contaminated water. Two-thirds of the respondents (319, 66.9%) indicated poor personal hygiene, while others mentioned poor environmental cleanliness (291, 61%), uncooked food (248, 52%), not using toilets or defecating in the open anywhere (247, 51.8%), flies (240, 50.3%), dirty hands (not washing hands) (200, 41.9%), microorganisms (170, 35.6%), change of season (69, 14.5%) and others (17, 3.6%).

Mother's knowledge regarding causes of diarrhoea was analysed and this was categorised as good or poor basing on the number of the mothers' responses. Mothers that could state none or only one to two diarrhoea causes were categorised as having poor knowledge and mothers that could mention more than two causes as having good knowledge. Accordingly, this analysis shows that over four-fifths of the respondents

(403, 84.5%) had good knowledge as they had mentioned at least three causes of diarrhoea, while 74 (15.5%) mothers had poor knowledge since they had stated none or only one to two causes. Table 5.22 provides the descriptive statistics of the mother's knowledge regarding causes of diarrhoea.

Table 5.22 Knowledge of mothers on causes of diarrhoea (N=477)

Characteristic	No.	%
Mothers' knowledge on causes of diarrhoea (watery stools) in a child under the age of 5 years (N=477)*		
Dirty/contaminated water	355	74.4
Dirty/contaminated food	368	77.1
Uncooked food	248	52.0
Not using toilet or defecating in the open field anywhere	247	51.8
Dirty hands (not washing hands)	200	41.9
Microorganisms	170	35.6
Poor personal hygiene	319	66.9
Poor environmental cleanliness	291	61.0
Flies	240	50.3
Change of season	69	14.5
Other	17	3.6
Mothers' knowledge of at least three causes of diarrhoea (N=477)		
Poor (mentioned none or 1 to 2)	74	15.5
Good (mentioned more than two or 3-12)	403	84.5

*Percentages totally exceed 100% as multiple response categories were used

Respondents were asked on their knowledge regarding the methods of diarrhoea prevention. About four-fifths of the respondents (377, 79%) were aware that washing hands regularly can prevent diarrhoea, whereas 330 (69.2%) respondents cited maintaining proper personal hygiene and 326 (68.3%) respondents suggested that preparing food hygienically and protecting food from contamination can prevent diarrhoea. Others mentioned proper environmental cleanliness (299, 62.7%), use of latrines (261, 54.7%), use soap for cleanliness (242, 50.7%), treating water (boiling, filtering, chlorinating) (220, 46.1%), proper disposal of children's excreta (e.g. dispose in latrines) (203, 42.6%), using clean and adequate water for drinking and domestic use (203, 42.6%), protection of water from contamination at home during storage and handling (201, 42.1%), proper disposal of solid waste (180, 37.7%), proper disposal of wastewater (147, 30.8%), good nutrition (130, 27.3%) and others (10, 2.1%) as practices that can prevent diarrhoea among children.

The respondents' knowledge regarding the prevention of diarrhoea was analysed and this was categorised as good or poor basing on the number of the mothers' responses. Mothers who could state none or only one to two preventive methods were categorised as having poor knowledge and mothers that could mention more than two were considered as having good knowledge. Accordingly, this analysis shows that a majority of the household respondents (438, 91.8%) had a good knowledge as they mentioned at least three ways to prevent diarrhoea, while 39 (8.2%) mothers had poor knowledge since they had stated none or only one to two prevention methods. Table 5.23 presents the descriptive statistics of the mothers' knowledge regarding diarrhoea prevention practices.

Table 5.23 Knowledge of mothers on diarrhoea prevention methods (N=477)

Characteristic	No.	%
Mothers' knowledge on methods of diarrhoea prevention (N=477)*		
Wash hands regularly	377	79.0
Use soap for cleanliness	242	50.7
Maintain proper personal hygiene	330	69.2
Use latrine	261	54.7
Proper disposal of children's excreta (e.g. dispose in latrines)	203	42.6
Proper environmental cleanliness	299	62.7
Proper disposal of wastewater	147	30.8
Proper disposal of solid waste	180	37.7
Use clean and adequate water for drinking and domestic use	203	42.6
Protection of water from contamination at home during storage and handling	201	42.1
Treat water (boil, filter, chlorinate)	220	46.1
Prepare food hygienically and protect food from contamination	326	68.3
Good nutrition	130	27.3
Other	10	2.1
Mothers' knowledge of at least three ways to prevent diarrhoea (N=477)		
Poor (mentioned none or 1 to 2)	39	8.2
Good (mentioned more than two or 3-15)	438	91.8

*Percentages totally exceed 100% as multiple response categories were used

Table 5.24 presents the results concerning the relationship between selected socio-demographic variables by availability of hand-washing facilities. There was a significant difference between those households that had hand-washing facilities and those that did not by family monthly income, $\chi^2(3, N=477) = 10.25$, $p=.02$. However, the

percentage of household respondents that had hand-washing facilities and those that did not have did not differ by area of residence (χ^2(1, N=477) = 1.33, *p*=.28) and type of house ownership (χ^2(1, N=477) = 0.07, *p* =.79).

Table 5.24 Selected socio-demographic variables by availability of hand-washing facility (N=477)

Characteristics	Availability of hand-washing facility		χ^2	*p*-value
	Yes No. (%)	No No. (%)		
Area of residence (N=477)				
Urban	414 (93.5)	29 (6.5)	1.33	0.28*
Rural	30 (88.2)	4 (11.8)		
Family monthly income (N=477)				
≤500	136 (97.1)	4 (2.9)	10.25	0.02**
501-1,000	157 (91.3)	15 (8.7)		
1,001-2,000	75 (87.2)	11 (12.8)		
>2,000	76 (96.2)	3 (3.8)		
Type of house ownership (N=477)				
Private owned	272 (92.8)	21 (7.2)	0.07	0.79
Rented	172 (93.5)	12 (6.5)		

*Fisher's exact test
**Statistically significant with *p*-value ≤ 0.05

5.4.1.4 *Prevalence, type and duration of diarrhoea among under-five children*

Information on childhood diarrhoea was obtained by asking the mother/caregiver whether the child had suffered from diarrhoea in the two-week period preceding the interview. Of the 477 children of the study households, 47 children had experienced diarrhoea in the two weeks preceding the interview. Accordingly, the prevalence rate of diarrhoea among under-five children in the previous two weeks preceding the interview day was found to be 9.9% (Table 5.25).

Of the 477 children of the study households, the prevalence rate of diarrhoea with blood was 1.3%. Furthermore, all of the children that had diarrhoea (47, 100%) were found to have suffered from the illness for duration of less than 14 days (acute diarrhoea) with mean of 3.3 days.

Of the 477 children of the study households, 10 children had experienced diarrhoea during the interview day. Accordingly, the diarrhoea prevalence rate during the interview

day among children was found to be 2.1%. The study result show that from those children that had diarrhoea during the interview day, 8 (80%) children had experienced diarrhoea 3 times a day, 2 children (20%) had it for more than 3 times a day and the mean was 3.4 times a day. Table 5.25 provides the descriptive statistics of the prevalence rate, type and duration of diarrhoea in children under the age of five years.

Table 5.25 Prevalence, type and duration of diarrhoea among under-five children

Characteristic	No.	%
Diarrhoea in under-five child within the last two weeks preceding the interview (N=477)		
Yes	47	9.9
No	430	90.1
Type of diarrhoea (N=477)		
Watery/mucus diarrhoea	41	8.6
Bloody diarrhoea	6	1.3
No diarrhoea	430	90.1
Duration of diarrhoea (n=47)		
<14 days (acute diarrhoea)	47	100
>14 days (persistent diarrhoea)	-	-
Diarrhoea prevalence during the interview day (N=477)		
Yes	10	2.1
No	467	97.9
Number of times of liquid stools during the interview day (n=10)		
3 times	8	80
>3 times	2	20

5.4.2 Bivariate analysis of factors associated with diarrhoea in children under-five years

The bivariate analysis of this study was performed using Chi-square test or Fisher's exact test to examine the existence of significant association between diarrhoea among under-five children and the risk factors. The bivariate analysis of the study was presented under the following subheadings:

- Association between the socio-economic and demographic factors and diarrhoea occurrence among under-five children
- Association between environmental health factors and diarrhoea occurrence among under-five children

5.4.2.1 Association between the socio-economic and demographic factors and diarrhoea occurrence among under-five children

5.4.2.1.1 Household socio-economic and demographic characteristics

Table 5.26 presents the relationship between the households' socio-economic and demographic factors and diarrhoeal disease occurrence among under-five children of Sebeta town. The study results show that there was significant difference in diarrhoea prevalence between children living in urban and rural areas, $\chi^2(1, N=477) = 7.71$, $p=.01$. Children living in rural areas (n=8, 23.5%) had a significantly higher proportion of diarrhoea than those living in urban areas (n=39, 8.8%).

The bivariate analysis shows that childhood diarrhoea did not differ by household head gender ($\chi^2(1, N=477) = 0.03$, $p=.70$) and household head age ($\chi^2(1, N=477) = 0.31$, $p=.58$). However, the rate of diarrhoea among children whose household head was female was higher (n=2, 11.1%) than those whose household head was male (n=45, 9.8%). Furthermore, the rate of diarrhoea among children whose household head age was less than 35 was higher (n=23, 10.7%) than those whose household head age was more than 35 (n=24, 9.2%). With regard to education status, there was significant difference in the prevalence of childhood diarrhoea by household heads' education level ($\chi^2(1, N=477) = 3.78$, $p=.05$).

As can be seen in Table 5.26, the results of this study show that there was no significant difference in prevalence of childhood diarrhoea by other socioeconomic and demographic differentials of the household head such as working status ($\chi^2(3, N=477) = 3.69$, $p=.30$), number of persons in households ($\chi^2(2, N=477) = 4.82$, $p=.09$), family monthly income ($\chi^2(3, N=477) = 0.57$, $p=.90$) and household asset index ($\chi^2(1, N=477) = 0.92$, $p=.34$).

Table 5.26 Association between the households' socio-economic and demographic factors and diarrhoea occurrence among under-five children (N=477)

Characteristic	Diarrhoea in under-five children		χ^2	*p*-value
	Yes No. (%)	No No. (%)		
Area of residence (N=477)				
Urban	39 (8.8)	404 (91.2)	7.71	0.01*'**
Rural	8 (23.5)	26 (76.5)		
Gender of head of the household (N=477)				
Male	45 (9.8)	414 (90.2)	0.03	0.70**
Female	2 (11.1)	16 (88.9)		
Household head age (N=477)				
≤35	23 (10.7)	192 (89.3)	0.31	0.58
>35	24 (9.2)	238 (90.8)		
Household head education (N=477)				
Illiterate	11 (16.4)	56 (83.6)	3.78	0.05*
Literate	36 (8.8)	374 (91.2)		
Main job of the household head (N=477)				
Private trade	12 (7.2)	154 (92.8)	3.69	0.30
Farmer	8 (9.6)	75 (90.4)		
Daily wage worker	13 (14.8)	75 (85.2)		
Others	14 (10.0)	126 (90.0)		
Number of persons in households (N=477)				
1-3	11 (12.2)	79 (87.8)	4.82	0.09
4-6	28 (8.2)	314 (91.8)		
7-11	8 (17.8)	37 (82.2)		
Family monthly income (ETB) (N=477)				
≤500	16 (11.4)	124 (88.6)	0.57	0.90
501-1,000	16 (9.3)	156 (90.7)		
1,001-2,000	8 (9.3)	78 (90.7)		
>2,000	7 (8.9)	72 (91.1)		
Household asset index (N=477)				
Poor	34 (10.8)	281 (89.2)	0.92	0.34
Well-off	13 (8.0)	149 (92.0)		

*Statistically significant with *p*-value ≤ 0.05
**Fisher's exact test

5.4.2.1.2 Maternal/caregivers' socio-demographic characteristics

As can be seen from Table 5.27, children of mothers/caregivers aged more than 30 years had a higher rate of diarrhoea (n=19, 16.7%) as compared with those aged less than 30 years (n=28, 9.1%). However, there was no statistically significant differences found in childhood diarrhoea by mothers' age, $\chi^2(1, N=477) = 0.57$, $p=.45$. The results of this study also show that there was no significant difference in prevalence of childhood diarrhoea by other maternal/caregivers' socio-demographic characteristics

such as by mothers' education (χ^2(1, N=477) = 1.56, *p*=.21), mothers' job (χ^2(2, N=477) = 1.03, *p*=.60), marital status of the mother (χ^2(1, N=477) = 2.20, *p*=.17) and the number of under-five children of the households (χ^2(1, N=477) = 3.06, *p*=.08). Table 5.27 examines the association between mothers'/caregivers' socio-economic and demographic factors and diarrhoea occurrence among under-five children.

Table 5.27 Association between mothers'/caregivers' socio-economic and demographic factors and diarrhoea occurrence among under-five children (N=477)

Characteristic	Diarrhoea in under-five children		χ^2	*p*-value
	Yes No. (%)	No No. (%)		
Mother's age (N=477)				
<30	28 (9.1)	280 (90.9)	0.57	0.45
≥30	19 (16.7)	150 (88.8)		
Mother's education (N=477)				
Illiterate	16 (12.7)	110 (87.3)	1.56	0.21
Literate	31 (8.8)	320 (91.2)		
Main job of the mother (N=477)				
Private trade (merchant)	6 (7.5)	74 (92.5)	1.03	0.60
Housewife	25 (9.6)	235 (90.4)		
Others	16 (11.7)	121 (88.3)		
Marital status of the mother/caregiver (N=477)				
Married	40 (9.2)	394 (90.8)	2.20	0.17*
Others	7 (16.3)	36 (83.7)		
Number of under-five children of the households (N=477)				
1	39 (33.9)	305 (88.7)	3.06	0.08
>1	8 (6.0)	125 (94.0)		

*Fisher's exact test

5.4.2.1.3 Childs' demographic characteristics

The results of this study in the bivariate analysis using a chi-square test show that there was no significant difference in prevalence of childhood diarrhoea by age of children (χ^2(3, N=477) = 1.94, *p*=.56). The study result also shows that there was no statistically significant difference of diarrhoea cases in boys (n=33, 11.6%) and girls (n=14, 7.3%) (χ^2(1, N=477) = 2.47, *p*=.12). Table 5.28 provides information on the child's demographic characteristics and diarrhoea among under-five children.

Table 5.28 Association between childs' demographic characteristics and diarrhoea occurrence among under-five children (N=477)

Characteristic	Diarrhoea in under-five children		χ^2	*p*-value
	Yes No. (%)	No No. (%)		
Age of child (months) (N=477)				
0-11	5 (6.2)	75 (93.8)	1.94	0.56
12-23	12 (11.8)	90 (88.2)		
24-35	13 (9.2)	129 (90.8)		
36-59	47 (9.9)	430 (90.1)		
Gender of child (N=477)				
Male	33 (11.6)	251 (88.4)	2.47	0.12
Female	14 (7.3)	179 (92.7)		

5.4.2.1.4 Housing characteristics

The results of this study show that there was no significant difference in prevalence of childhood diarrhoea by housing characteristics such as the type of house ownership ($\chi^2(1, N=477) = 0.08$, $p=.78$), number of separate house rooms ($\chi^2(1, N=477) = 0.56$, $p=.47$), main material of the wall ($\chi^2(1, N=477) = 0.02$, $p=.89$), main material of the floor ($\chi^2(1, N=477) = 0.81$, $p=.37$) and main material of the roof of the house ($\chi^2(1, N=477) = 0.10$, $p=1.00$). Table 5.29 summarises house characteristics and diarrhoea among under-five children.

Table 5.29 Association between house characteristics and diarrhoea occurrence among under-five children (N=477)

Characteristic	Diarrhoea in under-five children		χ^2	*p*-value
	Yes No. (%)	No No. (%)		
Type of house ownership (N=477)				
Private owned	28 (9.6)	265 (90.4)	0.08	0.78
Rented	19 (10.3)	165 (89.7)		
Number of separate house rooms (N=477)				
≤3	24 (9.0)	244 (91.0)	0.56	0.47
>3	23 (11.0)	186 (89.0)		
Main material of the wall of the house (N=477)				
Mud with wood	30 (9.7)	279 (90.3)	0.02	0.89
Others	17 (10.1)	151 (89.9)		
Main material of the floor of the house (N=477)				
Earthen floor	23 (8.7)	240 (91.3)	0.81	0.37
Non-earthen floor	24 (11.2)	190 (88.8)		
Main roofing material of the house (N=477)				
Corrugated metal sheet	45 (10.0)	407 (90.0)	0.10	1.00*
Others	2 (8.0)	23 (92.0)		

*Fisher's exact test

5.4.2.2 Association between environmental health factors and diarrhoea occurrence among under-five children

5.4.2.2.1 Household drinking water

The results of this study in the bivariate analysis using a chi-square test shows that there was no significant difference in prevalence of diarrhoea two weeks prior to the interview in children under-five years by type of main source of drinking water for the household ($\chi^2(1, N=477) = 0.08$, $p=.79$), ownership of main water source ($\chi^2(1, N=477) = 0.00$, $p=.99$), location of main water source ($\chi^2(1, N=477) = 0.02$, $p=.90$), time to obtain drinking water (round trip) ($\chi^2(1, N=477) = 1.93$, $p=.17$) and distance of water source from dwelling ($\chi^2(1, N=477) = 3.03$, $p=.08$). Table 5.30 displays the relationship between the prevalence of diarrhoea in the two weeks preceding the interview and drinking water source characteristics.

Table 5.30 Association between drinking water source characteristics and diarrhoea occurrence among under-five children (N=477)

Characteristic	Diarrhoea in under-five children		χ^2	*p*-value
	Yes No. (%)	No No. (%)		
Type of main source of drinking water of the household (N=477)				
Tap water on premises (inside dwelling and yard)	19 (9.4)	183 (90.6)	0.08	0.79
Other sources (public tap, tap outside yard and non-piped water source)	28 (10.2)	247 (89.8)		
Ownership of main water source (N=477)				
Private water source	17 (9.8)	156 (90.2)	0.00	0.99
Shared water source	30 (9.9)	274 (90.1)		
Location of main water source (N=477)				
Outside yard (compound)	28 (10.0)	252 (90.0)	0.02	0.90
On premises (in dwelling and compound)	19 (9.6)	178 (90.4)		
Time to obtain drinking water (round trip) (N=477)				
≤30 minutes	42 (10.7)	349 (89.3)	1.93	0.17
>30 minutes	5 (5.8)	81 (94.2)		
Distance of water source from dwelling (N=477)				
≤ 200 metres	42 (11.1)	338 (88.9)	3.03	0.08
> 200 metres	5 (5.2)	92 (94.8)		

The study results also show that there was no significant difference between childhood diarrhoea and other water-related variables including the person who fetched water from the main water source (χ^2(1, N=477) = 2.93, *p*=.09), water consumption from the mean daily amount of 12 litres per capita per day (χ^2(1, N=477) = 2.59, *p*=.11), water storage at home for all purposes of domestic water use (χ^2(1, N=477) = 0.005, *p*=.95), drinking water storage in separate containers from other domestic water storage (χ^2(1, n=343) = 0.08, *p*=.73), type of main water storage container (χ^2(1, n=317) = 0.15, *p*=.69), availability of narrow necked drinking water storage container (χ^2(1, n=317) = 0.08, *p*=.78), cleanliness of the inside of container used for drinking water storage (χ^2(1, n=317) = 0.93, *p*=.49) and method of water drawing (χ^2(1, n=317) = 0.04, *p*=.84).

There was only one factor in the bivariate analysis, i.e. household-level drinking water treatment which shows significant association from household drinking water variables. There was a significant difference in diarrhoeal disease between households that treated their drinking water compared with those households that did not treat their drinking water (χ^2(1, N=477) = 5.38, *p*=.02). The rate of diarrhoea among children of households that did not treat their drinking water was higher (n=29, 13.3%) than those

that treated their drinking water (n=18, 6.9%). Table 5.31 displays the relationship between drinking water handling, storage and treatment and diarrhoea among under-five children.

Table 5.31 Association between drinking water handling, storage and treatment and diarrhoea occurrence among under-five children

Characteristic	Diarrhoea in under-five children		χ^2	*p*-value
	Yes No. (%)	No No. (%)		
Person who fetch from the main water source (N=477)				
Adult woman (above 15)	30 (12.1)	218 (87.9)	2.93	0.09
Others	17 (7.4)	212 (92.6)		
Water consumption from mean daily amount of 12 litres per capita per day (LCD) (N=477)				
≤12	20 (7.8)	236 (92.2)	2.59	0.11
>12	27 (12.2)	194 (87.8)		
Water storage at home for all purpose of domestic water use (N=477)				
Yes	34 (9.9)	309 (90.1)	0.005	0.95
No	13 (9.7)	121 (90.3)		
Drinking water storage in separate container from other domestic water storage (n=343)				
Yes	31 (9.8)	286 (90.2)	0.08	0.73*
No	3 (11.5)	23 (88.5)		
Type of main water storage container (n=317)				
Plastic jerry can	22 (10.2)	193 (89.8)	0.15	0.69
Others	9 (8.8)	93 (91.2)		
Availability of narrow necked drinking water storage container (n=317)				
Yes	22 (10.1)	196 (89.9)	0.08	0.78
No	9 (9.1)	90 (90.9)		
Cleanliness of the inside of container used for drinking water storage (n=317)				
Good	30 (10.2)	263 (89.8)	0.93	0.49*
Poor	1 (4.2)	23 (95.8)		
Method of water drawing (n=317)				
Pour water from the container	22 (10.0)	198 (90.0)	0.04	0.84
Others	9 (9.3)	88 (90.7)		
Household-level water treatment (N=477)				
Yes	18 (6.9)	241 (93.1)	5.38	0.02**
No	29 (13.3)	189 (86.7)		

*Fisher's exact test
**Statistically significant with *p*-value ≤ 0.05

5.4.2.2.2 Excreta disposal

The results of this study show that there was no significant difference in prevalence of childhood diarrhoea between households that had toilet facilities and those that did not have (χ^2(1, N=477) = 0.07, *p*=1.00). The study results also indicate that there was no significant difference in diarrhoeal disease among households that used improved toilet facilities compared with those that used unimproved toilet facilities (χ^2(1, N=477) = 2.01, *p*=.15).

The results of this study also show that there was no significant difference in prevalence of childhood diarrhoea by other excreta related factors such as by type of toilet ownership (χ^2(1, n=442) = 3.52, *p*=.06), cleanliness of latrine (χ^2(1, n=442) = 0.70, *p*=.40), defecation methods of under-five children (χ^2(1, N=477) = 0.12, *p*=.73) and stool disposal practices (χ^2(1, N=477) = 1.27, *p*=.26). Table 5.32 displays the relationship between toilet characteristics and diarrhoea among under-five children.

Table 5.32 Association between toilet characteristics and diarrhoea occurrence among under-five children

Characteristic	Diarrhoea in under-five children		χ^2	*p*-value
	Yes No. (%)	No No. (%)		
Availability of toilet facility (N=477)				
Available	44 (10.0)	398 (90.0)	0.07	1.00*
Not available	3 (8.6)	32 (91.4)		
Type of toilet facility used (N=477)				
Improved	29 (8.6)	308 (91.4)	2.01	0.15
Unimproved	18 (12.9)	122 (87.1)		
Type of toilet ownership (n=442)				
Private toilet	42 (11.0)	339 (89.0)	3.52	0.06
Shared toilet	2 (3.3)	59 (96.7)		
Cleanliness of latrine (n=442)				
Yes	36 (9.5)	344 (90.5)	0.70	0.40
No	8 (12.9)	54 (87.1)		
Defecation methods of under-five children (N=477)				
Used potty	33 (9.6)	312 (90.4)	0.12	0.73
Others	14 (10.6)	118 (89.4)		
Stool disposal practices (N=477)				
Contained	41 (10.6)	346 (89.4)	1.27	0.26
Uncontained	6 (6.7)	84 (93.3)		

*Fisher's exact test

5.4.2.2.3 Wastewater disposal

The association between diarrhoea and household wastewater disposal practices were analysed using the chi-square test. The study results show that there was no significant difference in childhood diarrhoea among households that have used proper wastewater disposal methods compared with those that used improper wastewater disposal methods ($\chi^2(1, N=477) = 1.80$, $p=.18$). Table 5.33 presents the association between wastewater disposal characteristics and diarrhoea among under-five children.

Table 5.33 Association between wastewater disposal characteristics and diarrhoea occurrence among under-five children (N=477)

Characteristic	Diarrhoea in under-five children		χ^2	*p*-value
	Yes No. (%)	No No. (%)		
Type of domestic wastewater disposal method (N=477)				
Proper disposal	11 (7.2)	142 (92.8)	1.80	0.18
Improper disposal	36 (11.1)	288 (88.9)		

5.4.2.2.4 Solid waste disposal

The results of this study show that there was no significant difference in prevalence of childhood diarrhoea by type of household solid waste disposal method ($\chi^2(1, N=477) = 0.008$, $p=.93$), availability of solid waste storage container ($\chi^2(1, N=477) = 1.54$, $p=.26$), availability of solid waste container cover ($\chi^2(1, n=360) = 0.02$, $p=.88$) and cleanliness of home environment ($\chi^2(1, N=477) = 0.04$, $p=.84$).

Table 5.34 examines information on solid waste handling and disposal characteristics and diarrhoea among under-five children.

Table 5.34 Association between solid waste handling and disposal characteristics and diarrhoea occurrence among under-five children

Characteristic	Diarrhoea in under-five children		χ^2	*p*-value
	Yes No. (%)	No No. (%)		
Type of household solid waste disposal method (N=477)				
Proper disposal	27 (9.7)	250 (90.3)	0.008	0.93
Improper disposal	20 (10.0)	180 (90.0)		
Availability of solid waste storage container (N=477)				
Available	32 (8.9)	328 (91.1)	1.54	0.26
Not available	15 (12.8)	102 (87.2)		
Availability of solid waste container cover (n=360)				
Yes	18 (8.7)	189 (91.3)	0.02	0.88
No	14 (9.2)	139 (90.8)		
Cleanliness of home environment (N=477)				
Yes	42 (10.0)	380 (90.0)	0.04	0.84
No	5 (9.1)	50 (90.9)		

5.4.2.2.5 Hygiene behaviours and knowledge

The association between diarrhoea among under-five children and hand-washing behaviours and knowledge of mothers/caregivers were analysed. The bivariate analysis shows that there was no significant difference between diarrhoea and availability of soap in houses on the day of the interview (χ^2(1, N=477) = 0.98, *p*=.41). The study results also indicate that there was no significant difference in childhood diarrhoea among children whose mothers used soap for washing compared with those children whose mothers did not use soap for washing during the previous 24 hours (χ^2(1, N=477) = 3.84, *p*=.06).

Regarding the purpose of using soap by mothers for washing practices during the previous 24 hours, the findings of the study indicate that there was no significant difference between childhood diarrhoea and washing practices with soap mentioned by mothers including washing mother's hand (χ^2(1, N=477) = 0.88, *p*=.42), washing of children's hand (χ^2(1, N=477) = 0.95, *p*=.33), washing of clothes (χ^2(1, N=477) = 0.009, *p*=.93), washing mother's body (χ^2(1, N=477) = 0.58, *p*=.45) and washing of children's body (χ^2(1, N=477) = 0.02, *p*=.88). However, one factor showed a significant association from washing practices with soap mentioned by mothers. Accordingly, there

was a significant difference in childhood diarrhoea among children whose mothers washed the child's bottom after defecation compared with those children whose mothers did not wash the child's bottom after defecation during the 24 hours prior to the interview ($\chi^2(1, N=477) = 4.02$, $p=.05$). The rate of diarrhoea among children whose mothers did not wash a child's bottom after defecation was higher (n=30, 11.6%) than those children whose mothers washed a child's bottom after defecation (n=12, 6.1%). Table 5.35 presents the association between the availability and use of soap in houses and diarrhoea among under-five children.

Table 5.35 Association between availability and use of soap in houses and diarrhoea occurrence among under-five children (N=477)

Characteristic	Diarrhoea in under-five children		χ^2	*p*-value
	Yes No. (%)	No No. (%)		
Availability of soap in houses on the day of interview (N=477)				
Yes	44 (9.6)	415 (90.4)	0.98	0.41*
No	3 (16.7)	15 (83.3)		
Used soap for washing during the previous 24 hours (N=477)				
Yes	42 (9.3)	412 (90.7)	3.84	0.06*
No	5 (21.7)	18 (78.3)		
Purpose of use mentioned by mothers for having used soap for washing practices during the previous 24 hours (N=477)				
Washing mother's hands				
Yes	36 (8.8)	372 (91.2)	0.88	0.42
No	6 (13.0)	40 (87.0)		
Washing children's hands				
Yes	10 (7.2)	128 (92.8)	0.95	0.33
No	32 (10.1)	284 (89.9)		
Washing clothes				
Yes	26 (9.4)	252 (90.6)	0.009	0.93
No	16 (9.1)	160 (90.9)		
Washing mother's body				
Yes	18 (10.6)	152 (89.4)	0.58	0.45
No	24 (8.5)	260 (91.5)		
Washing children's body				
Yes	20 (9.5)	191 (90.5)	0.02	0.88
No	22 (9.1)	221 (90.9)		
Washing the child's bottom after defecation				
Yes	12 (6.1)	184 (93.9)	4.02	0.05**
No	30 (11.6)	228 (88.4)		

*Fisher's exact test
**Statistically significant with *p*-value ≤ 0.05

The bivariate analysis was performed on the mothers' practices on washing hands with soap during the most important times. The results of this study indicate that there was no significant difference in prevalence of diarrhoea and all the most important times of hand-washing practices. Furthermore, the mothers' hand-washing practices with soap at five critical times were analysed in the bivariate analysis, based on the category of good and poor practice levels. It was found that there was no significant difference between diarrhoea in children and mothers practices of hand-washing with soap during the five critical times based on the good and poor categories ($\chi^2(1, n=408) = 4.15$, p=.07). Table 5.36 displays the relationship between hand-washing practices and diarrhoea among under-five children.

Table 5.36 Association between hand-washing practices and diarrhoea occurrence among under-five children

Characteristic	Diarrhoea in under-five children		χ^2	*p*-value
	Yes No. (%)	No No. (%)		
Mothers' practices on the most important times to wash hands with soap (n=408)				
Before eating food				
No	3 (8.3)	33 (91.7)	0.01	1.00*
Yes	33 (8.9)	339 (91.1)		
After eating food				
No	12 (7.0)	159 (93.0)	1.19	0.28
Yes	24 (10.1)	213 (89.9)		
After going to toilet				
No	10 (10.4)	86 (89.6)	0.40	0.53
Yes	26 (8.3)	286 (91.7)		
Before preparing food				
No	18 (10.3)	156 (89.6)	0.87	0.35
Yes	18 (7.7)	216 (92.3)		
Before feeding children				
No	22 (11.5)	170 (88.5)	3.13	0.08
Yes	14 (6.5)	202 (93.5)		
After cleaning child's bottom				
No	23 (10.4)	199 (89.6)	1.43	0.23
Yes	13 (7.0)	173 (93.0)		
When hands are dirty				
No	24 (10.7)	201 (89.3)	2.12	0.15
Yes	12 (6.6)	171 (93.4)		
Mothers' practices of hand-washing with soap during five critical times (n=408)				
Poor (practice none or only one)	7 (17.5)	33 (82.5)	4.15	0.07*
Good (practice at least two or more)	29 (7.9)	339 (92.1)		

*Fisher's exact test
**Statistically significant with p-value ≤ 0.05

The bivariate analysis using a chi-square test was performed on the mothers' knowledge on the most important times to wash hands with soap. Accordingly, the findings from this study indicate that there was no significant difference between childhood diarrhoea and mothers' knowledge on the most important times to wash hands with soap including before eating food (χ^2(1, N=477) = 0.01, *p*=.91), after eating food (χ^2(1, N=477) = 1.70, *p*=.19), after going to toilet (χ^2(1, N=477) = 0.007, *p*=.93), before preparing food (χ^2(1, N=477) = 0.65, *p*=.42), after cleaning child's bottom (χ^2(1, N=477) = 0.95, *p*=.33) and when hands are dirty (χ^2(1, N=477) = 3.26, *p*=.07). However, one factor has showed a significant association from a mothers' knowledge on the most important times to wash hands with soap. Accordingly, there was a significant difference in childhood diarrhoea among children whose mothers had knowledge on the need to wash hands before feeding children compared with those mothers that did not have that knowledge to wash hands before feeding children, χ^2(1, N=477) = 3.69, *p*=.05. Children whose mothers that did not have knowledge on the need to wash hands before feeding children had a significantly higher proportion of diarrhoea (n=30, 12.4%) than those children whose mothers had knowledge on washing hands before feeding children (n=17, 7.2%).

The mothers' knowledge on hand-washing with soap at the five critical times was analysed in the bivariate analysis, based on the category of good and poor knowledge levels. The analysis shows that there was no significant difference in prevalence of childhood diarrhoea between children of mothers/caregivers with poor knowledge levels on hand-washing with soap and those with good knowledge, χ^2(1, N=477) = 0.94, *p*=.33.

Table 5.37 displays the association between hand-washing knowledge characteristics and diarrhoea among under-five children.

Table 5.37 Association between hand-washing knowledge and diarrhoea occurrence among under-five years children (N=477)

Characteristic	Diarrhoea in under-five children		χ^2	*p*-value
	Yes No. (%)	No No. (%)		
Mothers' knowledge on the most important times to wash hands with soap (N=477)				
Before eating food				
No	5 (9.4)	48 (90.6)	0.01	0.91
Yes	42 (9.9)	382 (90.1)		
After eating food				
No	27 (11.7)	204 (88.2)	1.70	0.19
Yes	20 (8.1)	226 (91.9)		
After going to toilet				
No	11 (9.6)	103 (90.4)	0.007	0.93
Yes	36 (9.9)	327 (90.1)		
Before preparing food				
No	23 (11.1)	184 (88.9)	0.65	0.42
Yes	24 (8.9)	246 (91.1)		
Before feeding children				
No	30 (12.4)	211 (87.6)	3.69	0.05*
Yes	17 (7.2)	219 (92.8)		
After cleaning the child's bottom				
No	28 (11.1)	224 (88.9)	0.95	0.33
Yes	19 (22.2)	206 (91.6)		
When hands are dirty				
No	33 (12.0)	243 (88.0)	3.26	0.07
Yes	14 (7.0)	187 (93.0)		
Mothers' knowledge on the five critical times of hand-washing with soap (N=477)				
Poor (name none or only one)	8 (13.3)	52 (54.1)	0.94	0.33
Good (name at least two or more)	39 (9.4)	378 (90.6)		

*Statistically significant with *p*-value ≤ 0.05

There was a statistically significant difference between availability of a specific places for hand-washing and diarrhoea in children, $\chi^2(1, N=477) = 5.98$, $p=.02$. The diarrhoea prevalence rate among children was significantly higher at households with no specific places for hand-washing (n=29, 13.6%) than those that had (n=18, 6.8%).

The findings from this study show that availability of hand-washing devices (facilities) showed a significant difference with regard to childhood diarrhoea, $\chi^2(1, N=477) = 16.69$, $p=.001$. Diarrhoea was lower among households that have hand-washing devices (n=37, 8.3%) and higher among households that did not have (n=10, 30.3%).

The bivariate analysis shows that there was a significant difference between diarrhoea and availability of water for hand-washing at the specific hand-washing place, $\chi^2(1,$

N=477) =7.65, *p*=.006). Accordingly, the prevalence rate of diarrhoea in children whose households had water for hand-washing at the specific hand-washing place was significantly lower (n=20, 6.8%) than those that did not have (n=27, 14.6%). However, no significant difference was found between childhood diarrhoea and the availability of bar soaps (χ^2(1, N=477) = 1.95, *p*=.17), detergents (χ^2(1, N=477) = 1.94, *p*=.21) and liquid soap (χ^2(1, N=477) = 1.21, *p*=.31) for hand-washing at specific hand-washing places. Table 5.38 displays the relationship between hand-washing facilities and supplies and diarrhoea occurrence among under-five children.

Table 5.38 Association between hand-washing facilities and supplies and diarrhoea occurrence among under-five children (N=477)

Characteristic	Diarrhoea in under-five children		χ^2	*p*-value
	Yes No. (%)	No No. (%)		
Availability of specific places for hand-washing (N=477)				
Available	18 (6.8)	245 (93.2)	5.98	0.02*
Not available	29 (13.6)	185 (86.4)		
Availability of hand-washing devices (water tap or water holding receptacle, pail with dipper, kettle, jug, basin or sink) (N=477)				
Available	37 (8.3)	407 (91.7)	16.69	0.001*, **
Not available	10 (30.3)	23 (69.7)		
Availability of items for hand-washing at the specific hand-washing places (N=477)				
Water				
Available	20 (6.8)	272 (93.2)	7.65	0.006*
Not available	27 (14.6)	158 (85.4)		
Bar soap				
Available	33 (8.8)	340 (91.2)	1.95	0.17
Not available	14 (13.5)	90 (86.5)		
Detergent				
Available	2 (4.2)	46 (95.8)	1.94	0.21*
Not available	45 (10.5)	384 (89.5)		
Liquid soap				
Available	7 (14.3)	42 (85.7)	1.21	0.31*
Not available	40 (9.3)	388 (90.7)		

*Statistically significant with *p*-value ≤ 0.05
**Fisher's exact test

The mothers' knowledge on causes of diarrhoea was analysed in the bivariate analysis, based on the category of good and poor knowledge levels. It was found that there was a significant difference between diarrhoea in children and mothers' knowledge of at least three causes of diarrhoea based on the good and poor categories, χ^2(1, N=477) = 5.87,

p=.02. Diarrhoeal disease occurrence was higher (n=13, 17.6%) among children of the mothers/caregivers with a poor knowledge level on causes of diarrhoea as compared to those with a good knowledge (n=34, 8.4%).

The bivariate analysis indicates that there was no significant difference between the diarrhoea prevalence rate and mothers' knowledge of at least three ways to prevent diarrhoea, $\chi^2(1, N=477) = 0.21$, $p=.79$. Table 5.39 presents the relationship between childhood diarrhoea and knowledge on diarrhoea causes and methods of prevention.

Table 5.39 Association between knowledge on diarrhoea causes and prevention and diarrhoea occurrence among under-five children (N=477)

Characteristic	Diarrhoea in under-five children		χ^2	*p*-value
	Yes No. (%)	No No. (%)		
Mothers' knowledge of at least three causes of diarrhoea (N=477)				
Poor (mentioned none or 1 to 2)	13 (17.6)	61 (82.4)	5.87	0.02*
Good (mentioned more than two)	34 (8.4)	369 (91.6)		
Mothers' knowledge of at least three ways to prevent diarrhoea (N=477)				
Poor (mentioned none or 1 to 2)	3 (7.7)	36 (92.3)	0.21	0.79**
Good (mentioned more than two)	44 (10.0)	394 (90.0)		

*Statistically significant with *p*-value ≤ 0.05
**Fisher's exact test

5.4.3 Multivariate analysis of factors associated with diarrhoea in children under-five years

The bivariate analysis was conducted using Chi-square tests or Fisher's exact tests to identify the risk factors of childhood diarrhoea; however, any possible confounding factors were not controlled at this level. Multivariate analysis using the binary logistic regression by backward stepwise method with a likelihood ratio approach was performed in order to identify the risk factors that are independently associated with diarrhoea while controlling for confounding variables. Before data were entered for the binary logistic regression analysis, the variables were converted to dichotomous variables. Only independent variables that were significantly associated with childhood diarrhoea at a *p*-value less than 0.25 in the bivariate analysis using Chi-square tests or Fisher's exact tests were included in the multivariable analysis.

In this study, using binary logistic regression analysis by controlling for the effects of other variables and employing a 0.05 criterion of statistical significance, five factors were independently associated with the risk of childhood diarrhoea. The five factors are described as follows (see Table 5.40):

- The type of toilet facility used was significantly associated with diarrhoea (p=0.023). Children from households that used improved toilets were 0.37 times less likely to have childhood diarrhoea as compared to those that used unimproved toilets (AOR: 0.37; 95% CI 0.16 – 0.87).
- The availability of specific places for hand-washing had a significant association with childhood diarrhoea (p=0.026). Children whose households had a specific place for hand-washing were 0.40 times less likely to have diarrhoea as compared to those children whose households did not have a specific place for hand-washing (AOR: 0.40; 95% CI 0.18 – 0.90).
- Childhood diarrhoea was significantly associated with the availability of hand-washing devices (facility) (p=0.012). Children from households that had hand-washing devices were 0.20 times less likely to have diarrhoea as compared to those that did not have hand-washing devices (AOR: 0.20; 95% CI 0.06 – 0.70).
- Mothers' knowledge on the causes of diarrhoea was significantly associated with diarrhoea in children (p=0.015). Children whose households had a poor knowledge on causes of diarrhoea were 3.09 times more likely to develop diarrhoea than those that had a good knowledge (AOR: 3.09; 95% CI 1.24 – 7.68).
- There was a significant association between water consumption from mean daily amount of 12 litres per capita per day and the occurrence of diarrhoea among under-five children (AOR: 0.43; 95% CI 0.20 – 0.94; p=0.034). Although statistically significant, the adjusted odds ratio shows that it was inversely related.

In summary, binary logistic regression with the backward stepwise regression technique procedure was performed to assess the household environmental health factors associated with the occurrence of diarrhoea in under-five children. The model indicated that the following four variables were found to be independently associated with the risk of childhood diarrhoea in the expected direction: the type of toilet facility used, availability of specific places for handwashing, availability of handwashing devices (facility) and mothers' knowledge on diarrhoea causation. The Hosmer–Lemeshow test indicates chi-square value with a $p > 0.05$ ($\chi^2 = 3.338$, 8 degrees of freedom, p=0.91)

which signify that the overall model fit is good. The model as a whole explained between 13% (Cox and Snell *R*-square = 0.127) and 28% (Nagelkerke *R*-square = 0.277) of the variance in childhood diarrhoea prevalence. Table 5.40 provides a summary of the binary logistic regression results.

Table 5.40 Multivariate analysis of factors associated with diarrhoea among under-five years children

Characteristics	Crude OR (95% CI)	Coefficient	Adjusted OR (95% CI)	*p*-value
Time to obtain drinking water (round trip) (≤30 minutes/>30 minutes)	1.95 (0.71-5.79)	1.270	3.56 (0.79-15.98)	0.097
Water consumption from mean daily amount of 12 litres per capita per day (LCD) (≤12/>12 LCD)	0.61 (0.32-1.16)	-0.837	0.43 (0.20-0.94)	0.034*
Type of toilet facility used (Improved/Unimproved)	0.64 (0.33-1.25)	-0.997	0.37 (0.16-0.87)	0.023*
Type of toilet ownership (Private toilet/Shared toilet)	3.65 (0.83-22.44)	1.452	4.27 (0.90-20.25)	0.067
Mothers' practices on hand-washing with soap before feeding children (No/Yes)	1.87 (0.88-3.98)	0.800	2.23 (0.98-5.05)	0.056
Availability of specific places for hand-washing (Available/Not available)	0.47 (0.24-0.91)	-0.910	0.40 (0.18-0.90)	0.026*
Availability of hand-washing devices (facility) (Available/Not available)	0.21 (0.09-0.51)	-1.597	0.20 (0.06-0.70)	0.012*
Mothers' knowledge on at least three causes of diarrhoea (Poor/Good)	2.31 (1.09-4.86)	1.127	3.09 (1.24-7.68)	0.015*
Constant		2.058	7.827	.000

*Statistically significant with *p*-value ≤ 0.05

5.5 DISCUSSION ON THE FINDINGS OF THE STUDY

This study examined the household environmental health factors associated with the occurrence of diarrhoea in children of Sebeta town in Ethiopia who were under-five years of age. The results of the study are discussed under the following subheadings:

- Prevalence of diarrhoea among under-five years children
- Association between the socio-economic and demographic factors and diarrhoea occurrence among under-five children

- Association between environmental health factors of the study households and diarrhoea occurrence among under-five children

5.5.1 Prevalence and type of diarrhoea among under-five years children

The results of the study indicate that the prevalence of diarrhoea, in under-five children in the previous two weeks preceding the interview, was 9.9%. This rate was less prevalent as compared to study findings by the Ethiopian Demographic and Health Survey of 2011 in which national childhood diarrhoea prevalence rate for the country was 13%, for Oromiya region it was 11.3% and for the urban areas of the country it was 11% (Central Statistical Agency & ICF International 2012:146). In addition, the findings of this study also showed that 1.3% of children under the age of five had diarrhoea with blood. This rate was also less prevalent as compared to study results of the Ethiopian Demographic and Health Survey of 2011 in which 3% of under-five children had diarrhoea with blood in the two-week period before the study (Central Statistical Agency & ICF International 2012:146).

The data for this study was collected during the month of November, which is a dry season in the study setting of Ethiopia. Performing the study in a dry season might not reflect similar situations with regard to diarrhoea prevalence rates as compared to the rainy season; as there is a relation between diarrhoeal illnesses and weather- and climate-related events (Agustina, Sari, Satroamidjojo, Bovee-Oudenhoven, Feskens & Kok 2013:8). In some studies diarrhoea prevalence was found to be higher in the rainy season than in the dry season (Hung 2006:18). Despite the less prevalence of childhood diarrhoea during the dry season for this study as compared to the indicated national, regional and urban prevalence rates of the country, diarrhoea remains one of the causes of morbidity in children with a 10% prevalence rate.

5.5.2 Association between the socio-economic and demographic factors and diarrhoea occurrence among under-five children

A bivariate analysis was performed using Chi-square or Fisher exact tests to examine the relationship between childhood diarrhoea and households' socio-economic and demographic factors, mother's/caregiver's socio-economic and demographic factors,

the child's demographic factors and housing factors and the results are presented below.

5.5.2.1 Association between household socio-economic and demographic characteristics and diarrhoea among under-five children

The bivariate analyses show that there was a significant difference between the prevalence of diarrhoea and area of residence (urban versus rural). Childhood diarrhoea was more prevalent in children living in rural areas (23.5%) than children living in urban areas (8.8%). However, their significance in a multivariate analysis was not maintained after controlling for other variables. Similarly, a study by Wilunda (2008:76) on the secondary data analysis of Thailand multiple indicator cluster survey of 2006 did not show a significant association between diarrhoea and residence (rural or urban). Furthermore, study conducted in Egypt (El-Gilany & Hammad 2005:762) found that living in rural areas was significantly associated with diarrhoea.

High prevalence rates of childhood diarrhoea occurred among children who belonged to households headed by women and whose household head age was less than 35. However, the chi-square test in the bivariate analysis shows that childhood diarrhoea did not differ by household head gender and household head age. In addition, a study conducted by El-Gilany and Hammad (2005:771) showed that a father's age may have been less important because they were less likely to be involved in childcare.

This study's bivariate analysis shows that household head education level had a significant association with diarrhoea prevalence in children. The higher the education level, the lower the prevalence rate of diarrhoea among their children, but in the multivariate analysis their significance was not maintained after controlling for other variables. However, the finding of the present study differ from a study by Alaa, Shah and Khan (2014:17) which shows that the risk of diarrhoea was three times higher among children with fathers who had lower level of education (OR: 3.3 95% CI 1.7 - 6.6).

The findings of this study indicate that the main job of a household head did not show significant association with childhood diarrhoea. However, according to a study done in

Saudi Arabia by al-Mazrou, Aziz and Khalil (1991), the incidence of diarrhoea was significantly associated with the fathers´ occupation.

The results of this study show that there was no significant difference in prevalence of childhood diarrhoea by family size (number of persons living in the household). Similarly, a study conducted in Kenya found no significant association between the incidence of diarrhoea and household size (Karambu, Matiru, Kiptoo & Oundo 2013:4).

Higher prevalence rates of childhood diarrhoea occurred among children who belonged to households that had family monthly income of less than 500 Ethiopian Birr and children whose households were in the poor asset index category. However, the bivariate analysis of the study, using the chi-square test, shows that family monthly income and household asset index were not significantly associated with childhood diarrhoea occurrence. In contrast to the findings of this study, a study in southern Asia reported that “affluence” — as measured by the value of the household asset index — was associated with a higher likelihood of young children having had diarrhoea while “poverty” — as measured by the fact of a household’s income being below a poverty line—was associated with a lower likelihood (Borooah 2004:129).

5.5.2.2 Association between mothers’/caregivers’ socio-economic and demographic factors and diarrhoea among under-five children

This study indicates that a majority of the mothers/caregivers were aged less than 30 and childhood diarrhoea occurrence was higher among children of mothers/caregivers with aged more than 30 (16.7%) as compared to those children of mothers/caregivers aged less than 30 (9.1%). However, the bivariate data analysis, using the chi-squared test, shows that mothers’/caregivers’ age was not significantly associated with childhood diarrhoea occurrence. This is similar to a previous report from the Lalitpur district of Nepal in South Asia which showed that there was no significant association between the caregivers’ ages and diarrhoeal disease occurrence among under-five children (Karki, Srivanichakorn & Chompikul 2010:248). Contrary to the finding of this study, El-Gilany and Hammad (2005:770) reported that a mother’s age significantly correlated with diarrhoea morbidity. Diarrhoea was more likely to occur among children of younger mothers (<25 years), perhaps because of their inexperience with childcare.

In this study, children of illiterate mothers account for higher prevalence rate of diarrhoea with 12.7 percent of diarrhoea cases as compared to literate mothers which accounted for 8.8 percent, the mothers' educational level, however, had no significant association with diarrhoea prevalence in children. A previous study in Kenya (Karambu et al 2013:4) found a similar lack of association between the incidence of diarrhoea and the parents´ (caretakers) level of education. Contrary to this finding, a study in the Accra metropolitan area by Boadi and Kuitunen (2005:1) reported that the education of the mother is a significant determinant of diarrhoea. Educated mothers are more exposed to the importance of hygiene, better childcare and feeding practices, and are more aware of disease causation factors and preventive measures (Boadi & Kuitunen 2005:10).

This study also finds that there was no significant difference in prevalence of childhood diarrhoea on the basis of a mother's main job. Similar results were reported on Nepal and Indonesia (Karki et al 2010:249; Rohmawati 2010:75). Another study on an East African country found that diarrhoea was significantly associated with the occupation of the parent/guardian (caretaker) (OR= 1.8, CI 1.44-4.99) (Karambu et al 2013:4).

In this study, the prevalence rate of childhood diarrhoea was lower (9.2%) in children of married mothers as compared to the others (16.3%). However, mother's marital status did not show an association with childhood diarrhoea. This finding corroborates with results from a study of secondary data analysis of a Thailand multiple indicator cluster survey of 2006 (Wilunda 2008:80).

The findings from this study indicate that the number of under-five children in the household did not show an association with childhood diarrhoea. Similarly, a study conducted in Thailand showed that there was no significant association between the number of children and diarrhoea in children (Wilunda 2008:80).

5.5.2.3 Association between childs' demographic characteristics and diarrhoea among under-five children

The results of this study show that diarrhoea was more common in children of the 12-23 months age group (11.8%). The prevalence rate among the 36-59 months age group of was 9.9%, 24-35 months was 9.2% and 0-11 months was 6.2%. However, no significant association between the prevalence of diarrhoea and the children's age was observed.

A previous study conducted in Nepal reported a similar finding which indicated that there was no significant association between diarrhoea and a child's age (Karki et al 2010:246). A study conducted in Saudi Arabia by Al-Mazrou, Khan, Aziz and Farid (1995:29) showed that the prevalence rate of diarrhoea was higher in children aged from 6 to 23 months ($p<0.01$) than in children of other age groups. According to the Ethiopian Demographic and Health Survey report of 2011, diarrhoea was most common among children aged 6–23 months (23-25 percent) (Central Statistical Agency & ICF International 2012:146).

The differences in the children's gender were not statistically significant in this study; however, the prevalence rate of diarrhoea was higher for male children (11.6%) than female children (7.3%). Similar findings have been reported in a study conducted in Indonesia that indicated that there was no statistically significant difference of diarrhoea cases in boys and girls (Rohmawati 2010:71). A study by El-Gilany and Hammad (2005:771) reported that no significant gender difference in the prevalence of diarrhoea was observed. The findings of the 2011 Ethiopian Demographic and Health Survey (Central Statistical Agency & ICF International 2012:147) have reported that childhood diarrhoea was more prevalent among males (14.3%) than females (12.5%). Studies carried out in developing countries show the importance of boys' greater environmental exposure and the greater likelihood of suffering from diarrhoea (Melo, Taddei, Diniz-Santos, Vieira, Carneiro, Melo & Silva 2008:92).

5.5.2.4 Association between house characteristics and diarrhoea among under-five children

This study did not have a statistically significant association between diarrhoea among children and any of the housing characteristics including the type of house ownership, number of rooms, type of housing construction materials (wall and roofing) and earthen floor of houses. With respect to the type of material making up the floor of the house, a similarly a study conducted in Egypt did not show an association between the flooring in the home (whether earth or cement/tile) and diarrhoea (El-Gilany & Hammad 2005:771). However, a study from Asia has reported that children who live in houses with earth floors had a higher rate of diarrhoea ($P<0.001$) than children living in houses with cemented floors. The reason is that the agents are easily transmitted through dust (Al-Mazrou et al 1995:33). A cement floor is easier to clean, and cleaning the floor assumes

greater importance in the prevention of diarrhoea, as people's shoes are easily contaminated with sewage (Genser, Strina, dos Santos, Teles, Prado, Cairncross & Barreto 2008:838).

5.5.2.5 Association between environmental health factors and diarrhoea occurrence among under-five children

5.5.2.5.1 Association between drinking water characteristics and diarrhoea among under-five children

The bivariate and multivariate analysis of this study shows that drinking water variables have little association with the occurrence of childhood diarrhoea in the studied households. This contradicts the general conception that water supply is responsible for diarrhoea. This study indicates that about two-fifths (42%) of the households had access to tap water on premises with either piped water inside the dwelling or in the yard; and children in households with access to tap water on premises (inside the dwelling and yard) had a marginally lower prevalence rate of diarrhoea (9.4%) than children from households that used other sources (public tap, tap outside yard and non-piped water source) (10.2%). However, the type of the main source of drinking water for each household (piped tap water on premises versus other sources) was not associated with prevalence of diarrhoea among children. Similar findings have been previously reported from a number of studies which found no association between drinking water and diarrhoea prevalence. In a study conducted in three East African countries, the results indicated that whether or not a household had piped water connection did not emerge as a significant determinant of diarrhoea prevalence (Tumwine, Thompson, Katua-Katua, Mujwajuzi, Johnstone, Wood & Porras 2002). In their study, Jalan and Ravallion do not find much difference in prevalence of diarrhoea between children in households that have piped water inside the premises versus those that draw water from a public tap located outside the periphery of the house. However, they found a longer duration of diarrhoeal occurrence in households using water from a public tap, thus suggesting contamination from handling and storage (Khanna 2008:6).

Not only the type of main source of drinking water but other water related variables also did not show association with diarrhoea prevalence. The bivariate analysis of this study, using the chi-square test, shows that the type of ownership of main water source

(private versus shared water source) and location of main water source (outside yard versus on premises) were not significantly associated with childhood diarrhoea occurrence. Contrary to the finding of this study, a research done in Indonesia indicated that a household which has a drinking water source had fewer children with diarrhoea than the household with a sharing or public facility drinking water source (Rohmawati 2010:78). A study in Accra, Ghana, also showed that the presence of drinking water at a household level had a negative association with the incidence of childhood diarrhoea (Boadi & Kuitunen 2005:4).

From the findings of this study, it emerged that households had access to a source of drinking water within reasonable time and distance to fetch drinking water as over four-fifths of the households (82%) took 30 minutes or less to fetch drinking water and four-fifths of the households (79.7%) had access to water within 200 metres distance from their dwelling house. The bivariate data analysis from the study shows that the time to obtain drinking water (round trip) and the distance of a water source from the dwelling were not associated with diarrhoea occurrence in children. On the contrary, several studies have shown the important role of time and distance to water source in the occurrence of diarrhoeal diseases. In a study conducted in Tanzania, the distance from the house to the water source was associated with the risk of diarrhoea (Gascón, Vargas, Schellenberg, Urassa, Casals, Kahigwa, Aponte, Mshinda & Vila 2000:4459). A systematic review and meta-analysis by Wang and Hunter (2010:582) regarding the relationship between the distance that people have to carry water home and ill health shows that the combined odds ratio (OR) indicated a significant increase in illness risk in people living farther away from their water source (OR = 1.45; 95% confidence interval [CI] = 1.04–1.68).

The results of this study indicate that the mean per capita per day water consumption of the households was 12.4 litres. This is below the recommendation of a daily per capita consumption of 20 litres by the World Health Organization (WHO) and United Nations Children's Fund (UNICEF) (2000:77). Ethiopia has developed a universal access approach to reach every citizen with 20 litres within 0.5 kilometres for urban areas (WaterAid Ethiopia 2012:9).

The bivariate analysis of the study results show that water consumption from a mean daily amount of 12 litres per capita per day was not significantly associated with under-

five childhood diarrhoea. After controlling the influences of other variables during multivariate analysis, the mean water consumption (litres/person/day) had a significant effect on childhood diarrhoea (AOR: 0.43; 95% CI 0.20 – 0.94; p=0.034). Although statistically significant, the adjusted odds ratio shows that it was inversely related. However, studies indicate that accessible and plentiful supplies of water facilitate and encourage better hygiene in general, and more hand-washing in particular. A study finding from Nicaragua shows that children from homes with poor water availability had a 34% higher rate of diarrhoea (Curtis et al 2000:27). Increased water availability and quantity associated with improved hygiene, may reduce faecal contamination of the hands, proper cleaning of utensils, food, and the home environment (Boadi & Kuitunen 2005:8).

In this study, the water storage practices were generally good, as about two-thirds (67.8%) of the households had used plastic jerry can containers, an overwhelming majority of households (98.4%) had covered their stored drinking water, over two-thirds (68.8%) of the households had used narrow-necked containers for drinking water storage, an overwhelming majority of the households (92.4%) had kept their drinking water containers clean, an overwhelming majority of the households (96.9%) cleaned their containers at least once or more per week and over two-thirds of the households (69.4%) had mentioned the use of pouring to draw water from a container. The chi-square test in the bivariate analysis shows that there was no significant association between childhood diarrhoea and variables related to water storage practices including water storage at home for all purpose of domestic water use, drinking water storage in separate containers from other domestic water storage, the type of main water storage containers, availability of water container covers, cleanliness of the inside of containers used for drinking water storage and the method of water drawing.

Contrary to this finding of the study, a descriptive cross-sectional study conducted in Kenya to assess the effects of water, sanitation and health education interventions on diarrhoeal morbidity among children under-five years in Mandera district, found that hygiene practices at the household level were the main factors in the spread of diarrhoea, including storing drinking and water for other purposes in the same container (X^2=8.471; *p*=0.004) and scooping of drinking water by pouring from the container (X^2=20.981; p=0.000) (Sheillah 2014). Günther and Schipper found that improved

methods of water storage were associated with a significantly lower risk of self-reported diarrhoea (Shaheed, Orgill, Montgomery, Jeuland & Brown 2014:284).

Slightly over half of the study households (54.3%) had treated their drinking water at home and the bivariate analysis of the study using chi-square test indicated that there was a significance association between diarrhoea and household-based drinking water treatment. Children of households that did not treat their drinking water had a higher prevalence of diarrhoeal disease than those children whose households treated their drinking water at home. However, after controlling the influence of other variables in the multivariate analysis, childhood diarrhoea and household-based drinking water treatment had no significant association. Similarly, a study conducted in Kenya found that none of the water treatment methods used by households had any association with diarrhoea (Karambu et al 2013:4). In contrast, a cross-sectional analytical study conducted in Tanzania showed that treating water with any method (AOR=0.49, 95% CI 0.28-0.84) and treating water by boiling (AOR=0.39, 95% CI 0.2-0.7) were associated with reduced risk of diarrhoea (Kakulu 2012:vii).

5.5.2.5.2 Association between excreta disposal characteristics and diarrhoea among under-five children

An overwhelming majority of households (92.7%) had toilet facilities that members of the household usually used and the bivariate analysis shows that children in households that did not have toilet facilities had a higher rate of child diarrhoea than those households that had toilet facilities. However, the availability of toilet facilities for the use of household members did not show any statistically significant association with diarrhoea in children. On the contrary, a study conducted in Ghana found that the availability of a toilet facility is inversely related with the incidence of diarrhoea (r (489) = -0.29, $p<0.0001$) (Boadi & Kuitunen 2005:5).

The study findings indicate that over one-third of the households used unimproved toilet facilities and childhood diarrhoea prevalence was higher in households that used unimproved toilets (12.9%) than those that used improved toilet facilities (8.6%). However, the type of toilet facility used showed no significant association with diarrhoeal disease in children when examined in the bivariate analysis. In the multivariate analysis, the type of toilet facility used was significantly associated with childhood diarrhoea and

showed a significant negative effect (AOR: 0.37; 95% CI 0.16 – 0.87; p=0.023). This means that children of households with improved toilet facilities had a lower prevalence of diarrhoeal disease than those children whose households used unimproved toilets. This indicates the importance of the availability of improved toilet facilities and its health impact in reducing childhood diarrhoea.

The study results show that the type of toilet ownership (private toilet versus shared toilet) had no statistically significant association with childhood diarrhoea occurrence. The findings of this study did not concur with a previous study conducted in Ghana which reported that households that shared a toilet facility with more than five other households are more likely to have high incidence of childhood diarrhoea ($p<0.0001$) (Boadi & Kuitunen 2005:5). The shared status of a toilet facility can be less hygienic than facilities used by a single household (World Health Organization & United Nations Children's Fund 2006:13). A high sharing of toilet facilities creates unsanitary and unkempt conditions which provide conducive environments for vectors and pathogenic organisms associated with diarrhoea infection, and also increases the possibility of transmitting pathogens from infected household to others (Boadi & Kuitunen 2005:9).

The results of this study indicate that there was no statistically significant association between diarrhoea in children and toilet cleanliness. Some studies have found that an unimproved toilet facility that is not constantly clean is a route for infection (Fayehun 2010:21).

In this study, the children's stool in a majority of households was contained and out of every five households, four had either dropped into the toilet facility or buried (81%) it. The bivariate analysis using the chi-square test shows that childhood diarrhoea was not significantly associated with child defecation methods and a mother's stool disposal practices. The association between childhood diarrhoea and child defecation and stool disposal practices has been investigated in a number of studies. Indiscriminate defecation near the home or in living areas was found to be associated with an increased incidence of diarrhoea (Curtis et al 2000:26).

5.5.2.5.3 Association between wastewater disposal characteristics and diarrhoea among under-five children

The study results indicate that two-thirds of the households (67.9%) had used unsafe wastewater disposal methods and childhood diarrhoea prevalence was higher in households that used improper methods of wastewater disposal (n=36, 11.1%) than those households that used proper wastewater disposal methods (n=11, 7.2%). However, this relationship was not statistically significant in the bivariate and multivariate analysis. On a contrary, a cross-sectional study conducted among children aged 12–59 months in East Jakarta's urban areas showed that children living in a house with less dirty sewage had a significantly lower diarrhoea prevalence compared to those who did not (AOR: 0.16, 95% CI 0.03-0.73) (Agustina et al 2013:1).

5.5.2.5.4 Association between solid waste handling and disposal characteristics and diarrhoea among under-five children

In this study, childhood diarrhoea was not significantly associated with the type of household solid waste disposal method, availability of solid waste storage containers, availability of solid waste container cover and nor the cleanliness of the home environment. Similarly, a study in Atwima Nwabiagya District of the Ashanti Region of Ghana showed that there was no statistically significant association between childhood diarrhoea and refuse disposal (Danquah et al 2014:124). In contrast, studies conducted in the Congo and Nigeria have found that improper refuse disposal was associated with an increased prevalence of diarrhoea (Harner, Simon, Thea & Keush 1998:11).

5.5.2.5.5 Association between hygiene behaviours and knowledge characteristics and diarrhoea among under-five children

The findings of this study did not show significant association between diarrhoea and the availability of soap in houses on the day of the interview. However, the findings of the present study differ from the results of the previous research conducted on a Malawian refugee camp as 27% fewer diarrhoeal episodes were reported in houses with soap (Peterson, Roberts, Toole & Peterson 1998:520).

In the bivariate analysis, there was no statistically significant association between diarrhoea among children and those households that used soap for washing during the previous 24 hours (p=0.06). The bivariate analysis also indicates that, except washing a child's bottom after defecation which showed statistically significant association with childhood diarrhoea (p=0.05), all the variables of mother's washing practices with soap including washing hands and her body, washing the children's hands, washing clothes and washing the children's body did not show significant association with childhood diarrhoea. After controlling for other variables in the multivariate analysis, washing a child's bottom after defecation was not significantly associated with diarrhoea occurrence. Even though washing hands with soap did not show a significant relationship with diarrhoea in this study, the importance of using soap to clean the hands of microbiological contamination and its association with reducing the risk of diarrhoea have been demonstrated consistently in the past in several studies (Saadé, Bateman & Bendahmane 2001:40).

Mothers' practices on handwashing with soap in all of the most important occasions (before eating food, after eating food, after going to toilet, before preparing food, before feeding children, after cleaning child's bottom and when hands are dirty) did not show any significant relationship with diarrhoea in children. Similarly, a cross-sectional survey in Bangladesh reported that there was no significant association between handwashing with or without soap before feeding a child, before eating, or after cleaning a child's bottom after defecation and subsequent child diarrhoea (Luby, Halder, Huda, Unicomb & Johnston 2011:1). In addition, a mother's handwashing practices with soap at five critical times were analysed on the basis of the category of good and poor practice levels and it was found that there was no significant relationship between diarrhoea in children and mothers practices of handwashing with soap. However, studies indicate that handwashing with soap at key times is a major way to prevent diarrhoeal diseases and respiratory infection. Research by Curtis and Cairncross (2003) suggests that handwashing with soap, especially after defecating and handling a child's stools, can reduce diarrhoea by 42-47%, even in areas with poor sanitation and high levels of faecal contamination (Environmental Health Project 2004:17).

The results of this study in the bivariate analysis, using a chi-square test, show that apart from the mothers' knowledge on hand-washing with soap before feeding children, which showed statistically significant association with childhood diarrhoea, the mothers'

knowledge in all of the other most important times to wash hands with soap did not show significant association. After controlling for other variables in the multivariate analysis, the mothers' knowledge on hand-washing with soap before feeding children was not significantly associated with diarrhoea occurrence.

In addition, the mothers' hand-washing knowledge with soap at five critical times was analysed in the bivariate analysis using a chi-square test, basing on the category of good and poor knowledge levels. It was found that there was no significant relationship between diarrhoea in children and the mothers' knowledge of hand-washing with soap. However, other studies indicate that a lack of awareness among mothers about hygiene (such as the use of soap, ash or soil for hand-washing by mother and children after defecation and before having main meals) leads to the exposure of children to diarrhoea (Alam 2007:104). According to studies conducted by the Sanitation Family Education Project in Bangladesh, it was found that the knowledge of poor hand-washing practices as a cause of diarrhoea is particularly important and most strongly associated with the risk of diarrhoea (Bateman et al 1993:9).

Studies have shown that the existence of a designated place for hand-washing is a good approximation of actual hand-washing practice and closely related to diarrhoeal disease prevalence (Kelly, Khanfir, David, Arata & Kleinau 1999:23). In the bivariate analysis, it was found that there was a significant association between availability of specific places for hand-washing and diarrhoea in children of under-five years. This significant association was retained even after controlling for all the other variables in the multivariate analysis. Children from households where the households had a specific place for hand-washing were 0.40 times less likely to have diarrhoea as compared to those children from households that did not have specific places for hand-washing (AOR: 0.40; 95% CI 0.18 – 0.90; p=0.026). Studies in developing countries have found out that a hand-washing facility or station where soap and water are co-located at a dedicated place in the home for hand-washing at key times, are an important determinant of good hand-washing with soap habits (Jenkins, Anand, Revell & Sobsey 2013:295).

The results of this study in the bivariate analysis show that there was significant difference in childhood diarrhoeal disease among households that had hand-washing devices (facilities) compared with those that did not have. Even after controlling for

other variables, the difference in the risk of diarrhoea remains significant. Children from households that had hand-washing facilities were 0.20 times less likely to have diarrhoea as compared to those that did not have hand-washing facilities (AOR: 0.20; 95% CI 0.06 – 0.70; p=0.012).

Although water for hand-washing at the hand-washing specific places showed an association with the occurrence of childhood diarrhoea in the bivariate analysis, after controlling for the influences of other variables it indicated no significant association with diarrhoea morbidity. The findings of the study also show that the availability of other items, such as bar soap, detergent and liquid soap for hand-washing at hand-washing specific places did not show significant association with childhood diarrhoea.

The mothers' knowledge of at least three ways to prevent diarrhoea was not significantly associated with childhood diarrhoea in this study. On the other hand, the mothers' knowledge of at least three causes of diarrhoea was significantly associated with childhood diarrhoea in the bivariate analysis. This significant association was maintained even after controlling for the effects of other variables in the multivariate analysis. Children whose households had poor knowledge on at least three causes of diarrhoea were 3.09 times more likely to develop diarrhoea than those that had a good knowledge (AOR: 3.09; 95% CI 1.24 – 7.68; p=0.015).

A cross-sectional survey, conducted as a baseline survey to provide data for monitoring the impact and effectiveness of a water supply and sanitation intervention project, showed that responses to four of the survey questions reflecting the knowledge of disease causation and prevention were associated on their own with significant differences in diarrhoea prevalence among the index children (Kelly et al 1999:ix). Children whose caretakers thought that washing the children's hands, supervising what they eat, washing fruits and vegetables, and washing kitchen utensils are important preventive actions had a lower prevalence of diarrhoea. All such practices were protective against diarrhoea, reducing risk by about 40% when compared with children of mothers who thought that these practices were unimportant in diarrhoea prevention.

5.6 CONCLUSION

In conclusion, this chapter presented the research results and the discussion of the study which show the magnitude of the domestic environmental health conditions and explored its relationship with childhood diarrhoea prevalence in the study households of Sebeta town in Ethiopia. Prevalence of childhood diarrhoea over a period of two weeks was 9.9%. In the bivariate analysis, using the chi-squared test and Fischer's exact test, a number of risk factors, such as area of residence, household head education, household-level water treatment, mothers' washing practices with soap for washing child's bottom after defecation, availability of specific places for handwashing, availability of handwashing devices (facilities), availability of water for handwashing at the specific handwashing places, mothers' knowledge on handwashing with soap before feeding children and mothers' knowledge on at least three causes of diarrhoea appeared to be significantly associated with under-five childhood diarrhoea. During multivariate analysis, four factors were independently associated with the risk of childhood diarrhoea in the expected direction; these were the type of toilet facilities, availability of specific places for handwashing, availability of handwashing devices (facilities) and mothers' knowledge on diarrhoea causation. Thus, the findings of this study indicate that childhood diarrhoea has a number of environmental determinants, notably due to both the facilities and behavioural aspects of environmental health factors.

The following chapter focuses on conclusions and recommendations of the research.

CHAPTER 6

SUMMARY, CONCLUSIONS, RECOMMENDATIONS, CONTRIBUTIONS AND LIMITATIONS OF THE STUDY

6.1 INTRODUCTION

This chapter presents the summary of the study with the major findings, conclusions drawn from the main research findings, the contributions of the study and its limitations. The study's recommendations, issues for further research and concluding remarks are also described in the chapter.

6.2 SUMMARY OF THE STUDY FINDINGS

In Chapter 1, the aim of the study, the research questions and the theoretical framework of the study, which formed the basis of the research, was presented. The purpose of this study was to assess and explore the household environmental health factors associated with the occurrence of diarrhoea in children under-five years in Sebeta town of Ethiopia, in order to develop environmental health strategies to optimise actions to be prioritised in the prevention of childhood diarrhoea. The objectives of the study were to identify the demographics and other factors related to childhood diarrhoea; assess the environmental risk factors of childhood diarrhoea with regard to water, environmental sanitation and hygiene practices of the households; determine the prevalence of diarrhoea among children under-five years among the study households; and explore the relationship between households' environmental health factors and the occurrence of diarrhoea among children under-five years. This research was therefore conducted at household level in Sebeta town on the basis of the aforementioned aim and research questions of the study.

A total of 77 factors were assessed using bivariate analysis by Chi-square tests or Fisher's exact tests for their association with childhood diarrhoea. Of these, 9 variables showed significant association in the bivariate analysis at *p*-value less than or equal 0.05. Variables that were significant at *p*-value less than 0.25 in the bivariate analysis were subsequently included in the multivariate regression analysis. The stepwise

regression method using backward regression technique was used and four variables were independently associated with the risk of childhood diarrhoea.

This study has provided some important insights into the role that water supply, basic sanitation, waste management and hygienic practices play in Sebeta town's studied households. The major finding of the study is that the prevalence of childhood diarrhoea was 9.9% and the average duration of diarrhoea in children was 3.3 days. The study also led to the conclusion that childhood diarrhoea has a number of environmental determinants, notably due to environmental health factors associated with the lack of appropriate household sanitation facilities and poor hygiene knowledge and practices.

The major findings of the study regarding environmental health risk factors in relation to childhood diarrhoea are summarised and presented below.

6.2.1 Prevalence, type and duration of diarrhoea among under-five children

Despite the less prevalence of childhood diarrhoea in the study households of the town, as compared to national and regional prevalence rates, diarrhoea clearly remains one of the causes of morbidity in children with prevalence rate of 9.9% and mean duration of 3.3 days. The prevalence rate for diarrhoea with blood among total study households was 1.3%. Childhood diarrhoea prevalence rate during the interview day among children was found to be 2.1%.

6.2.2 Socio-economic and demographic factors

A bivariate analysis was performed using a chi-square test to examine the relationship between childhood diarrhoea and households' socio-economic and demographic factors, mother's/caregiver's socio-economic and demographic factors, child's' demographic factors and housing factors. The bivariate analysis shows that except for area of residence and household head education, there was no significant association between the children's diarrhoea and all of the other household head's, mother's and children's' socio-economic and demographic and housing factors included in the study. During the multivariate analysis, no factors from the socio-economic and demographic and housing characteristics were independently associated with the risk of childhood diarrhoea.

6.2.3 Household drinking water

The bivariate and multivariate analysis of this study shows that drinking water variables have little association with the occurrence of childhood diarrhoea in the studied households, which contradicts the general conception that water supply is responsible for diarrhoea. There was no statistically significant association between childhood diarrhoea and the type of the main source of drinking water at the household, ownership of main water source, location of main water source, time to obtain drinking water (round trip) and distance of water the source from the dwelling. The results of this study also show that there was no significant association between childhood diarrhoea and other water-related variables including the person who fetched water from the main water source, water storage at home for all purposes of domestic water use, drinking water storage in separate container from other domestic water storage, type of main water storage container, availability of narrow necked drinking water storage container, cleanliness of the inside of container used for drinking water storage and methods of water drawing. The chi-square test in the bivariate analysis shows that household-level drinking water treatment (p=0.05) was significantly associated with childhood diarrhoea occurrence; however, after controlling the effects of other variables, childhood diarrhoea and household-based drinking water treatment had no significant association. The study shows that water consumption from mean daily amounts of 12 litres per capita per day was not significantly associated with under-five childhood diarrhoea during bivariate analysis. After controlling the influences of other variables, the mean water consumption (litres/person/day) had a significant effect on childhood diarrhoea (AOR: 0.43; 95% CI 0.20 – 0.94; p=0.034); though it was inversely related.

6.2.4 Excreta disposal

The analysis shows that availability of toilet facilities for the use of household members did not show a statistically significant association with diarrhoea in children. The study indicated that the type of toilet facility used has no significant association with diarrhoeal disease in children when examined in the chi-square test. In the regression analysis, the type of toilet facility used was significantly associated with childhood diarrhoea and showed a negative significant effect (AOR: 0.37; 95% CI 0.16 – 0.87; p=0.023). This means that children from families with improved toilet facilities had a lower prevalence of diarrhoeal disease than those children whose families used unimproved toilets. The

data analysis of the study also indicated that there was no statistically significant association between diarrhoea in children and the type of toilet ownership, toilet cleanliness, defecation practices of children and the mother's/caregiver's stool disposal practices.

6.2.5 Wastewater disposal

Childhood diarrhoea prevalence was higher in households that used improper methods of wastewater disposal (n=36, 11.1%) than those households that used proper wastewater disposal method (n=11, 7.2%). However, this relationship was not found to be significant in the data analysis.

6.2.6 Solid waste disposal

In this study, childhood diarrhoea was not significantly associated with the type of household solid waste disposal method, availability of solid waste storage container, availability of solid waste container cover and cleanliness of the home environment.

6.2.7 Hygiene behaviours and knowledge

The association between diarrhoea among under-five children and hand-washing knowledge and practices of mothers/caregivers were analysed. The chi-square test shows that there was no association between diarrhoea and availability of soap in houses on the day of interview (p=0.41). In addition, there was no statistically significant association between diarrhoea in children and those households that used soap for washing during the previous 24 hours (p=0.06). Mothers'/caregivers' practices on hand-washing with soap in all of the most important occasions (before eating food, after eating food, after going to toilet, before preparing food, before feeding children, after cleaning a child's bottom and when hands are dirty) did not show significant a relationship with diarrhoea in children. In addition, the mothers'/caregivers' knowledge in all the most important times to wash hands with soap did not show significant association. The study shows that there was significant association between diarrhoea in children and the availability of a specific place for hand-washing (AOR: 0.40; 95% CI 0.18 – 0.90; p=0.026) as well as the availability of a hand-washing device (facility) (AOR: 0.20; 95% CI 0.06 – 0.70; p=0.012).

The chi-square test during the bivariate analysis shows that a mothers/caregiver's knowledge of at least three causes of diarrhoea and knowledge of at least three ways to prevent diarrhoea were not significantly associated with childhood diarrhoea. After adjusting the effects of other variables, the mothers'/caregivers' knowledge of diarrhoea causation was significantly associated with diarrhoea in index children (AOR: 3.09; 95% CI 1.24 – 7.68; p=0.015).

6.3 CONCLUSIONS

The prevalence of childhood diarrhoea over a period of two weeks preceding the study was 9.9%. In the bivariate analysis using chi-squared test and Fischer's exact test, a number of risk factors including area of residence, household head's education, household-level water treatment, mother's/caregiver's washing practices with soap on washing a child's bottom after defecation, availability of specific places for hand-washing, availability of hand-washing devices (facility), availability of water for hand-washing at the specific hand-washing places, the mother's/caregiver's knowledge on hand-washing with soap before feeding children and the mothers'/caregivers' knowledge on at least three causes of diarrhoea appeared to be significantly associated with under-five childhood diarrhoea. In the logistic regression, socio-economic, demographic and housing factors were not significantly associated with diarrhoea prevalence. Rather, the multivariate regression model of the study indicated that the following four variables were independently associated with the risk of childhood diarrhoea in the expected direction: the type of toilet facility, availability of specific places for hand-washing, availability of hand-washing devices (facility) and the mothers' knowledge on diarrhoea causation.

6.4 RECOMMENDATIONS

Based on the findings of the study, the following recommendations were made in order to improve the identified environmental health risk factors with the aim to prevent childhood diarrhoea in the studied town. These are:

1. Urban sanitation promotion

- Increased emphasis should be made on the availability and use of improved toilet facilities by developing and implementing a sustainable programming and planning framework for the development of town-wide urban sanitation programmes that expand improved sanitation coverage to as many residents as possible in order to achieve a universal access to improved sanitation.
- To achieve universal access to improved sanitation by households, it would be essential to promote household access to appropriate sanitation facilities with appropriate sanitation technology options that address the city-wide nature of the challenge; and incremental sanitation (sanitation ladder) that allows consumers to choose an option depending on their preferences and ability to pay and provide an avenue to upgrade services for improved sanitation coverage.

2. Hand-washing promotion

- Promoting the availability and use of specific place for hand-washing for the washing of hands and particularly locating them in or near the toilet facility is essential. There should also be a promotion of the availability and use of hygienic hand-washing facilities for washing of hands so as to facilitate hand-washing at critical times.

3. Hygiene promotion

- Promoting proper hygiene behaviours through hygiene promotion programmes for mothers (caregivers), household members and communities on the availability and use of improved sanitation facilities and good hygiene practices particularly focusing on the availability and use of hand-washing designated places and hand-washing facilities and mothers'/caregivers' knowledge about the causes of diarrhoea.
- A city-wide hygiene promotion programme should be developed and implemented for the promotion of good hygiene behaviours and practices that help households and communities to prevent diarrhoeal diseases. The programme should particularly focus on advocacy, social mobilisation,

community participation, communication interventions and work in a participatory manner through sustainable community-based structures and frontline health workers.

4. Further research

Further research based on a country-wide approach on the country's urban settings is essential for a further understanding of the complete dynamics of diarrhoea morbidity and the associated environmental health and other related risk factors in the towns of Ethiopia. This study should consider seasonal variations in the prevalence of diarrhoea and include a comparative study on differentials of child diarrhoea in urban and rural settings.

6.5 CONTRIBUTIONS OF THE STUDY

The research findings will contribute to the body of knowledge and research on the subject area of the study. This study has documented valuable findings about the prevalence of diarrhoea among under-five children and household environmental health risk factors such as sanitation and hygiene conditions that contribute to the occurrence of diarrhoea in an urban setting of Sebeta town in Ethiopia. The study gives an insight into the environmental health and hygiene status in relation to childhood diarrhoea at household level and has identified a number of environmental health risk factors associated with lack of improved sanitation and hand-washing facilities and poor knowledge on diarrhoea causation. This is of importance in the design and development of targeted interventions to improve household environmental health conditions for prevention of childhood diarrhoea. It, therefore, adds to the body of knowledge, and research on environmental health, urban sanitation and hygiene promotion programmes and the prevention and control of diarrhoea.

The study has also some important planning, policy and practice implications in the following ways:

- The research findings, recommendations and strategies will have important contributions in setting the benchmarks and examining progress in the

implementation of environmental health and health extension programmes of the country at local levels.

- The study pointed out the recommendations on which to focus for the prevention of childhood diarrhoea by enhancing universal access to improved sanitation, household hygiene technologies for hand-washing and promoting proper hygiene behaviours through hygiene promotion.
- The findings of the study will have important contributions in tackling and addressing the identified risk factors of childhood diarrhoea at household level and can be used to educate and raise awareness specially targeting communities and households on the identified environmental risk practices for the prevention of childhood diarrhoea.
- The findings of the research and the strategies will be informative for planners, policy makers and implementers in the overall effort to review, formulate and implement through the introduction of feasible and innovative urban sanitation and hygiene promotion programme strategies for the prevention of childhood diarrhoea.

6.6 LIMITATIONS OF THE STUDY

In view of Grove et al (2013:598), limitations refer to restrictions or problems in a study that may decrease the generalisability of the findings. Some of the limitations from this study are as follows:

- The study units (households) that were included in the study were from the municipal communities of Sebeta town in Oromiya Regional State and other towns in Ethiopia were not included in this study. Research results therefore were limited to this particular town and may not be generalised to other towns in the country.
- As a cross-sectional study in the design where the study units were sampled from the population at a particular point in time, it shares the drawbacks of similar cross-sectional studies. Hence the study was not a trend or follow-up type of research and did not consider seasonal differences in the occurrences of diarrhoea (see section 5.5.1).

6.7 CONCLUDING REMARKS

The findings of the study provide important insights into household environmental health risk factors associated with the occurrence of diarrhoea in children under-five years. The study has identified important environmental determinants that contribute to the occurrence of diarrhoea in under-five children. Both facilities (technologies) and behavioural aspects of environmental health act more notably as determinants of childhood diarrhoeal disease. The findings of the study concludes that childhood diarrhoea has a number of environmental determinants, particularly due to environmental health risk factors associated with lack of improved sanitation and hand-washing facilities and poor knowledge on diarrhoea causation. This clearly indicates the importance of environmental health as a determinant of child health; the significance of focussing on the primary barriers from the F-diagram model of faecal-oral disease transmission prevention and control; the importance of providing priority to the promotion on the availability and use of improved sanitation technologies and good hygiene practices particularly focusing on the availability and use of hand-washing designated places and hygienic hand-washing facilities; and ensuring mothers'/caregivers' knowledge about the causes of diarrhoea. This implies that hygiene promotion programmes should give priority to the safe disposal of excreta material, the adequate washing of hands and increasing mothers'/caregivers' knowledge on the causes of diarrhoea to encourage appropriate hygiene practices. These actions need to be addressed in the planning and implementation of urban environmental health, sanitation and hygiene promotion programmes for the prevention of diarrhoea. The findings of this study, therefore, recommend that there is a need for effective measures to curtail the prevalence of diarrhoea among children by enhancing universal access to improved sanitation, household hygiene technologies for hand-washing and promoting proper hygiene behaviours through hygiene promotion.

The following chapter focuses on the development of urban environmental health strategies for the prevention of childhood diarrhoea.

CHAPTER 7

DEVELOPMENT OF ENVIRONMENTAL HEALTH STRATEGIES FOR PREVENTION OF CHILDHOOD DIARRHOEA

7.1 INTRODUCTION

This chapter presents the urban environmental health strategies for the prevention of childhood diarrhoea. The strategies design was based on the study main findings, theoretical framework of the research and the related literature review conducted. The ultimate aim of the study was to formulate environmental health strategies in order to optimise actions to be prioritised in the prevention of childhood diarrhoea.

7.2 URBAN ENVIRONMENTAL HEALTH STRATEGIES FOR THE PREVENTION OF CHILDHOOD DIARRHOEA

A strategy is a systematic, well-planned series of actions, combining different methods, techniques and tools, to achieve an intended change or objective utilising the available resources within a specific time frame (Mefalipulos & Kamlongera 2004:8). The process for developing the urban environmental health strategies for the prevention of childhood diarrhoea was based on the main findings of the current study, the theoretical framework of the research which was based on the F-diagram model of faecal-oral disease transmission prevention and control (described in chapter 1 and 3), and the related literature review. The literature review for the development of strategies were focused on the assessment of the country's status on environmental health, sanitation and hygiene promotion programmes, review of factors affecting the progress of environmental health implementation with emphasis in prevention of diarrhoea, institutional and policy issues, finance and human resources.

There are slow progresses for the effective implementation of sanitation programmes for the prevention of diarrhoea in Ethiopia. The main problems are due to the low level priority of sanitation at all levels; limited resources for the promotion of sanitation and hygiene which mainly depended on donor and non-governmental organisation support (only one percent of the health budget is available for sanitation and hygiene

promotion); unclear institutional framework, roles and responsibilities; lack of appropriate and cost-effective sanitation technologies and poorly constructed latrines in sanitation projects; and subsidies that have created unrealistic local expectations as a variety of subsidised latrine slabs have been applied (Ministry of Health of Ethiopia 2005b:17). Furthermore, the major problems in the sector are due to an inadequate policy implementation as a result of limited finance and capacity. Besides the financial constraints to the improvement of Ethiopia's sanitation condition, there are also technical skills and implementation gaps regarding effective use of participatory approaches, social marketing and micro-credit or use of the revolving fund to finance for promotion of sanitation programmes. There is also no separate urban sanitation strategy that was formulated nor is there a clear institutional understanding regarding urban sanitation guidance (Water Supply and Sanitation Collaborative Council 2009:4).

The findings of the present study have identified risk factors for the occurrence of childhood diarrhoea in the study area. Based on these findings, as well as the theoretical framework of the research and related literature review, recommended strategies for the prevention of diarrhoea are proposed and presented in detail in this chapter. The strategies to promote environmental health for the prevention of childhood diarrhoea that emerge from this research are organised into five main categories, with each category subdivided into a number of strategies. The recommended environmental health strategies for the prevention of diarrhoea are presented under the following subheadings:

1) *Planning and programming of urban sanitation and hygiene promotion programmes for diarrhoea prevention*
    - ♦ Planning through appropriate sanitation programming frameworks and sanitation promotion approaches
    - ♦ The guiding programming framework of urban sanitation and hygiene promotion for diarrhoea prevention

2) *Urban sanitation promotion*
    - ♦ Promoting appropriate and sustainable sanitation technologies to accelerate improved sanitation coverage
    - ♦ Service delivery systems for the urban sanitation services to ensure sustainability
    - ♦ Reaching the unserved populations and the urban poor

3) Hand-washing promotion

- Increasing the availability of designated places for hand-washing and to encourage appropriate hygiene practices
- Increasing the availability of hand-washing facilities for the encouragement of appropriate hygiene practices

4) Hygiene promotion

- Advocacy
- Social/community mobilisation
- Community participation and community groups and organisations
- Social marketing
- Communication and education methods in hygiene promotion

5) Strengthening the enabling environment

- Policy environment and specifying regulatory and policy issues
- Institutional framework: Establishing sanitation task forces and implementing agency for the city-wide sanitation promotion programmes
- Financing and resource allocation and mobilisation
- Human resource development, capacity building and training

7.2.1 Planning and programming of urban sanitation and hygiene promotion programmes for diarrhoea prevention

7.2.1.1 Planning through appropriate sanitation programming frameworks and sanitation promotion approaches

To enhance the coverage and accessibility of improved household sanitation and hygiene facilities for underserved population in order to prevent childhood diarrhoea, it is imperative to explore successful sanitation programming frameworks and approaches. Programming frameworks are sanitation and hygiene organising ideas or frameworks that can be used to plan project and programme interventions (Peal et al 2010:95). There have been a number of innovative initiatives providing the coverage of sanitation services from different parts of the world. These approaches are based on demand-driven and participatory approaches that both motivate community involvement and

encourage appropriate technology which better fits the realities in the field (Lüthi, McConville & Kvarnström 2010:50). It would be essential to explore the successful programming frameworks and approaches for sanitation planning, and implementation from within the country and abroad, and implement such successful programmes.

Three sanitation and hygiene promotion programming frameworks which are useful in planning and programming of sanitation and hygiene promotion programmes and projects for the prevention of diarrhoea are discussed below.

7.2.1.1.1 Hygiene improvement framework (HIF)

The Hygiene Improvement Framework (HIF) is an overarching concept for the prevention of diarrhoea that is applicable in both urban and rural areas. It was originally developed by the Environmental Health Project (EHP) of the United States Agency for International Development (USAID) and it has been further refined by United Nations Children's Fund (UNICEF), the Water and Sanitation Programme of the World Bank (WSP) and others (Peal et al 2010:106). Hygiene improvement is a comprehensive approach to prevent childhood diarrhoea (Kleinau & Pyle 2004:1). This framework is based on the premise that in order to prevent diarrhoea, an intervention should comprise three components: access to hardware, hygiene promotion and an enabling environment (Peal et al 2010:106). It is a combination of improving access to water supply and sanitation hardware and household technologies; promoting hygiene; and strengthening the enabling environment to ensure the sustainability of hygiene improvement activities (Kleinau & Pyle 2004:1). These three components are the key elements of the framework and are designed to encourage household behaviours that reduce the incidence of childhood diarrhoea (Peal et al 2010:106).

7.2.1.1.2 Community-led total sanitation (CLTS)

In its pure form community-led total sanitation (CLTS) is a 'no subsidy' approach to rural sanitation that – through participatory methodologies – helps communities to recognise the problem of open defecation and take collective action to become 'open defecation free' (WaterAid 2012:26). Community-led total sanitation is a grassroots approach that uses community involvement to increase sanitation coverage. Based on Participatory Rural Appraisal (PRA) tools and approaches, CLTS emphasises the importance of self-

respect and dignity to help communities achieve open defecation free status. Its application implies a shift from counting latrines to counting sanitised communities, and abandoning the use of subsidies (Hygiene Improvement Project 2010:ii). The Government of Ethiopia has endorsed community-led total sanitation (CLTS) as an approach for the promotion of sanitation and hygiene in the country (Community-Led Total Sanitation 2013).

7.2.1.1.3 Household-centred environmental sanitation (HCES)

Household-centred environmental sanitation (HCES) is an area-based planning approach which targets unserved or underserved urban communities (Lüthi & Parkinson 2011:2). It places the household and neighbourhood at the core of the planning and implementation process (Peal et al 2010:103). It integrates water supply, storm-water and sewage management; facilitates the incorporation of input from diverse actors; and utilises the concept of urban zones to enhance the implementation of decentralised options. It proposes a 10-step process initiated with a direct request from a community or community leader and culminating in the implementation of plans developed during the planning process (Lüthi et al 2010:52).

The process of learning the case studies validation has led to the refinement and streamlining of a new urban planning framework that organizes and guides urban environmental sanitation planning (Lüthi 2012:187). The updated planning guideline is called Community-Led Urban Environmental Sanitation (CLUES), which is based on the lessons learned from piloting the HCES approach. The name change from HCES to CLUES highlights the importance of broad community involvement (beyond the household level) in the planning and decision-making processes. Although the name changed, the main characteristics stay the same: a multi-sector and multi-actor approach accounting for water supply, sanitation, solid waste management and storm drainage and emphasising the participation of all stakeholders from an early stage in the planning process (Lüthi, Morel, Tilley & Ulrich 2011:5).

Combined approaches of household-centred environmental sanitation (HCES) and community-led total sanitation (CLTS) for urban contexts: The two approaches, HCES and CLTS, have complementary features that make a combination of both approaches ideal for tackling sanitation service delivery in a sustainable manner in

challenging urban and peri-urban contexts. The CLTS approach with its triggering and stimulating positive behavioural change has strengths in creating genuinely meaningful action through a community-led and community-owned process. However, CLTS cannot maintain a more complex sanitation system as this involves stakeholders at higher levels than the community. HCES on the contrary, with its forte as a structured planning methodology with multi-stakeholder involvement does ensure sustainable basic urban services, especially for disenfranchised urban areas, but it is less strong in triggering behavioural change which may be necessary in many urban and peri-urban settings (Lüthi et al 2010:61).

Urban and peri-urban areas are complex with regard to meeting infrastructure needs and the problems facing them are heterogeneous and are interlinked. However, this does not mean that these problems are impossible to solve. Solutions will require a planning approach to environmental sanitation that is more inclusive, participatory, comprehensive and multi-disciplinary. Service provision in such a mixed environment will require an integrated planning process and a variety of technologies that meet the needs of the poor, rich and middle income groups. Planning will need to recognise the mixture of rural and urban characteristics within the peri-urban interface and draw on established strengths within these respective fields. Sanitation plans should utilise behaviour change and community mobilisation techniques and at the same time establish an institutional framework to ensure sustainability (Lüthi et al 2010:61).

7.2.1.2 The guiding programming framework of urban sanitation and hygiene promotion for diarrhoea prevention

Based on the aforementioned programming frameworks, the related literature review, the main findings and recommendations of the study; it is considered essential to put forth an urban sanitation and hygiene promotion programming framework for diarrhoea prevention that provides the basis for the development of the strategies for the present study. The purpose of the framework is to provide organized ideas that can be used to plan project and programme interventions for achieving accelerated and sustainable urban sanitation and hygiene promotion coverage. Accordingly, a programming framework of urban sanitation and hygiene promotion for diarrhoea prevention was illustrated in Figure 7.1 after carrying out a detailed literature review and it was mainly adapted from the publications of United States Agency for International Development

(USAID) Environmental Health Project (EHP) (Kleinau & Pyle 2004:27; Rosensweig, Perez, Corvetto & Tobias 2002:37), Water Supply and Sanitation Collaborative Council (Peal et al 2010:17), Ministry of Urban Development of India (2008:15), and Water Supply and Sanitation Collaborative Council and World Health Organization (2005:4). The strategies elaborated in this chapter are based on this framework.

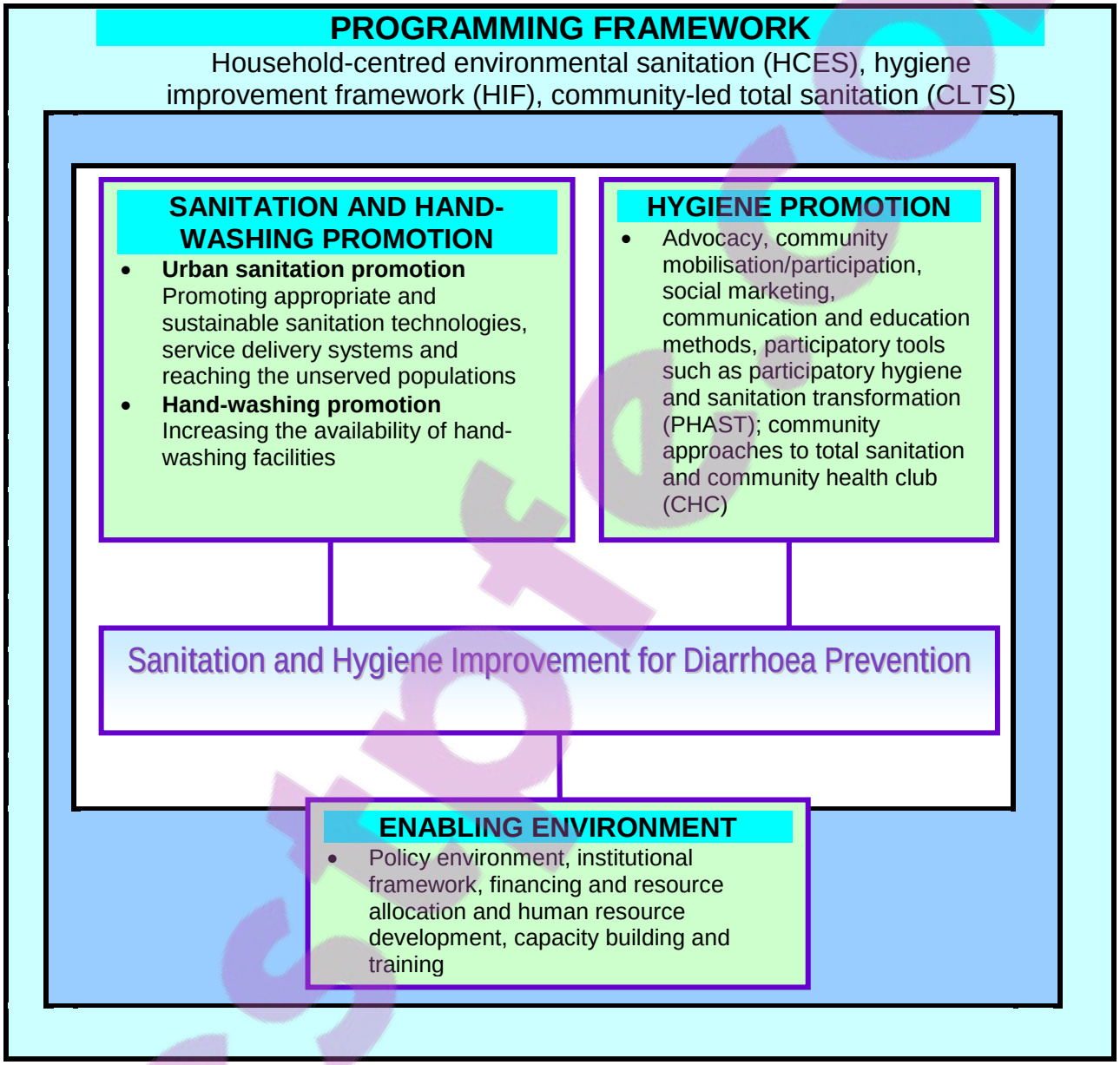

Figure 7.1 Sanitation and hygiene promotion programming framework for diarrhoea prevention

(Kleinau & Pyle 2004:27, Ministry of Urban Development of India 2008:15; Peal et al 2010:17; Rosensweig et al 2002:37 & Water Supply and Sanitation Collaborative Council and World Health Organization 2005:4)

7.2.2 Urban sanitation promotion

Based on the current study findings, it is essential to strive for high and sustained coverage of sanitation facilities and household hygiene technologies with interventions known to be effective, especially interventions that help families and communities in the prevention of diarrhoeal diseases among children under the age of five years. This section discusses the recommended strategies for the improvement of access to household sanitation facilities focussing on the promotion of town-wide solutions that expand improved sanitation coverage to as many residents as possible.

The findings from the current study indicate that about one-third of the households had used unimproved toilet facilities and childhood diarrhoea prevalence was higher in these households than those that used improved toilet facilities. In the multivariate analysis, the type of toilet facility was significantly associated with childhood diarrhoea and showed negative significant effect. This indicates the necessity for increased emphasis on improved sanitation and in accelerating the coverage and accessibility of improved household sanitation facilities for the underserved population in order to achieve the universal access to improved sanitation by the households and prevent childhood diarrhoea.

This section discusses the strategies for town-wide urban sanitation promotion programmes that expand improved sanitation coverage with the aim of achieving universal access to improved sanitation.

7.2.2.1 Promoting appropriate and sustainable sanitation technologies to accelerate improved sanitation coverage

The following are the main strategies for selection and promotion of appropriate and sustainable sanitation technologies that will accelerate improved sanitation coverage in urban areas:

Identify technology options: In order to promote the appropriate and sustainable sanitation technologies, it is important first to identify the possible options. For practical purposes, sanitation technologies can be divided into on-site and off-site technologies. On-site sanitation is a system of sanitation where the means of collection, storage and

treatment (where this exists) are contained within the plot occupied by the dwelling and its immediate surrounding (Water Supply and Sanitation Collaborative Council & World Health Organization 2005:VI). The most commonly used on-site systems are simple pit latrines, ventilated pit latrines, pour-flush latrines and septic tanks (United Nations Children's Fund 2008:79). On-site systems may be low-cost options such as various forms of pit latrine, or high-cost options such as septic tanks that provide a similar level of service to sewerage. They may be 'wet' systems, where water is used to flush the waste into a tank or pit, or dry systems using little or no water (Howard, Jahnel, Frimmel, McChesney, Reed, Schijven & Braun-Howland 2006:281). Pit latrines and ventilated improved pit (VIP) latrines are operated without flush water and are designated 'dry'. Pour-flush latrines and septic tanks are 'wet' systems in that they require water (Carr 2001:100). The most appropriate and affordable technology for excreta disposal in developing countries is generally provided by on-plot pit latrines, such as simple pits with pre-cast slabs which may be reinforced or domed, ventilated improved pit latrines (VIPs), and pour-flush latrines (Department for International Development 1998:170).

Off-site sanitation is a system of sanitation where excreta are disposed from the plot occupied by the dwelling and its immediate surroundings (Water Supply and Sanitation Collaborative Council & World Health Organization 2005:VI). In off-site systems (e.g. sewerage), excreta is transported to another location for treatment, disposal or use (Howard et al 2006:281). While off-site systems generally provide better protection to communities and households by removing excreta from the local environment, the opposite can be true when systems are poorly operated and maintained (United Nations Children's Fund 2008:79). Broadly speaking, sanitation technologies fall into four main types as shown in Table 7.1 (Water Supply and Sanitation Collaborative Council & World Health Organization 2005:74).

Table 7.1 Categories of sanitation systems

Sanitation systems	Dry systems	Wet systems
On-site (individual onsite/decentralized systems)	▪ Pit latrines or ▪ Variants of these types (e.g. Ecological Sanitation, ventilated improved pit latrines (VIPs), composting toilets, etc.)	▪ Septic tanks ▪ Pour-flush latrines plus soakaways ▪ Flush toilets with drains system
Off-site	▪ Public toilets ▪ Biogas systems	▪ Conventional waterborne sanitation system and treatment plants ▪ Vacuum/small bore sewer system (low-cost unconventional sewerage such as small-bore sewers/settled sewerage and simplified sewerage) and treatment plants

(Mara 1998:249; Water Supply and Sanitation Collaborative Council & World Health Organization 2005:77)

Selection and identification of feasible technical options: It is important to note that there is no single appropriate technology for all circumstances and all socio-economic segments of a community, town or city. There are numerous technical options for excreta management, many of which, if properly designed, constructed, operated and maintained will provide adequate and safe services as well as health benefits. It is necessary to choose technically, economically and financially feasible options for sustainable excreta management (Carr 2001:99). The purpose of the selection process stage is to identify the range of sanitation-related technologies that may be feasible and acceptable in order to present them to the community. The assessment of options should include household-centred approaches as well as more conventional wastewater collection and treatment. The examination of these options should be at the pre-feasibility level, which implies a preliminary analysis that will provide enough information to narrow the range of options for a more detailed consideration (Rosensweig et al 2002:41).

Promoting incremental sanitation (sanitation ladder) to increase improved sanitation coverage: The findings of the present study indicate that almost about one-third of households (29.4%) used unimproved toilet facilities which include pit latrine without slab/open pit (22%) and 7.4% of the households did not have any kind of latrine and used open field defecation.

Within a community, several different sanitation options may be required with varying levels of convenience and cost (sometimes called a sanitation ladder) (Howard et al 2002:38). Sanitation promotion programmes are generally more successful when households have a choice of technologies to buy. Sanitation programmes facilitate the development of a range of technologies (sanitation ladders), allowing consumers to choose an option depending on their preferences and ability to pay and providing an avenue to upgrade service in the future (United Nations Children's Fund 2008:80).

The sanitation ladder is a way of analyzing sanitation practices that highlight trends in using improved, shared, and unimproved sanitation facilities and the trend in open defecation. The four-step ladder is a technology-based concept that includes the proportion of the population: (i) practising open defecation (ii) using an unimproved sanitation facility (iii) using a shared sanitation facility; and (iv) using an improved sanitation facility (Lüthi 2012:65).

It would be essential to promote incremental household sanitation facilities with upgrading sequence. As resources become available, local systems can gradually be improved with the active participation of communities and households. Further up the sequence of sanitation upgrading are simple pit latrines. For those who can afford, the pit latrines might be improved with a squatting slab made of concrete or ferro-cement. Next will be the ventilated improved pit latrine (VIP), the composting latrine and the pour-flush or cistern-flush (World Health Organization Regional Office for South-East Asia 1993:6). The advantage of the sanitation ladder approach is that it allows households to progressively upgrade sanitation facilities over time (Howard et al 2002:38).

7.2.2.2 Service delivery systems for the urban sanitation services to ensure sustainability

There can be a range of potential management options appropriate for towns that enable these urban centres to provide sanitation services in sustainable ways. An on-site sanitation approach requires the existence of skills for the assessment of household demand for various levels of service and to promote a sanitation programme throughout the town; design and develop hygiene behaviour change programmes; monitor environmental impacts; provide technical support to private contractors and households;

as well as arrange for financing, whether it be based on microenterprise, access to credit or administering subsidies (Rosensweig et al 2002:39). While some householders may be able to build their own simple latrines, in many places, construction will be undertaken by contractors or self-employed skilled craftspersons. Apart from latrine construction, firms or individuals may be able to prefabricate components, such as slabs, blocks, pans and pipes (Franceys et al 1992:152).

The following are broad allocations of responsibility for a range of partners at town level:

- ***Urban government*:** provision and management of trunk services and facilities (either directly or through a utility), management of waste, licensing of small scale providers, oversight of credit providers, technical assistance to communities, etc (Water Supply and Sanitation Collaborative Council & World Health Organization 2005:49). Local government and municipalities are often the frontline organisations responsible for implementing national policy and guidance at the district or town/city level (Water Aid 2011:11).

- ***Non-governmental organisations (NGOs)***: provision of technical support to communities, delivery of hygiene promotion and community development support, provision of credit services, oversight on progress through participatory monitoring and evaluation, etc (Water Supply and Sanitation Collaborative Council & World Health Organization 2005:49).

- ***Private sector***: *sanitation marketing* is an approach to increase sanitation coverage using the assumption that sanitation is a business where services and products can be sold by providers and retailers to interested consumers. It borrows from private sector experience to develop, place, and promote an appropriate product at the right price, which can be a latrine, toilet, or other excreta disposal system. It brings together supply and demand, and assumes that market research needs to be conducted to understand consumer demand, and that appropriate products and services need to be put in place to satisfy that demand (Hygiene Improvement Project 2010:iii). Furthermore, there are two types of sanitation marketing:

  - *Microenterprises for sanitation services (small-scale independent provider)*: individuals, companies or voluntary/non-profit organisations (Water Supply and

Sanitation Collaborative Council & World Health Organization 2005:vii) that construct latrines, provide technical advice to home owners, empty latrine pits and septic tanks, transport septage and operate small scale treatment plants and build and run public toilets. They employ both simple technologies, such as emptying pits manually, and more sophisticated equipment, such as suction trucks for emptying septic tanks (Peal et al 2010:88).

- *Sanitary marts*: Sanitary marts are an effective way of increasing the acquisition of household latrines since they bring accurate information and materials for construction of latrines within close proximity of potential latrine owners. The sanitary marts serve as focal points for promotion of latrine acquisition by ensuring readily available information on various latrine options and their proper operation and maintenance. These facilities also support the promotion of the sanitation ladder and play an important role in promoting self acquisition of latrines and less reliance on latrine subsidies (Awuah 2009:9).

- ***Communities***: participatory planning, identification of appropriate local institutions for management of resources and facilities, assessment and negotiation of local demands, management of internal cross subsidies if needed, etc (Water Supply and Sanitation Collaborative Council & World Health Organization 2005:49).

- ***Households***: key investment decision making, financing and management of facilities, hygiene behaviours and outcomes (Water Supply and Sanitation Collaborative Council & World Health Organization 2005:49).

7.2.2.3 Reaching the unserved populations and the urban poor

Sanitation services should be prioritised for high-risk and under-served groups (United Nations Children's Fund 1997:85). A differentiated approach is necessary to extend good quality sanitation services to the poor. Participatory approaches are needed to consult the poor settlements and involve them in the process of planning and management of sanitation arrangements (Ministry of Urban Development of India 2008:27).

7.2.3 Hand-washing promotion

The study results indicate that over two-fifths of the households (44.9%) had no dedicated place for hand-washing, which may prevent hand-washing at key times. Diarrhoea prevalence rate among children was higher at households without specific places for hand-washing (13.6%) than those that had specific places for hand-washing (6.8%). The multivariate analysis shows that children from households that had a specific place for hand-washing were 0.40 times less likely to have diarrhoea as compared to those children from households that did not have a specific place for hand-washing.

The study findings also indicate that diarrhoea was lower among households that have hand-washing devices (8.3%) and higher among households that did not have hand-washing devices (30.3%). The multivariate analysis shows that children from households that had hand-washing facilities were 0.20 times less likely to have diarrhoea as compared to those that did not have hand-washing facilities.

Accordingly, these data indicate that the other required component for hygiene improvement is household technologies and materials which particularly refer to the increased availability and accessibility to specific places for hand-washing and proper hand-washing facilities. These would encourage the washing of hands and appropriate hygiene practices.

The details of hygiene promotion strategies for increasing the availability and use of hand-washing designated places and hand-washing facilities, such as community participation, hygiene education and communication methods, training, human resources, other appropriate support mechanisms and other non-technology aspects are described in section 7.2.3 with other hygiene practices to be promoted.

This section discusses the hand-washing promotion strategies focusing on the designated places and technology aspects of hand-washing in order to encourage appropriate hygiene practices.

7.2.3.1 Increasing the availability of designated places for hand-washing to encourage appropriate hygiene practices

For the hygiene situation of a household to improve, the primary caretaker must have easy access to a place that has water and soap within easy reach to wash his or her hands. Hand-washing behaviour is strongly influenced by access to both water and a properly equipped hand-washing place. To be optimally effective, the hand-washing place should be located in close proximity to the toilet facility so that the caregivers can conveniently clean their hands after defecation. Access to a place to wash hands means that members of the household can wash their hands when this is needed (Kleinau & Pyle 2004:58).

A hand-washing station may facilitate behaviour by providing soap and water together in an established location convenient to the behaviour, such as near a toilet or in a food preparation area. In addition to establishing a designated place for hand-washing, the design of the hand-washing station influences use (Hulland, Leontsini, Dreibelbis, Unicomb, Afroz, Dutta, Nizame, Luby, Ram & Winch 2013:2). Research findings from the Water and Sanitation Programme's (WSP) Global Scaling-Up Hand-washing Project and other sources suggest that access issues, including convenient access to water and soap in pertinent times and locations that have a designated place for hand-washing with soap, are important determinants for hand-washing (Devine 2010:1). The Water and Sanitation Programme's (WSP) Global Scaling-Up Hand-washing Project in Vietnam reported that characteristics, such as tap design, soap presentation, and container parameters, influenced acceptability of the hand-washing station (Hulland et al 2013:2).

A proper hand-washing place should meet all of the following criteria:

1. At least one hand-washing place located in or near the toilet facility.
2. All necessary items for hand-washing present: these include water; soap, or locally available cleansing agents such as ash or other detergent; washing devices allowing for unassisted hand-washing (tap, basin, bucket, sink, tippy tap) and clean drying material (this is optional, drying by air is encouraged).
3. Wastewater from hand-washing can be safely disposed of in the following ways: seepage pit or soak-away pit and connection to a septic system or toilet facility (Kleinau & Pyle 2004:58)

Thus, it would be essential to promote the availability and use of a specific place for hand-washing for the washing of hands and that it is particularly located in or near the toilet facility so as to facilitate hand-washing at critical times.

7.2.3.2 Increasing the availability of hand-washing facilities to encourage appropriate hygiene practices

To improve household hygiene, it is important that caregivers and those responsible for food preparation wash their hands after using toilet facilities, after handling a child's faeces, and/or before preparing food. This behaviour is associated with their knowledge about proper hand-washing behaviours (when and how) as well as access to safe water and hand-washing facilities. It is important that everyone in the household, including the children, wash their hands with soap at appropriate times (Kleinau & Pyle 2004:40).

To encourage hand-washing to become part of the daily routine, suitable facilities must be located near places such as latrines and kitchens, where they will be needed. If running water is available, the facilities should include a tap, a sink and soap (Howard et al 2002:66).

People's ability to wash hands at appropriate times depends on whether households have immediate and easy access to all of the following supplies necessary for hand-washing and that these are ideally located in a dedicated place: water — from tap or container; soap, ash, or other detergents; a device that facilitates unassisted hand-washing such as a basin, sink, bucket, or tippy tap and clean towel or cloth, although this is optional because air drying is an acceptable alternative (Kleinau & Pyle 2004:40).

Although knowledge and motivation as well as access to water are the most important factors influencing hand-washing practices, the existence, type, location and cost of hand-washing facilities are also important. Designing hygienic low-cost hand-washing facilities is especially difficult in poor communities where water in the home is scarce because it is expensive or must be fetched by hand from distant sources (United Nations Children's Fund 2008:84).

The hand-washing facilities must be hygienic (usually by providing a stream of water for hand-washing), use very little water, be easily made at low cost and easily installed at or near latrines and in homes. Several designs including “tippy-taps”, modified soft-drink bottles, and hollowed out gourds have been used to meet this challenge (United Nations Children’s Fund 2008:84).

There are different types of hand-washing facilities, which are described as follows:

- *Conventional sink or tap stands* with piped water supply (Devine 2010:1; WaterAid 2012:39);
- *Simple push operated taps* to dispense small amounts of water.
- *Container with faucet*: A container, such as an oil-can or bucket fitted with a tap is the simplest way of providing hand-washing facilities where they are needed. Some are mounted on stands with a ledge on which to place soap (Ferron, Morgan & O'Reilly 2000:231).
- *Tippy tap*: when tipped, pours water on to the hands of the person using it (Ferron et al 2000:231). It is simple enabling technology appropriate for people in communities without access to running water to wash hands with soap (Naughton 2013:11). Tippy taps are simple and economical hand-washing stations, made with commonly available materials and not dependent on a piped water supply. They can be made from a variety of local materials, including cast off plastic containers, jerry cans or gourds (Eshuchi 2013:81).

The Global Scaling-Up Hand-washing Project defines tippy taps as an enabling technology which can influence individuals’ opportunity to perform a behaviour (i.e. hand-washing practices). Tippy taps accomplish three important tasks: 1) they store and regulate the flow of water in sufficient quantity to facilitate hand-washing, 2) manage or store soap within a household or institution, and 3) bring together water and soap in one place. This is especially important for busy mothers to have soap and water readily available whether they are washing before preparing meals, feeding their children, or cleaning up their child after they have defecated (Naughton 2013:11).

The Global Public-Private Partnership for Hand-washing (2003-2010) was implemented in Peru, Senegal, Tanzania and Vietnam, with technical assistance from the World Bank Water and Sanitation Programme (WSP). The main objective was to promote hand-washing with soap at three key times: before meals, before cooking and after using the

toilet (World Bank 2012). In Peru, the Hand-washing Project has implemented and distributed a hand-washing dispenser in collaboration with plastic factory. The distributions were made through government and non-governmental organisations, and a branded commercial product has also been implemented (Devine 2010:7). The prototypes were tested in schools and households in rural areas of the Peruvian coast and highlands. Results were found to be encouraging as hand-washing with soap increased by nearly 30% in schools (World Bank 2012).

7.2.4 Hygiene promotion

Based on the present findings of the study, it is imperative to endeavour for sustained hygiene promotion interventions known to be effective, especially interventions that assist families and communities in the prevention of diarrhoeal diseases among children under-five years. Hygiene promotion interventions are activities that encourage community education and participation, training, hygiene education, and other non-technology aspects (United Nations Children's Fund 1997:2).

According to the UNICEF, hygiene promotion is a planned approach to preventing diarrhoeal diseases through the widespread adoption of safe hygiene practices. It begins with and is built on what local people know, do and want. According to the United States Agency for International Development (USAID) Hygiene Improvement Framework, promoting hygiene refers to advocating for, teaching, and supporting behaviours, such as proper hand-washing, proper disposal of excreta, and safe water storage and use for drinking and preparing food, which are known to reduce diarrhoeal disease (Kleinau & Pyle 2004:28).

Hygiene promotion interventions should target high risk behaviours of childhood diarrhoeal diseases as these have the greatest impact in minimising the hygiene challenges being faced by the community/residents (Institute of Water and Sanitation Development 2012:14). Accordingly and basing on the findings from the present study, the priority behaviours for prevention of childhood diarrhoea are as follows:

1. Availability and proper use of improved toilet facilities
2. Availability and proper use of specific hand-washing places for washing hands with soap

3. Availability and proper use of hygienic hand-washing facilities for washing hands with soap
4. Increasing mothers'/caregivers' knowledge on the causes of diarrhoea

A hygiene promotion programme can consist of five strategies that can be applied alone or in combination, depending on the nature of the programme and these are: advocacy, social mobilisation, community participation, social marketing and communication (Kleinau & Pyle 2004:28).

This section discusses on the recommended strategies for city-wide hygiene promotion programme for the promotion of good hygiene behaviours and practices that help households and communities to prevent diarrhoeal diseases.

7.2.4.1 Advocacy

Advocacy among policy-makers and organisations is critical in order to persuade other sector stakeholders on sanitation and hygiene promotion (WaterAid 2012:45; Stuart & Achterberg 1997). The hygiene promotion programme needs advocacy programmes to gain the support and commitment of the different sectors and stakeholders in order to facilitate and accelerate the hygiene improvement of any given situation (Stuart & Achterberg 1997).

7.2.4.2 Social/community mobilisation

Social mobilisation is a process that seeks to obtain and maintain the involvement of various community groups and sectors in the control of disease. For example, a community group might design and implement a campaign to increase the use of soap for hand-washing or one that promotes the proper use and maintenance of sanitation facilities (Kleinau & Pyle 2004:29).

7.2.4.3 Community participation and community groups and organisations

Community participation, an essential component of the hygiene promotion process, typically involves such activities as a collective examination of barriers to practicing hygiene in the community, designing measures to use sanitation facilities and improve

practices, or community-based monitoring of progress in achieving behaviour change (Kleinau & Pyle 2004:29). Hygiene behaviours are particularly difficult to change because they relate to daily activities. In addition, they are shared by the whole community, and form part of the culture and traditions of the community. The improvement of water supply, sanitation and hygiene should be seen as part of an overall process of community development. It is important, therefore, to work with the community and to involve them in all stages of hygiene promotion, including selecting priority hygiene behaviours, understanding the influences on such behaviours, selecting educational methods, and implementation (World Health Organization 1997:131). For effectiveness, local community groups can be formed to spearhead the hygiene and sanitation promotion interventions (Institute of Water and Sanitation Development 2012:14).

To make community participation a meaningful component of hygiene and sanitation programme, there is need to design strategies for the building of capacity to make needed and sustainable changes in personal, domestic, and environmental hygiene and sanitation (United Nations Children's Fund 1997:33). Building community capacity may involve:

- A range of training, mentoring, and organizational and other support activities to enable community groups to undertake joint activities (Favin, Yacoob & Bendahmane 1999:29)
- Organizing and supporting community groups and committees.
- Helping communities to analyse their current hygiene and sanitation.
- Encouraging the private sector to develop sanitation and hygiene products (Howard et al 2002:76).

7.2.4.4 Social marketing

Social marketing is the use of commercial marketing techniques to promote the adoption of behaviour that will improve the health or well-being of the target audience or of society as a whole (Peal et al 2010:86). An example of the marketing of a single intervention approach is the Public-Private Partnerships for Hand-washing with Soap, which promote hand-washing with soap in order to reduce diarrhoea (Peal et al 2010:69).

7.2.4.5 Communication and education methods in hygiene promotion

7.2.4.5.1 Focus on priority behaviours and practices

From an epidemiological point of view, sanitation is the first barrier to many faecally transmitted diseases, and its effectiveness improves when integrated with improved water supply and behaviour change. Sanitation comprises both behaviours and facilities, which should be promoted together to maximise health and socioeconomic benefits (United Nations Children's Fund 1997:85). The most successful efforts that enable the prevention of diarrhoea involve interventions to improve sanitation, improve water quality, increase water quantity, and increase hand-washing, all of which have been conclusively shown to reduce diarrhoeal disease incidence in developing countries (Environmental Health Project 2004:7). Hence, based on the findings of the present study, hygiene promotion interventions programme for the prevention of diarrhoea in the study area should focus on the availability and use of improved sanitation facilities, and encourage good hygiene practices, particularly focusing on hand-washing and mothers'/caregivers' knowledge on the causation of diarrhoea.

7.2.4.5.2 Prioritising target audiences

Hygiene promotion is aimed at two kinds of target groups:

- ***Primary target group***: Mothers are designated as the primary target audience, since they are usually the main caregivers for young children and are most influential in a family setting (Howard et al 2002:77). It would be essential to promote proper hygiene behaviours through hygiene promotion focusing on women, men (household heads), household members, children, grandparents, and others who care for children. Sanitation and hygiene promotion programmes should equally address the needs and preferences of children, women, and men, however programmes should guard against directing messages only to women or placing the burden of improved sanitation primarily upon women (United Nations Children's Fund 1997:85).
- ***Secondary target group*** (motivators of behaviour change): While targeting mothers is useful in influencing change at household level, there is also a need to involve the immediate family and other people who influence women's behaviour (Howard at al

2002:77). This group includes key opinion or local leaders at the community level, teachers, government officials and service providers, assembly members, associations, community-based organisations, and other community groups and community members.

7.2.4.5.3 Developing hygiene promotion materials and communication channels

The availability of adequate background information about the target groups leads to the development of a socially and culturally appropriate communication strategy, consisting of *approaches, messages, and methods.* Those approaches that are appropriate for each group should be chosen. These could be a combination of any of the following: *individual, group, or mass approaches* using *information, education/training, motivation, entertainment or advocacy.* Messages vary according to the kinds of behaviour-change specified in the objectives, the available resources and services, technologies, other relevant information, participant needs, and method of delivery. In order that each approach be used, activities must be defined according to the programme objectives. Appropriate messages, media, and methods should be designed and pre-tested according to the audience's abilities, resources, and preferences (Stuart & Achterberg 1997).

1. Communication channels

Information, education, and communication approaches are used to reach target groups using all available and potential communication approaches, resources, techniques, channels, methods, and tools (Stuart & Achterberg 1997). For this implementation, it is important to identify appropriate communication channels to reach participants with selected messages, and involve participants in appropriate communication activities (meetings, training programmes, counselling sessions, etc.) (United Nations Children's Fund 1999:32).

Some examples of information, education, and communication activities are: the development, production and distribution of appropriate printed materials such as brochures, pamphlets, posters, leaflets, and flyers; radio spots, plugs, jingles, documentaries, and schools on-the-air; video and other audio-visual materials like slide-

tape presentations and film showings; and messages integrated into communication programmes, services, and products of allied agencies (Stuart & Achterberg 1997).

Hygiene education messages can be communicated in different ways, including posters, drama and storytelling, mass media messages, group discussions and home visits. Some methods, such as the use of mass media and posters, communicate messages to large numbers of people. Other approaches emphasise the need to work with small groups, through meetings and household visits. No single method is always effective, however. Most health education works best when interventions are made at different levels and use a mixture of awareness-raising tools, and when they focus on individual activities, such as “child-to-child” programmes or home visits by health educators. Getting households and community members involved in learning about hygiene is often crucial to improving hygiene practices and reducing the risks to health. The messages should be understandable to the target audience. This can be accomplished by first testing educational materials on small groups of the population (Howard et al 2002:78).

2. Participatory methods and tools

A participatory methodology involves the use of methods, materials and techniques that encourage the active involvement of individuals in a group process, regardless of their age, gender, or economic or educational background. Participatory approaches aim to build self-esteem, make decision-making easy and enable people to learn from each other (WaterAid 2012:4). There are many community-based participatory methods that can be used in hygiene improvement programmes, and these should be used for planning, communications, implementation, monitoring and evaluation (World Health Organization Regional Office for South-East Asia 1993:9). The commonly used participatory tools are described below:

i) Participatory hygiene and sanitation transformation (PHAST)

One of the participatory tool that has been specifically adapted for water and sanitation issues is the Participatory Hygiene And Sanitation Transformation (PHAST) (Kvarnström & McConville 2007:9). It is based on the idea that as communities gain awareness of their water, sanitation and hygiene situation through participatory activities,

they are empowered to develop and carry out their own plans to improve their situation (WaterAid 2013:2).

ii) Community approaches to total sanitation

There are several participatory planning approaches which, though very successful, have been geared more towards rural settings. *Community approaches to total sanitation* is an umbrella term used by the UNICEF sanitation practitioners to encompass a wide-range of community-based sanitation programming. It encompasses a variety of community- and demand-led approaches, including community-led total sanitation (CLTS), total sanitation, school-led total sanitation and related approaches (United Nations Children's Fund 2011:14). The aim of these approaches is total sanitation which means the complete separation of waste from humans, i.e. no open defecation and 100% of excreta to be hygienically contained (Ministry of Health of Ethiopia 2011b:107).

iii) Community health club (CHC)

Community health clubs (CHCs) are community-based organisations formed to provide a forum for information and good practice relating to improving household health. It helps to promote a 'culture of health' where healthy living becomes highly valued and brings about behaviour change. The main activity is the holding of regular meetings to learn about and discuss ways to improve household and community hygiene (Peal et al 2010:53).

7.2.5 Strengthening the enabling environment

According to the Hygiene Improvement Framework (HIF) of United States Agency for International Development (USAID) Environmental Health Project (EHP), the prevention of diarrhoea involves creating an enabling environment — whether at the community, municipal, regional, or national level — which supports the envisioned technology and hygiene interventions (Kleinau & Pyle 2004:30). This may be accomplished through advocacy, training, institutional strengthening and other appropriate support mechanisms (Favin, Naimoli & Sherburne 2004:2).

Hygiene improvement interventions cannot be scaled-up or be sustainable without a supportive enabling environment that includes policy improvement, institutional strengthening and partnerships (Kleinau 2004:18). This section discusses the recommended strategies for strengthening the enabling environment in order to enhance access to improved sanitation and household hygiene facilities for the prevention of diarrhoea focussing on policy environment, institutional framework, financing and resource allocation and mobilisation, and human resource development, capacity building and training.

7.2.5.1 Policy environment and specifying regulatory and policy issues

The scale-up of successful sanitation programmes will require a supportive policy environment at the national level. There may be a few policy issues that, if not addressed, will make it impossible for a town to even get started on the sanitation programmes. The full range of policy issues should be identified and then subdivided into those, if any, that must be addressed to move forward immediately and those that are part of a longer-term agenda (Rosensweig et al 2002:39).

Basic legislation is necessary to enable a public health agency to initiate and develop activities in the field of public health and sanitation. Enabling legislation is normally confined to statements of broad principles, responsibilities and penalties. On the basis of such legislation, the public health and environmental health agency concerned is in a position to formulate more detailed rules, regulations and standards (Franceys et al 1992:182). Governments should also review legislation that may be outdated and could impede the implementation of a sanitation and hygiene promotion programme (World Health Organization Regional Office for South-East Asia 1993:9).

Public education, enforcement of laws and regulations are pillars for the enhancement of sanitation (Awuah 2009:14). Increased education and awareness raising about public health and sanitation laws with clear regulations for adequate sanitation in all public and private dwellings and institutions are necessary (United Nations Children's Fund 2009:18). To overcome the difficulties in enforcing the regulations, the general populace should be made aware of the existence of the legislations and their provisions through strategic educational campaigns. The regulations can be abridged and translated into

local languages to make easier reading and understanding (Awuah 2009:17). Hence, education must precede legislation (Franceys et al 1992:183).

In Ethiopia, the rural-focused Strategy for Sanitation and Hygiene was developed in 2005 but has not yet been developed for the urban environment (WaterAid Ethiopia 2012:10). Although Ethiopia does not have a national sanitation and hygiene policy or has no separate environmental health policy of its own; the Government of Ethiopia is addressing hygiene and sanitation as part of the Health Sector Development Programme (HSDP) as well as through the National Sanitation and Hygiene Strategy (Water Supply and Sanitation Collaborative Council 2009:9). The Health Extension Programme, a component of the Health Sector Development Programme, is the main vehicle for scaling-up equitable access to preventive essential health services. This is done mainly through *kebele* (community)-based health services, which emphasise on prevention and increasing awareness (Ministry of Health of Ethiopia 2012:3).

7.2.5.2 Institutional framework: Establishing sanitation task forces and implementing agency for city-wide sanitation promotion programmes

Successful environmental health governance requires strong institutional underpinnings, with clearly articulated roles at all levels of administration within a country (World Bank 2008:11). Government ministries of health, water supply, urban development, local government, agriculture and social welfare, and local government councils may all have an interest in sanitation. This concern may be at central, regional or local level. For a programme to succeed, there should be an agency/entity with the sanitation mandate and a designated office which has the responsibility and authority to take executive action (Franceys et al 1992:155). Thus, the sanitation needs of all population target groups should be under the clear responsibility of specified institutions. The roles of each institution should be defined, and there should be a designated office (Elledge, Rosensweig, Warner, Austin & Perez 2002:45).

Agencies at the national level play an important role in providing technical and policy inputs related to environmental health actions. One set of issues relates to providing the performance standards, norms, guidelines, training modules, and technical support for environmental health services. In addition, national-level health agencies can provide critical information gathered from disease surveillance, assessment of health threats,

and research to help local governments respond appropriately to environmental health risks (World Bank 2008:106).

In Ethiopia, the major actors that are involved in urban sanitation include the urban development, health, water and education sectors (Ministry of Water and Energy of Ethiopia 2011:6). For several years in the past, environmental health programmes have been coordinated under the Hygiene and Environmental Health Department of the Ministry of Health of Ethiopia. Although the Department of Hygiene and Environmental Health maintained its status, regional states developed teams of environmental health professionals organised under the Department of Disease Prevention and Control or Department of Health Programmes from the beginning of the 1990s. Environmental health personnel worked in administrative units that coordinated and guided socioeconomic development at the grassroots levels. Health extension packages targeted households with a strong focus on community-based approaches and sustained preventive and promotional health care (World Bank 2008:103).

Although the Ministry of Health is the lead agency for sanitation and hygiene in Ethiopia, there is no specific unit for sanitation at federal level, and no separate budget line at any level of government (WaterAid Ethiopia 2012:3). The Ministry of Health (MoH) is in charge of policies related to sanitation and hygiene promotion. It has adopted a Sanitation and Hygiene Promotion Strategy. Sewerage in urban areas is under the responsibility of the Ministry of Water and Energy, while the promotion of on-site sanitation is the responsibility of the Ministry of Health (Community-Led Total Sanitation 2013).

Studies indicate that national governments have responsibilities that include the facilitation of programming, policy development, creation of facilitative laws and regulations, publication of verified national data on coverage and progress, and financing for technical assistance to service providers and community groups, regarding sanitation and hygiene promotion (environmental health) (Water Supply and Sanitation Collaborative Council & World Health Organization 2005:49). The central governments have the leadership responsibility in relation to policy and legislation, definition of roles and responsibilities, coordination, sector monitoring and regulation. The regulatory role of the governments should specifically include the establishment and enforcement of health regulations and standards (WaterAid 2011:11). The

regional/local governments have the responsibility over the management of sanitation and hygiene promotion (environmental health) and community development activities, monitoring of technical issues, licensing of sanitation service providers, certification of community support organisations, and coordination of local monitoring and collation of data for planning purposes (Water Supply and Sanitation Collaborative Council & World Health Organization 2005:49).

Different institutions may want to play an active role in the promotion of sanitation, and may be able to provide specialist skills and inputs that are of vital importance. A forum or meeting for an open discussion on needs and concerns may be of value. An intersectoral advisory committee from this forum or meeting can be drawn for more regular discussions of progress (Franceys et al 1992:156). Establishing coordinating mechanisms such as interagency committees, steering committees, or task forces is a key to effective partnerships, and a successful coordination of the activities of all the partners is likewise a key element for the creation of an effective enabling environment (Kleinau & Pyle 2004:31).

It is important, at town-level, to have an implementing agency with the sanitation and hygiene promotion (environmental health) mandate. Task force or working groups which constitute a multi-stakeholder for coordination and implementation of urban sanitation promotion programmes can be formed to build support for sanitation as a development priority and to help guide efforts. Thus, the most important step would be, in most circumstances, to establish or reactivate a town/city sanitation task force or working group of professionals at town level which can serve as a guiding force for the hygiene and sanitation promotion programme (Ministry of Urban Development of India 2008:44; United Nations Children's Fund 1997:20; United Nations Children's Fund 1999:14).

7.2.5.3 Financing and resource allocation and mobilization

From an implementation point of view, sanitation should be treated as a priority issue in its own right. Sanitation requires its own resources and its own time frame to achieve optimal results (United Nations Children's Fund 1997:85). According to a report by WaterAid Ethiopia Office, a significant proportion of sanitation-related activities in Ethiopia are funded by donor agencies (development partners, non-governmental organisations, communities, private sector, etc). Although the Ministry of Health is

responsible for the coordination and implementation of the national sanitation programmes, there is no separate budget line at any levels of the government. There are some donor programmes taking an integrated approach to water supply and sanitation with a specific percentage of their funds going towards sanitation and hygiene. The national sanitation strategy of Ethiopia acknowledges that the nation's sanitation infrastructure does not have a subsidy approach, which means that the construction of latrines is the responsibility of households, except to those that cannot afford the construction costs. The available public finance from donor agencies is used for hygiene and sanitation promotion (WaterAid Ethiopia 2012:3).

The costs associated with implementing national sanitation policies include: (i) the capital costs required for sanitation infrastructure and facilities; such as construction materials, subsidies (in exceptional circumstances only), demonstration models, "macro" investments, contractor costs, etc; (ii) the recurrent costs required to operate and maintain the facilities; operation and maintenance is generally assumed to be 100 percent the responsibility of households or communities, depending on the type of intervention; and; (iii) the programme costs for training, institutional development, community organisation and hygiene improvement; costs for hygiene promotion aspects such as behavioural change programmes, social marketing, health education materials, training programmes, credit schemes and extension work (iv) administrative framework and programme overheads costs such as staff costs, offices, transport, accounts and computers. Sources of funds typically include national governments, local governments, donors and users (Elledge 2003:21; United Nations Children's Fund 1997:53).

7.2.5.4 Human resource development, capacity building and training

Men and materials are fundamental elements required for putting a programme of environmental health into effect. A limited availability of these elements will have adverse consequences for the success of the programme (World Health Organization 1970:24). Several kinds of professional staff may be concerned with sanitation improvement programmes/projects (Franceys et al 1992:159). For this purpose, a minimum complement of environmental health workforce are needed at each administrative level to implement and ensure good environmental health (World Bank 2008:108).

A better knowledge of the health effects of, and the measures that can be taken to ameliorate, these conditions will help the environmental health workforce to be more effective in health advocacy and in encouraging the various sectoral agencies concerned, the media and the people themselves to take the necessary action, as well as in supervising and managing their activities (World Health Organization 1991:47). The role of environmental health professionals will have to be reoriented through in-service training at the local level to address the changing priorities in environmental health (World Bank 2008:108). The reorientation requires a set of skills among staff such as training in participatory techniques. Others may need to learn about how to undertake knowledge, attitude and practice studies and employ social marketing techniques. Communications and facilitation will become the keynotes of the sector and all staff will need to become better communicators and facilitators (World Health Organization Regional Office for South-East Asia 1993:10).

There is a need to consistently reorient organisations and individuals involved in the sanitation sector to approaches that foster consumer decision making and high levels of participation. The implementing agency staff needs to be trained in facilitative roles. Training can be multilevel, experiential, and field-based to enable personnel to shape new roles through direct contact and experience and to gain confidence, practical methods, and skills in moving from directive to a more facilitative individual and organisational roles (United Nations Children's Fund 1997:66).

The building of capacity at community level is essential for multi-stakeholder processes to run smoothly. Strengthening local capacity is therefore a crucial issue for the future development of urban areas: there must be adequate capacities in terms of programme/project administration, mediation, community-involvement, health and hygiene promotion, as well as civil and environmental health (sanitary) engineering to implement and maintain urban infrastructure improvements (Lüthi 2012:190).

Outside the health services, those who may become involved in hygiene promotion include teachers in schools and participants from adult education and literacy programmes. Other workers in the community can also be mobilized for hygiene education. Agricultural extension workers who advise communities on growing crops can also provide education on health and nutrition. Community development officers engaged in promoting community organisations and cooperatives can play a key role in

promoting community action on health issues. Field staff and volunteers may need training in hygiene education, particularly in the participatory learning methods. The aim should be to develop self-sustaining programmes of hygiene promotion as part of the normal workload of local fieldworkers in the community (World Health Organization 1997:138).

7.3 CONCLUSIONS

This chapter described the urban environmental health strategies meant for the prevention of childhood diarrhoea. Strategies to promote environmental health for prevention of childhood diarrhoea based on the findings of the study were presented into four sections: urban sanitation promotion, hand-washing promotion, hygiene promotion and the enabling environment with a number of strategies in each of the categories. The strategies presented in this chapter can be seen as an attempt at strengthening the effective development of environmental health, sanitation and hygiene promotion programmes in order to promote the availability of improved sanitation facilities and encourage good hygiene behaviour and the means to ensure that those hygiene improvement interventions are supported by appropriate enabling environments. The chapter also discussed the synthesis of policy and programme implications in the promotion of accelerated improved sanitation coverage and hygiene practices in the urban settings. Government agencies and development partners may find the recommended strategies to be a useful input for the overall efforts of strengthening the implementation of effective urban environmental health, sanitation and hygiene promotion programmes. Hence, this may in turn contribute to the improvement of the environmental health conditions, thus leading to the prevention of childhood diarrhoea of Sebeta town in particular and the urban settings of the country in general.

ANNEXURE A

APPROVAL FROM UNIVERSITY

UNISA university of south africa

UNIVERSITY OF SOUTH AFRICA
Health Studies Higher Degrees Committee
College of Human Sciences
ETHICAL CLEARANCE CERTIFICATE

HSHDC/200/2013

Date: 13 August 2013 Student No: 4320-379-5

Project Title: Development of environmental health strategies for prevention of childhood diarrhea in Sebeta Town, Ethiopia.

Researcher: Abdulwahid Idris Mohammed

Degree: D Litt et Phil Code: DPCHS04

Supervisor: Prof LI Zungu
Qualification: PhD
Joint Supervisor: Dr MBJ Monyemore

DECISION OF COMMITTEE

Approved [√] **Conditionally Approved** [ ]

Prof L Roets
CHAIRPERSON: HEALTH STUDIES HIGHER DEGREES COMMITTEE

Prof MM Moleki
ACADEMIC CHAIRPERSON: DEPARTMENT OF HEALTH STUDIES

PLEASE QUOTE THE PROJECT NUMBER IN ALL ENQUIRES

ANNEXURE B

DATA COLLECTION TOOL

DEVELOPMENT OF ENVIRONMENTAL HEALTH STRATEGIES FOR PREVENTION OF CHILDHOOD DIARRHOEA IN SEBETA TOWN OF ETHIOPIA

HOUSEHOLD DATA COLLECTION TOOL: INTERVIEW SCHEDULE

NO.	QUESTIONS AND FILTERS		RESPONSE CODING CATEGORIES	SKIP
HOUSEHOLD IDENTIFICATION				
1.	Date of interview (Day/Month/Year)		____/____/_____	
2.	Time interview started:			
3.	Residence address:	*Kebele*	_____	
4.		Village	_____	
5.		House number	_____	
6.		Location	Urban …….. 1 Rural …….. 2	
7.	Name of the household head			
8.	Who is the respondent of the interview? [WHERE THE MOTHER IS NOT AVAILABLE, INTERVIEW A FEMALE PERSON OF AT LEAST 18 YEARS OF AGE]		Mother of the under-five child …….. 1 Caregiver person …….. 2	
9.	Do you have any child(ren) under the age of five years (0-59 months) in this household?		Yes …….. 1 No …… 2	→10
SECTION I: SOCIO-DEMOGRAPHIC DATA				
	i. HOUSEHOLD SOCIO-DEMOGRAPHIC DATA			
10.	Age of the household head		years	
11.	Gender of the household head		Male …… 1 Female …….. 2	
12.	What is the education level of the household head? [ONE RESPONSE ONLY]		Cannot read and write …..... 1 Can read and write …….. …… 2 Primary education (1-8) …… 3 Secondary education (9-12) …… 4 Above secondary school level (university/college)….5	
13.	What is the job of the household head? (i.e. main type of work) [ONE RESPONSE ONLY]		Private trade (merchant) …….. 1 Private trade establishment employed …….. 2 Government employee …… 3 Non-government organization employed …….. 4 Farmer …… 5 Pensioner/retiree …….. 6 Student …… 7 Daily wage worker …… 8 Housewife …….. 9 Unemployed …… 10 Other (specify) _____ 11	
14.	Marital status of the household head		Single …… 1 Married ……..…… 2 Divorced/separated …….. 3 Widowed/widower …… 4	
15.	How many people live in this household? [HOUSEHOLD FAMILY SIZE]			

NO.	QUESTIONS AND FILTERS	RESPONSE CODING CATEGORIES	SKIP
16.	How many children under-five years live in this household? [NUMBER OF UNDER-FIVE CHILDREN]		
17.	What is your family's monthly income? [THIS INCLUDES INCOME EARNED BY ALL MEMBERS OF THE HOUSEHOLD]	Monthly Birr ≤500 …… 1 501-1,000 …… 2 1,001-2,000 …… 3 2,001-3,000 …… 4 >3,000 …… 5	
18.	Does your household own the following items (if in working condition only)? [READ EACH ITEM FROM THE LIST] [MULTIPLE CODES POSSIBLE, CIRCLE ALL THAT APPLY]	Radio..... 1 Tape/cassette player …… 2 Television..... 3 Video deck …… 4 Cable/satellite dish …… 5 Camera …… 6 Bed..... 7 Refrigerator..... 8 Wood furniture (cupboard or cabinet) …… 9 Iron …… 10 Chair and table …… 11 Sofa..... 12 Computer …… 13 Mobile telephone …… 14 Regular telephone …… 15 Sewing machine..... 16 Bicycle..... 17 Modern stove …… 18 Electricity …… 19 Farm or other land …… 20 Motorcycle..... 21 Kerosene lamp..... 22 Farm animals …… 23 Car/truck..... 24 Nothing …… 25 Other (specify) _____ 26	
ii. MOTHER/CAREGIVERS' SOCIO-DEMOGRAPHIC DATA			
19.	Name of the mother/caregiver		
20.	Age of the mother/caregiver	years	
21.	What is your relationship with the under-five child (0-59 months)?	Mother …… 1 Caregiver …… 2	
22.	What is the education level of the mother/caregiver? [ONE RESPONSE ONLY]	Cannot read and write …… 1 Can read and write …… 2 Primary education (1-8) …… 3 Secondary education (9-12) …… 4 Above secondary school level (university/college)….5	
23.	Marital status of the mother/caregiver [ONE RESPONSE ONLY]	Single …… 1 Married …… 2 Divorced/separated …… 3 Widowed/widower …… 4	

NO.	QUESTIONS AND FILTERS	RESPONSE CODING CATEGORIES	SKIP
24.	What is the job of the mother/caregiver? (i.e. main type of work) [ONE RESPONSE ONLY]	Private trade (merchant) ……1 Private trade establishment employed …….. 2 Government employee …… 3 Non-government organization employed …….. 4 Farmer …… 5 Pensioner/retiree …….. 6 Student …… 7 Daily wage worker …….. 8 Housewife …….. 9 Unemployed …… 10 Other (specify) _____ 11	
	iii. CHILDS' SOCIO-DEMOGRAPHIC DATA [INDEX CHILD]		
25.	Name of the index child [RECORD THE CHILD OF UNDER-FIVE YEAR, WHEN THERE ARE MORE THAN ONE UNDER-FIVE CHILD IN THE HOUSEHOLD, THEN SELECT AND RECORD THE YOUNGEST CHILD]		
26.	Age of the child (in years or months)	____ years ____ & ____ months	
27.	Gender of the child	Male …… 1 Female …….. 2	
	iv. HOUSE CHARACTERISTICS		
28.	Type of house ownership	Private owned …… 1 Rented from *kebele*/government …… 2 Rented from private owner …… 3 Rent-free …… 4 Other (specify) _____ 5	
29.	How many separate rooms are in this household? [INCLUDE ALL ROOMS, INCLUDING KITCHEN, TOILET, SLEEPING ROOMS, SALON, etc.]	NUMBER OF ROOMS ____	
30.	What is the main material of the wall of the house? [RECORD OBSERVATION]	Cement with blocks, bricks or stone …….. 1 Cement with mud …….. 2 Mud with wood …….. 3 Wood planks …….. 4 Corrugated iron sheet …….. 5 Other (specify) _____ 6	
31.	What is the main material of the floor of the house? [RECORD OBSERVATION]	Ceramic or marble tiles …….. 1 Cement/concrete …….. 2 Wood …….. 3 Earth …….. 4 Stone …….. 5 Other (specify) _____ 6	
32.	What is the main roofing material of the house? [RECORD OBSERVATION]	Corrugated metal sheet …….. 1 Thatch/straw …….. 2 Concrete/cement …….. 3 Roofing tiles …….. 4 Other (specify) _____ 5	

NO.	QUESTIONS AND FILTERS	RESPONSE CODING CATEGORIES	SKIP
SECTION II: ENVIRONMENTAL HEALTH CONDITIONS			
	i. WATER		
33.	What is the main source of drinking water for members of your household? [ONE RESPONSE ONLY]	PIPED WATER Piped water into dwelling …… 1 Piped water to yard …… 2 Piped water outside compound …… 3 Public tap/standpipe …… 4 DUG WELL Protected dug well …… 5 Unprotected dug well …… 6 SPRING Protected spring …… 7 Unprotected spring …… 8 Rainwater …… 9 Surface water (river, stream, pond) …… 10 Other (specify) _____ 11	
34.	Where is the water source located? [AFTER LOCATION KNOWN AND ASK: "is the water source: private, communal or public?"] [RECORD ONE RESPONSE ONLY]	In dwelling, private water source …… 1 In yard (compound) Private water source…… 2 Shared from private neighbourhood source …… 3 Shared from communal source …… 4 Outside yard (compound) Private water source …… 5 Shared from private neighbourhood source …… 6 Shared from communal water source …… 7 Shared from public water source…… 8 Other (specify) _____ 9	
35.	How long does it take to go to your main water source, get water, and come back?	| | minutes Water on premises..... 1	
36.	How far is the main water source from your dwelling?	| | metres Water on premises..... 1	
37.	Who usually goes to your main water source to fetch the water for your household? [PROBE: IS THIS PERSON UNDER AGE 15 YEARS? WHAT GENDER? CIRCLE THE CODE THAT BEST DESCRIBES THIS PERSON]	Adult woman (above 15)…… 1 Adult man (above 15) …… 2 Female child (under 15 years) …… 3 Male child (under 15 years) …… 4 Mix of female and male children …… 5 Mix of female and male adults …… 6 Adult woman and child(ren) …… 7 Adult man and child(ren) …… 8 Other (specify) _____ 9	
38.	What is the volume of container in litre which is usually used to collect water? [CHECK BY OBSERVATION]	| | litres	
39.	Usually, how many times per day do you collect water with the container? [FOR ALL PURPOSE OF THE HOUSEHOLD WATER USE]	| | times	
40.	Total amount of water collected daily [VOLUME OF CONTAINER MULTIPLIED BY NUMBER OF TIMES COLLECTED] [Q. 38 X Q. 39]	| | litres	
41.	Do you store water at home for all domestic water use?	Yes..... 1 No 2	→42 →49

NO.	QUESTIONS AND FILTERS	RESPONSE CODING CATEGORIES	SKIP
42.	Do you store drinking water in a separate container from other domestic water?	Yes..... 1 No 2	→43 →49
43.	If yes, what is the main type of container you use to store drinking water in your household? [OBSERVE THE CONTAINER] [ONE RESPONSE ONLY]	Plastic bucket ..... 1 Metallic bucket ..... 2 Plastic drum/barrel ..... 3 Metallic drum/barrel ..... 4 Plastic jerry can ..... 5 Clay pot ..... 6 Water storage tank ..... 7 Other (specify) _____ 8	
44.	Is narrow necked drinking water storage container used? [OBSERVE]	Yes..... 1 No 2	
45.	Is the drinking water container covered? [OBSERVE]	Yes..... 1 No 2	
46.	Is the inside of the container used for drinking water storage clean? [OBSERVE] [THE INSIDE OF WATER STORAGE CONTAINER IS CLEAN WHEN KEPT FREE OF VISIBLE DIRT]	Yes..... 1 No 2	
47.	How often does your household usually clean the drinking water storage container? [ONE RESPONSE ONLY]	Once daily ..... 1 Several times daily (more than once) ..... 2 Every alternate day ..... 3 Once a week ..... 4 Twice a week ..... 5 Several times per week (more than twice) ..... 6 Every two week ..... 7 Once a month ..... 8 Nothing ..... 9 Other (specify) _____ 10	
48.	How do you usually get water from the container for domestic water use? [ONE RESPONSE ONLY]	Pour water from the container ..... 1 Use dipper without handle ..... 2 Use dipper with handle ..... 3 Use both pouring and dipping ..... 4 Container has spigot/faucet ..... 5 Other (specify) _____ 6	
49.	What do you usually do to the water to make it safer to drink? [ONE RESPONSE ONLY]	Boil..... 1 Add chlorine ..... 2 Filter it through cloth ..... 3 Water filter with sand or other method ..... 4 Settling for sometime (let it stand and settle) ..... 5 Nothing ..... 6 Don't know ..... 7 Other (specify) _____ 8	
	ii. EXCRETA DISPOSAL		
50.	Does your household have toilet facility that members of your household usually use?	Yes..... 1 No 2	

NO.	QUESTIONS AND FILTERS	RESPONSE CODING CATEGORIES	SKIP
51.	What kind of toilet facility do members of your household usually use? [ASK TO OBSERVE THE TOILET FACILITY AND CIRCLE THE APPROPRIATE CODE] [IF "Flush" OR "Pour Flush" THEN ASK: "Where does it flush to?"]	FLUSH OR POUR FLUSH TOILET Flush to piped sewer system …….. 1 Flush to septic tank (holding tank) …….. 2 Flush to pit latrine …….. 3 Flush to river/stream …….. 4 Flush to anywhere …….. 5 PIT LATRINE Pit latrine with slab …….. 6 Pit latrine without slab/open pit …….. 7 Ventilated improved pit latrine (VIP) …….. 8 No facilities or open field defecation anywhere …… 9 Other (specify) _____ 10	
52.	Where is the latrine facility located? [AFTER LOCATION KNOWN AND ASK: "is it shared? Shared with whom or from where shared: private, communal or public?"] [RECORD ONE MENTIONED]	In dwelling, private toilet …….. 1 In yard (compound) Private toilet …….. 2 Shared from private neighbourhood latrine …….. 3 Shared from communal latrine …….. 4 Outside yard Private toilet …….. 5 Shared from private neighbourhood latrine …….. 6 Shared from communal latrine …….. 7 Shared from public toilet …….. 8 No facilities or open field defecation anywhere …… 9 Other (specify) _____ 10	
53.	Is the latrine kept clean? [OBSERVATION] [CLEAN LATRINE MEANS THAT LATRINE WHICH IS NOT FULL, DO NOT HAVE FAECAL MATTER ON THE LATRINE FLOOR AND WALL, NO OR FEW FLIES IN OR NEAR THE LATRINE, DOES NOT SMELL BAD]	Yes..... 1 No ..... 2 No private or shared latrine …….. 3	
54.	Where do usually young children (0-5 years) pass stool? [ONE RESPONSE ONLY]	Used latrine …….. 1 Used potty …….. 2 Used diaper/cloth …….. 3 Went in house yard/compound …….. 4 Went outside the premises …….. 5 Other (specify) _____ 6	
55.	Where do you usually dispose of the young children (0-5) stools? [ONE RESPONSE ONLY]	Put/rinse into toilet …….. 1 Put/rinse into drainage …….. 2 Disposed into garbage …….. 3 Disposed in yard/compound …….. 4 Disposed outside premises …….. 5 Buried …….. 6 Did nothing/left it there …….. 7 Other (specify) _____ 8	
	iii. WASTEWATER DISPOSAL		
56.	Where do you usually dispose your domestic liquid waste? [CIRCLE ONE RESPONSE]	Soakage pit …….. 1 Septic tank …….. 2 Open ditch/open pit …….. 3 Drain in closed sewer system …….. 4 Discharge into premises yard …….. 5 Poured or carried into toilet facility …….. 6 Discharge outside premises anywhere …….. 7 Other (specify) _____ 8	

NO.	QUESTIONS AND FILTERS	RESPONSE CODING CATEGORIES	SKIP
	iv. SOLID WASTE DISPOSAL		
57.	How does your household mainly dispose of solid waste? [CIRCLE ONE RESPONSE]	Collected from home by waste collectors (private establishments/associations/individuals)…… 1 Disposed within premises in private waste pit …..... 2 Disposed within premises anywhere …….. 3 Disposed outside premises in communal waste pit ..4 Disposed outside premises anywhere …….. 5 Burned …… 6 Composted …… 7 Other (specify) _____ 8	
58.	What type of main material do you use for solid waste storage? [OBSERVE THE MATERIAL] [CIRCLE ONE RESPONSE]	Plastic waste container …… 1 Bag/sack …… 2 Small metallic container …… 3 Barrel …….. 4 Bamboo basket …….. 5 No storage container …… 6 Other (specify) _____ 7	
59.	Is the solid waste storage container covered? [OBSERVE ONLY]	Yes …….. 1 No …… 2 No storage container …… 3	
60.	Is the surrounding of the house clean? [OBSERVE] [IT IS CLEAN IF AREAS AROUND DWELLINGS ARE UNCONTAMINATED BY SOLID WASTE AND OBSERVABLE FAECES, KEPT FREE OF ANIMAL FAECES, WASTEWATER DRAINS ARE KEPT CLEAR AND WASTEWATER DO NOT CONTAMINATE THE SURROUNDING ENVIRONMENT]	Yes …….. 1 No …… 2	
	v. HYGIENE PRACTICES		
61.	Do you have soap in your house today? [SOAP IS IN BAR OR POWDER FORM] [ONLY ASK FOR THE AVAILABILITY OF SOAP HERE] [OBSERVE]	Yes …….. 1 No …… 2	
62.	Have you used soap today or yesterday?	Yes …….. 1 No …… 2	→63 →65
63.	When you used soap today or yesterday, what did you use it for? [DO NOT READ THE ANSWER, CIRCLE ALL THAT APPLY, MULTIPLE CODES POSSIBLE]	Washing my hands …… 1 Washing children's hand …….. 2 Washing clothes …… 3 Washing my body …….. 4 Washing children's body …….. 5 Washing child's bottom after defecation..... 6 Other (specify) _____ 7	64 →65

NO.	QUESTIONS AND FILTERS	RESPONSE CODING CATEGORIES	SKIP
64.	If for washing hand is mentioned, what was the occasion? [DO NOT READ THE ANSWER (CIRCLE ALL THAT APPLY)] [MULTIPLE CODES POSSIBLE]	Before eating food ..... 1 After eating food ..... 2 After going to toilet ..... 3 Before preparing food ..... 4 Before feeding children ..... 5 After cleaning child's bottom ..... 6 When hands are dirty ..... 7 Don't know (nothing) ..... 8 Other (specify) _____ 9	
65.	Where you most often wash your hands (place for handwashing)? [ASK TO SEE AND OBSERVE. RECORD ONLY ONE HAND WASHING PLACE. THIS IS THE HAND WASHING PLACE THAT IS USED MOST OFTEN BY HOUSEHOLD]	Inside or near toilet facility ..... 1 Inside or near kitchen or cooking place ..... 2 Elsewhere in the compound ..... 3 Outside the compound ..... 4 Inside house ..... 5 No specific place ..... 6 Other (specify) _____ 7	
66.	Is there a handwashing device? [HANDWASHING DEVICE INCLUDES WATER FROM A TAP OR OTHER TYPE OF LOCAL WATER HOLDING CONTAINER (E.G. PAIL WITH DIPPER, TIPPY TAP (MADE FROM JERRY CAN ) OR KETTLE/JUG) AND HANDWASHING-BASIN OR SINK] [OBSERVE]	Yes ..... 1 No 2	
67.	Is water present at the specific place for handwashing? [OBSERVE WHETHER WATER IS PRESENT AT THE TAP OR THE CONTAINER]	Water is available ..... 1 Water is NOT available 2	
68.	Is soap or detergent present at the specific place for handwashing? [OBSERVE] [CIRCLE ALL THAT APPLY] [MULTIPLE CODES POSSIBLE]	Bar soap ..... 1 Detergent (powder) ..... 2 Liquid soap ..... 3 Not available ..... 4 Other (specify) _____ 5	
69.	Is an alternative cleaning agent other than soap or detergent present at the specific place for handwashing? [OBSERVE] [CIRCLE ALL THAT APPLY] [MULTIPLE CODES POSSIBLE]	Ash ..... 1 Soil/mud ..... 2 Sand ..... 3 Leaves ..... 4 Not available ..... 5 Other (specify) _____ 6	
70.	What do you think are the most important times to wash your hands? [DO NOT READ THE ANSWERS, ENCOURAGE BY ASKING IF THERE IS ANYTHING ELSE UNTIL SHE SAYS THERE IS NOTHING ELSE] [MULTIPLE RESPONSES ARE ALLOWED, CIRCLE ALL THAT APPLIES]	Before eating food ..... 1 After eating food ..... 2 After going to toilet ..... 3 Before preparing food ..... 4 Before feeding children ..... 5 After cleaning child's bottom ..... 6 When hands are dirty ..... 7 Other (specify) _____ 8	

NO.	QUESTIONS AND FILTERS	RESPONSE CODING CATEGORIES	SKIP
SECTION III: CHILDHOOD DIARRHOEA			
71.	Has the child [*NAME OF CHILD*] had diarrhoea in the last 2 weeks? [DIARRHOEA: 3 OR MORE LOOSE OR LIQUID STOOLS IN 24 HOURS]	Yes ..... 1 No 2	→72 →74
72.	Was there any blood in the stools? [CIRCLE ONE RESPONSE]	Yes ..... 1 No ..... 2 Don't know 3	
73.	What was the duration of diarrhoea?	[ ] [ ] days Less than 14 days ..... 1 Greater than 14 days 2	
74.	Does your child have diarrhoea today? [DIARRHOEA: 3 OR MORE LOOSE OR LIQUID STOOLS IN 24 HOURS]	Yes ..... 1 No 2	→75 →76
75.	If the child has diarrhoea today, how many times a day he/she passes stool?	[ ] [ ] times Three times ..... 1 More than three times ..... 2 Don't know 3	
76.	What do you think is the cause of diarrhoea (watery stools) in a child under the age of 5 years? [MULTIPLE CODES POSSIBLE] [DO NOT READ THE ANSWERS, ENCOURAGE BY ASKING IF THERE IS ANYTHING ELSE UNTIL SHE SAYS THERE IS NOTHING ELSE AND CIRCLE ALL THAT APPLY]	Dirty/contaminated water..... 1 Dirty/contaminated food..... 2 Uncooked food..... 3 Not using toilet or defecating in the open field anywhere ..... 4 Dirty hands (not washing hands)..... 5 Germs ..... 6 Poor personal hygiene ..... 7 Poor environmental cleanliness ..... 8 Flies..... 9 Change of season ..... 10 Don't know ..... 11 Other (specify) _____ 12	
77.	Do you think diarrhoea can be prevented?	Yes ..... 1 No 2	→78
78.	If yes, in your opinion, how diarrhoea can be prevented? [MULTIPLE CODES POSSIBLE] [DO NOT READ THE ANSWERS, ENCOURAGE BY ASKING IF THERE IS ANYTHING ELSE UNTIL S/HE SAYS THERE IS NOTHING ELSE AND CIRCLE ALL THAT APPLY]	Wash hands regularly ..... 1 Use soap for cleanliness..... 2 Maintain proper personal hygiene ..... 3 Use latrine ..... 4 Proper disposal of children's excreta (e.g. dispose in latrines) ..... 5 Proper environmental cleanliness ..... 6 Proper disposal of wastewater ..... 7 Proper disposal of solid waste ..... 8 Use clean and adequate water for drinking and domestic use ..... 9 Protection of water from contamination at home during storage and handling ..... 10 Treat water (boil, filter, chlorinate)..... 11 Prepare food hygienically and protect food from contamination ..... 12 Good nutrition..... 13 Don't know ..... 14 Other (specify) _____ 15	
79.	TIME INTERVIEW FINISHED	[ ]:[ ]	

Interviewer visit

	Visit 1	Visit 2	Visit 3
Date			
All questions completed?	Completed……..1 Eligible person not available2 Dwelling not found……3 Refused……..4 Partially completed……5 Other (specify)_____6	Completed……..1 Eligible person not available2 Dwelling not found……3 Refused……..4 Partially completed……5 Other (specify)_____6	Completed……..1 Eligible person not available2 Dwelling not found……3 Refused……..4 Partially completed……5 Other (specify)_____6

Interviewer:	Name: _____ Signature: _____ Date: ___/___/_____
Checked by:	Researcher: Name: _____ Signature: _____ Date: ___/___/_____

ANNEXURE C

INFORMED CONSENT LETTER

PARTICIPANTS' INFORMED CONSENT LETTER
(Introduction and consent)

Dear Participant,

GREETINGS!

My name is ……. Your household has been randomly chosen to participate in a research of student Abdulwahid Idris Mohammed to fulfil Doctoral Degree in Health Studies requirements at the University of South Africa (UNISA). The purpose of the study is to assess and explore the household environmental health factors associated with the occurrence of diarrhoea in children under-five years of age of Sebeta town in Ethiopia in order to develop health strategies so as to optimise actions to be prioritised in the prevention and control of childhood diarrhoea.

I request your permission to participate in an interview on issues related to environmental sanitation conditions of your household and childhood diarrhoea. The interview session will ask you questions that relate to:

- Environmental health condition of the household
- Observation of the sanitation facilities of the household
- Under-five child health issues (childhood diarrhoea)

The information you provide will be kept confidential and will only be used for research purposes. You are therefore assured of anonymity as no names and addresses of any of the participants (personally identifiable information) will be used during data collection, report writing or in the event of a publication or presentation resulting from the research.

Your participation will be voluntary and you will be permitted to withdraw from participating in the study interview at any moment if not willing to participate and you will not be expected answer any questions if you do not want to. As your views are important, you are thus requested to participate in this study.

Thank you for your time and cooperation and if you have questions you can ask me about the study now.

Do you have any questions?
May I begin with the interview now?

I agree to participate in this study: Yes ☐ No ☐

Signature of study participant: _____ Date: ___/___/_____
Signature of interviewer: _____ Date: ___/___/_____

ANNEXURE D

INSTRUCTIONS FOR DATA COLLECTORS

INSTRUCTIONS FOR INTERVIEWERS FOR THE COMPLETION OF THE INTERVIEW SCHEDULE

HOW TO INTRODUCE AND INTERVIEW THE HOUSEHOLD FOR DATA COLLECTORS

- You will be provided with the name of the household head and the address of the household to be interviewed.
- You will be provided with the interview schedule for each assigned household and hold the interview schedule for each household when going to conduct the interview.
- Once you get the house and arrived at the household, you should get permission to enter into the house and make greeting, and then ask whether the household has under-five child, if the household has a child ask whether the mother of the under-five child is present, if the mother is not available, ask whether a female caregiver person of at least 18 years of age is present for interview.
- If the mother/caregiver is not around, take another date for return visit. Record the date of return visit on the interview schedule.
- If the mother/caregiver is there, explain the purpose of the visit by using the "PARTICIPANTS' INFORMED CONSENT LETTER" and ask for her consent.
- Ask each question exactly as it is written on the questions of the interview schedule.
- The information that you record in the interview schedule should be based upon answers directly provided by the study participant for each question. Generally there are two types of responses based on the type of questions:
  - For closed-ended questions, circle on the appropriate answer code (numbered) for each question based on the answer of the participant.
  - For open-ended questions, write the answer given by the study participant on the space provided for each question.
- Changes in font are used to indicate the various components of the interview schedule in which the meaning of the format are as follows:
  - Questions in small letters: each question is written in small letters which is to be read to the participants.
  - CAPITAL LETTERS IN []: are statements that appear under each question which indicates instructions for data collectors including observations of items in the household and should not be read aloud to the participant. Out of the statements in [CAPITAL LETTERS], there are some 'questions' in small letters that are put in the form of filters which are used for probe to ask further questions to the respondent.
  - Response categories for closed-ended questions are written in small letters and coded with numbers.
- For question with either "main", "usually", or "principal" give only one answer.
- Whenever observation and estimations are required, do it carefully.
- If the study participant gives an answer not included in the given answer lists, write it in space given "other (specify)" and if the participant replied she do not know for some questions, mark as "don't know" where this response category is made available.
- Skip instructions are given for few questions which are indicated by the symbol of arrow (→) followed by a number which instructs the data collector to omit some questions and continue to the question number indicated in the arrow so as to ask the participant only those questions that are relevant to the household's situation.
- After completing the interview schedule, check to ensure that no question has been missed and all information required in each question are collected (unless skipped according to the type of the questions). If missed information is found, the data collector will reinterview the households.
- Upon completion of the interview, thank the study participant.

ANNEXURE E

LETTER REQUESTING PERMISSION TO CONDUCT THE STUDY

September 6, 2013

Oromiya Regional State Health Bureau
ADDIS ABABA

Subject: Request for permission and cooperation to conduct a research at Sebeta town in Finfinne surrounding special zone of Oromiya region in Ethiopia

I am Abdulwahid Idris Mohammed, a Doctoral Degree Student at the University of South Africa (UNISA). I will be conducting a research project for fulfillment of the requirements for a Doctoral Degree in Health Studies. The title of my study is **"STUDY TITLE: DEVELOPMENT OF ENVIRONMENTAL HEALTH STRATEGIES FOR PREVENTION OF CHILDHOOD DIARRHOEA IN SEBETA TOWN OF ETHIOPIA".**

The purpose of the study is to assess and explore the household environmental health factors associated with the occurrence of diarrhoea in children under-five years of age of Sebeta town in Ethiopia in order to develop health strategies so as to optimise actions to be prioritised in the prevention and control of childhood diarrhoea. In this study, the source population will comprise of all households' mothers or caregivers of children of under-five living in Sebeta town of Ethiopia and the accessible population includes a sample of randomly selected households with under-five children in Sebeta town.

It is envisaged that this study research would help to contribute with existing knowledge for the health professions on which to base in enhancing environmental health programme for the prevention and control of childhood diarrhoea and provide a framework for environmental health intervention programme strategies based on the study findings. This would help to contribute for improving environmental health conditions and childcare in the study area, which in turn contribute for improvement of the health of the entire population.

Therefore, I hereby request for permission to conduct the research in Oromiya region of Sebeta town and also request for letters of cooperation to Sebeta Town Health Office.

Sincerely,

Abdulwahid Idris Mohammed

ANNEXURE F

LETTER FROM OROMIYA REGIONAL HEALTH BUREAU OF ETHIOPIA GRANTING PERMISSION TO CONDUCT THE STUDY (IN ETHIOPIAN LANGUAGE OF AFAN OROMO)

BIIROO EEGUMSA FAYYAA OROMIYAA

OROMIA HEALTH BUREAU
የኦሮሚያ ጤና ጥበቃ ቢሮ

Lakk/Ref. No. BEFO/HBTDH/1-8/2823

Guyyaa /Date 10-01-2006

W/E/F/Bulchiinsa Magaalaa Sabbataa tiif
Sabbataa

Dhimmi: **Xalayaa deeggarsaa ilaala**

Akkuma beekamu Biiroon keenya ogeeyyii, dhaabbilee akkasumas namoota qorannoo gaggeessuuf piroppoozaala dhiyeeffatan piroppoozaala isaanii madaaluun akkanumas iddoo biraatti ilaalchisanii fudhatama argatee (approved) dhiyaateef, piroppoozaala isaanii ilaaludhaan waraqaa deeggarsaa ni-kenna. Haaluma kanaan mata-duree " **Development of environmental health strategies for prevention of child hood diarrhoea in Sebeta town ethiopia"** jedhurratti **Obbo Abdulwahid Idris** qorannoo Magaalaa Sabbataatti keessatti hojjachuuf piroppoozaalii isaanii Koree **"Health Research Ethical Review Committee" university of south africa health studies higher degrees committee college of human sciences ethical clearance certificate tti** dhiyeeffachuun mirkaneessisanii Koree "Health Research Ethical Review Committee" Biiroo keenyaatti dhiyeesaniiru.

Haaluma kanaan Koreen "Health Research Ethical Review Committee"Biiroo keenyaas piroppoozaala kana ilaaluun fudhatee qorannoon kun akka hojiirra oolu murteessee jira.

Waan kana ta'eef hojii qorannoo kanarratti deeggarsa barbaachisaa akka gootaniif; akkanumas nama tokko tokko kan adeemsa qorannoo kanaa hordofuu akka ramaddanii hordoftan jechaa, **Obbo Abdulwahid Idris** qaamni qorannoo hojjatu **wayitii** qorannoon kun qaacceffamee xumurame fiiriisaa Biiroo Eegumsa Fayyaa Oromiyaa fi iddoowwan qorannoon irratti adeemsifameef kooppii tokko tokko akka galii godhan garagalchaa xalayaa kanaatiin isaan beeksifna.

Obbo Abdulwahid Idris, qorataa kan taahe wayitii qorannoon kun qaacceffamee xumurame fiiriisaa kooppii tokko tokko Biiroo Eegumsa Fayyaa Oromiyaa fi iddoowwan qorannoon irratti adeemsifameef akka galii goonu mallattoo keenyaan mirkaneessina.

Nagaa wajjin

Mallattoo Abdulwahid
Maqaa Abdulwahid Idris
Guyyaa 10/01/2006
Lakk. Bilbilaa **0911644595**
G/G
Abdulwahid Idris
Bakka jiranitti

B/B Tasfaayee Deettii (BSC, MPH)
Gaggeessaa Adeemsa Hojii Ijoo Balaa
Tasaa Fayyaa Hawaasaa Qu'annoo fi
Qorannoo Fayyaa

Teessoo: Tel:+251-011-369-01-49, Fax: +251-011-361-01-27 P.O.Box.24341 E-mail: **ohbhead@telecom.net.et**
Address: ADDIS ABABA/FINFINNE-ETHIOPIA

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