ASSESSING ENVIRONMENTAL SANITATION IN URBAN SETTING OF DUKEM TOWN, ETHIOPIA

by

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DECLARATION

I declare that **ASSESSING ENVIRONMENTAL SANITATION IN URBAN SETTING OF DUKEM TOWN, ETHIOPIA** is my own work and that all sources that I have used or quoted have been indicated and acknowledged by means of complete references and that this work has not been submitted before for any other degree at any other institution.

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ABSTRACT

The aim of this study was to assess the environmental sanitation conditions with regard to water, sanitation, waste management and personal hygiene of households of Dukem town in Ethiopia. A cross-sectional study design was used to conduct the research. A total of 391 households had participated in the study. Majority of households had access to improved source of drinking water. The mean per capita per day water consumption of the households was low. Two-thirds of households had improved toilet facilities. Availability of improved waste management was grossly inadequate. Two-thirds of households had washed hands after visiting toilet. Generally households had good domestic environmental sanitation conditions but it also emerged that the households were deprived from full range of access to the most essential environmental sanitation services. Therefore, the inadequate level of service to the study area could be seen as opportunity for further focused improvements towards universal access to improved environmental sanitation.

Keywords:
Environmental sanitation, domestic water, basic sanitation, wastewater, solid waste, handwashing, personal hygiene, hygiene practices, Dukem town, Ethiopia.

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LIST OF ABBREVIATIONS

3ie	International Initiative for Impact Evaluation
CSA	Central Statistical Agency
DHS	Demographic and Health Survey
EHP	Environmental Health Project
ETB	Ethiopian Birr
GoE	Government of Ethiopia
HSDP	Health Sector Development Programme
HSEP	Health Service Extension Programme
IFH	International Scientific Forum on Home Hygiene
IFRC/RCS	International Federation of Red Cross and Red Crescent Societies
IRC	International Water and Sanitation Centre
ISWM	Integrated solid waste management
JMP	Joint Monitoring Programme for Water Supply and Sanitation
LCD	Litres per capita per day
MDG	Millennium Development Goal
MoH	Ministry of Health
MoWR	Ministry of Water Resources
NGOs	Non-governmental organizations
PAHO	Pan American Health Organization
PASDEP	Plan for Accelerated and Sustained Development to End Poverty
POU	Point-of-use treatment
RHB	Regional Health Bureau
SPSS	Statistical Package for the Social Sciences
UAP	Universal Access Programme
UNEP	United Nations Environment Programme
UNESCO	United Nations Educational, Scientific, and Cultural Organization
UNICEF	United Nations Children's Fund
UN-HABITAT	United Nations Human Settlements Programme
UNU-INWEH	United Nations University Institute for Water, Environment and Health
USAID	United States Agency for International Development
VIP	Ventilated improved pit latrine
WASH	Water, sanitation and hygiene
WEDC	Water, Engineering and Development Centre
WHO	World Health Organization
WSSCC	Water Supply and Sanitation Collaborative Council

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CHAPTER 1

ORIENTATION TO THE STUDY

1.1 INTRODUCTION

Safe drinking water, sanitation and good hygiene are fundamental to health, survival and development (World Health Organization & United Nations Children's Fund 2006b:2). Yet, 1.1 billion people in the world lack access to improved water supplies and 2.6 billion people lack adequate sanitation (Moe & Rheingans 2006:41). Unsafe water, inadequate sanitation, and insufficient hygiene practices account for an estimated 9.1 percent of the global burden of disease and 6.3 percent of all deaths, according to the World Health Organization (WHO) (Prüss-Üstün, Bos, Gore & Bartram 2008:10).

According to data from the Ministry of Health of Ethiopia (2009:16), 66% of households in the country have access to an improved source of drinking water. The latrine coverage data provided by the Central Statistical Agency (CSA) of Ethiopia and ORC Macro (2006:23-25) based on the Demographic and Health Survey (DHS) shows that access to toilet facilities in the country is among the lowest in the world. Sixty two percent of the population still practice open field defecation. Only 7 percent of the population use improved sanitation facilities that are not shared.

The research was conducted in an urban setting of Dukem town of Ethiopia so as to study the environmental sanitation conditions of the households of the town which would give insight about the magnitude of sanitation and hygiene problems and optimise actions to be prioritised in the prevention of environmental sanitation and hygiene-related diseases.

1.2 BACKGROUND INFORMATION ABOUT THE RESEARCH PROBLEM

1.2.1 The source of the research problem

Infectious and communicable diseases account for about 60-80% of the health problems in the country (Ministry of Health 2005a:4). The major causes of morbidity among patients seeking treatment in health facilities include respiratory infections, malaria, skin infections, diarrhoea diseases, and intestinal parasitic infections. For children, these five illnesses accounted for over 63 percent of all reported cases of child morbidity. In general, the poor health status of Ethiopians can be characterised by vulnerability to largely preventable infectious diseases and nutritional deficiencies (Ministry of Water Resources 2004:18-19).

Water supply and sanitation situation in Ethiopia is inadequate. Most of the populations, urban and rural alike, do not have access to safe and adequate water supplies and sanitation facilities. Few households show sufficient understanding of environmental sanitation or hygienic practices regarding food, water and personal hygiene. As a result, three-fourths of the health problems in Ethiopia are due to communicable diseases attributable to unsafe/inadequate water supply, and unhygienic/unsanitary waste management, particularly excreta. Diarrhoeal diseases caused by improper management of water and sanitation is among the major causes of infant and child morbidity and mortality (Ministry of Water Resources 2004:19). The increased magnitude of environmental health problems in urban settings of the country demands community-based studies that will facilitate a better understanding of the issues and influence policy and decision-making at the community, town, regional state and national level.

Dukem was selected for this study and is one of urban settings in Ethiopia. The town is located in Finfinne surrounding special zone of Oromia region. Finfinne special zone is one of the 18 zones of Oromia Regional state located at short distance surrounding in Addis Ababa city. It is a town in central Ethiopia at 37 kilometres to the South of Addis Ababa and 10 kilometres Northwest of Bishoftu (Dukem Town Administration 2009). The town has a population of more than twenty four thousand (Dukem Town Health Office 2010:2).

Dukem town has one main seasonal river called Dukem River. There is piped water supply system in the town in which the source of the water is from the underground water and the town has 10 public water stand taps (Dukem Town Administration 2009).

The town's health services and programmes are under the administration and supervision of Dukem Town Health office. Available health institutions in Dukem town are one government health centre, four private drug vendors and six private clinics. Out of the six private clinics, four are medium clinics and the two are junior clinics. Regarding manpower, the Town's Health Office has 13 health workers and the health centre has 42 health workers, totally making 55 health workforces (Dukem Town Health Office 2010:2-3). It is reported that diarrhoea to be the most prevalent health problem followed by seasonal malaria epidemics in the town (Melkamu 2007:9).

With this context, Dukem was selected to study the situation of water, sanitation, hygiene and waste handling practices in the households of the town.

1.2.2 Background to the research problem

Globally, an estimated 24% of the disease burden (healthy life years lost) and an estimated 23% of all deaths (premature mortality) was attributable to environmental factors (Prüss-Üstün & Corvalán 2006:9). Among children between 0 and 14 years of age, the proportion of deaths attributed to the environment was as high as 36%. Diseases with the largest absolute burden attributable to modifiable environmental factors included: diarrhoeal diseases; lower respiratory tract infections; 'other' unintentional injuries; and malaria. 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).

Access to water supply and sanitation is a fundamental need and a human right. It is vital for the dignity and health of all people (World Health Organization & United Nations Children's Fund 2000:1). Water, sanitation and good hygiene practices have the potential to prevent at least 9.1% of the global disease burden and 6.3% of all deaths (Prüss-Üstün et al 2008:10).

One of the most important benefits of water, sanitation and hygiene is by providing barriers to transmission from the environment to the human body of diarrhoeal disease, which is responsible for an estimated 21 percent of fatalities of under-fives in developing countries or 2.5 million deaths per year. In order to improve the quality of life around the world, it is important to focus in interventions that result in improvements of water, sanitation and hygiene (Waddington, Snilstveit, White & Fewtrell 2009:8). However, according to the WHO and United Nations Children's Fund (UNICEF) Joint Monitoring Programme for water supply and sanitation estimates that 1.1 billion people live without improved water sources, while over half of the developing world population (representing 2.6 billion people) lack access to improved sanitation (Waddington et al 2009:8).

One of the targets of Millennium Development Goal (MDG) 7, which is concerned mainly with environmental sustainability, is to halve the number of people who do not have sustainable access to safe drinking-water and basic sanitation by 2015. This target requires coverage of 75% of the population by improved water sources. In the area of sanitation, the target is 66% coverage by improved services by 2015 (World Health Organization Regional Office for Africa 2006:98). Sub-Saharan Africa represents about 11 percent of the world population, but almost a third of all people live without access to safe drinking water (United Nations Children's Fund 2006:5) or 37% of people not using an improved source of drinking-water live in Sub-Saharan Africa (World Health Organization & United Nations Children's Fund 2010:56). Among the largest disparities in safe water and basic sanitation are those between urban and rural populations. Globally, access to improved drinking-water sources is 95 percent in urban areas, compared with 73 percent in rural areas. There is great difference in urban-rural divide in drinking water in sub-Saharan Africa, where 81 percent of people in urban areas are served, compared with 41 percent in rural areas (United Nations Children's Fund 2006:5).

Problems with sanitation are intensified when there is inadequate drainage and waste removal. Where sanitation is poor, many people must defecate in the open, or into plastic bags or paper thrown out 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

stormwater cannot be easily drained, flooding spreads waste and excreta widely throughout the surrounding area (Bartlett 2003:66).

In Ethiopia, the provision of safe and adequate water supply for the population has far reaching effects on health, productivity and quality of life, as well as on the socio-economic development. 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).

According to Demographic and Health Survey (DHS) of Central Statistical Agency and ORC Macro (2006:23) of Ethiopia, 61 percent of households in the country have access to an improved source of drinking water with access in urban areas much higher than in rural areas (94 percent and 56 percent, respectively). Based on Ministry of Health (2009:16) data, 66.2% of households in Ethiopia have access to an improved source of drinking water. Out of this, 88.6% is in urban and 66.2% is in rural area.

The latrine coverage provided by the Central Statistics Agency and ORC Macro (2006:25) shows that 62 percent of Ethiopian households do not have access to toilet facility. Overall a small proportion (7 percent) of households use improved toilets that are not shared. However, according to data from the Ministry of Health of Ethiopia (2009:16), 60% of households have access to excreta disposal.

Because of growing concerns of environmental health risks from the towns of the country, it is essential to perform community-based studies that will support better understanding of the issues and problems. Based on these contexts, this study was conducted with regard to household environmental sanitation conditions of Dukem town.

1.3 RESEARCH PROBLEM

It is reported that the overwhelming communicable disease burden in Ethiopia is attributable to poor sanitation (Ministry of Health 2005b:15). According to the National Hygiene and Sanitation Strategy of Ethiopia, more than 250,000 children die every year from sanitation and hygiene related diseases (Ministry of Health 2005b:5-6; Government of Ethiopia 2007:36). It is estimated that diarrhoea contributes 20% of the

cause-specific proportions for under-5 mortality (World Health Organization Regional Office for Africa 2004).

Several disease conditions have significance for public health in Dukem town. It is reported that diarrhoea and other infectious diseases to be the most prevalent health problems in the town (Melkamu 2007:9). Therefore, this study aimed to assess the environmental sanitation and hygiene conditions of households of Dukem town in Ethiopia in order to give insight about the magnitude of sanitation and hygiene problems and optimise actions to be prioritised in the prevention of environmental sanitation and hygiene-related diseases.

1.4 AIM OF THE STUDY

1.4.1 Research purpose

The purpose of this study was to assess the environmental sanitation conditions with regard to water, excreta disposal, waste disposal, personal and domestic hygiene of the households of Dukem town in Ethiopia. This would give insight about the magnitude of sanitation and hygiene problems and optimise actions to be prioritised in the prevention of environmental sanitation and hygiene-related diseases.

1.4.2 Research objectives

The objectives for this study were to:

- Investigate the accessibility, availability and usage pattern of drinking water of households.
- Ascertain the accessibility and availability of environmental sanitation facilities.
- Examine the knowledge and practices of the households in relation to environmental sanitation and hygiene conditions.
- Identify factors contributing for the availability of environmental sanitation facilities in relation to household characteristics.

1.5 SIGNIFICANCE OF THE STUDY

As the development of environmental sanitation services were given attention in the government policies, strategies and plans; the study would help to scrutinise the accessibility, availability and utilisation of the environmental sanitation services and hygiene facilities. The study would serve to identify the problems and helps to distinguish the hygiene risk practices in households. In addition, the information gathered from the research will inform the activities of the environmental health programme, to best achieve its goal of improved environmental health through better water and environmental sanitation services.

1.6 DEFINITIONS OF TERMS

- **Improved drinking water source**: are piped water into dwelling, plot, or yard, public tap/standpipe, tube well/borehole, protected dug well, protected spring and rainwater collection (Hygiene Improvement Project 2010:10). In this study, improved water source refers to private piped water inside the house, private piped water inside the compound, shared neighbourhood piped water, water bought from neighbourhood private piped tap, public tap/standpipe, protected dug well and protected spring.
- **Unimproved drinking water source**: include unprotected dug well, unprotected spring, cart with small tank/drum, tanker truck, surface water (river, dam, lake, pond, stream, canal, irrigation channel) and bottled water (Hygiene Improvement Project 2010:10). In this study, unimproved water source include surface water (pond or river).
- **Basic sanitation**: refers to the management of human faeces at the household level (Girei & Giroh 2011; Ministry of Health 2011b:3). In this study, basic sanitation refers to household toilet facilities.
- **Improved sanitation facilities**: are connection to public sewer, connection to septic tank, pour-flush latrine, simple pit latrine and ventilated improved pit latrine. The excreta disposal system is considered improved if it is private and if it hygienically separates human excreta from human contact (World Health Organization & United Nations Children's Fund 2004:5). In this study, improved sanitation facilities refer to flush/pour-flush toilet, ventilated improved pit latrine and traditional pit latrine.

- **Unimproved sanitation facilities**: includes flush or pour/flush toilets without a sewer connection, pit latrines without slab/open pit, bucket latrines, hanging toilets/latrines and no facilities, open defecation (Hygiene Improvement Project 2010:52). In this study, basic sanitation facility includes communal latrines, public toilet and field or anywhere.
- **Hygiene practices**: are the safe handling of excreta, water, and food, personal and domestic hygiene (Murphy, Stanton & Galbraith 1997:13) and which all aimed at preserving cleanliness and health (WaterAid 2010:3). In this study, hygienic practices includes washing hands at critical times, proper handling and storage of water, keeping latrines clean, proper disposal of child's faeces and such personal and domestic hygiene practices.
- **Environmental sanitation condition:** in this study, it is concerned with basic environmental sanitation conditions at household level which mainly includes domestic water, excreta disposal, waste disposal, personal and domestic hygiene facilities, services or practices.

1.7 FOUNDATIONS OF THE STUDY

The purpose of this research was to assess the environmental sanitation conditions with regard to water, excreta disposal, waste disposal, personal and domestic hygiene of the households and this purpose addresses the theoretical framework of the F-diagram. The F-diagram is chosen as a framework because in Ethiopia more than 250,000 children die every year from sanitation and hygiene related diseases (Ministry of Health 2005b:5-6; Government of Ethiopia 2007:36). It is estimated that diarrhoea contributes 20% of the cause-specific proportions for under-5 mortality (World Health Organization Regional Office for Africa 2004). It is reported that diarrhoea and other infectious diseases to be the most prevalent health problems in Dukem town (Melkamu 2007:9).

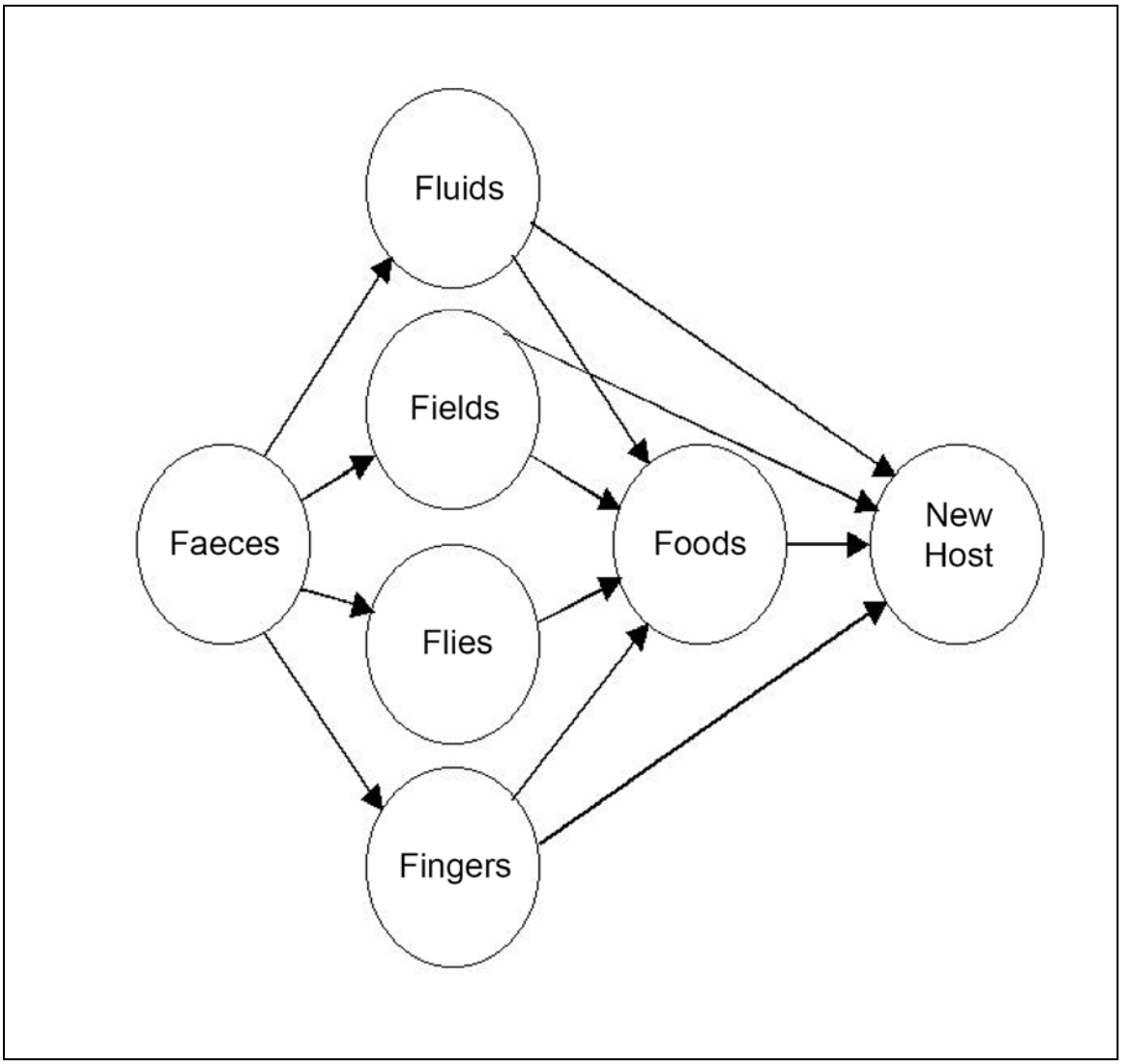


Figure 1.1 The F-diagram for faecal-oral disease transmission

(Curtis, Cairncross & Yonli 2000:25)

Most of the diseases which result in diarrhoea are spread by pathogens (disease-causing organisms) found in human excreta (faeces and urine). The faecal-oral mechanism, in which some of the faeces of an infected individual are transmitted to the mouth of a new host through one of a variety of routes, is by far the most significant transmission mechanism: it accounts for most diarrhoea and a large proportion of intestinal worm infections. This mechanism works through a variety of routes, as shown in Figure 1.1 – the "F" diagram (Water Supply and Sanitation Collaborative Council & World Health Organization 2005:10).

From the original causal agent – faeces – the bacteria, viruses, and protozoa that cause diarrhoea can make their way to the host via five (F-diagram) different but often

intersecting paths: (1) fluids, (2) fields, (3) food, (4) flies, and (5) fingers (Environmental Health Project 2004b:6).

1. *Fluids:* usually refers to the water used for drinking or cooking. The host can either drink contaminated water directly or eat food that has been washed in contaminated water.
2. *Fields:* People defecate outdoors or use faecal material as agricultural fertiliser. Children often defecate in the yard around a house. This exposes the microorganisms in faeces to rain water, to flies, and to food – from which it can infect the host.
3. *Food:* can be contaminated by flies, by microorganisms present on the utensils used to prepare it or in the preparation area itself, by contact with contaminated water, or by contact with contaminated fingers.
4. *Flies:* touch down on faeces and transmit the bacteria, protozoa, and viruses in faeces to food, water, utensils, the preparation area, or directly to the mouth of the host.
5. *Fingers:* can become contaminated by unhygienic cleansing practices and pass disease agents to the new host directly or by contaminating food or water (Environmental Health Project 2004b:6).

Figure 1.2 allows a distinction to be made between primary and secondary measures to prevent the spread of diarrhoeal pathogens in the environment. The four arrows originating from excreta on the left represent the primary routes by which infectious organisms get into the environment. Primary barriers are the practices that stop this happening. These include the disposal of stools in such a way that they are isolated from all future human contact (by the use of latrines, sewers, burying, etc.) and the removal of traces of faecal material from hands after contact with excreta. Secondary barriers are hygiene practices that stop faecal pathogens that have got into the environment in stools 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 such a way as to avoid pathogen survival and multiplication (Curtis et al 2000:25).

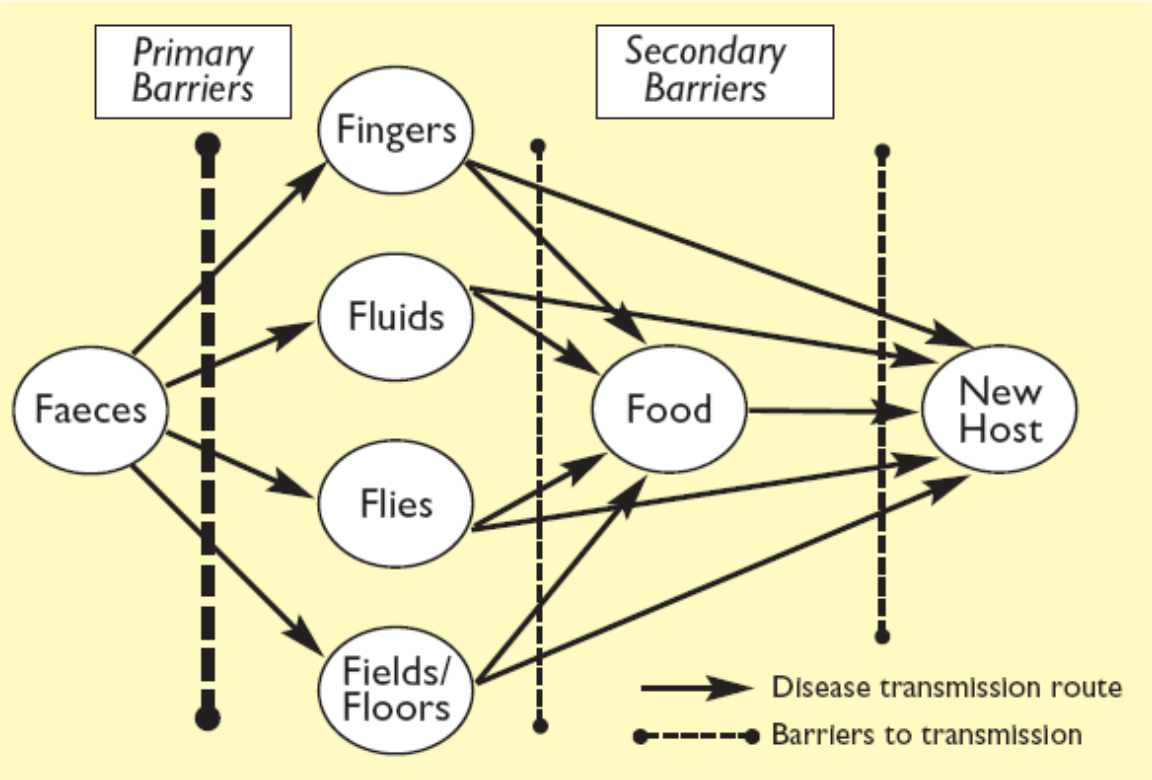


Figure 1.2 The F-diagram of disease transmission prevention and control
(Water Supply and Sanitation Collaborative Council & World Health Organization 2005:10)

The most successful efforts to prevent diarrhoea involve interventions to improve sanitation, improve water quality, increase water quantity, and increase handwashing, all of which have been conclusively shown to reduce diarrhoeal disease incidence in developing countries. Access to clean water and sanitation is important not only to prevent diarrhoeal diseases but other water-related diseases as well, such as ascariasis, hookworm, helminth infection, schistosomiasis, trachoma and Guinea worm (Environmental Health Project 2004b:7).

As shown in Figure 1.2, each intervention blocks certain pathways to contamination but not others, suggesting that such interventions are most effective when used in combination (Environmental Health Project 2004b:7).

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

1. **Improved basic sanitation** (safely disposing 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, either by keeping flies away from faeces or by 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 safe to use in all aspects of food preparation but only if that water stays clean and is not contaminated via other pathways.
3. **Increased water quantity** allows the family to wash food more thoroughly during preparation, wash food preparation surfaces and utensils more thoroughly and frequently, and to bathe and wash hands more thoroughly. These activities can block a number of the paths to contamination, including most of those involving fingers and flies and most having to do with food, but if the water thus made available remains contaminated, then merely having more of it is not the answer.
4. **Increased handwashing,** if done correctly at critical times, blocks all the pathways that directly or indirectly involve the fingers (Environmental Health Project 2004b:7-8).

All of these interventions – whether of the “hardware” (sanitation facilities, community water systems) or “software” (handwashing, water protection, safe excreta disposal) variety – have been shown to considerably reduce the prevalence of diarrhoea. And while each of these approaches is effective on its own, in combination they can deliver even greater results (Environmental Health Project 2004b:8).

Where sanitation facilities are badly planned and constructed, poorly maintained, used wrongly or not used at all, their construction can set up further potential disease transmission routes, and lead to contamination of the environment (Figure 1.3). 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).

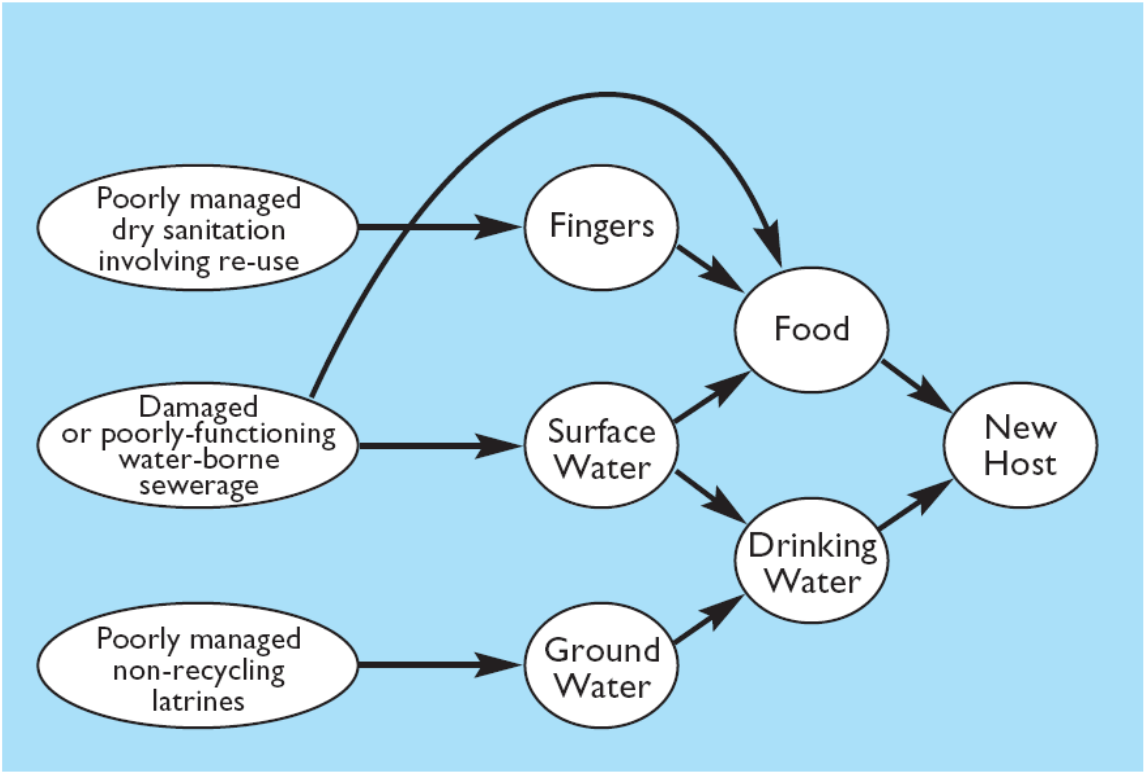


Figure 1.3 Additional transmission pathways due to poorly-managed sanitation
(Water Supply and Sanitation Collaborative Council & World Health Organization 2005:10)

To achieve full health benefits and in the interests of human dignity, other sources of contamination and disease also need to be managed including (Water Supply and Sanitation Collaborative Council & World Health Organization 2005:10):

- 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)

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

Based on this conceptual framework, it is considered important to study the situation of water, basic sanitation, hygiene and waste handling in the households of Dukem town. The research focuses on issues pertaining to household environmental sanitation-specific issues such as water, sanitary facilities, solid waste, liquid waste and hygiene practices as well as data collection on socio-economic and demographic characteristics of the study population.

1.8 RESEARCH DESIGN AND METHOD

A descriptive, quantitative research design, involving the method of cross-sectional research was chosen and used to conduct the study on the status of environmental sanitation conditions of the households of Dukem town. Simple random sampling method was utilised for selection of households. The sample size of the study was 406, which was determined using the statistical formula for the single population proportion. Two types of structured data collection methods were used in the study. These were interview and observational methods. The data collection instrument employed was using structured interview schedule and observational checklist. All responses to the research data collection instrument were coded and entered using EPI info. Statistical analysis was performed using SPSS software. Descriptive statistics was computed by means of frequency distribution and percentages and these were displayed using tables and graphs.

1.9 SCOPE OF THE STUDY

The scope of this research on environmental sanitation is not limited to the disposal of human waste. The study encompasses other elements such as water supply, disposal of solid waste and wastewater, personal and domestic hygiene. But the study is limited to the research problems related to environmental sanitation of household level and based on data collected from sampled households. The research does not include assessment based on data gathering from institutions. The results from the study may not be generalised for the entire country or the regional state given the fact that the study was conducted in one urban setting of the country.

1.10 STRUCTURE OF THE DISSERTATION

This dissertation consists of five chapters and is organised as follows:

CHAPTER	CHAPTER TITLE	CONTENT OVERVIEW
1	ORIENTATION TO THE STUDY	This chapter gives the background to the study and includes: introduction, background information, research problem, aim of the study, significance, definitions, foundations and scope of the study.
2	LITERATURE REVIEW	The chapter presents literature review of books, research reports, journals and other publications on environmental sanitation problems based on the research done internationally, in Africa and in Ethiopia.
3	RESEARCH DESIGN AND METHOD	The chapter presents the detailed description of the research design, research method, population, sampling methods, data collection, data analysis, validity and reliability and ethical considerations.
4	ANALYSIS, PRESENTATION AND DISCUSSION OF RESEARCH FINDINGS	This chapter presents data analysis procedures used and details of the findings of the research. The findings are interpreted and data explained with the help of tables, frequencies and statistical information.
5	SUMMARY, CONCLUSIONS, RECOMMENDATIONS AND LIMITATIONS OF THE STUDY	The final chapter summarises the research findings. Lastly conclusion and recommendations are stated.

1.11 CONCLUSION

Chapter 1 presented the background information to conduct the study. This study was conducted mainly in relation to household environmental sanitation conditions of Dukem town. Dukem was selected for the study which is one of urban setting in Ethiopia. The background information, research problem, aim of the study, purpose and objectives for the research were provide, as well as significance, key definitions of terms, foundations and scope of the study were presented. It was indicated that a descriptive, quantitative, cross-sectional study using simple random sampling method was used to conduct the research.

CHAPTER 2

LITERATURE REVIEW

2.1 INTRODUCTION

In this chapter, findings of the relevant literature reviewed are discussed. The review starts with the basic concepts of environmental sanitation and communicable diseases related to environmental sanitation. Then reviewed on various topic areas of the most important environmental sanitation interventions, namely basic sanitation (safe excreta disposal), personal hygiene and handwashing, safe water supply, wastewater management, solid waste management and hygiene promotion. Finally, the chapter includes literature reviewed on water and environmental sanitation conditions in Ethiopia. A conclusion is drawn at the end of the chapter which highlights the reviewed literature.

2.2 THE BASIC CONCEPTS OF ENVIRONMENTAL HEALTH/ENVIRONMENTAL SANITATION

The WHO Expert committee on environmental sanitation in 1950 defined environmental sanitation as “the control of all those factors in man’s physical environment, which exercise or may exercise a deleterious effect on his physical development, health and survival” (Dwivedi & Sharma 2007:7). 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).

Environmental problems have since grown in complexity, especially with the advent of radiation and chemical hazards. Meanwhile, the world's needs for essential sanitation services (i.e., drinking-water supply, excreta and wastewater disposal) have greatly increased as a result of rapid population growth and higher expectations. This led to the designation by the United Nations of the International Drinking Water Supply and Sanitation Decade (1981-1990) (Franceys et al 1992:3).

The terms “hygiene” and “sanitation” can mean different things to different people (Peal, Evans & Van der Voorden 2010:2). Because of considerable awareness of community water supply needs, the problems of excreta and wastewater disposal have received less attention. 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 WHO 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).

Sanitation means the prevention of human contact with wastes, for hygienic purposes. It also means promoting health through the prevention of human contact with the hazards associated with the lack of healthy food, clean water and healthful housing, the control of vectors (living organisms that transmit diseases), and a clean environment. It focuses on management of waste produced by human activities (Ministry of Health 2011b:3).

There are different types of sanitation relating to particular situations (Ministry of Health 2011b:3). Basic sanitation is used to refer to the management of human faeces at the household level (Ministry of Health 2011b:3; Girei & Giroh 2011). This terminology is the indicator used to describe the target of the Millennium Development Goals on sanitation (Girei & Giroh 2011).

Environmental sanitation refers to the control of environmental factors that form links in disease transmission. This category includes solid waste management, water and wastewater treatment, industrial waste treatment and noise and pollution control (Ministry of Health 2011b:3). Environmental sanitation comprises disposal and treatment of human excreta, solid waste and wastewater, control of disease vectors, and provision of washing facilities for personal and domestic hygiene. It aims at improving the quality of life of the individuals and contributing to social development. It has been defined by the Water Supply and Sanitation Collaborative Council as “Interventions to reduce people’s exposure to disease by providing a clean environment in which to live, with measures to break the cycle of disease. Environmental sanitation comprises both a change in behaviour and facilities to form a hygienic environment (Mmom & Mmom 2011:116).

Environmental health is broader than hygiene and sanitation; it encompasses hygiene, sanitation and many other aspects of the environment. It also involves studying the environmental factors that affect health (Ministry of Health 2011b:4). The WHO in Bulgaria in 1993, defined “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).

2.3 ENVIRONMENTAL SANITATION AND COMMUNICABLE DISEASES

Numerous studies indicate a direct link between environmental health risks and limited access to clean water, sanitation facilities and services on the one hand, and poor hygiene practices on the other. Water-borne pathogens alone infect around 250 million people per year, resulting in 10–20 million deaths. This leads to negative health impacts, environmental degradation and related economic impacts on the affected population. Access to qualitatively good drinking water, adequate sanitation facilities and services and satisfactory hygiene practices significantly contribute to reducing the rate of morbidity and mortality among populations (Dongo, Zurbrügg, Cissé, Obrist, Tanner & Biémi 2010:241). There are a number of diseases related to excreta and wastewater which commonly affect people in the developing countries and which can be subdivided into communicable and noncommunicable diseases (Franceys et al 1992:7).

Communicable diseases flourish where the environment fails to provide barriers against pathogens. Environmental conditions that favour the spread of communicable diseases are described hereunder (World Health Organization 1991:18):

- ***Lack of an adequate and safe water supply*** is associated with typhoid fever, cholera, hepatitis, gastrointestinal diseases, a number of parasitic diseases, trachoma and skin infections.
- ***Insanitary disposal of excreta*** is a major cause of infant diarrhoea, gastrointestinal infections, cholera and parasitic diseases.

- ***Inadequate disposal of solid wastes*** is a major factor in the spread of gastrointestinal and parasitic diseases and leptospirosis, primarily as a result of the proliferation of insect and rodent vectors.
- ***The absence of or inefficient drainage of surface waters***, as a result of flooding, wastewater accumulation or poor run-off of heavy rain, also encourages vector breeding and infections due to contact with contaminated water.
- ***Inadequate personal and domestic hygiene*** increases risks of the faecal-oral, skin, eye and vector-borne infections and ***poor food safety practices*** increase those of gastrointestinal and diarrhoeal diseases and malnutrition (World Health Organization 1991:18).

All of the transmission routes of excreta-related diseases particularly the faeco-oral routes can be blocked by changes in domestic hygiene practice. Improved technologies, such as water and excreta disposal facilities, can also contribute to preventing transmission (Curtis et al 2000:25). Environmental health interventions for the prevention of diarrhoeal disease typically include steps to improve the proper disposal of human faeces (sanitation), improving water quality, water quantity and access, and promoting handwashing and other hygiene practices (Clasen, Bostoen, Schmidt, Boisson, Fung, Jenkins, Scott, Sugden & Cairncross 2010:5).

2.4 ESSENTIAL INTERVENTIONS IN ENVIRONMENTAL SANITATION

There are many environmental sanitation interventions that can help to prevent diarrhoeal and other infectious diseases. The environmental health interventions to control diarrhoeal diseases involve low-cost measures that communities and households can implement on their own (Murphy, Stanton & Galbraith 1997:11). The most important environmental sanitation interventions are reviewed in this section:

2.4.1 Safe excreta disposal (basic sanitation)

2.4.1.1 Introduction

Basic sanitation generally refers to the provision of facilities and services for the safe disposal of human urine and faeces (Ministry of Health 2011c:77). Sanitation reduces or prevents human faecal pollution of the environment, thereby reducing or eliminating

transmission of diseases from that source. Effective sanitation isolates excreta and/or inactivates the pathogens within faeces (Prüss-Üstün et al 2008:17). Therefore, safe disposal of human faeces is essential for the health of families and the community as a whole (United Nations Children's Fund 2008:78). It is, thus, directly impacts disease transmission through person-to-person contact, water and the food chain (Fewtrell & Bartram 2001:89).

2.4.1.2 Sanitation and disease

Human excreta and the lack of adequate personal and domestic hygiene have been implicated in the transmission of many infectious diseases (Fewtrell & Bartram 2001:90). One of the primary purposes of sanitation provision is the protection of human and environmental health. The links between sanitation and health have been established, and sanitation is widely accepted as one of the most effective barriers against the transmission and spread of disease. A host of diseases (of bacterial, viral, and helminth origins) are excreta related and are transmitted through diverse routes from an infected person to others. 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).

Excreta related diseases may be classified based on their environmental transmission routes, they may also be classified according to causative agents and consequent effects on infected persons. The environmental classification system is presented in Table 2.1 (Ilesanmi 2002:11).

Table 2.1 Environmental classification of excreta-related diseases

CATEGORY	ENVIRONMENTAL TRANSMISSION FEATURES	MAJOR EXAMPLES OF INFECTION	ENVIRONMENTAL TRANSMISSION FOCUS
I. Non-bacterial faeco-oral diseases	Non-latent Low to medium persistence Unable to multiply High infectivity No intermediate host	Viral: Hepatitis A and E; Rotavirus diarrhoea; Norovirus diarrhoea. Protozoan: Amoebiasis Crystosporidiasis, Giardiasis. Helminthic: Enterobiasis, Hymenolepiasis	Personal, Domestic Wastewater
II. Bacterial faeco-oral diseases	Non-latent Medium to high persistence Able to multiply Medium to low infectivity No intermediate host	Campylobacteriosis, Cholera, Pathogenic Escherichia coli infection, Salmonellosis Shigellosis Typhoid Yersiniosis	Personal, Domestic Wastewater, Crops
III. Geo-helminthiases	Latent Very persistent Unable to multiply No intermediate host Very high infectivity	Ascariasis, Hookworm infection, Strongyloidiasis, Trichuriasis	Peri-domestic wastewater, Crops
IV. Taeniases	Latent Persistent Able to multiply Very high infectivity Cow or pig intermediate host	Taeniases	Peri-domestic Wastewater Fodder Crops
V. Water-based helminthiases	Latent Persistent Able to multiply High infectivity Intermediate aquatic host(s)	Schistosomiasis, Clonorchiasis, Fasciolopsiasis	Wastewater Fish, aquatic species or aquatic vegetables
VI. Excreta-related insect vector disease		Bancroftian filariasis transmitted by Culex quinquefasciatus	Wastewater
VII. Excreta-related rodent – vector disease		Leptosporosis	Wastewater

(Ilesanmi 2002:11)

Of all possible transmission routes, those of greatest importance for the spread of excreta-related diseases according to many researchers are those transmitted via the faeco-oral routes (Ilesanmi 2002:12). The infectious agents associated with diarrhoeal disease are transmitted mainly through the faecal-oral route. A wide variety of bacterial, viral, and protozoan pathogens excreted in the faeces of humans and animals are known to cause diarrhoea. The importance of individual pathogens varies between settings, seasons, and conditions. These pathogens may be transmitted through the

ingestion of contaminated food, water or other beverages, by person-to-person contact, and by direct or indirect contact with infected faeces (Clasen et al 2010:4).

2.4.1.3 The importance and benefits of safe excreta disposal

Access to basic sanitation is an important indicator of development as denoted by its inclusion in the millennium development goals (MDGs) for sustainable development. At the local or community levels, basic sanitation or a lack of it has direct and concrete impact on people and the environment in which they live. Appropriate and safe excreta management is essential for the protection of human and environmental health, and also offers important social benefits to communities (Ilesanmi 2002:9).

Some of these benefits include the elements described hereunder:

Human health: the impact of lack of basic sanitation is seen primarily in the area of health. Links between sanitation and health have long been established; a host of debilitating and deadly diseases are associated with lack of sanitation and may be reduced or prevented with sanitation interventions; health benefits of sanitation can be seen in the reduction of diseases in communities where sanitation facilities are present (Ilesanmi 2002:9).

Environmental health: the release of untreated excreta into the environment is a significant factor in the pollution and degradation of both water and soil quality. The effects of this can be seen in developing countries as most of the generated raw wastewater is discharged into surface water bodies (Ilesanmi 2002:9).

Poverty and economy: sanitation related diseases exert a significant toll on the lives of people globally, it thus stands to reason that sanitation and related interventions will lead to an improvement in health, consequently productivity and ultimately poverty reduction. In addition to these positive effects of improved sanitation on individual livelihood, there are indirect potential (communal and national) economic benefits as well (Ilesanmi 2002:9).

Convenience, privacy and safety: beyond health, access to toilets, enhances privacy, dignity and safety particularly for women (Shordt 2006b:3).

Justice and equity: equity and justice are fundamental principles underlining a sustainable society and development. The 2002 report of the United Nations Economic and Social Council on Economic, Cultural and Social Rights states that “the right to drinking water and sanitation is an integral part of officially recognised human rights and may be considered as a basic requirement for the implementation of several other human rights”. It basically recognises the right to water and sanitation as a human right, which when lacking negatively affects life, and as such is a vital component of the right to life, health, housing and education among other rights. Simply put, sanitation is important because it is not a luxury but a basic need and even a right (Ilesanmi 2002:10).

2.4.1.4 Risk factors relating to excreta and basic sanitation

There are five major problems relating to excreta and basic sanitation which can result in a health risk (Rottier & Ince 2003:74):

- There is open defecation as people do not use sanitary structures.
- People do not wash their hands (properly) after defecation.
- Sanitary structures are not used correctly, are poorly designed, or are poorly maintained.
- Excreta is re-used as a fertiliser, fish food, building material, or for fuel.
- People come in contact with excreta of infected animals (Rottier & Ince 2003:74).

2.4.1.5 Prevention and control of excreta-related diseases

Proper excreta disposal and minimum levels of personal and domestic hygiene are essential for protecting public health. Safe excreta disposal and handling act as the primary barrier for preventing excreted pathogens from entering the environment. Therefore for maximum health protection, it is important to treat and contain human excreta as close to the source as possible before it gets introduced into the environment (Fewtrell & Bartram 2001:90).

Sanitation facilities interrupt the transmission of much faecal–oral disease at its most important source by preventing human faecal contamination of water and soil. Epidemiological evidence suggests that sanitation is at least as effective in preventing

disease as improved water supply. Often, however, it involves major behavioural changes and significant household cost. Sanitation is likely to be particularly effective in controlling worm infections. Adults often think of sanitation in adult terms, but the safe disposal of children's faeces is of critical importance. Children are the main victims of diarrhoea and other faecal–oral disease, and also the most likely source of infection. Child-friendly toilets, and the development of effective school sanitation programmes, are important and popular strategies for promoting the demand for sanitation facilities and enhancing their impact (World Health Organization & United Nations Children's Fund 2000:3).

Numerous studies have shown that the incidence of many diseases is reduced when people have access to, and make regular use of, effective basic sanitary installations. It is particularly important to keep pathogens out of the environment in the first place because many of these organisms are capable of surviving for long periods of time under different conditions. Therefore, effective excreta management at the household and community levels produces far ranging societal benefits by helping to protect water resources and the food supply from faecal contamination (Fewtrell & Bartram 2001:94).

2.4.1.6 Sanitation technology options for safe 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 (Fewtrell & Bartram 2001:99).

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. The more costly or, apparently, convenient technologies may not provide the greatest health benefit or may be unsustainable from an economic or technological viewpoint Fewtrell & Bartram 2001:99).

For sanitary installations to deliver health benefits they need to be able to

- isolate the user from their own excreta
- prevent nuisance animals (e.g. flies) from contacting the excreta and subsequently transmitting disease to humans
- contain the excreta and/or inactivate the pathogens (Fewtrell & Bartram 2001:100)

For practical purposes, sanitation technologies can be divided into on-site and off-site technologies. On-site systems (e.g. latrines) store and/or treat excreta at the point of generation. In off-site systems (e.g. sewerage), excreta is transported to another location for treatment, disposal or use. Some on-site systems, particularly in densely populated regions, require off-site treatment components as well. For example, the faecal sludges accumulating in single pit or vault latrines in urban areas and in septic tanks periodically need to be removed and treated off-site for use or disposal (Fewtrell & Bartram 2001:99).

Broadly, sanitation technologies fall into four main types as shown in Table 2.2. The choice of technology will be strongly influenced by a range of factors, of which the two most important are:

- How much used water (wastewater) must be removed from the household?
- Will the disposal of the excreta be on-site or off-site? (Water Supply and Sanitation Collaborative Council & World Health Organization 2005:74).

Table 2.2 Range of technology choices

WATER SUPPLY VOLUME **DISPOSAL POINT**	**LIMITED (< 20 LITRES PER CAPITA PER PERSON)**	**AMPLE (>20 LITRES PER CAPITA PER PERSON)**
On-site	Pit latrine and variants, Pour flush latrines	Septic tanks Pit latrines plus soakaways
Off-site	Conservancy/bucket system Public toilets	Sewers (including non-conventional variants)

(Water Supply and Sanitation Collaborative Council & World Health Organization 2005:77)

2.4.1.7 The state of sanitation in developing countries

An estimated 2.6 billion people or 39% of the world's population lack access to improved facilities for the disposal of human excreta, such as a basic pit latrine, a toilet connected to a septic tank or piped sewer system, or a composting toilet according to the WHO and UNICEF (Clasen et al 2010:3). Worldwide, only 61% of people have access to private, improved sanitation facilities (United Nations University Institute for Water, Environment and Health 2010:12). This has significant health repercussions because indiscriminate defecation near the home is associated with increased morbidity and mortality, specifically, the incidence of diarrhoea and worm infestation (Shordt 2006b:2).

In low-income regions, where people are most vulnerable to infection and disease, only one in two people is covered by improved sanitation. More than one billion people still practice open defecation. In sub-Saharan Africa and southern Asia coverage is just 31% and 33%, respectively (Clasen et al 2010:3). According to the WHO and UNICEF Joint Monitoring Programme for Water Supply and Sanitation (JMP) (2010:16), the use of improved sanitation facilities is particularly low in Sub-Saharan Africa which is at 31%.

2.4.1.8 Factors determining the availability of latrines

The factors which determine whether basic sanitation facilities are present or absent from the household plot are complex and diverse (Shaw 1999:113). The most commonly identified reason for the lack of a household toilet was the high cost, followed by 'use public latrines', 'lack of space', and 'difficult to operate and maintain'. The most common are related to poverty, socio-cultural issues, and technical difficulties (McConville 2003:3).

2.4.1.9 Barriers to progress in basic sanitation

Forty percent of the world's population still do not have access to basic sanitation facilities. The most important reason for this is that in many circumstances there is far less demand for basic sanitation than there is for water and other services, both among communities and decision makers. Successful and sustainable sanitation programmes

begin with demand creation – at both the political and household level (United Nations Children's Fund 2008:78).

The barriers to the progress in providing basic sanitation outlined by UNICEF include: lack of political will, low prestige and recognition, weak institutional framework, inadequate and poorly used resources, inappropriate approaches, low demands from households, ineffective promotion, and low public awareness (United Nations Children's Fund 1997:82-84).

The slow pace of improving sanitation coverage demonstrates that so far promotion efforts have been insufficient. New sanitation promotion initiatives rely on a variety of techniques to accelerate coverage. These include improved research and baseline surveys to better assess awareness levels and motivation of target audiences, using a wide variety of communication methods and media, and using social marketing approaches to better package and promote sanitation to communities (United Nations Children's Fund 2008:78).

2.4.1.10 Access to basic sanitation

The Millennium Development Goal (MDG) has a target that calls for halving the proportion of people without sustainable access to safe drinking water and basic sanitation by 2015. Basic sanitation refers to the management of human faeces at the household level (Bérézíat 2009:6-7). According to the WHO and UNICEF Joint Monitoring Programme for Water Supply and Sanitation (JMP), improved sanitation is defined as:

- Flush or pour/flush facilities connected to a piped sewer system, septic system and pit latrine
- Pit latrines with a slab
- Composting toilets
- Ventilated improved pit latrines (Hygiene Improvement Project 2010:52)

Unimproved sanitation includes:

- Flush or pour/flush toilets without a sewer connection
- Pit latrines without slab/open pit
- Bucket latrines
- Hanging toilets/latrines
- No facilities, open defecation (Hygiene Improvement Project 2010:52)

Multi-country research published in 1996 explored whether incremental improvements in water and sanitation resulted in incremental health effects on diarrhoea and nutritional status. Improvements in sanitation were found to have a greater impact than improvements in water provision; in fact, benefits from improved water were felt only when sanitation was also improved. And the effects of improved provision were greater for urban than for rural dwellers. Other research looking at the benefits of partial coverage has produced mixed findings. 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).

Health improvement comes from the proper use of sanitation facilities, not simply their physical presence, and they may be abandoned if the level of service does not meet the social and cultural needs of community members at an affordable cost. Within a community, several different sanitation options may be required, with varying levels of convenience and cost (sometimes called a sanitation ladder). The advantage of this approach is that it allows households to progressively upgrade sanitation facilities over time (Howard 2002:38).

2.4.2 Personal hygiene and handwashing

2.4.2.1 Introduction

Hygiene is the practice of keeping one's self and one's surroundings clean, especially to avoid illness and the spread of infection (International Federation of Red Cross and Red Crescent Societies 2007:6). The focus is mainly on personal hygiene that looks at cleanliness of the hair, body, hands, fingers, feet and clothing (Ministry of Health 2011b:3).

Most people do not usually practice hygiene for health reasons. There are other motivations such as, a general dislike of dirt, an aesthetic preference for cleanliness, a desire to protect their children and themselves from dangerous, external influences, or, (most commonly of all), considerations of status, self-respect and social standing (International Federation of Red Cross and Red Crescent Societies 2007:6).

Though many hygiene practices can assist in preventing disease, the one with the strongest evidence for effectiveness and cost-effectiveness in developing countries is handwashing with soap (Ensink 2007).

2.4.2.2 Personal hygiene

Personal hygiene is widely practised at the individual level and at home. It involves maintaining the cleanliness of our body and clothes. Personal hygiene is personal, as its name implies. In this regard, personal hygiene is defined as a condition promoting sanitary practices to the self. Generally, the practice of personal hygiene is employed to prevent or minimise the incidence and spread of communicable diseases (Ministry of Health 2011b:31).

All areas of the skin, the mouth and the nose contain: a "resident flora" - microbes which colonise the body surface and a "transient flora" - microbes which are picked up onto the skin during our day to day activities. Some of these microbes can produce infection if transferred to other areas of the body e.g. the urinary tract, or if they enter a cut or abrasion. This is known as "self infection". Regular bathing/showering, handwashing

and good general personal hygiene can reduce the risks of self infection (Bloomfield & Nath 2006:89).

The body has nearly two million sweat glands. Moistened and dried sweat and dead skin cells all together make dirt that sticks on to the skin and the surface of underclothes. The action of bacteria decomposes the sweat, thereby generating bad odour and irritating the skin. This is especially observed in the groin, underarms and feet, and in clothing that has absorbed sweat (Ministry of Health 2011b:32).

The first task in body hygiene is to find water, soap and other cleansing materials. Bathing can be every day or after periods of sweating or getting dirty. Taking a bath or a shower using body soap at least weekly is very important to ensuring our body stays clean (Ministry of Health 2011b:33).

Regular bathing and laundering are important for cleanliness and good personal appearance. They also prevent hygiene-related diseases such as scabies, ringworm, trachoma, conjunctivitis and louse-borne typhus. Educational and promotional activities can encourage bathing and laundering, but increasing the number of washing facilities and locating them conveniently may be more effective. Bathing with soap is an important means of preventing the transmission of trachoma — an illness that can cause blindness and other eyesight problems. Children's faces in particular should be washed regularly and thoroughly. If a child has trachoma, a special towel or tissue should be used to wipe or dry the child's face; the towel should never be used for other children because of the risk of transmitting the disease. Ideally, programmes that promote bathing should be combined with a programme to reduce the numbers of flies, which spread trachoma and other diseases, and to improve sanitation (Howard 2002:66).

2.4.2.3 Handwashing

2.4.2.3.1 Handwashing with soap: The most effective means of preventing diarrhoeal diseases

Human faeces are the main source of diarrhoeal pathogens. They are also the source of shigellosis, typhoid, cholera, all other common endemic gastro-enteric infections, and

some respiratory infections: just one gram of human faeces can contain 10 million viruses and one million bacteria. These pathogens are passed from an infected host to a new one via various routes. While the routes are numerous, they all emanate from one source: faeces. While secondary measures (food handling, water purification, and fly control) may have an impact, far more important are the primary barriers – sanitation and handwashing – after faecal contact. These barriers prevent faecal pathogens from reaching the domestic environment in the first place (World Bank 2005:9).

Handwashing interrupts the transmission of disease agents and so can significantly reduce diarrhoea and respiratory infections, as well as skin infections and trachoma. A review made by Curtis and Cairncross in 2003 suggests that handwashing with soap, particularly after contact with faeces (post-defecation and after handling a child's stool), can reduce diarrhoeal incidence by 42-47 percent, while study work by Rabie et al. suggests a 30 percent reduction in respiratory infections is possible through handwashing (World Bank 2005:9).

Handwashing is one of the most effective means of preventing diarrhoeal diseases, along with safe stool disposal and safe and adequate household water supply. Evidence suggests that improved handwashing can have a major impact on public health in any country and significantly reduce the two leading causes of childhood mortality – diarrhoeal disease and acute respiratory infection. If the millennium development targets for reduction in child mortality are to be met, handwashing habits must be improved along with access to safe water and sanitation (World Bank 2005:7).

2.4.2.3.2 Handwashing behaviours

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

Unfortunately, handwashing with soap does not seem to be common. A review of nine studies found that the median rate of handwashing with soap after cleaning stools from the child's bottom was about 13% with a range was 0 to 20%. Handwashing after

cleaning the child is important because the caregiver often also cooks the food and feeds the child (Shordt 2006a:21).

Appropriate hand washing behaviour includes three elements: (1) handwashing supplies, (2) handwashing at critical times and (3) handwashing technique (International Federation of Red Cross and Red Crescent Societies 2007:49).

(a) Technique: How to wash hands

How should hands be washed? The evidence suggests that soap – any soap – and water adequately remove microbe-containing dirt from hands. Antibacterial soaps or other hand-sanitising technologies have no additional advantage. Hands have to be fully covered with soap and then rinsed off (World Bank 2005:10).

In research which measured faecal coliforms on hands after different handwashing protocols, Hoque in 2003 found that effectiveness is determined by the thoroughness and the time taken to wash hands. It was the volume of the water and increased rubbing that resulted in significantly lower faecal coliform counts on hands. Using one or two litres of water for overall handwashing provided significantly cleaner hands than 0.5 litres (98%, confidence interval 1.23 to 5.25 for the right hand). Air drying hands was preferred to prevent the recontamination of clean hands (Shordt 2006a:4).

A typical description of the recommended handwashing 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 (Shordt 2006a:4).

(b) Critical times for handwashing

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

2006a:5). According to USAID Food and Nutrition Technical Assistance Project "*water and sanitation indicators measurement guide"* the critical times for handwashing are after defecation, after cleaning babies' bottoms, before food preparation, before eating and before feeding children (Billig, Bendahmane & Swindale 1999:14). Critical moments that WHO 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 (Environmental Health Project 2004a.41).

(c) Materials for handwashing

A number of studies suggest that soap is a critical component in handwashing (Shordt 2006a:5). Rinsing fingers with water only is not enough to remove sticky particles which contain microbes. Hands need to be well washed after contact with faeces; either with a detergent such as soap or rubbed with an abrasive such as ash or mud (United Nations Children's Fund 2008:36). The use of soap (or other mediums like sand or ash) has the added benefit that it increases the contact time, facilitates friction and breaks down grease and dirt (which contain the largest concentrations of microbes). The use of soap in addition results in fresh and clean smelling hands, which makes promotion much easier. Trials in Bangladesh and Zimbabwe showed that handwashing with soap was more effective than handwashing with only water to reduce faecal bacteria on hands (Ensink 2007).

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

A proper handwashing place should meet all of the following criteria:

i. At least one handwashing place is located in or near the toilet facility.
ii. All necessary items for handwashing are present:
    - Water
    - Soap, or locally available cleansing agent such as ash or other detergent

- Washing device allowing for unassisted handwashing (tap, basin, bucket, sink, tippy tap)
- Clean drying material (this is optional, if drying by air is encouraged)

iii. Liquid waste from handwashing can be safely disposed of in the following ways:

- Seepage pit or soak-away pit
- Connection to a septic system or toilet facility (Environmental Health Project 2004a:58)

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

2.4.2.3.3 The challenge of handwashing promotion

If handwashing with soap is so important, why doesn't everyone do it? Studies indicate that worldwide rates of handwashing with soap are very low. While many wash their hands with water, only a small percentage use soap at critical times (World Bank 2005:11).

The cause of low handwashing rates is rarely a lack of soap. Soap is present in the vast majority of households worldwide, but it is commonly used for bathing and laundry, not handwashing. Lack of water is usually not a problem either, as hands can be effectively washed with little, or recycled, water. In studies around the world, the main reason given why rates of handwashing with soap are so low is that it is simply not a habit. The challenge remains – to make handwashing with soap a habit and a social norm on a worldwide basis (World Bank 2005:12).

Handwashing before eating, before feeding children and before preparing food are all helpful. But we now know that following such advice systematically would require a woman to wash her hands with soap about 30 times a day, which may not be practical. Most important is handwashing with soap (or ash) after stool contact (United Nations Children's Fund 1999a:36). It is important, therefore, to distinguish between

handwashing as a primary barrier (to remove faecal matter after contact with stools) and handwashing as a secondary barrier (before preparing food, handling fluids, feeding, eating). This is because it is not reasonable to expect handwashing with soap on every conceivable occasion. The cost of soap also limits handwashing by the family in many settings. Hygiene promotion programmes, thus, have to make a choice as to when handwashing is most needed for health protection (Curtis et al 2000:26).

2.4.2.4 Promoting good hand and personal hygiene

Promoting good personal hygiene often requires that community members are mobilised towards this goal and awareness is raised about how to achieve it. It is important that hygiene education programmes do more than simply tell people that if they do not wash their hands they will become sick because of pathogens they cannot see. This rarely works. Instead, education programmes should try different methods to maximise community participation in the programmes and to encourage people to promote good hygiene (Howard 2002:65).

2.4.3 Safe water supply

2.4.3.1 Introduction

An adequate, safe and accessible water supply must be available to all people, and improving access to safe drinking water can result in tangible benefits to health (Ministry of Health 2011c:1). WHO defines domestic water as being water used for all usual domestic purposes including consumption, bathing and food preparation. Domestic water supplies are one of the fundamental requirements for human life. Without water, life cannot be sustained beyond a few days and the lack of access to adequate water supplies leads to the spread of disease (Howard 2003:1-2).

2.4.3.2 Water and disease

The great majority of water-related health problems are the result of microbial (bacteriological, viral, protozoan or other biological) contamination. Infectious waterborne diseases such as diarrhoea, typhoid and cholera are leading causes of death and illness in the developing world (Ministry of Health 2011c:1).

Several terms are used to describe the types of disease associated with water. These are:

- ***Waterborne diseases*** are those caused by ingestion of water that is contaminated by human or animal excrement and contains pathogenic microorganisms. Waterborne diseases include most of the enteric and diarrhoeal diseases caused by bacteria and viruses, including cholera, typhoid and bacillary dysentery.
- ***Water-washed diseases*** are caused by poor personal hygiene, and skin and eye contact with contaminated water.
- ***Water-based diseases*** are caused by parasites that spend part of their lifecycle in water.
- ***Water-related diseases*** are caused by insect vectors, especially mosquitoes that breed or feed near water (Ministry of Health 2011c:2).

2.4.3.3 The state of water supply in developing countries

In developing regions, while 73% of the urban population uses piped water from a household connection, only 31% of rural inhabitants have access to household piped water supplies. In Sub-Saharan Africa, only 5% of the rural population gets water piped to premises. In contrast, in urban areas of Sub-Saharan Africa, 35% of urban dwellers use water piped to the household (World Health Organization & United Nations Children's Fund 2010:25).

2.4.3.4 Accessibility of water

Access to improved water sources is one of the indicators tracked by the Joint Monitoring Programme (JMP) to determine if the MDG target for water and sanitation is being met. JMP is the official United Nations mechanism in charge of monitoring progress toward the MDG target, which is to: "Halve by 2015 the proportion of people without sustainable access to safe drinking water and basic sanitation." Access to improved water sources should serve as a backdrop to understand the extent to which households are practicing water treatment and storage at the point of use for water obtained from this resource (Hygiene Improvement Project 2010:10).

An improved water source is an infrastructure improvement to a water source, a distribution system, or a delivery point, which by the nature of its design and construction is likely to protect the water source from external contamination, in particular from faecal matter (Hygiene Improvement Project 2010:10).

Improved drinking water sources, according to the JMP, are:

- Piped water into dwelling, plot, or yard
- Public tap/standpipe
- Tube well/borehole
- Protected dug well
- Protected spring
- Rainwater collection (Hygiene Improvement Project 2010:10)

Unimproved drinking water sources, according to the JMP, are:

- Unprotected dug well
- Unprotected spring
- Cart with small tank/drum
- Tanker truck
- Surface water (river, dam, lake, pond, stream, canal, irrigation channel)
- Bottled water (Hygiene Improvement Project 2010:10)

2.4.3.5 Availability of adequate water

The importance of adequate water quantity for human health has been recognised for many years and there has been an extensive debate about the relative importance of water quantity, water quality, sanitation and hygiene in protecting and improving health. The WHO/UNICEF Joint Monitoring Programme (JMP), which produces the Global Assessment of Water Supply and Sanitation data, describe 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 2003:1). Although 20 litres per person per day is the WHO/UNICEF 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 are all taken into account (Bartlett 2003:63).

According to the guidance manual of the Department for International Development (United Kingdom), 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 supply (Howard 2003:1).

2.4.3.6 Water collection time and distance to a water source

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. UNICEF and WHO 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 person per day. This range is considered suitable for a person to meet basic needs. The international community assumes that 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).

2.4.3.7 Household water handling, storage and treatment

Numerous studies have clearly shown that improving the microbiological quality of household water by on-site or point-of-use treatment (POU) and safe storage in improved vessels reduces diarrhoeal and other waterborne diseases in communities and households of developing as well as developed countries. Reductions in household

diarrhoeal diseases of 6-90% have been observed, depending on the technology and the exposed population and local conditions (World Health Organization 2002:vi).

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 water quality deteriorates during the storage and transport of water:

- poor hygiene knowledge prevents people from taking basic steps to minimise contamination
- inadequate household latrines, handwashing facilities and poor community environmental sanitation results in more faeces in and around households
- commonly used transport and storage containers 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 (United Nations Children's Fund 2008:76 & Rottier & Ince 2003:57).

All 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 stop 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 2002:32-33).

Properly protected water resources and water sources and well-managed municipal and community treatment systems should result in safe water for consumers. In reality, this is often hard to achieve, especially in rural and poor urban areas in developing countries. Home treatment (also known as household treatment or point-of-use treatment) is an option increasingly adopted by householders themselves. In urban settings (both in developing and industrialised countries) it is now common for middle class and richer households to boil, filter or use ultraviolet disinfection systems to treat real or perceived threats to the quality of water in piped systems. In rural settings some form of treatment – usually filtration – is also common in some areas (United Nations Children's Fund 2008:118).

2.4.4 Wastewater management

2.4.4.1 Introduction

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. Runoff is simply rainwater that collects on the ground and runs off into channels, ditches and rivers (Ministry of Health 2011c:68).

Sullage is domestic wastewater other than that which comes from the toilet. It results from food preparation, personal washing, and washing of cooking and eating utensils and clothes (Franceys et al 1992:222). Management of liquid waste focuses on finding a way to dispose of the waste in a way that is safe for humans and the environment (Ministry of Health 2011c:78).

2.4.4.2 The characteristics of domestic wastewater

Domestic wastewater can be divided into two categories: sewage and sullage. Sewage includes human wastes (i.e. faeces and urine), as well as wastewater from various sources. Sullage is the wastewater that arises from domestic activities such as washing in bathrooms and kitchens, including water from food preparation and dishwashing; it does not contain human excreta (Ministry of Health 2011c:77).

The nature of the sullage is markedly influenced by factors such as diet, methods of washing clothes and utensils, habits of personal hygiene, and the existence of bathrooms and other facilities (Franceys et al 1992:222). About 99 percent of wastewater is water, and only one percent is solid wastes (Vigneswaran & Sundaravadivel 2004).

2.4.4.3 Health problems caused by poor drainage

Proper disposal of stormwater and household wastewater (sullage) is an important environmental health intervention for reducing disease. Poorly drained stormwater forms stagnant pools that provide breeding sites for disease vectors. Because of this, some diseases are more common in the wet season than the dry season. Household wastewater may also contain pathogens that can pollute groundwater sources, increasing the risk of diseases such as lymphatic filariasis. Poor drainage can lead to flooding. Flooding may also damage water supply infrastructure and contaminate domestic water sources (Howard 2002:48).

Ponding of sullage is caused by excessive discharge on to the ground, by blockage of surface drains, or by unsatisfactory construction or maintenance of open channels to carry the sullage (Franceys et al 1992:222). 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 a risk of faecal-oral infections and beef and pork tapeworm if people and animals use this water as drinking-water (Rottier & Ince 2003:92).

2.4.4.4 Wastewater management in developing countries

Urban sanitation is a priority issue for cities everywhere. Major deficiencies in the provision of this basic service contribute to environmental health problems and the degradation of scarce water resources. The rapid growth of cities and the accompanying concentration of population lead to increasing amounts of human wastes that needs to be managed safely. The relative success in providing cities with usable water has led to greater volumes of wastewater requiring management, both domestic and industrial (Bartone 1997:1).

As population densities in cities increase, the volumes of wastewater generated per household exceed the infiltration capacity of local soils and require greater drainage capacity and the introduction of sewer systems. Wastewaters flowing out of cities can, in turn, affect downstream water resources and threaten their sustainable use (Bartone 1997:1). A staggering 80–90 percent of all wastewater generated in developing countries is discharged directly into surface water bodies (Corcoran, Nellemann, Baker, Bos, Osborn & Savelli 2010:19).

2.4.4.5 Disposal methods of domestic wastewater

There are different methods of disposing wastewater which are described as follows:

(a) The drainage of stormwater

Stormwater drains should be designed to collect water from all parts of the community and lead it to a main drain, which then be discharged. The size of the drains should be calculated according to the amount of water they would be expected to carry in a storm (Howard 2002:49).

(b) Sullage disposal methods

Every household generates sullage. Sullage may be disposed of either at home, using on-site methods, or through the drainage system. When sullage is disposed of at home, a soakaway pit can be constructed. Alternatively, sullage can be used to irrigate small gardens, thus improving the crop yield and nutrition, and this should be promoted if possible. However, sullage can be reused this way only if it contains little or no detergent, which may damage crops (Howard 2002:50).

Soakaway pits and trenches can be used where wastewater could be polluted, space is available, and the infiltration capacity of the soil is sufficient. A soakaway will have to be adapted to the physical situation and the characteristics of the sullage to prevent blockage or overloading (Rottier & Ince 2003:95).

Sullage can be treated on-site to make it more acceptable for final disposal or reuse. Septic tanks can be used; they are effective in removing grease and solids, and do not require frequent desludging (Franceys et al 1992.225).

(c) Other types of surface water

Temporary ponds or unwanted reservoirs can be filled to reduce the health risks. No new ponds should be created when sourcing the filling material. Where filling is not feasible, the vegetation along the sides of the water can be removed to make it less attractive to snails and mosquitoes, or the shoreline can be made steeper to control the vegetation (Rottier & Ince 2003:98).

2.4.5 Solid waste management

2.4.5.1 Introduction

According to Tchobanoglous, Theisen and Vigil (1993:xvii), solid waste is all the waste arising from human and animal activities that are normally solid and that are discarded as useless or unwanted. To keep the household and village environment clean and to reduce health risks, solid waste (refuse) should be disposed of properly. Untreated refuse degrades both the quality of the environment and the quality of life in the community. It also provides a breeding ground for disease vectors, such as mosquitoes, flies and rats. If waste is not properly disposed of, animals can bring it close to the home and children can come into contact with disease vectors and pathogens. To be effective, solid waste disposal programmes require action at both household and community levels - if only a few households dispose of waste properly, the village environment may remain dirty and contaminated (Howard 2002:52).

2.4.5.2 Types of solid wastes

In urban settings, municipal waste refers to the solid waste that is collected by local government (the municipality) and may include household, commercial, industrial waste and street sweepings. Solid waste from general housekeeping can be described as residential waste, household waste or domestic waste (Ministry of Health 2011c:70).

Residential waste generated by households may contain organic waste (for example, from the kitchen and gardens), recyclable waste (for example, plastics, paper, cans, etc.), non-recyclable waste (that has no recycling value), and household hazardous waste (batteries, some oils, etc.) (United Nations Environment Programme 2009:10).

2.4.5.3 Health and environmental risks of solid waste

There are some human health risks associated with solid waste handling and disposal in all countries to some degree, but certain problems are more acute and widespread in underdeveloped nations. Cointreau has classified these into four main categories: 1) presence of human faecal matter, 2) presence of potentially hazardous industrial waste, 3) the decomposition of solids into constituent chemicals which contaminate air and water systems, and 4) the air pollution caused by consistently burning dumps and methane release. Human faecal matter is present in every solid waste system; in developing nations the problem varies with the prevalence of adequate sanitary disposal systems such as municipal sewerage or on-site septic systems, outhouses, etc. In areas where such facilities are lacking (especially shantytowns and over-crowded municipal districts), the amount of human faecal matter present in the solid waste stream is likely to be higher. This presents a potential health problem not only to waste workers, but also to scavengers, other users of the same municipal drop-off point, and even small children who like to play in or around waste containers (Zerbock 2003).

Piles of rubbish in the streets or at dump sites can provide a habitat for rats and flies, and thus contribute to the spread of a number of diseases; rats are major vectors of plague, leptospirosis and other infections, and flies are one of the transmission routes in the F-diagram for faecal-oral disease. Apart from these direct health impacts, solid waste is also linked to the faecal-oral transmission route in a number of ways (Department for International Development 1998:72).

2.4.5.4 Solid waste management in developing countries

Municipal solid waste management is an important part of the urban infrastructure that ensures the protection of environment and human health. The accelerated growth of urban population with unplanned urbanisation, increasing economic activities and lack of training in modern solid waste management practices in developing countries

complicates the efforts to improve solid waste services. The changes in consumption patterns with alterations in the waste characteristics have also resulted in a quantum jump in solid waste generation (Nabegu 2010:111).

A significant proportion of the urban population of Africa has poor access to refuse collection for proper solid waste management. Poorly managed waste presents a health risk to communities. This is primarily because untreated waste and waste that remains uncollected or improperly disposed of can be a source of contaminants and breeding sites. Such wastes contribute to diarrhoea, vector-borne disease, and the contamination of drinking water and other water resources (World Health Organization Regional Office for Africa 2009:25).

2.4.5.5 Managing solid waste

Proper management of solid waste is critical to the health and well-being of urban residents (Nabegu 2010:111). The overall objective of solid waste management is to minimise the adverse environmental effects caused by indiscriminate disposal of solid wastes (Kaseva & Mbuligwe 2003:254).

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 2011c:74).

Some methods for managing household solid waste are described as follows:

(a) Solid waste storage

Onsite storage means the temporary collection of waste at the household level. It is important that waste is stored in proper containers. These could be baskets, preferably made from locally available materials, plastic buckets or metal containers (Ministry of Health 2011c:120).

(b) Solid waste collection

In urban centres, collection is a function that has its own process and services. Waste is collected and held at central transfer stations where waste is stored before it is transported to a final disposal site. In rural areas, waste is not normally collected in this way and disposal is limited to onsite processing options, although sometimes there may be communal collection of solid waste using animal carts (Ministry of Health 2011c:121).

In developing countries, the householder is responsible to convey their waste to a communal bin or transfer point provided in the locality. The municipality then collects the waste from these points and takes it to the final disposal site. Communal bins are often too far away for easy transfer of waste by householders. As a result, waste builds up in local areas of cities (Appleton, Ali & Cotton 2000:3).

Primary solid waste collection schemes have been initiated in many developing countries in response to this problem. These schemes are managed by non-governmental organisations (NGOs), community groups, or micro-contractors. They provide the door-to-door collection of waste and its subsequent transportation to the local municipal bins. The service charges are usually made directly to the users of the service but sometimes supplemented by external funding (Appleton et al 2000:3).

(c) Resource recovery and processing

Resource recovery means finding a way to use the waste so it becomes a valuable resource, rather than just a disposal problem. This is a very important part of waste management. Resource recovery includes a range of processes for recycling materials or recovering resources from the waste, including composting and energy recovery (Ministry of Health 2011c:121).

(d) Solid waste disposal methods

Even after recycling and resource recovery, there will be some residual waste that needs final disposal. Methods of disposal can be sanitary or unsanitary. Open field dumping is the most unsanitary method of refuse disposal and is most likely to cause a

health hazard. Sanitary methods include controlled tipping or controlled burial, incineration and sanitary landfill (Ministry of Health 2011c:121).

2.4.5.6 Integrated solid waste management

Ideally, waste management should go beyond pollution prevention and disease prevention for humans and should benefit society by providing economic gain for families and communities. The preferred approach for dealing with solid waste is integrated solid waste management (ISWM) (Ministry of Health 2011c:74). Integrated solid waste management (ISWM) is defined by Tchobanoglous et al (1993:15) as the selection and application of appropriate techniques, technologies, and management programmes to achieve specific waste management objectives and goals.

ISWM means considering not only the appropriate disposal of solid waste but integrating this with other management options such as minimising waste production, recycling, composting and other waste recovery options. The advantages of ISWM are that it considers all options and aims to manage waste in ways that are most effective in protecting human health and the environment. ISWM can also have many economic and social benefits for the community (Ministry of Health 2011c:74).

2.5 IMPACTS OF WATER, SANITATION AND HYGIENE

The impact of deficient water and sanitation services falls primarily on the poor. Unreached by public services, people in rural and peri-urban areas of developing countries make their own inadequate arrangements or pay excessively high prices to water vendors for meagre water supplies. Their poverty is aggravated and their productivity impaired, while their sickness puts severe strains on health services and hospitals (Department for International Development 1998:1).

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 improved nutritional status (Billig et al 1999:6).

In a systematic review of the literature on diarrhoeal disease, 2000 abstracts were screened, and then 50 studies were relevant to the focus of this study and were analysed. Of the 50 studies, 38 were used in the meta-analysis because the studies were presented with a measure of relative risk or data from which a relative risk could be calculated. The overall results are summarised in Table 2.3 (Fewtrell, Kaufmann, Kay, Enanoria, Haller & Colford 2005; Prüss-Üstün et al 2008:17).

Table 2.3 Impacts on diarrhoeal disease reduction by intervention area

INTERVENTION AREA	REDUCTION IN DIARRHOEA FREQUENCY
Hygiene	37%
Sanitation	32%
Water supply	25%
Water quality	31%
Multiple	33%

(Prüss-Üstün et al 2008:17)

Achieving the primary objective of improving the health status of the community depends on the implementation of an integrated strategy aimed at improving hygiene practice at home through changes of attitudes and higher levels of health education, in conjunction with community water supply and environmental sanitation programmes. Almost all the water-borne, water-based and water-washed diseases are spread through exposure of food and drinking water to human faeces. Hence, the rate of infection may be reduced by improving human waste disposal practices as well as home hygiene practices, along with water quality and food hygiene. Supply of safe water provides little advantage if water becomes contaminated because of unhygienic practices at home. Storage and handling of food and drinking water should be an important component of any programme for promoting domestic hygiene (Beumer, Bloomfield, Exner, Fara, Scott & Nath 2002:9). On the other hand, improvement in the hygienic behaviour of a community cannot be sustained without concurrent improvement in the quality of environmental sanitation and drinking water (Beumer 2002:9).

2.6 HYGIENE PROMOTION AND EDUCATION

Hygiene promotion encourages all the hygienic conditions and behaviours that can contribute towards good health. It aims to stimulate and facilitate the right behaviour change. Research has shown that hygiene-related practices such as safe disposal of faeces and handwashing after contact with faecal material can reduce the rates of intestinal infection considerably (International Federation of Red Cross and Red Crescent Societies 2007:7).

Improvements in water and sanitation do not automatically result in improvements in health. The addition of hygiene education is often required to see that health impacts are materialised (Billig et al 1999:7). Most people are aware of a link between hygiene and health, but there is a lack of conviction about the need for change that probably results from years of tolerance of unhygienic surroundings. In a sample survey, it was found that the majority of the surveyed population believed that personal hygiene, and to some extent household hygiene, influence health but failed to see the possibility that environmental hygiene was also an important factor. Most people are unaware about the scientific aspects of personal, domestic and environmental hygiene and the risk of infection (Beumer et al 2002:7).

2.7 ENVIRONMENTAL SANITATION IN ETHIOPIA

2.7.1 Water supply status

According to Demographic and Health Survey (DHS) of Ethiopia of 2005, 61 percent of households in Ethiopia have access to an improved source of drinking water with access in urban areas much higher than in rural areas (94 percent and 56 percent, respectively) (Central Statistical Agency & ORC Macro 2006:23). Based on Ministry of Health of Ethiopia (2009:16), 66.2% of households in the country have access to an improved source of drinking water. Out of this, 88.6% is in urban and 66.2% is in rural area. The most common source of improved drinking water in urban areas is piped water with 90% of households having access to this source. The proportion of households with access to piped water has increased from about 14% in 1994 to 18% in 2000 and 24% in 2005 (Central Statistical Agency & ORC Macro 2006:23).

The same data of Ethiopian Demographic and Health Survey (DHS) indicated that only 8 percent of households reported having water on their premises. Households not having access on their premises were asked for the time taken to fetch water. Forty-four percent of all households (36 percent urban and 46 percent rural) take less than 30 minutes to fetch drinking water. In the majority (74 percent) of households, an adult female usually collects drinking water. Female children under age 15 are over three times more likely than male children the same age to fetch drinking water (Central Statistical Agency & ORC Macro 2006:24).

Regarding water treatment at houses, an overwhelming majority of households (92 percent) do not treat drinking water. Rural households are somewhat more likely than urban households to treat drinking water and this is mostly done by straining water through cloth (Central Statistical Agency & ORC Macro 2006:25).

Estimates for average per capita per day water consumption vary between 10 and 20 litres per day in some areas in Ethiopia. However, in most rural areas of Ethiopia, depending upon seasonality and location of source and availability of water, daily consumption is as low as 3-4 litres per capita per day. Women and children particularly girls have to fetch water, often walking for 3-8 kilometres from their dwellings (Ministry of Water Resources 2004:83-86). Table 2.4 shows the per capita water consumption based on information collected from 208 towns in Ethiopia.

Table 2.4 Water consumption (LPD) from 208 towns in Ethiopia

Variants	LPD for towns with Population >10,000	LPD for towns with population 10,000-30,000	National
Minimum	6.04	0.00	0.00
Maximum	30.79	19.50	30.79
Mean	14.77	5.63	6.34
Median	13.35	4.88	5.15

(Ministry of Water Resources 2004:106)

2.7.2 Excreta disposal status

The latrine coverage provided by the Central Statistics Agency for 2005 shows that 62 percent of Ethiopian households do not have a toilet facility. Overall a small proportion (7 percent) of households use improved toilets that are not shared. Urban households are more than three times as likely as rural households to have access to improved toilet facilities. In urban areas, a pit latrine with a slab (12 percent) is the major type of improved toilet facility. There has been a decline recently in the proportion of households with no toilet facilities from 82 percent in 2000 to 62 percent in 2005. The decline was observed in both urban and rural areas (from 30 percent to 12 percent in urban areas and from 92 percent to 70 percent in rural areas) (Central Statistical Agency & ORC Macro 2006:25). However, according to data of Ministry of Health of Ethiopia (2009:16), 60% of households have access to excreta disposal.

The proper disposal of children's stools is extremely important in preventing the spread of disease. According to Demographic and Health Survey (DHS) of Ethiopia of 2005, sixty-seven percent of children's stools are left uncontained: 7 percent are put or rinsed into a drain or ditch, 11 percent are thrown into the garbage, and 49 percent are left in the open. Slightly more than one in five children's stools are disposed of hygienically. Two percent of children under five use a toilet or latrine. Additionally, 17 percent of children's stools are disposed of in the toilet or latrine, and 2 percent are buried in the yard (Central Statistical Agency & ORC Macro 2006:140).

2.7.3 Urban sanitation and waste disposal

Although urban sanitation figures generally far outstrip rural access, it is widely known that the poor, unplanned, densely populated areas are badly underserved. This density, therefore, poses a greater risk of contamination than thinly populated rural areas. Limited sanitation options and high demand are compounded by poverty and limited space, creating a major challenge. Mobile urinals and communal latrines meet only a fraction of the unmet excreta disposal needs of the urban poor who resort to high risk disposal practices (Ministry of Health 2005b:14).

Public sanitation services such as public toilet facilities, sludge (seepage) collection and related environmental health services, they are generally inadequate and do not meet

demands. Addis Ababa is the only town with a small sewerage system with coverage of only 2% of the inhabitants of the city (Ministry of Water Resources 2004:83-86).

The assessment on existing situation of solid waste management in the country shows that the services are inadequate and the coverage is very low. The problem of solid waste management is critical in densely populated urban centres. Domestic solid wastes are dumped at the riverbanks, roadsides, ditches, drainage pipes and pit latrines (Ministry of Water Resources 2004:188). Refuse disposal sites in urban areas are often insufficient and unorganised (Ministry of Water Resources 2004:97-98).

2.7.4 Policy issues on environmental health and water in Ethiopia

2.7.4.1 Environmental health

The health policy was issued by the Government of Ethiopia in 993 (Ministry of Water Resources 2004:113). The Ethiopian National Health policy considers that hygiene and environmental health is one of the cornerstones of the strategy for the promotion of health and wellbeing of people. More than 60-80% of communicable diseases in Ethiopia are believed to be preventable using environmental health interventions, so targeting environmental health is vital for improving the health of the population at large (Ministry of Health 2011b:v).

The government has established a Health Sector Development Programme (HSDP), which incorporates a 20 years health development strategy through a series of 5-years investment programmes. This programme call for the democratisation and decentralisation of health services, development of preventable health care, capacity building within the heath service system, equitable access to heath services, self reliance, promotion of intersectoral activities and participation of the private sector, including nongovernmental organisations and cooperation and collaboration with all countries in general and neighbouring countries ain particular and between regional and international organisations (Ministry of Water Resources 2004:113).

The health policy gives emphasis on the preventive aspect of health services. Strategies adopted to meet environmental health service needs 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 Water Resources 2004:113).

In fact sanitation in terms of protecting the environment and safeguarding human health is also given due importance in the Environmental Policy, Water Resources Management Policy and in the Public Health Proclamation. The Water Resources Management Policy places particular emphasis on creating a favourable environment for the promotion of appropriate sanitation services. The Water Resource Management Policy also calls for more decentralised decision-making; promoting the involvement of all stakeholders, including the private sector; increasing levels of cost recovery; as well as integrating water supply, sanitation and hygiene promotion activities (Water Supply and Sanitation Collaborative Council 2009).

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. 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).

The Hygiene and Sanitation Strategy is implemented through several major programmes such as: i) the Health Service Extension Programme (HSEP) which is a new programme and perceived to be the primary vehicle for driving sanitation improvements at the *kebele* level *(kebele* is the smallest government administrative unit); ii) the Ministry of Health (MoH)/Regional Health Bureau (RHB)/UNICEF supported water and sanitation community based programme (disease prevention for women and children); and iii) the World Bank supported Rural Water Supply and Environment Programme and the Water, Sanitation and Hygiene (WASH) Initiative. The Hygiene and Sanitation Programme gets financial support from the World Bank, non-governmental organisations (NGOs)/Civil Society, WHO and other donors (Government of Ethiopia 2007:39).

The National Hygiene and Sanitation Strategy was developed to enable 100% adoption of improved sanitation and hygiene practice particularly in the rural settings of Ethiopia. According to the national strategy, hygiene promotion should mainly address the 3 key behaviours: toilet use, handwashing and keeping water safe (Water Supply and Sanitation Collaborative Council 2009).

The National Protocol for Hygiene and "On-site" Sanitation is designed to follow the National Hygiene and Sanitation Strategy with its focus on universal access (100% hygienic and sanitised households) primarily in rural or peri-urban environments. Both the national strategy and the protocol stress a zero subsidy approach for household sanitation facilities but with some allowance for supporting the vulnerable. Hygiene promotion, capacity building, support to create and maintain an enabling environment, as well as public and institutional sanitation facilities are to be financed by the public (Water Supply and Sanitation Collaborative Council 2009).

2.7.4.2 Water

The Water Resources Management Policy has been formulated in 2006/07 to guide the development of the sector. The National Water Sector Strategy has been prepared and implemented by the government. This strategy provides a road map to translate the policy into action. To achieve the water policy objectives, the Water Sector Development Programme has been prepared using the guidelines set under the national sector strategy (Government of Ethiopia 2007:36).

Water supply and sanitation services are one of the key programmes included in the Plan for Accelerated and Sustained Development to End Poverty (PASDEP). The Millennium Development Goals for water supply and sanitation aim to reduce the existing proportions of unserved people by half from the end of the century. This not enough and it has been found important to design and implement a programme that enables rapid expansion of services to all members of the community. This programme is thus called the "Universal Access Programme" (UAP). The main objective of the UAP is to enable residents of towns to reliably get access to 20 litres of water per day within half a kilometre distance from their residences and to avail toilet services to all residents of towns and enable some to benefit from sewerage systems (Government of Ethiopia 2007:37).

2.7.4.3 Health extension programme in Ethiopia

The Health Service Extension Programme (HSEP) is an innovative, community-based programme that was first introduced in Ethiopia in 2003. This programme was launched after realising that the basic health services were not reaching the majority of the population. The objective of HSEP is to improve equitable access to mainly preventive health services through community (*kebele*) based services. These services all have a strong focus on health promotion and preventive health activities, as well as increased community health involvement. The principle behind this programme is to transfer ownership and the responsibility of maintaining health to individual households (Ministry of Health 2011a:6).

The HSEP is an approach that brings healthcare down to the household level. It has been designed to provide a number of health packages which are categorised under four main topics: disease prevention, family health service, hygiene and environmental sanitation, and health education and communication (Ministry of Health 2011a:6). The health extension has 16 packages (Water Supply and Sanitation Collaborative Council 2009). These packages have been developed to tackle the main health problems of the country (Ministry of Health 2011a:6).

Out of the 16 health extension packages, 7 of which cover on hygiene and environmental sanitation: excreta disposal, solid and liquid waste disposal, water quality control, food hygiene, proper housing, vector control, personal hygiene, health education and promotion (Water Supply and Sanitation Collaborative Council 2009).

2.8 CONCLUSION

Chapter 2 presented the findings of the relevant literature reviewed. There are many environmental sanitation interventions that can help prevent diarrhoeal and other infectious diseases. Improvements in excreta disposal, personal hygiene, water supply, wastewater disposal and solid waste management are the most important barrier to many infectious diseases and to improve health. The chapter reviewed these most important environmental sanitation interventions as well as the water and environmental sanitation conditions in Ethiopia. The following chapter will explain how this research was done. The research design and method are fully discussed.

CHAPTER 3

RESEARCH DESIGN AND METHOD

3.1 INTRODUCTION

This chapter describes the research design and methodology that was followed when conducting the study. The research design and method followed in this study which includes description of the study area, sampling method used, data collection and analysis as well as the ethical considerations are discussed in this chapter.

3.2 RESEARCH DESIGN

3.2.1 Study area

This research was conducted in Dukem Town of Finfinne surrounding special zone of Oromia region in Ethiopia. Finfinne surrounding special zone is one of the 18 zones in Oromia Regional State located in the central part of the region at 37 kilometres away from Addis Ababa. Dukem Town is administratively divided into 4 *kebeles*. The town has a population of more than twenty four thousand (Dukem Town Health Office 2010:2).

3.2.2 Research paradigm

Quantitative research paradigm has been used to investigate the problems identified for this study. This paradigm was chosen because it was intended to measure the magnitude of sanitation and hygiene problems and optimise actions to be prioritised in the prevention of environmental sanitation and hygiene-related diseases.

Quantitative research is used to answer questions about relationships among measured variable with the purpose of explaining, predicting, and controlling phenomena (Leedy & Omrod 2001:103). The intent is to establish, confirm, or validate relationships and to develop generalisations that contribute to theory.

3.2.3 Research design

A descriptive, contextual cross-sectional survey was used to conduct this study on the environmental sanitation conditions of the households of Dukem town. A descriptive study provides more information about characteristics within a particular field of study. Its purpose is to provide a picture of situations as they naturally happen. It is used for the purpose of identifying problems with current practice, justifying current practice, making judgements or determining what others in similar situations are doing (Burns & Grove 2005:232). In line with the aim and objectives of the study, the researcher wanted the respondents to describe the environmental sanitation conditions with regard to water, excreta disposal, waste disposal, personal and domestic hygiene of the households of Dukem town.

3.3 RESEARCH METHODS

3.3.1 Population

The target population refers to the entire set of individuals or elements who meet the sampling criteria (Burns & Grove 2005:342). In this study, the target population were all the residents living in Dukem town of Ethiopia. An accessible population is the portion of the target population to which the researcher has reasonable access (Burns & Grove 2005:342). In this study, the accessible population included a sample of selected households in Dukem town.

3.3.2 Sampling methods

The study employed two types of sampling techniques including purposive sampling and simple random sampling. Dukem town which is located in Finfinne surrounding special zone of Oromia region in Ethiopia was selected with purposive sampling. All the four *kebeles* (*kebele* is the smallest government administrative unit) of Dukem town were included in the study.

Simple random sampling method was used to select households which are the sampling units of the study. All households in the four *kebeles* of Dukem town were included as sampling unit having equal chance of being selected. The sampling frame

was the list of registered households of the town and this list was obtained from registration performed by health extension workers in each *kebele* and used for the selection of households.

Using the simple random sampling method, households in Dukem town were selected randomly by means of the table of random numbers from the registered list of households in each of the four *kebeles* which is the sampling frame. The households were randomly selected from the registered list of all the households of the town according to the inclusion and exclusion criteria, a number was assigned to each head of household name on the list, and then using a table of random numbers the households were selected from the registered list.

Inclusion sampling criteria for this cross-sectional research was being a household lived in a registered housing unit of Dukem town. Exclusion sampling criteria for the research were: (i) being institutions (such as offices, hotels, etc) other than households; and (ii) households that were not registered in the *kebeles* of the town.

A respondent from the randomly selected household was interviewed, following informed consent. The eligibility criteria for being a respondent of the interview was (i) household head, who is responsible for household work; (ii) the female household head was given priority, because they are both knowledgeable about domestic water and household sanitation; and (iii) where the two respondents were not available, a person of at least 18 years of age, preferably an adult female of the household, who is most familiar and knowledgeable concerning the water and environmental sanitation of household members was interviewed.

During the data collection, respondents from the randomly selected households that were eligible and willing to participate in the study were made to take part in the study. Respondents from randomly selected households that were unwilling to participate in the study; housing units that were empty (no person in the house), dwelling unit not found or where no eligible person present for interview in at least three times visits or where the households no longer lived at the original location were recorded as non-responses.

The sample size was determined using the single population proportion formula of $n = Z^2P(1-P)/d^2$. Where "n" is sample size of households. Hence:

- P is the proportion of households using improved water and sanitation. The value of P is based on the data of the coverage of environmental sanitation with main component of national latrine coverage (basic sanitation) for Ethiopia which is 60%.
- d = Degree of accuracy required (sampling error) is 5% i.e. d = 0.05.
- Z = Standard score for 95% confidence level is 1.96.
- Registered number of households of the town during the time of the research were 3,845.
- This gave a sample size of 369. To minimise errors arising from the likelihood of non-response rate, ten percent of the sample size was added to the calculated sample.

Thus, based on the above assumptions, the total sample size "n" was determined to be 406 households.

The entire data collection process was completed from October 3 to 25, 2011. The mentioned period of time was used for the activities which include the main household data collection visits, follow-up and return visits for unavailable respondents. It also includes for data checking in the field and refilling of data collection instrument at households after finding of incomplete responses in the filled data collection instrument which were found during checking and monitoring. Interviewers repeatedly revisited households in which the housing units were empty (no person in the house), dwelling units were not found and where no eligible persons were present for interview in at least three times visits.

From the randomly selected 406 households, 15 households were found to be non-responses. The reasons for the non-responses were as follows: the housing units were not found, the households were no longer lived at the original location and had moved during the study period and no persons were available in the house during repeated visits of at least three times.

3.3.3 Data collection methods

The data collection approach used for this study was a structured data collection tool. It entailed a fixed set of questioning that were answered by participants in a specified sequence and with designated response options (Polit & Beck 2008:371-372).

The data collection was performed at household level. Two types of structured data collection methods were used in the study. These were:

Household interview: Face-to-face interview was carried out with respondents by asking questions about water and environmental sanitation of the households.

Observation: Information on the sanitary facilities and environmental sanitation conditions of the households were also collected using observational method.

The data collection instrument employed for household interview was using structured interview schedule. The data collection tool for the observational method was using a structured checklist. The interview questions answered by respondents and the observational questions checked by observation by data collectors was developed as one data collection instrument (Annexure B). Hence, the data collection instrument used during the interview had also contained interview questions that were visually and physically checked by the observation of the data collectors.

A pre-coded and structured data collection instrument containing interview and observational questions was developed which was adapted from Environmental Health Project's (2004a:121-151) "a*ssessing hygiene improvement: Guidelines for household and community levels* and from World Health Organization and United Nations Children's Fund's (2006a:8-15) "*core questions on drinking-water and sanitation for household surveys*.

The interview schedule questions of the data collection instrument were constructed containing a list of issues pertaining to household environmental sanitation-specific issues such as domestic water, basic sanitation (toilet facilities), solid waste, liquid waste and hygiene practices as well as socio-economic and demographic characteristics were also included. The observational questions of the data collection

instrument focused on domestic water storage containers, toilet facilities, cleanliness of latrines, solid and liquid waste facilities, the presence of soap and other essential supplies in the house for handwashing facilities.

The structured data collection instrument had consisted of mainly closed-ended questions and also included some open-ended items for both interview and observational questions. The data collection instrument of interview questions were provided with clear instructions for interviewers. In addition, the data collection instrument for the observational questions which required checking by observation by data collectors for the availability of household environmental sanitation facilities were performed with clear instructions and definitions in each questions for the interviewers.

The data collection instrument was originally prepared in English prior to use in the study. The interview was conducted in the local language and for this purpose the data collection instrument was translated into Afan Oromo and Amharic. The average time taken to complete all the household data collection instruments per a household were found to be 32 minutes.

The study data collection instrument was pre-tested in the study area of the population of Dukem town. The purpose of the pre-test was to assess the suitability of the data collection instrument with regards to duration, language appropriateness, content validity, and question clarity. The pre-test was carried out in 10% (41 households) of the total sample size of the study. The pre-test at selected households was performed in the month of September 2011 by ten data collectors who are urban health extension workers. Discussions were conducted with the data collectors before and after performing the pre-test. The results of the pre-test were used to provide feedback to data collectors as well as used to correct and revise the data collection instrument with respect to the completeness of response sets, flow of questions, clarity of wording of questions, whether instructions for data collectors were understood and appropriate and the time required to complete the data collection instrument.

The data collection (field) team was composed of the researcher and with 11 trained field workers who were grouped into four teams as per the four *kebeles* to gather the data from 406 sampled households. The data collection of the research was daily coordinated and monitored by the researcher. The researcher was responsible for

organising and facilitating of the data collection, recruitment of data collectors and monitoring and checking of the data quality on daily basis. The data from households were collected using a ten-page data collection instrument by ten trained Urban Health Extension Workers from each *kebele* health posts. The data collectors speak the local language of the study area and had related experience in community health data collection. One field assistant was recruited and assisted in the data collection activities. Completed data collection instruments were checked daily during data collection process for completeness by the researcher and the field assistant.

The ten data collectors and one field assistant were trained for one day in a theoretical and practical session to familiarise them with the study objectives and in data collection and interview/observation methodology. The training was conducted at the Dukem Town Health Office. During the training, the data collectors were provided with a clear explanation of the study with guidance notes, its purpose, tasks to be accomplished, the sampling method, interviewing techniques, content of the data collection instrument, data quality, and ethical conduct of human research. Special emphasis on establishing mutual trust with respondents before asking questions, sources of bias and observational techniques were discussed. The half day of the training had included pre-testing of the data collection instrument.

3.3.4 Data analysis

All responses to the research data collection instrument of interview schedule and observation were first checked, edited and coded. Afterwards data were entered and cleaned using EPI info. Descriptive statistics was performed by means of frequency distribution and percentages and these are displayed using tables and graphs. Chi-squared test was carried out to find association between two categorical variables. Values less than 0.05 were considered statistically significant. The statistical analysis was conducted using SPSS 11.0 statistical package.

3.4 VALIDITY AND RELIABILITY

In conducting descriptive research, control is exercised by applying the principles of external validity. External validity refers to the generalisability of findings with respect to other settings or samples (Burns & Grove 2005:396; Polit & Beck 2008:287). In this

research, external validity was addressed in the sampling strategies and recruitment procedures of the study participants. It was enhanced by using random sampling of households, using statistical formula for appropriate sample size and by improving participation of respondents.

The validity of data collection instrument of the study was considered in the construction of individual questions and the conduct of pre-testing of the study on the first version of the household interview schedule. This has allowed in the identification of problems arising from question structure and interpretation. The results of the pre-testing study were used to refine the development of the final household interview schedule.

Various measures were undertaken to ensure the reliability of the data collection instrument and to enhance the accuracy of measurements, namely:

- Standardised data collection instrument was used.
- The data collection tool was pre-tested by data collectors and the necessary correction was made after the pre-test.
- Interviewers and the field assistant were trained on the objective of the study, sources of bias, observation and interview techniques.
- Data collectors and the field assistant possessed experience in data collection works previously.
- Completed data collection instruments were daily checked during data collection process for completeness by the researcher and the field assistant.

3.5 ETHICAL CONSIDERATIONS

This study has involved human participants in which a respondent from the household was interviewed regarding personal hygiene and domestic sanitation conditions. Therefore, the following ethical considerations were adhered to during the execution of this study process:

3.5.1 Protecting the rights of the participants

The ethical protections of the households were ensured in this research.

Informed consent: Informed consent was voluntarily sought from all the study participants. The respondent of the interview was household head or spouse and where the two respondents were not available, a person of at least 18 years of age was interviewed. Households that were interviewed have received a verbal explanation on the purpose of the study for the interview. They have been informed that a series of questions related to water and environmental sanitation of the household will be asked and observation at the sanitary facilities and related items of the household will be made. At the beginning of each interview schedule, a letter of informed consent form was attached together and it requests the permission from the interviewee. A respondent has been made to sign on it, when agreed to participate in the research.

Autonomy: Participation in the study was voluntary. The rights of the households not to participate were respected at anytime if they refused to participate or if they choose to withdraw from their participation during the interview and observation without any prejudice.

Confidentiality: Participants were informed that the collected data from the households to be kept strictly confidential.

Beneficence**:** Participants in the study have the right to protection of wellbeing. The researcher and all data collectors have safeguarded against any discomforts that may arise during the data collection process.

Non-maleficence**:** Participants in the study have the right to protection from discomfort and harm. This principle stipulates that care should be taken to prevent harm such as for questions which asks personal responses that could be emotional, social or physical. Such occurrences in the study were addressed by using experienced data collectors, providing thorough training for interviewers, use of proper introduction using the informed consent form, proper design of questions with local language translation which were pre-tested and providing assurance of strict confidentiality.

Justice**:** Each participant in the study was treated fairly and the right to privacy was respected. Fair selection of study participants were assured based on proper scientific methodology. Anonymity was assured by using codes in the data compilation and analysis.

3.5.2 Protecting the rights of institutions

Ethical clearance was obtained from Research and Ethics Committee of the Department of Health Studies at University of South Africa (UNISA) (Annexure A). Institutional consent was obtained from concerned institutions after communicating with formal letter written by UNISA Regional Centre. Permission for data collection from Dukem town was sought from Oromia Regional State Health Bureau. Accordingly, Dukem Town Health Office have supported the research and written letter to Dukem Town Municipality and to the four *kebeles'* administration offices for the necessary support during the data collection.

3.5.3 Scientific integrity

Scientific integrity was ensured in the research by protecting the intellectual property of the authors of the publications which were consulted in the study by giving proper attribution and citation on the list of references. Data were collected, analysed, interpreted and reported based on approved research proposal, appropriate procedures and scientific evidence.

3.6 CONCLUSION

The research design and method used in this study were described in this chapter. A descriptive, quantitative, cross-sectional study using simple random sampling method was used to conduct the research in Dukem town of Ethiopia. The sampling procedure, data collection method, data collection instrument and data analysis were also discussed fully. The next chapter will explain the data analysis, presentations and discussion of the research findings.

CHAPTER 4

ANALYSIS, PRESENTATION AND DISCUSSION OF RESEARCH FINDINGS

4.1 INTRODUCTION

This chapter presents the analysis and details of the findings of the research. The analysis, presentations and description of the research findings was illustrated by means of tables and figures with frequencies, percentages and other pertinent statistical information. Presentation of socio-economic and demographic characteristics is provided. The results of the data analysis pertaining to household drinking water, basic sanitation, wastewater, solid waste, personal hygiene and hygiene education are presented. A discussion of the research results is also presented in this chapter.

4.2 DATA MANAGEMENT AND ANALYSIS

4.2.1 Data quality assurance

The researcher and a statistician, who is recruited for data entry, checked all completed data collection instrument for completeness and consistency before being entered into computer.

4.2.2 Data entry

The raw data on data collection instrument was coded and entered into computer by a statistician using EPI info.

4.2.3 Data cleaning

The researcher and the statistician had worked in ensuring that data was accurately captured and cleaned using Epi info and SPSS (Window version 11.0). All inconsistent data entries were identified, verified and corrected.

4.2.4 Data processing and analysis

Data from the EPI info were imported into SPSS database. Descriptive statistics was performed using frequency distribution and percentages and these were displayed using tables and graphs. Chi-squared test was carried out to find association between two categorical variables. Values less than 0.05 were considered statistically significant. Using the SPSS, further statistical analysis was performed and computed.

4.3 RESEARCH RESULTS

4.3.1 Socio-economic and demographic characteristics of the study households

From a total of 406 households sampled in Dukem town, 391 households have participated in this study, giving a response rate of 96.3%. Of the 391 households that participated in the study, all the four *kebeles* of the town were included and the distribution of the households by *kebeles* were as follows: 170 (43.5%) were from Dukem 01 *kebele* (which is mostly the central part of the town) and the other three *kebeles* are adjacent to rural areas, in which 93 (23.8%) were from Tedicha *kebele*, 80 (20.5%) were from Koticha *kebele* and 48 (12.3%) were from Gogicha *kebele*.

The results also showed that the mean age of the respondents was 35.2 years. The majority of the respondents were between the age range of 18-27 years (134, 34.3%), followed by those within 28-37 years of age at 117 (29.9%). Respondents who belonged to the age group from 38-47 years were 71 (18.2%), those within the age group of 48-57 years were 34 (8.7%) and those above 58 years were 35 (9.0%).

One-fourth (100, 25.6%) of households were headed by women and 63.7% (249) of the respondents were females, but the majority (291, 74.4%) were headed by males as shown in Table 4.1. The largest proportion (272, 69.6%) of head of households were married. According to the results 96 (24.6%) of the head of households could not read and write (illiterate), 90 (23%) reported that they could read and write and 205 (52.4%) of the respondents received formal education. The mean family size of the households was 4.2. The majority of households (195, 49.9%) had household members of 4 to 6, followed by 1 to 3 household size (152, 38.9%). Households which belonged to more than 7 household members were 44 (11.3%).

With respect to type of job of the heads of households, the results showed that 95 (24.3%) were farmers, 76 (19.4%) were traders, 70 (17.9%) were unskilled labourers, 56 (14.3%) were private sector employees, 24 (6.1%) were civil servants, 24 (6.1%) were non-governmental organisation employees and 46 (11.4%) were other type of jobs. The majority (223, 57%) of the houses were privately owned, followed by rented (168, 43%) from private and government/*kebeles*.

The results of the study showed that the majority of households (162, 41.4%) had family monthly income of less than 500 Ethiopian Birr (ETB), followed by those between ETB 501 to 1,000 at 146 (37.3%). Households which earned family monthly income of more than ETB 1,000 were only 46 (11.8%). The missing responses were 37 (9.5%) which is presented as unspecified as shown in Table 4.1. Table 4.1 summarises the basic descriptive statistics of socio-economic and demographic characteristics of the households surveyed.

Table 4.1 Socio-economic and demographic characteristics of the head of households and respondents, Dukem town, October 2011 (n=391)

Characteristic	**n**	**%**
Age of the respondent		
18-27	134	34.3
28-37	117	29.9
38-47	71	18.2
48-57	34	8.7
>58	35	9.0
Total	**391**	**100.0**
Gender of head of the household		
Male	291	74.4
Female	100	25.6
Total	**391**	**100.0**
Gender of respondents		
Male	142	36.3
Female	249	63.7
Total	**391**	**100.0**
Total number of persons in households		
1-3	152	38.9
4-6	195	49.9
≥7	44	11.3
Total	**391**	**100.0**
Education level of the head of household		
Literate (formal schooling)	205	52.4
Illiterate	96	24.6
Read and write	90	23.0
Total	**391**	**100.0**

Characteristic	n	%
Main job of the head of household		
Farmer	95	24.3
Trader	76	19.4
Unskilled worker	70	17.9
Private sector employed	56	14.3
Civil servant	24	6.1
Non-government organisation employed	24	6.1
Other	46	11.4
Total	**391**	**100.0**
Household's monthly income in ETB*		
≤500	162	41.4
501-1000	146	37.3
>1,000	46	11.8
Unspecified**	37	9.5
Total	**391**	**100.0**
Type of house ownership		
Private owned	223	57.0
Rented	168	43.0
Total	**391**	**100.0**

*1 US Dollar equals 17.1019 on October 15, 2011 (Commercial Bank of Ethiopia 2007).

**Include those unemployed and those who do not know their incomes

4.3.2 Household drinking water

As shown in figure 4.1, the majority of households had obtained drinking water from private piped water inside the compound (152, 38.9%), followed by households that bought water from neighbourhood private piped tap (112, 28.6%). Other households had obtained drinking water from public tap/standpipe (88, 22.5%), private piped water inside the house (14, 3.6%), shared neighbourhood piped water (14, 3.6%), surface water (pond or river) (6, 1.5%), protected dug well (3, 0.8%) and protected spring (2, 0.5%).

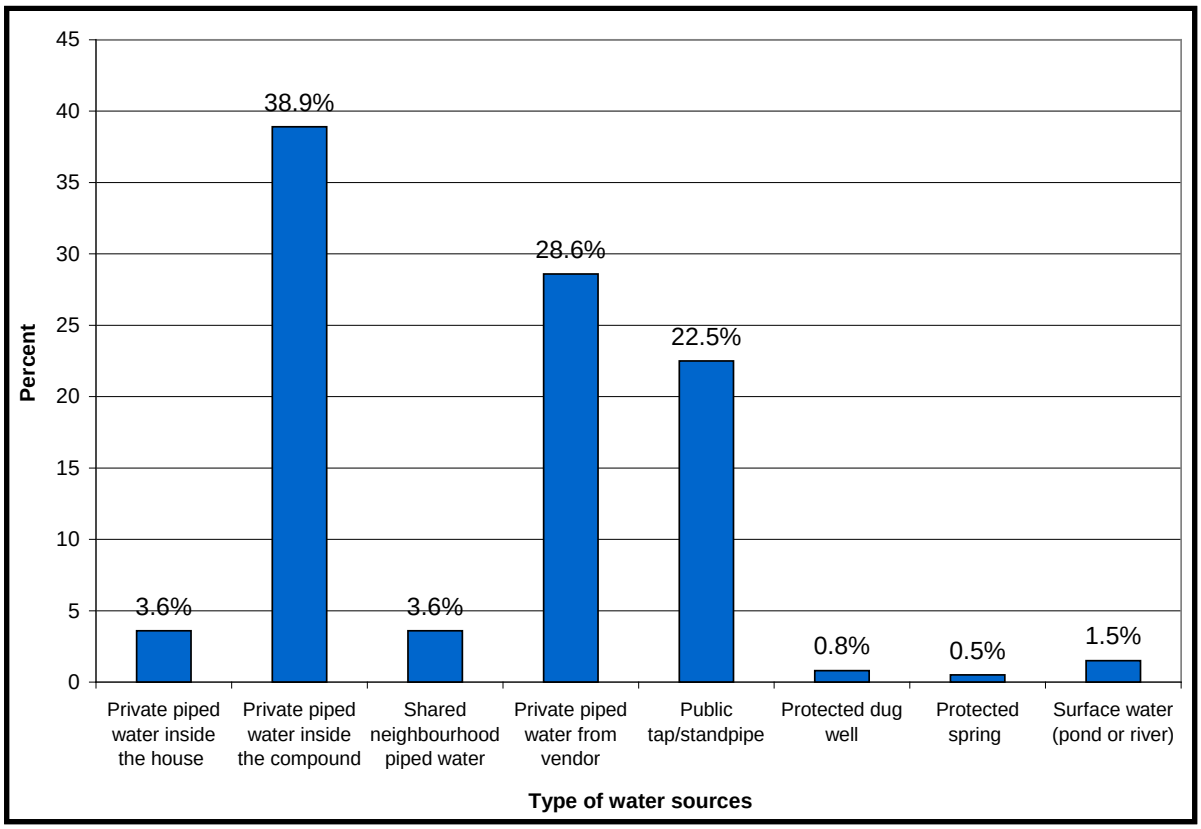


Figure 4.1 Type of water sources used, Dukem town, October 2011 (n=391)

Table 4.2 classifies the type of water sources into different categories. Accordingly, households that used improved municipal piped water connection includes households that used private piped water inside the compound (152, 38.9%), public tap/standpipe (88, 22.5%), private piped water inside the house (14, 3.6%) and shared neighbourhood piped water (14, 3.6%). This makes access to improved municipal piped water to be 68.6%. But when those households that bought water from neighbourhood private piped tap (112, 28.6%) are taken into account, the improved municipal piped water coverage would be 97.2%. The other improved water source category is households that obtained water from protected dug well and spring (5, 1.3%). Thus, when these are summed up together, 385 (98.5%) households had access to improved sources of drinking water, which this is high coverage because of reasonable access to municipal piped water connections. This coverage was high as compared to study conducted in Ethiopian DHS survey of 2005 in which national access to improved water is 61%, national access to urban improved water is 94% and national access to urban piped water is 90% (Central Statistical Agency & ORC Macro 2006:23).

Table 4.2 Type of sources of drinking water, Dukem town, October 2011 (n=391)

Source of drinking water	n	%
Improved source		
Private piped		
Private piped water inside the house	14	3.6
Private piped water inside the compound	152	38.9
Communal piped		
Shared neighbourhood piped water	14	3.6
Buy water from neighbourhood private piped tap	112	28.6
Public tap/standpipe	88	22.5
Protected well/spring		
Protected dug well	3	0.8
Protected spring	2	0.5
Unimproved source		
Surface water (pond or river)	6	1.5
Total	**391**	**100.0**

As shown in table 4.2 above, the results of the study also indicated that 42.5% of the households had access to their own private piped water inside their house or in their compound. This can be compared to global situations in which in developing countries an average of 73% of the urban population uses piped water from a household connection and in urban areas of Sub-Saharan Africa 35% of urban dwellers use water piped to the household (World Health Organization & United Nations Children's Fund 2010:25). A study conducted in 2003 by Jyotsna Jalan and Martin Ravallion find that, overall, in households with piped drinking water, the prevalence and duration of diarrhoeal disease among children was significantly lower. The benefits of a piped water system appear to be further increased when the tap is located within the house, as opposed to a communal tap shared by several households (Bachhuber, Conrad & Shadix 2008:8).

Piped systems, especially with household connections, provide greater convenience and are thus preferred by people in most communities. However, making large quantities of safe water readily accessible to all households is often not easily realisable (United Nations Children's Fund 1999b:36). Households that did not have access to private piped water on their premises (225, 57.5%) were asked for reasons of not having. About one-third (30.2%) of the respondents mentioned financial problem, whereas 27.1% of the respondents reported lack of piped water connection in the locality. Over one-fifth (22.2%) of respondents attributed their house rental status as a responsible factor. Other respondents suggested they can easily access water from

public taps (8.4%), they have other priorities (8%), they can easily access water from private piped water vendor (3.6%), lack permission for installation (2.2%) and installation cost unaffordable (0.9%).

Ensuring access to water supply systems can greatly reduce the time women spend collecting water, allowing more time to care for young children and more time for income generating activities (Environmental Health Project 2004a:27). Households were asked for the time taken to fetch water and distance of the water source from the dwelling. As shown in table 4.3 concerning time taken to obtain drinking water (round trip), 161 (41.2%) households had access to water on their premises, 161 (41.2%) households took less than 30 minutes to fetch drinking water and the rest of 69 (17.6%) households took more than 30 minutes to fetch drinking water. Thus, generally an overwhelming majority (82.4%) of households had access to water within a time of 30 minutes or less.

With respect to distance of water source from dwelling, table 4.3 shows that 161 (41.2%) households had access to water on their premises, 67 (42.7%) households had access to water within 200 metre distance from their dwelling house and the rest of 63 (16%) households had to walk over 200 metre to reach the nearest source of water. The study therefore found out that 83.9% of the households had access to water within a distance of upto 200 metre or less. This observation can be compared with the findings of study conducted in Kisumu city (Kenya) in which 77.1% of the households access water within a distance of upto 200 metre or less (Wagah, Onyango & Kibwage 2010:122).

Table 4.3 Time taken to fetch water and distance of the water source from the dwelling, Dukem town, October 2011 (n=391)

CATEGORY	FREQUENCY	%
Time to obtain drinking water (round trip)		
Water on premises	161	41.2
Less than 30 minutes	161	41.2
More than 30 minutes	69	17.6
Total	**391**	**100.0**
Distance of water source from dwelling		
Water on premises	161	41.2
≤ 200 metres	167	42.7
> 200 metres	63	16.0
Total	**391**	**100.0**

In many communities, household water is managed exclusively by women. Women and girls are generally the ones who obtain water for the home, transport it, store it and then use it for various household purposes (United Nations Children's Fund 2008:141). As shown in table 4.4, in the majority of households (323, 82.6%) an adult woman usually collected drinking water from water sources. Females carried 85.9% of the water from water sources and children were responsible for 4.1% of all water carried. Female children (under age 15) are over four times more likely than male children of the same age to fetch drinking water. This finding indicates that the task of water collection is considered a task for women and girls. In terms of uneven distribution of the burden of collecting water, this compares unfavourably to the data for all developing countries, which shows an average of 64% (WE Consult Lda & UNICEF Mozambique 2009:24). Despite the fact that most of the hardship associated with water hauling affects females in the studied households, but the accessibility to an improved source of drinking water within reasonable time and distance to fetch drinking water in the majority of households could reduce the burden of hardship and the time spent for collecting water by women.

Table 4.4 Persons who usually collects household water, Dukem town, October 2011 (n=391)

Persons who collects drinking water for households	n	%
Adult woman (age >15)	323	82.6
Adult man (age >15)	48	12.3
Female child (under age 15)	13	3.3
Male child (under age 15)	3	0.8
Other	4	1.0
Total	**391**	**100.0**

For the hygiene situation in a household to improve, water must not only be accessible, it must also be available in sufficient quantity (Environmental Health Project 2004a:60). The result of the study indicated that the average daily consumption of water per households was 62.1 litres and the mean per capita per day water consumption of the study households was found to be 14.7 litres. The finding of 14.7 litres per capita per day (LCD) was lower than the WHO/UNICEF Joint Monitoring Programme (JMP) recommendations which describes reasonable access as being *'the availability of at least 20 litres per person per day from a source within one kilometre of the user's dwelling'* (World Health Organization & United Nations Children's Fund 2000:77). Using the recommended basic water requirement of 20 litres per person per day, there was a mean daily water per capita shortfall of 5.3 litres in the studied households. From the

recommended requirement and the actual per capita water use, the shortfall represents 26.5% of daily per capita water requirement. This implies that only 73.5% of the daily basic water requirements of the residents of the sampled households were met. According to “Universal Access Programme” (UAP) of Government of Ethiopia (2007:37), the programme has the objective to enable residents of towns to reliably get access to 20 litres of water per day within half a kilometre distance from their residences.

As shown in table 4.5, 328 (83.9%) households had used less than 20 litres per capita per day and 218 (55.8%) households had used less than 15 litres per capita per day. The cross-tabulation of table 4.5 indicates households that had used daily water consumption above the basic minimum of 20 LCD and those that had private piped water were only 8.2% of the total households sampled. In addition, households that had used daily water consumption above 15 LCD and those that had private piped water were 20.2% of the total households sampled.

Table 4.5 Daily amount of water used (litres) by availability of private piped water sources, Dukem town, October 2011 (n=391)

Daily water consumption in litres	Availability of private piped water source		Total n (%)
	Private piped water source n (%)	Non-private water source n (%)	
Water consumption from minimum recommended 20 LCD			
≤20	134 (34.3)	194 (49.6)	328 (83.9)
>20	32 (8.2)	31 (7.9)	63 (16.1)
Total	**166 (42.5)**	**225 (57.5)**	**391 (100.0)**
Water consumption from mean daily amount of 15 LCD			
≤15	87 (22.3)	131 (33.5)	218 (55.8)
>15	79 (20.2)	94 (24.0)	173 (44.2)
Total	**166 (42.5)**	**225 (57.5)**	**391 (100.0)**

The data from Table 4.6 indicates that the per capita daily water use varies according to the household characteristics. Households that earned family monthly income with more than 1,000 ETB (Ethiopian Birr), the mean water consumption was 17.4 LCD which is less in 2.6 LCD from the recommended requirement while households with 501-1,000 ETB monthly income the mean water consumption was 16.3 LCD, which is less in 3.7 LCD from the recommended requirement. Households with less than 500 ETB monthly income the mean water consumption was 16.7 LCD, which is less in 3.3 LCD from the

recommended requirement. The data also showed that households where their source of water were located on house premises or in closer distance of less than 200 metres, their mean water consumption were slightly higher than those of households that obtained drinking water at distance of more than 200 metres, but in each of the distance category the basic minimum requirement of 20 LCD have not been met.

Table 4.6 Mean daily amount of water used (litres) by household characteristics, Dukem town, October 2011 (n=391)

Characteristics	%	Mean water consumption in LCD	Difference from the recommended basic water requirement of 20 LCD
Family's monthly income in ETB (Ethiopian Birr)			
≤500	41.4	16.7	-3.3
501-1000	37.3	16.3	-3.7
>1,000	11.8	17.4	-2.6
Unspecified*	9.5	13.0	-7.0
Total	**100.0**		
Distance of water source from dwelling (n=391)			
Water on premises	41.2	16.6	-3.4
≤ 200 metres	42.7	16.6	-3.4
> 200 metres	16.0	14.7	-5.3
Total	**100.0**		

* Include those unemployed and those who do not know their incomes

The cross tabulation of Figure 4.2 shows a clear correlation between the 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 about 20.5 litres per person per day, which is almost equivalent with minimum requirement amount of 20 litres per person per day.

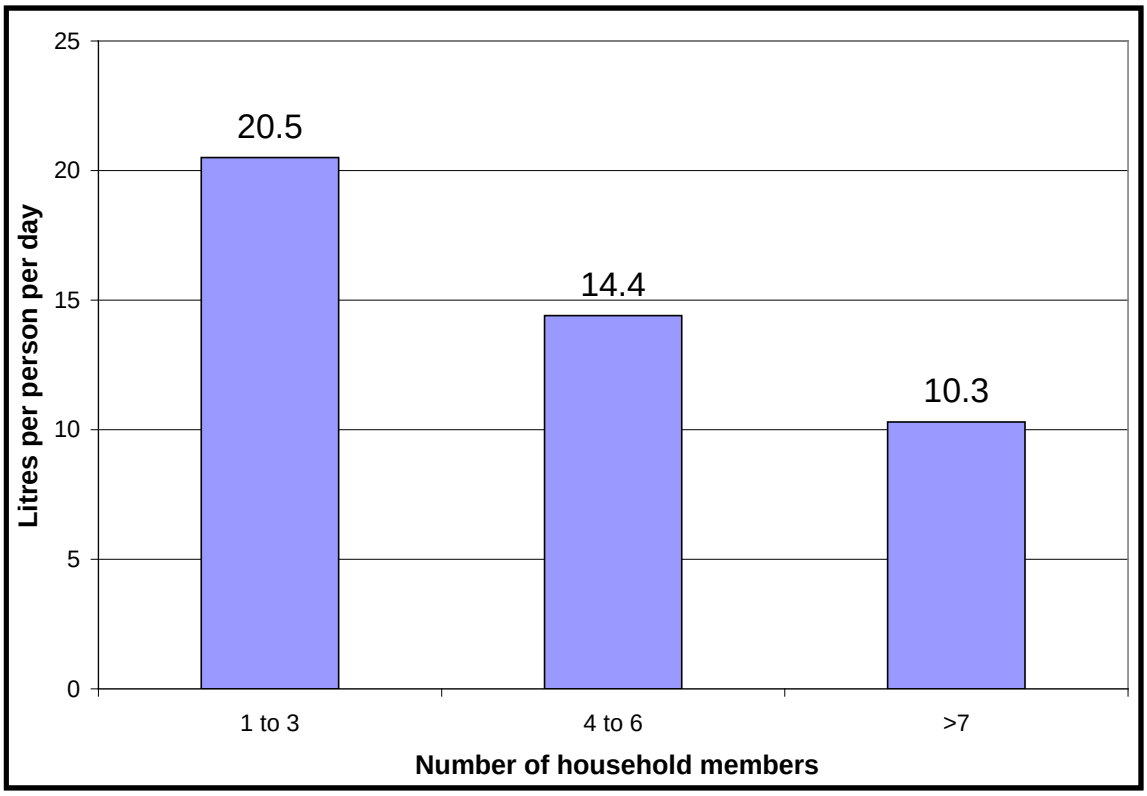


Figure 4.2 Drinking water consumption and household size relation, Dukem town, October 2011 (n=391)

While access to safe water is important, it is also necessary for the household to store its water properly so that it remains safe (Environmental Health Project 2004a:46). Data collectors observed the presence and type of a water storage vessel. As shown in figure 4.3, the study results showed that almost three-quarters (291, 74.4%) of households used plastic jerry can container (hard plastic container with a capacity of approximately 20 litres). The other commonly used containers were plastic drum/barrel (48, 12.3%), plastic bucket (13, 3.3%), metallic drum/barrel (8, 2%), metallic bucket (4, 1%), storage tank (3, 0.8%) and clay water pot (2, 0.5%). The rest of 22 (5.6%) households had no water storage containers.

Observation was made by data collectors whether the household water container was covered or not. The result showed that most households (344, 93.2%) had covered their stored water. The practice of covering water storage containers at households would minimise the possibility of contamination by microorganisms. Thus, the availability of narrow-necked plastic jerry can containers in most households (74.4%) and the practice

of covering water storage containers in majority of households (93.2%) are generally indicative of good hygiene practices.

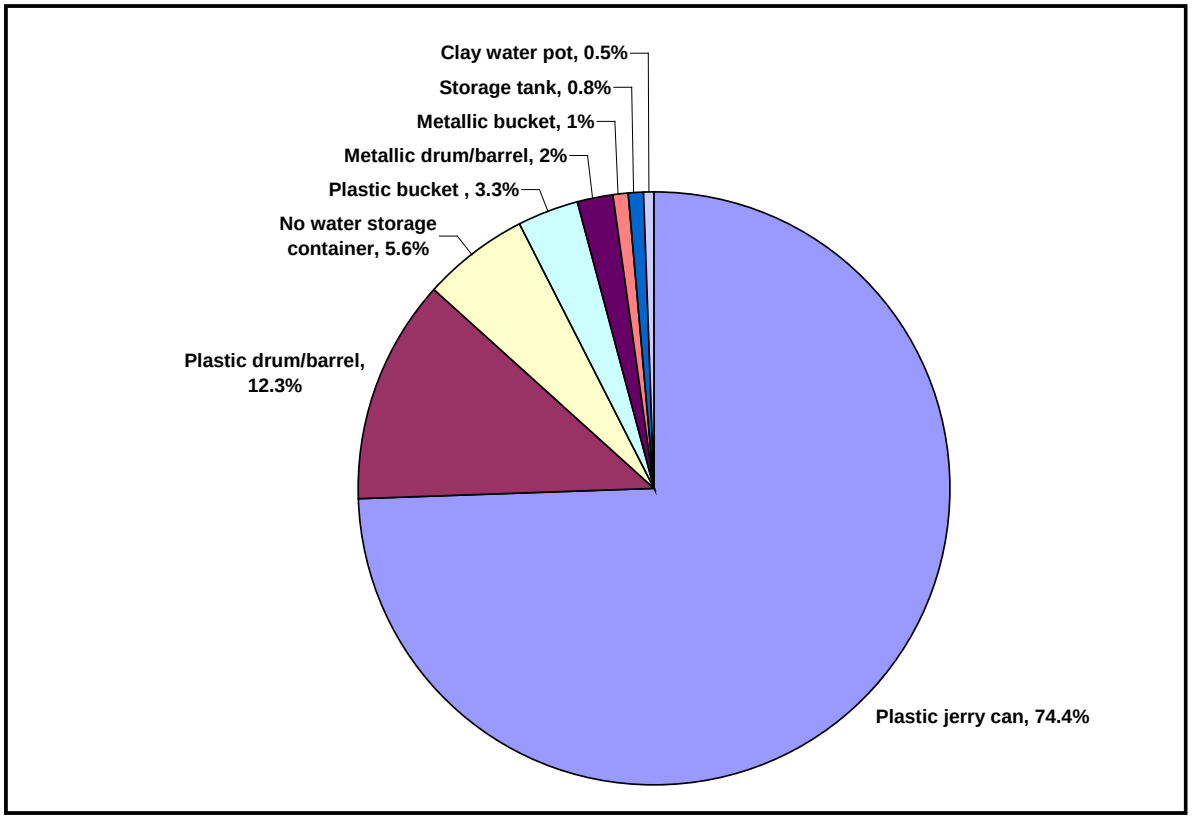


Figure 4.3 Type of water storage container, Dukem town, October 2011 (n=391)

One of the essential parts in the safe water chain is the possession and use of a clean/safe dipper that allows the water from a safe source to be transferred to a vessel for drinking (Environmental Health Project 2004a:64). The study result showed that most of the households (271, 73.4%) mentioned to use pouring for drawing water from a container. Other methods of drawing water from a container as cited by the households were 74 (20.1%) households used dipper with handle, 33 (8.9%) households used dipper without handle, 8 (2.2%) households used a container that has a spigot/faucet and 3 (0.8%) households used tap faucet. The use of pouring for drawing water from a container is a safe method in domestic water management.

In order to reduce contamination by diarrhoea-producing pathogens in the most accessible water source, households needs to use some form of household water treatment (Environmental Health Project 2004a:63). An overwhelming majority of the surveyed households (330, 84.4%) of the town did not treat their drinking water at

home. Only 15.6% of the households practiced some form of household water treatment. Of those who treated their water, the primary treatment method used was adding bleach/chlorine (37, 9.5%), followed by those who used by letting water container to settle down (15, 3.8%). Only 1.3% of the households boiled water as a home water treatment. The results clearly showed that water treatment is only practised in a minority of households.

Table 4.7 presents the results with regard to selected socio-demographic variables (house ownership and family size) and availability of private piped water source. The results indicate that there was a statistically significant association between private house ownership and private piped water availability ($p<0.05$). However, there was no significant relationship between family size and availability of private piped water ($p=0.318$).

Table 4.7 Selected socio-demographic variables by availability of private piped water sources, Dukem town, October 2011 (n=391)

Characteristics	**Availability of private piped water source**		**Total n (%)**	**χ^2 (*p*-value)**
	Private piped water source n (%)	**Non-private water source n (%)**		
Type of house ownership				14.35 (p=0.000)
Private owned	113 (28.9)	110 (28.1)	223 (57.0)	
Rented	53 (13.6)	115 (29.4)	168 (43.0)	
Total	**166 (42.5)**	**225 (57.5)**	**391 (100.0)**	
Number of persons in households				2.29 (p=0.318)
1-3	60 (15.3)	92 (23.5)	152 (38.9)	
4-6	83 (21.2)	112 (28.6)	195 (49.9)	
≥7	23 (5.9)	21 (5.4)	44 (11.3)	
Total	**166 (42.5)**	**225 (57.5)**	**391 (100.0)**	

As shown in table 4.8, combined availability of piped water and different types of sanitary facilities were analysed. The cross-tabulation indicates households that had improved toilet facilities and those that had improved private piped water were 36.8% of the total households sampled. Households that had safe solid waste disposal facilities and those that had improved private piped water were 28.6% of the total households. Households that had safe wastewater disposal facilities and those that had private piped water were 14.8% of the total households. The benefits of access to safe drinking water will be maximised if undertaken in conjunction with sanitation and hygiene practices. These can lead to an enhanced influence on health and well-being when

implemented together (United Nations University Institute for Water, Environment and Health 2010:13). Thus, the result of the study shows the need for combined availability of the facilities at households and the need for concerted effort at all levels to encourage integrated implementation of water and environmental sanitation facilities.

Table 4.8 Availability of private piped water connection by availability of improved sanitary facilities, Dukem town, October 2011 (n=391)

Type of water supply sources	Type of sanitary facilities					
	Toilet		Solid waste		Wastewater	
	Improved n (%)	Unimproved n (%)	Safe disposal n (%)	Unsafe disposal n (%)	Safe disposal n (%)	Unsafe disposal n (%)
Private piped water source	144 (36.8)	22 (5.6)	112 (28.6)	54 (13.8)	58 (14.8)	108 (27.6)
Non-private water source	130 (33.2)	95 (24.2)	96 (24.6)	129 (33.0)	39 (10.0)	186 (47.6)
Total	**274 (70.1)**	**117 (29.9**	**208 (53.2)**	**183 (46.8)**	**97 (24.8)**	**294 (75.2)**

4.3.3 Basic sanitation facilities (excreta disposal)

For the hygiene situation of households to improve, it must have easy access to functioning and hygienic toilet facilities (Environmental Health Project 2004a:56). Appropriate basic sanitation facility play a crucial role in ensuring good health. Accordingly, during the household survey, information was elicited about the availability of toilets in the households.

As shown in table 4.9, about two-thirds (274, 70.1%) of households used improved private toilets (flush/pour-flush toilet, ventilated improved pit (VIP) latrine and traditional pit latrine). Over half of households (215, 55%) had traditional type of latrine facility. The other type of improved toilets used was ventilated improved pit (VIP) latrine (50, 12.8%) and flush/pour-flush toilet (9, 2.3%). Studies showed that community coverage of improved sanitation at the 75% level to be associated with improved health and less than 75 percent 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). Improved hygiene and sanitation when practiced by more than 80% of the population is known to radically reduce diarrhoeal disease and worm infestations (Ministry of Health 2006:6).

Table 4.9 Type of toilet facilities used by households, Dukem town, October 2011 (n=391)

Type of toilet facilities (n=391)	n	%
Improved		
Flush/pour-flush toilet	9	2.3
Ventilated improved pit latrine	50	12.8
Traditional pit latrine	215	55.0
Unimproved		
Communal latrine	50	12.8
Public toilet	33	8.4
Field or anywhere	34	8.7
Total	**391**	**100.0**

As shown in table 4.9 above, 117 (29.9%) households had used unimproved toilet facilities. Out of which 12.8% had used communal latrine, 8.4% had used public toilet and 8.7% had no any kind of latrine at all. According to other studies, mostly communal or public latrines are invariably poorly maintained and poorly maintained public latrines are a definite health hazard (Department for International Development 1998:75).

The nine percent households that relied on the field or anywhere as their defecation place might cause harm to the environment and human health. This compares with the results of Ethiopian DHS survey of 2005 in which sixty-two percent of the population practice open field defecation (Central Statistical Agency & ORC Macro 2006:23-25). Evidently, the main reasons given by the households for the lack of household private latrines were: close to two-fifths (37.6%) reported that the house is rented, over one-fourth (26.5%) cited financial problem as the reason, less than one-fourth (23.9%) mentioned they lack adequate space on which to build latrine and over one-tenth (11.1%) indicated the unsuitability of land to construct latrine. Other reasons provided were availability of other priorities (3.4%), lack of adequate construction materials and tools (1.7%) and lack of adequate know-how to build latrine (0.9%).

As shown in table 4.10, from the households that had their own private latrines, 21.9% were shared. 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 2006a:13).

Table 4.10 Sharing of private toilet with other households, Dukem town, October 2011 (n=274)

Whether households share private toilet with other households	n	%
Yes	60	21.9
No	214	78.1
Total	**274**	**100.0**

To improve the hygiene situation of a household, a toilet facility must be kept clean and well maintained (Environmental Health Project 2004a:79). Information on cleanliness of toilets was also gathered by observing the toilets in the households. Hygienic (clean latrine) was defined as 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 and does not smell bad. Data collectors assessed and visually checked based on this definition as to whether the toilets were clean or not. The result indicated that 85% of the latrines were kept clean. A high level of coverage with hygienic latrines appears to have health advantages.

The proper disposal of faeces for children under 3 years is important for the hygiene improvement of a household and the community at large because it lowers risk of disease pathogens in the environment (Environmental Health Project 2004a:62). As shown in table 4.11, from households that had children of under three years of age, 74.2% used potty, 12.4% used diaper/cloth and 6.2% used in house yard for children's defecation. In 81 (83.5%) of households, the children's stools were contained and dropped into toilet facility and this is the preferred method of disposal which ensures protection of the household environment from faecal contamination. It is also an indication of good hygiene practices. In the rest of 16 (16.5%) households, the children's stools were left uncontained and they were disposed outside premises (6, 6.2%), disposed into drain (3, 3.1%), thrown into the garbage (3, 3.1%) and disposed in yard (2, 2.1%).

Table 4.11 Stool disposal of children, Dukem town, October 2011 (n=97)

Variable	n	%
Where usually young children (0-3 years) pass stool		
Used potty	72	74.2
Used latrine	2	2.1
Used diapers/cloth	12	12.4
Went in house yard/compound	6	6.2
Went outside the premises	2	2.1
Don't know	3	3.1
Total	**97**	**100.0**
Where households usually dispose the young children (0-3) faeces		
Contained		
Dropped into toilet facility	81	83.5
Uncontained		
Thrown away to drainage system	3	3.1
Disposed into solid waste	3	3.1
Disposed in yard/compound	2	2.1
Disposed outside premises	6	6.2
Did nothing/left it there	1	1.0
Other	1	1.0
Total	**97**	**100.0**

Households in the study area had good awareness about the benefits of having latrine as the vast majority of households (337, 86.2%) mentioned that having a latrine avoid bad smell. Over one-half (208, 53.2%) of respondents were aware that having a latrine improves hygiene/cleanliness, whereas just under one-half of respondents (193, 49.4%) suggested it prevents disease and improves health, 180 (46%) respondents suggested it reduces environmental contamination and 178 (45.5%) respondents cited it minimises open defecation. Other respondents cited it provides more comfort (37, 9.5%), privacy (26, 6.6%), saves time (13, 3.3) and did not felt its importance (2, 0.5%). While households in the study area had a good awareness about the benefits of having latrine, but over one-quarter of households used unimproved latrine facilities, out of this nearly one-in-ten residents of the studied households had no any kind of latrine at all.

Table 4.12 presents the results concerning selected socio-demographic variables (house ownership and family size) and availability of private toilet facility. The results indicate that availability of private toilet was significantly associated with private house ownership ($p<0.05$). In addition, there was a statistically significant relationship between family size and availability of private toilet facility ($p<0.05$).

Table 4.12 Selected socio-demographic variables by availability of toilet facility, Dukem town, October 2011 (n=391)

Characteristics	Availability of toilet facility		Total n (%)	χ^2 (*p*-value)
	Yes n (%)	No n (%)		
Type of house ownership				67.14 (p<0.05)
Private owned	193 (49.4)	30 (7.7)	223 (57.1)	
Rented	81 (20.7)	87 (22.3)	168 (43)	
Total	**193 (49.4)**	**30 (7.7)**	**391 (100)**	
Number of persons in households				12.62 (p<0.05)
1-3	94 (24.0)	58 (14.8)	152 (38.8)	
4-6	141 (36.1)	54 (13.8)	195 (49.9)	
≥7	39 (10.0)	5 (1.3)	44 (11.3)	
Total	**274 (70.1)**	**117 (29.9)**	**391 (100)**	

4.3.4 Wastewater disposal

As shown in table 4.13, the finding of this study indicated that three-fourths (294, 75.1%) of the overwhelming majority of households had used unsafe wastewater disposal methods and did not have appropriate type of wastewater disposal systems. The major types of unsafe disposal methods used were as follows: about two-fifths (153, 39.1%) of households had discharged into street surface or empty space outside premises, over one-third (128, 32.7%) of households had discharged into premises yard and 13 (3.3%) households had used open ditch as illustrated in figure 4.4. Inadequate drainage and consequent accumulation of water in the vicinity of the homes has been the root cause of vector breeding and transmission of vector-borne diseases (Beumer et al 2002:36).

Table 4.13 Type of domestic wastewater disposal method by household, Dukem town, October 2011 (n=391)

Type of domestic liquid waste disposal method	n	%
Safe disposal		
Seepage pit/soak-away pit	33	8.4
Cesspit/septic tank	13	3.3
Drain in closed sewer system	5	1.3
Drain directly to garden	25	6.4
Poured or carried into toilet facility	21	5.4
Unsafe disposal		
Discharge into street surface or empty space outside premises	153	39.1
Discharge into premises yard	128	32.7
Open ditch	13	3.3
Total	**391**	**100.0**

As shown in table 4.13, 97 (24.8%) households used safe wastewater disposal facilities. Out of which 33 (8.4%) households used seepage pit/soak-away pit, 25 (6.4%) households drained directly to garden, 21 (5.4%) households poured or carried into toilet facility, 13 (3.3%) households used septic tank and 5 (1.3%) households drained in closed sewer system as illustrated in figure 4.4.

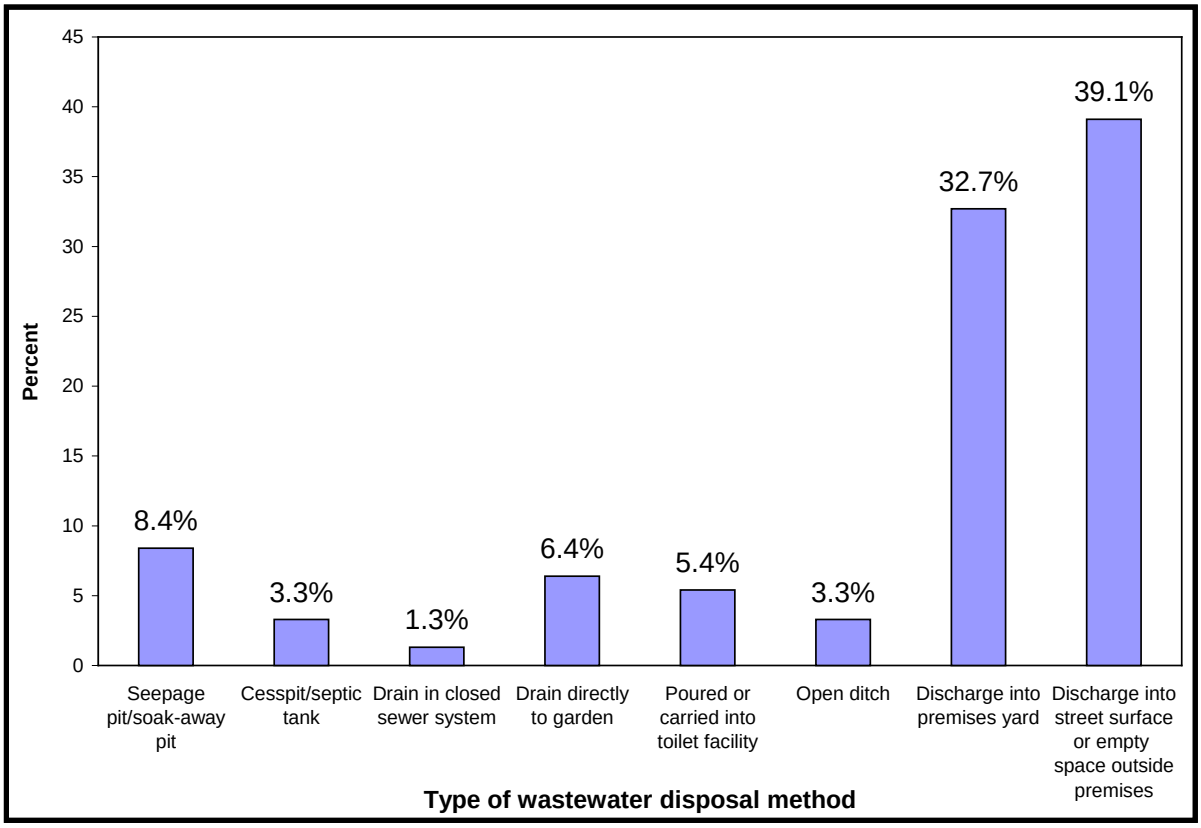


Figure 4.4 Type of domestic wastewater disposal method, Dukem town, October 2011 (n=391)

Information on the presence of stagnant water near the dwelling house was also gathered by observing around the households by data collectors. The result showed that in 347 (88.7%) households, there were no stagnant water around the dwelling units, which this is generally an indication of good hygiene practices.

Households were asked on their knowledge regarding the problems caused by inappropriate wastewater disposal. Almost three-quarters (290, 74.2%) of the total sampled households cited that inappropriate wastewater disposal provides breeding

sites for mosquitoes. Over half (212, 54.2%) of respondents mentioned it causes nuisance by bad smell, 43.7% (171) indicated that it causes diarrhoeal and other diseases while others mentioned it spread germs (145, 37.1%), makes the locality dirty (112, 28.6%), pollutes surface water sources (73, 18.7%), causes stagnation of wastewater around residential houses (37, 9.5%), seeps to the ground and contaminate ground water (29, 7.4%), causes injury (14, 3.5%) and causes flooding or erosion (3, 0.8%). While households in the study area had awareness about the problems caused by inappropriate wastewater disposal, but three-fourths of the total sampled households practically disposed their wastewater in open field disposal indiscriminately.

Table 4.14 presents the results concerning selected socio-demographic variables (house ownership and family size) and availability of safe wastewater disposal facility. The results indicate that availability of safe wastewater disposal facility was significantly associated with private house ownership ($p<0.05$). In addition, there was a statistically significant relationship between family size and availability of safe wastewater disposal ($p<0.05$).

Table 4.14 Selected socio-demographic variables by availability of wastewater disposal facility, Dukem town, October 2011 (n=391)

Characteristics	**Availability of wastewater disposal**		**Total n (%)**	**χ^2 (*p*-value)**
	Safe disposal n (%)	**Unsafe disposal n (%)**		
Type of house ownership				4.21 (p<0.05)
Private owned	64 (16.4)	159 (40.7)	223 (57.1)	
Rented	33 (8.4)	135 (34.5)	168 (42.9)	
Total	**97 (24.8)**	**294 (75.2)**	391 (100.0)	
Number of persons in households				15.67 (p<0.05)
1-3	23 (5.9)	129 (33.0)	152 (38.9)	
4-6	65 (16.6)	130 (33.2)	195 (49.8)	
≥7	9 (2.3)	35 (9.0)	44 (11.3)	
Total	**97 (24.8)**	**294 (75.2)**	391 (100.0)	

4.3.5 Solid waste disposal

The basic functional units of solid waste management start with onsite storage and handling of wastes. About two-thirds (153, 67.7%) of the total sampled households had temporary storage container (a container where the solid waste is temporally stored before final disposal) in their compound. As shown in table 4.15, about one-third (126,

32.2%) of households had no storage container. The study result indicated that 21 (5.4%) households used plastic waste container, 2 (0.5%) used metallic container, 2 (0.5%) used bamboo basket and the large proportion (238, 60.8%) of households relied on bag/sack. This observation also correlate with the findings of study conducted in Ijebu Ode (Southwest Nigeria) in which that the large percentage (58%) of the waste storing container was sack (Banjo, Adebambo & Dairo 2009:65). However, about three-fifths (160, 40.9%) of the households did not covered their solid waste container and left unprotected which might expose household members to the risk of waste contamination.

Table 4.15 Type of solid waste storage containers used by households, Dukem town, October 2011 (n=391)

Type of storage materials	n	%
Bag/sack	238	60.8
Plastic waste container	21	5.4
Metallic container	2	0.5
Bamboo basket	2	0.5
Other	2	0.5
No storage container	126	32.2
Total	**391**	**100.0**

For the hygiene situation of a household to improve, it must have a safe solid waste disposal method (Environmental Health Project 2004a:62). As shown in table 4.16, over one-half (208, 53.3%) of households used a safe solid waste disposal method. Of the safe method of collection and disposal, over one-fourth (100, 25.6%) of the sampled households used private waste collectors, 66 (16.9%) households used private waste pit, 19 (4.9%) households used communal waste pit outside the premises and 19 (4.9%) households used composting of wastes for gardening within premises as illustrated in figure 4.5. Small community-based organisations (such as cooperatives) and private microenterprises play an important part in providing waste management services. These small-scale service providers offer several advantages, including low-cost, labour-intensive approaches and greater community participation, which encourage better collection and source separation (Hoornweg & Giannelli 2007).

Table 4.16 Type of solid waste disposal method used by households, Dukem town, October 2011 (n=391)

Method of household solid waste disposal method	n	%
Safe disposal		
Collected from home by private waste collectors	100	25.6
Disposed within premises in private waste pit	66	16.9
Disposed outside premises in communal waste pit	19	4.9
Composting of wastes for gardening within premises	19	4.9
Recycling of waste	4	1.0
Unsafe disposal		
Burning of waste within premises	110	28.1
Disposed outside premises anywhere	53	13.6
Disposed within premises anywhere	20	5.1
Total	**391**	**100.0**

Domestic waste, when sorted, recycled well or composted, can be turned into a resource but it was found that the greater part of waste generated generally did not undergo such process before the final disposal. The study result indicated that only 19 (4.9%) of the sampled households had used waste as manure (compost) for home gardening (Figure 4.5).

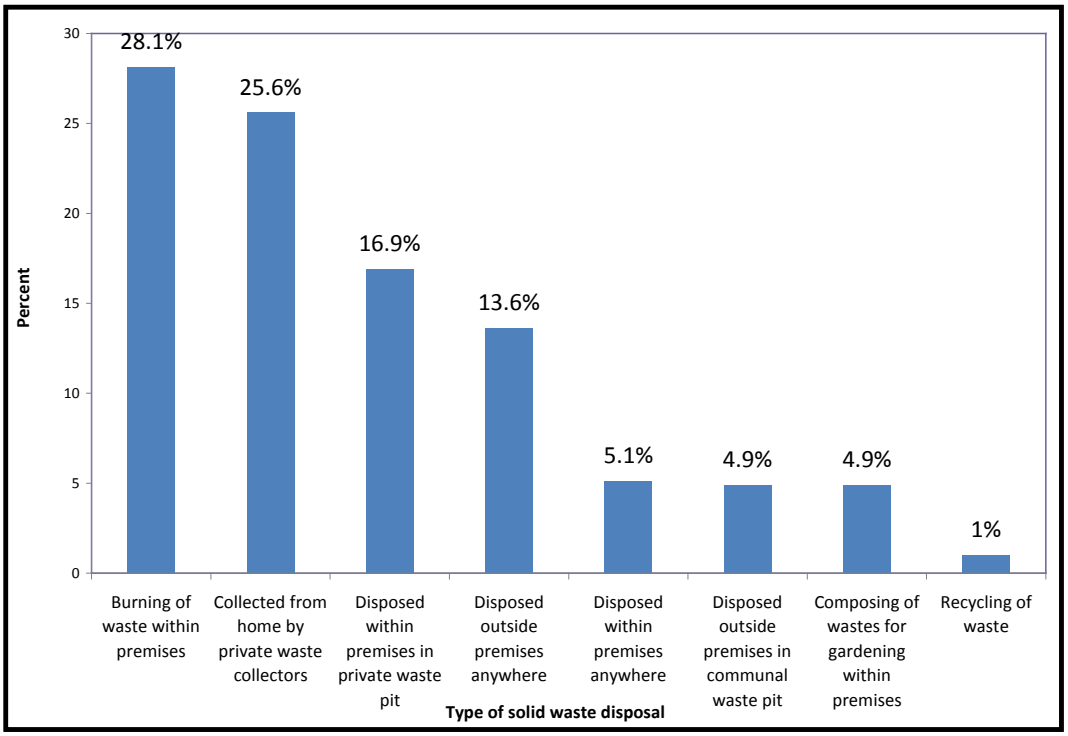


Figure 4.5 Type of household solid waste disposal method, Dukem town, October 2011 (n=391)

As shown in table 4.16, 183 (46.8%) households used unsafe solid waste disposal methods (open field disposal), in which more than one-quarter (110, 28.1%) of households used burning of waste within premises, 53 (13.6%) households used disposal outside premises anywhere and 20 (5.1%) households used disposal within premises anywhere. As a matter of fact, these situations would contribute to improper domestic solid waste management. This practice of open dumping particularly around households represents a major health risk to residents. Poorly managed waste presents a health risk to communities. This is primarily because improperly disposed waste can be a source of contaminants and breeding sites (World Health Organization Regional Office for Africa 2009:25). There is, thus, a need for availability of improved solid waste disposal systems or services in the residential houses.

With regard to cleanliness of the surrounding of houses, data collectors had assessed by observation. Cleanliness of the surrounding of a house was defined as clean if areas around the dwelling is 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. The study result indicated that in three-fourths (301, 77%) of the households, the surrounding of the houses were observed to be clean. The rest of less than one-fourth (90, 23%) of households did not kept the surrounding of their residential area not clean, which might cause risks to health of residents.

Households were asked on their knowledge regarding the problems caused by inappropriate solid waste disposal. The findings of the study showed that from the total sampled households, 83.6% of households cited that inappropriate solid waste disposal causes bad smells (odour) and 41.9% mentioned it provides breeding site for flies and dogs. The respondents also had awareness about the problems caused by inappropriate solid waste disposal in which they indicated that it causes diarrhoeal and other diseases (41.4%) while others mentioned it makes the locality dirty (41.2%), spread germs (37.9%), clogs canals/drains (30.4%), piles of wastes causes nuisance to the community (7.4%), burning of wastes cause air pollution (3.3%) and contaminates water sources (1.5%). While households in the study area had a good awareness about the problems caused by inappropriate solid waste disposal, but slightly less than half of the total sampled households practically disposed their solid waste in open field disposal indiscriminately. Other studies indicate that most people are aware of a link between hygiene and health, but there is a lack of conviction about the need for change

that probably results from years of tolerance of unhygienic surroundings (Beumer et al 2002:7).

Table 4.17 presents the results pertaining to selected socio-demographic variables (house ownership and family size) and availability of safe solid waste disposal facility. The results indicate that availability of safe solid waste disposal facility was not significantly associated with private house ownership (p=0.898). In addition, there was no significant relationship between family size and availability of safe solid waste disposal facility (p=0.421).

Table 4.17 Selected socio-demographic variables by availability of solid waste disposal facility, Dukem town, October 2011 (n=391)

Characteristics	**Availability of solid waste disposal**		**Total n (%)**	**χ^2 (*p*-value)**
	Safe disposal n (%)	**Unsafe disposal n (%)**		
Type of house ownership				0.02 (p=0.898)
Private owned	118 (30.2)	105 (26.9)	223 (57)	
Rented	90 (23)	78 (19.9)	168 (43)	
Total	**208 (53.2)**	**183 (46.8)**	**391 (100)**	
Number of persons in households				1.73 (p=0.421)
1-3	77 (19.7)	75 (19.2)	152 (38.9)	
4-6	110 (28.1)	85 (21.7)	195 (49.9)	
≥7	21 (5.4)	23 (5.9)	44 (11.3)	
Total	**208 (53.2)**	**183 (46.8)**	**391 (100)**	

4.3.6 Personal hygiene practices

An essential component of proper handwashing is the use of soap, without which it is difficult to reduce incidents of sanitation-related diseases such as diarrhoea (Environmental Health Project 2004a:63). The majority (374, 95.7%) of the households had soap in their houses on the day of interview which indicates the availability of higher percentage of soap in the households. The overwhelming percentage (345, 88.2%) of respondents reported for using of soap for washing during the interview day or a day before the interview. Because of the difference by 7.5% in the availability of soap and their practical use of soap for washing, the high presence of soaps in the households observed suggests that the problem of not using soap for washing by some of the respondents is not the result of the absence of this resource.

Respondents were asked for what purpose they have used soap during the interview day or a day before the interview. The main reasons mentioned by the respondents were for washing their hands (223, 64.6%), washing of clothes (192, 55.7%), washing of body (100, 29%), washing their children's body (78, 22.6%) and washing their children's hand (31, 9%). Others (6, 1.7%) had cited other reasons. Those households that mentioned they have washed their hands with soap, they were asked the occasions of handwashing performed. A large majority of the households (159, 71.3%) had reported they washed their hands before eating food. It is essential to note that 69.1% (154) of the respondents indicated that they washed their hands with soap after visiting toilet facility. Over half (126, 56.5%) of the respondents indicated that they washed their hands when hands got dirty. Other responses mentioned by households were after eating food (115, 51.6%), before preparing food (63, 28.3%), before and after feeding children (31, 13.9%) and after cleaning children's bottom (19, 8.5%). The World Bank Handwashing Handbook reports on six studies from India, Ghana, Peru and Senegal showing less than 35% prevalence of handwashing with soap after defecation (Shordt 2006a:21).

Handwashing behaviour is strongly influenced by access to water as well as access to a properly equipped handwashing place. To be optimally effective, the handwashing place should be located in close proximity to the toilet facility so that the households can conveniently clean their hands after defecation (Environmental Health Project 2004a:59). Households were asked whether they had a place for washing their hands and data collectors had gathered the information by checking through observation. As shown in figure 4.6, the study result showed that households rarely had dedicated places for handwashing. In 53 (13.6%) of households, they had no specific place to wash their hands. Of those that had specific places, about two-thirds (267, 68.3%) of households had washed their hands anywhere in yard/compound, 27 (6.9%) households used inside or near kitchen/cooking place and 16 (4.1%) households used outside yard/compound. Availability of handwashing near latrines make people to use them after visiting latrine to prevent water and sanitation-related diseases, but the finding of this study showed that only 28 (7.2%) households had handwashing facilities located inside or near toilet facility which makes handwashing after defecation impractical. Unavailability of conveniently located and easily accessible handwashing place in most of the households may not encourage handwashing at critical times.

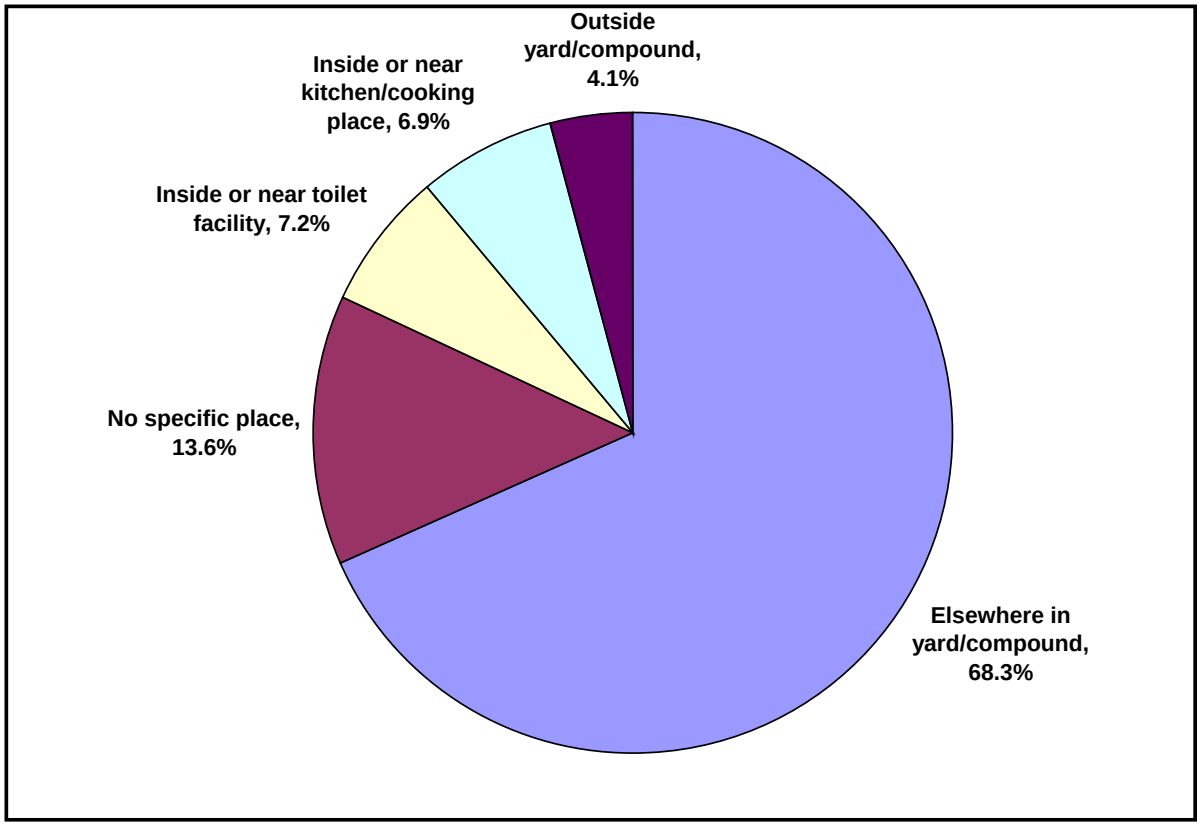
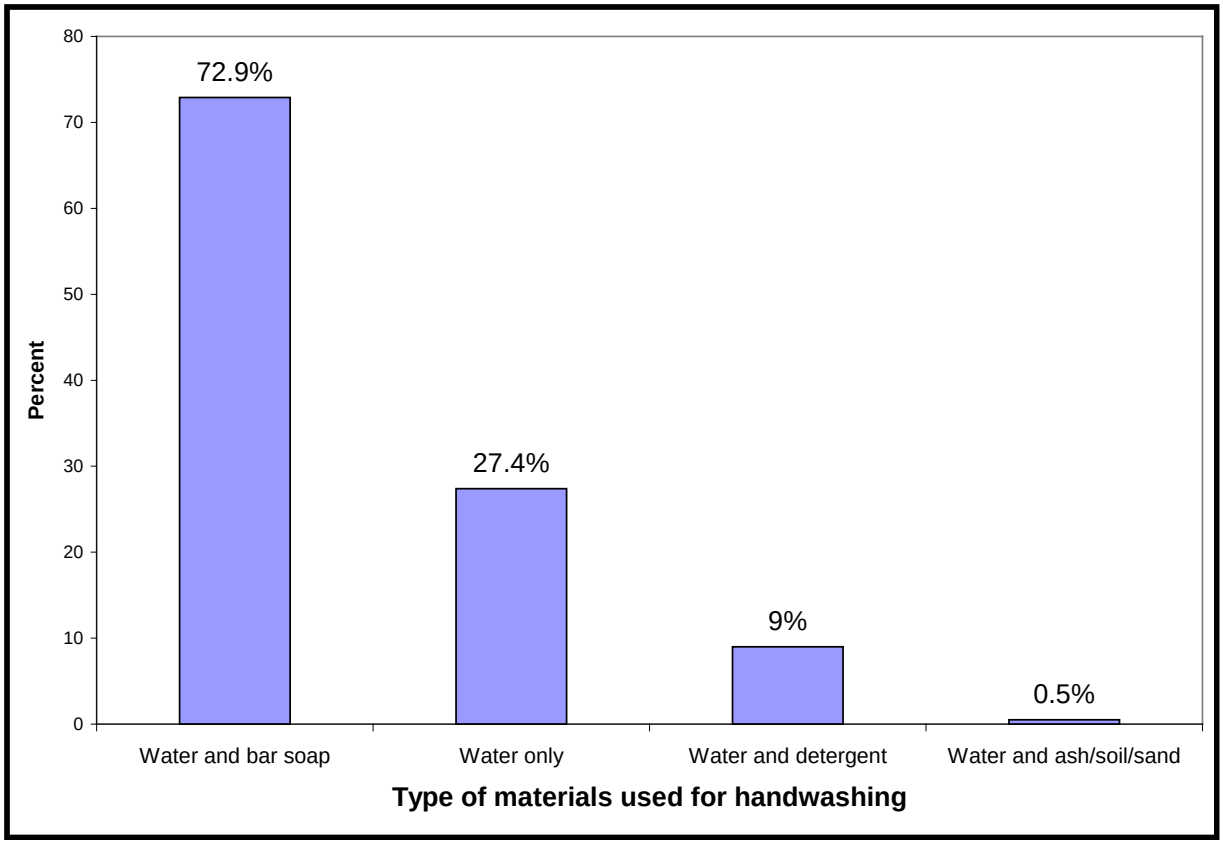


Figure 4.6 Place where households wash their hands, Dukem town, October 2011 (n=391)

People's ability to wash hands at appropriate times depends on whether households have immediate and easy access to water, soap and handwashing device necessary for handwashing (Environmental Health Project 2004a:59). Households were asked to show if they have handwashing facility such as water from tap or container, tippy tap, basin, sink, or other local container materials. The finding indicated that about three-fifths (229, 58.6%) of the households had handwashing devices. However, unavailability of handwashing device in two-fifths (40.4%) of households makes difficult for washing hands at critical times.

As illustrated in figure 4.7, the most common materials used by the households to wash their hands were water and bar soap (285, 72.9%), which this indicates that bar soap is the most commonly used cleaning product. Other commonly used materials were water only (107, 27.4%), water and detergent (35, 9%) and water and ash/soils/sand (2, 0.5%). Rinsing fingers with water only is not enough to remove sticky particles which contain microbes. Hands need to be well washed after contact with faeces; either with a

detergent such as soap or rubbed with an abrasive such as ash or mud (United Nations Children's Fund 1999a:36). Trials in Bangladesh and Zimbabwe showed that handwashing with soap were more effective than handwashing with only water to reduce faecal bacteria on hands (Ensink 2007). Any activities on raising awareness on handwashing practices should not only focus on the importance of handwashing itself, but also on how handwashing should be done.



(Percentages sum to greater than 100 because of multiple responses allowed)

Figure 4.7 Type of materials used by households to wash hands, Dukem town, October 2011 (n=391)

Handwashing is an effective means of preventing diarrhoea when done properly at critical times. It is essential that household members know when it is most important to wash their hands in order to decrease the prevalence of sanitation-related diseases. Critical moments that WHO 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 (Environmental Health Project 2004a:41). All respondents were asked pertaining

to their knowledge about the critical or the most important times for washing hands. The majority of the households reported that handwashing before eating food (332, 84.9%), after defecation (293, 74.9%) and after eating food (262, 67%) was important. About two-fifths (171, 43.7%) of households mentioned handwashing is important when hands got dirty. Only about one-third (123, 31.5%) of households mentioned before food preparation, over one-fourth (78, 19.9%) mentioned before and after feeding children and 26 (6.6%) households cited after cleaning children's bottom. While three-quarters (74.9%) of households felt handwashing after defecation was important, but 69% of the total sampled households washed their hands after using toilet practically. Hands need to be well washed after contact with faeces; either with a detergent such as soap or rubbed with an abrasive such as ash or mud (United Nations Children's Fund 2008:36).

Households were asked for the designated place of taking bath for the household members. As shown in table 4.18, the majority of households (271, 69.3%) had in-house or in toilet bathing place with bucket, followed by 82 (21%) households used open field in the compound and 25 (6.4%) households used in-house or in toilet bathing place with shower or bath. Others used showers of neighbour (6, 1.5%), open field outside the house compound (3, 0.8%), communal/public shower facility (2, 0.5%) and open field in the area of water source (2, 0.5%). The result of the study also showed the frequency of bathing. Respondents mentioned that they took bathing once a week (219, 56%), twice a week (63, 16.1%), as needed (47, 12%), every alternate day (30, 7.7%), every two week (19, 4.9%), every day (10, 2.6%) and once a month (3, 0.8%). About two-thirds (259, 66.3%) of the households surveyed that performed bathing once a week, every alternate day and every day had performed good hygiene practices. Bathing can be every day or after periods of sweating or getting dirty. Taking a bath or a shower using body soap at least weekly is very important to ensuring our body stays clean (Ministry of Health 2011b:33).

Table 4.18 Places where household members take bath, Dukem town, October 2011 (n=391)

Type of bathing place	n	%
In-house or in toilet bathing place with bucket	271	69.3
Open field in the compound	82	21.0
In-house or in toilet bathing place with shower or bath	25	6.4
Use neighbour's shower	6	1.5
Open field outside the house compound	3	0.8
Communal/public shower facility	2	0.5
Open field in the area of water source	2	0.5
Total	**391**	**100.0**

Table 4.19 presents the results concerning selected socio-demographic variables (house ownership and family size) and availability of handwashing facility. The results indicate that there was a statistically significant association between private house ownership and handwashing facility availability ($p<0.05$). However, there was no significant relationship between family size and availability of handwashing facility ($p=0.056$),

Table 4.19 Selected socio-demographic variables by availability of handwashing facility, Dukem town, October 2011 (n=391)

Characteristics	Availability of handwashing facility		Total n (%)	χ^2 (*p*-value)
	Yes n (%)	No n (%)		
Type of house ownership				27.74 (p=0.000)
Private owned	156 (39.9)	67 (17.1)	223 (57.0)	
Rented	73 (18.7)	95 (24.3)	168 (43.0)	
Total	**229 (58.6)**	**162 (41.4)**	**391 (100)**	
Number of persons in households				5.76 (p=0.056)
1-3	78 (19.9)	74 (18.9)	152 (38.9)	
4-6	125 (32.0)	70 (17.9)	195 (49.9)	
≥7	26 (6.6)	18 (4.6)	44 (11.3)	
Total	**229 (58.6)**	**162 (41.4)**	**391 (100)**	

4.3.7 Hygiene education

Practicing improved water and sanitation behaviours depends on effective communication strategies (Environmental Health Project 2004a:70). As shown in table 4.20, the overwhelming majority (358, 91.6%) of households stated that they had previously received hygiene education about water, sanitation or hygiene in the year of the interview. Of the households who received hygiene education about water,

sanitation or hygiene, the findings of the study showed that an overwhelming majority (329, 91.9%) of the households had got relevant information from health extension workers of government health post. Health education and communication is one of the components of the government's health extension programme and its main objective is to bring about behavioural change through intensive and continued investment of knowledge to the community (Bezabih 2007:3).

Radio or television were reported by over two-fifths (159, 44.4%) households as the second most important source of information, while only around one-tenth (38, 10.6%) had reported family, friends, neighbours or other villagers as their main source of information on environmental sanitation. Health workers of the health centre were cited as source of information by a small minority of households (32, 8.9%), and health workers at health institutions may provide a good opportunity for dissemination of health and hygiene awareness. The other source of information cited were schools/teachers and school-going children (14, 3.9%), non-governmental organisation worker (5, 1.4%), development worker (5, 1.4%), at workplace (5, 1.4%), place of worship (1, 0.3%) and newspaper (1, 0.3%). No household had reported that they have got access to written material depicting hygiene promotion.

The study result clearly showed that the community of the town had got health and hygiene information from a range of sources and this provides some indication as to what might be important channels of communication. For example, health extension workers seem to be a very significant source of information. Mass media such as television and radio, close family members and friends, health centre health staff and schools to be an important source information in hygiene education.

Table 4.20 Sources of hygiene information, Dukem town, October 2011 (n=358)

Sources of information	n	%*
Health extension worker	329	91.9
Radio or television	159	44.4
Family, friends, neighbours or other villagers	38	10.6
Health workers of the health centre	32	8.9
Schools/teachers and school-going children	14	3.9
Non-governmental organisation (NGO) worker	5	1.4
Development workers	5	1.4
At workplace	5	1.4
Religious leaders /place of worship	1	0.3
Newspaper or magazine	1	0.3
Total	**589**	

*Percentages sum to greater than 100 because of multiple responses allowed

Households who stated that they had received hygiene information in the year were asked on the topics of the education they have got. The topics mentioned by the households were personal hygiene (273, 76.3%), environmental sanitation (269, 75.1%), solid waste disposal (222, 62%), communicable diseases control and prevention (211, 58.9%), drinking water (196, 54.7%), liquid waste disposal (195, 54.5%), food hygiene (190, 53.1%), excreta disposal (185, 51.7%), housing hygiene (124, 34.6%) and vector control (60, 16.8%).

4.4 CONCLUSION

In conclusion, this chapter presented the results of the study which showed the magnitude of the domestic environmental sanitation conditions of Dukem town. The findings of the study basically indicated that there were good domestic environmental sanitation conditions in the surveyed households. It also emerged that the studied residents of the town were deprived from full range of access to basic environmental sanitation services, facilities and interventions in which the water, basic sanitation, waste management and personal hygiene practices of the households falls short of the required stage. The majority of households had access to an improved source of drinking water within reasonable time and distance. But households that had private piped water connection were not adequate. The daily per capita water consumption was lower than the recommended minimum requirement. The large proportion of households had improved private toilets; however, the majority of the facilities were traditional type of pit latrine. The large proportion of households had poorly-managed household solid

and liquid wastes disposal methods. There was a higher percentage of availability of soap and reported use of soap for washing purpose, but availability of handwashing facilities near latrines were very low among the studied residents of the town. It was found that health extension workers were the most important source of information about water, sanitation or hygiene for the households. The following chapter will focus on summary, conclusions, recommendations and limitations of the research.

CHAPTER 5

SUMMARY, CONCLUSIONS, RECOMMENDATIONS AND LIMITATIONS OF THE STUDY

5.1 INTRODUCTION

This chapter lays out the summary of the research findings, conclusions drawn from the research findings and contributions of the study. The study limitations and the recommendations with public health implications have been described as well as recommendations for further research are provided in this chapter.

5.2 SUMMARY

In Chapter 1 the nature of the problem, which formed the basis of the study, was presented. As already indicated, the purpose of this study was to assess the environmental sanitation conditions with regard to water, excreta disposal, waste disposal, personal and domestic hygiene of the households of Dukem town in Ethiopia. This research has dealt with the objectives of the study which were to investigate the accessibility, availability and usage pattern of drinking water of households; to ascertain the accessibility and availability of environmental sanitation facilities; to examine the knowledge and practices of the households in relation to environmental sanitation and hygiene conditions and to identify factors contributing for the availability of environmental sanitation facilities in relation to household characteristics. Based on the aim, objectives and research questions of the study, this research was conducted at household level of Dukem town.

The study was able to indicate the condition of environmental sanitation in Dukem town at household level mainly in relation to water supply, basic sanitation, waste management and hygienic practices. Overall, the finding of the study showed that there are good domestic environmental sanitation conditions. It also became known that the studied residents of the town were deprived from full range of access to basic and

essential environmental sanitation services, facilities and interventions. The results of the study brought forth the following major findings.

5.2.1 Household drinking water

From the findings of this study, it emerged that the majority of households had access to an improved source of drinking water within reasonable time and distance to fetch drinking water. However, households that had private piped water in their premises were inadequate. There are gender inequities in the responsibilities for the collection of water as females carried in large majority of water collections from water sources. The mean per capita per day water consumption of the households was lower than the recommended basic requirement. The study showed a clear correlation between the consumption per person per day and the size of the household; the larger the household, the lower the consumption per member. Water storage practices were generally good, as majority of households used a narrow-necked plastic jerry can container, most households covered the stored water and most households used pouring for drawing water from a container. An overwhelming majority of households did not treat drinking water at their home.

5.2.2 Basic sanitation facilities (excreta disposal)

The majority (two-thirds) of households used improved private toilets. Nearly half of the improved latrines were traditional type of latrine facility. The majority of the latrines were kept clean, which appears to have health advantages. While households in the study area had a good awareness about the benefits of having latrine, but over one-quarter of households used unimproved latrine facilities, out of this nearly one-in-ten residents of the surveyed households had no any kind of latrine at all. This condition makes that the availability of improved basic sanitation facility grossly inadequate. In large majority of households, the children's stools were contained and dropped into toilet facility which this is the preferred method of disposal.

5.2.3 Wastewater disposal

The situation with respect to safe domestic waste management was inadequate in the studied households of the town. The high proportion of households used unsafe

wastewater disposal methods and did not have appropriate type of wastewater disposal systems. While households in the study area had a good knowledge about the problems caused by inappropriate wastewater disposal, but three-fourths of the total sampled households practically disposed their wastewater in open field disposal indiscriminately, mostly used open disposal by discharging into street surface or empty space outside premises.

5.2.4 Solid waste disposal

A large proportion of households had temporary solid waste storage container in their compound and most households relied on bag/sack. However, in three-fifths of the households, they did not covered their solid waste container and left unprotected. Over half of households used safe solid waste disposal system. Of the safe method of collection and disposal, the surveyed households mainly used private waste collectors and disposal within premises in private waste pit. While households in the study area had a good awareness about the problems caused by inappropriate solid waste disposal, but slightly less than half of the total sampled households practically disposed their solid waste in open field disposal indiscriminately. In addition, about one-fourth of households did not kept their surrounding residential area not clean. It is clear that there were inadequate domestic waste disposal facilities in the studied households. Inadequate waste disposal exposes people to unhygienic practices, which can lead to health problems.

5.2.5 Personal hygiene practices

There was a higher percentage of availability of soap in the surveyed households and reported use of soap for washing. The main reasons mentioned by households to have used soap for washing were for washing their hands, washing of clothes, washing of body and washing their children’s body. A large majority of the households had reported washing their hands before eating food, over half of the respondents indicated that they washed their hands when hands got dirty and most of the respondents indicated that they washed their hands with soap after visiting toilet facility. The study result indicated that households rarely had dedicated places for handwashing as about two-thirds of households washed their hands anywhere in yard/compound. Only small proportion of the households had handwashing facilities located inside or near toilet which makes

handwashing after defecation impractical. The study also showed that about two-fifths of the households did not have handwashing devices. Thus, unavailability of conveniently located and easily accessible handwashing place and handwashing device in most of the households may not encourage handwashing at critical times.

5.2.6 Hygiene education

The overwhelming majority of the households stated that they had previously received hygiene education about water, sanitation or hygiene in the year. The study showed that a large majority of the households had got relevant information from health extension workers of government health post. Radio or television were reported by over two-fifths households as the second most important source of information, while only around one-tenth had reported family, friends, neighbours or other villagers as their main source of information. Health workers of the health centre were cited as source of information by a small minority of households. The study result clearly showed that the community of the town had got health and hygiene information from a range of sources and this provides some indication as to what might be important channels of communication.

5.3 CONCLUSIONS

As has been demonstrated above, the situations of the households to have full attainment of access to improved environmental sanitation and the practices of good hygiene is a challenge. From the findings of this study, it emerged that the majority of households had access to an improved source of drinking water within reasonable time and distance. However, households that had access to private piped water in their premises were inadequate. The daily per capita water consumption was lower than the recommended minimum requirement. The availability of improved basic sanitation facility grossly were inadequate as over one-quarter of households used unimproved latrine facilities, out of this nearly one-in-ten residents of the studied households had no any kind of latrine at all. The situation with respect to safe domestic waste management was not adequate as high proportion of households used unsafe wastewater disposal methods and nearly half of the households practically disposed their solid waste in open field disposal indiscriminately. There was a higher percentage of availability of soap and reported use of soap for washing in the studied households. A large majority of households had reported washing their hands before eating food, over half of the

respondents indicated that they washed their hands when hands got dirty and most respondents also indicated that they washed their hands with soap after visiting toilet facility. Only small proportion of the households had handwashing facilities located inside or near toilet which make handwashing after defecation impractical. A large majority of households had got relevant information from health extension workers of government health post. Thus, the inadequate level of service to the study area could be seen as opportunity for further focused improvements towards the universal access to improved water and environmental sanitation practices in an innovative way.

5.4 RECOMMENDATIONS

Therefore, the following recommendations were made in order to alleviate the problems of environmental sanitation in the studied community based on the findings of this study:

I. HOUSEHOLD DRINKING WATER

- Water supplies should be as close to the point of use as possible to maximise the health benefit. Thus, it is important to make improved water available, preferably by increasing the coverage and accessibility of improved piped water supply with private or yard tap connections for underserved population.
- Promoting the use of safe water storage and low-cost effective water treatment methods at the household level to avoid the possibility of contaminations.

II. BASIC SANITATION FACILITIES (EXCRETA DISPOSAL)

- Increased emphasis on improved basic sanitation and reducing environmental contamination should be made by promoting Total Sanitation Approach which aims to achieve universal access and use of toilets and the elimination of open defecation in the communities.
- Promoting incremental sanitation (sanitation ladder) by which initially starting with simple pit latrine, then upgrading to ventilated improved pit latrine (VIP) and pour-flush and then later to a sewered flush toilet. Hence, it would be essential to promote the upgrading of traditional pit latrines to ventilated improved pit latrines.

III. WASTEWATER DISPOSAL

- Promoting proper wastewater collections and disposal systems of households such as by implementing soakaway pits, stormwater drainage, sewered drainage channels and decentralised low-cost sewerage technology options.

IV. SOLID WASTE DISPOSAL

- Promoting proper household solid waste management during onsite handling, storage and collection and minimise the adverse effects caused by improper practices.
- Promoting integrated solid waste management (ISWM) by waste recovery options, particularly the use of organic waste materials for making compost for home gardening.
- Promoting door-to-door collection systems by private or community-based waste collectors which could contribute in improvements of domestic solid waste management.
- Crude dumping and open burning of waste should be completely avoided by encouraging safe solid waste collection and disposal methods.

V. PERSONAL HYGIENE PRACTICES

- Promoting availability and accessibility to hygienic low-cost handwashing facilities with water and soap for washing of hands and particularly located in conjunction with toilet structure, near kitchen or accessible place with main dwelling so as to facilitate handwashing at critical times.

VI. HYGIENE PROMOTION AND EDUCATION

- Strengthening hygiene education specially targeting communities and households on the practices of domestic drinking water, basic sanitation, waste disposal and good hygiene practices.
- Strengthening hygiene promotion programme through all possible media, materials and methods, particularly using the most popular source of hygiene information in the community including health extension workers; mass media such as television and radio; community groups; health institutions and schools.
- Implementing innovative strategies such as participatory hygiene promotion techniques and gender considerations approaches for enhancing and scaling-up of the universal access to water and environmental sanitation facilities.

VII. FURTHER RESEARCH

- Country-wide further research in urban settings of the country would be essential on urban environmental sanitation conditions that can further give support to the process of improving the environmental health condition of the residents of the urban settings of the country.

5.5 CONTRIBUTIONS OF THE STUDY

The findings of this study will make important contributions to policy, planning and implementation issues of environmental sanitation and hygiene promotion programme, because:

I. Concerned bodies may use the study findings as a reference in the implementation of environmental health and health extension programmes.
II. It may be helpful in tackling the identified problems of hygiene risks at household level through overall effort to formulate and implement sound urban environmental sanitation development strategies and effective sanitation approaches.
III. The findings of the study may be used to educate the community about good environmental sanitation practices.
IV. Various institutions, researchers and other similar towns can use the study as an input in investigating similar problems at other study settings.
V. The research will inform policy and practice as well as lead to further research to give support to the process of improving the environmental health condition of the residents of Dukem town in particular and the urban settings of the country in general.

5.6 LIMITATIONS OF THE STUDY

- The households that were included in the study were from one town only (Dukem) and other towns in Ethiopia were not incorporated in this study. Research results therefore are limited to this particular town and cannot be generalised to other towns in Ethiopia.

- The study was limited to the problems related to domestic environmental sanitation condition at household level and did not include data collection from the local

institutions such as the municipality, the town's health office, the health centre and other relevant institutions at different levels such as community, municipal, regional or national level.

5.7 CONCLUDING REMARKS

Access to water supply and sanitation is a fundamental need and a human right (World Health Organization & United Nations Children's Fund 2000:1). It is an indispensable component of primary health care and a precondition for success in the fight against poverty, hunger and child deaths and in achieving gender equality (United Nations Department of Economic and Social Affairs [S.a.]). The Millennium Development Goal (MDG) has a target that calls for halving the proportion of people without sustainable access to safe drinking water and basic sanitation. The Ethiopian National Health policy considers that hygiene and environmental health is one of the cornerstones of the strategy for the promotion of health and wellbeing of the people (Ministry of Health 2008a:v). This accompanied with appropriate hygiene education and promotion programmes can result in tangible benefits to improve public health of the citizens of Ethiopia. The inadequate level of services to the area could serve to inform the environmental health programme to best achieve its goal of improved environmental sanitation through further focused improvements which will be able to address the shortcomings in an innovative way. Therefore, due attention has to be given by all concerned institutions to provide and promote universal access to improved water, basic sanitation, waste management and hygiene practices to all communities and households and environmental health and health education programme should be emphasised in order to improve practice towards household-centred environmental sanitation.

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ANNEXURE A

APPROVAL FROM UNIVERSITY

UNISA university of south africa

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

Date of meeting: 26 July 2011 Project No: 4320-379-5

Project Title: Assessing environmental sanitation in the small urban setting of Dukem Town, Ethiopia.

Researcher: Abdulwahid Idris Mohammed

Degree: Masters in Public Health Code: DIS4986

Supervisor: Prof LI Zungu
Qualification: DLITT et Phil
Joint Supervisor: -

DECISION OF COMMITTEE

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

Prof E Potgieter
CHAIRPERSON: HEALTH STUDIES HIGHER DEGREES COMMITTEE

Prof MC Bezuidenhout
ACADEMIC CHAIRPERSON: DEPARTMENT OF HEALTH STUDIES

PLEASE QUOTE THE PROJECT NUMBER IN ALL ENQUIRES

ANNEXURE B

DATA COLLECTION INSTRUMENT

ASSESSING ENVIRONMENTAL SANITATION IN URBAN SETTING OF DUKEM TOWN, OROMIA REGION, ETHIOPIA

HOUSEHOLD DATA COLLECTION INTERVIEW AND OBSERVATION SCHEDULE

PARTICIPANTS' INFORMED CONSENT LETTER

Dear Participant

GREETINGS!

My name is _____. Your household has been randomly chosen to participate in a research thesis of student for Master of Public Health in University of South Africa (UNISA), Department of Health Studies. The aim of the research is to assess the environmental sanitation conditions with regard to water, excreta disposal, waste disposal, personal and domestic hygiene of the households of Dukem town.

I would like to ask you a series of questions related to water and environmental sanitation with regard to your household. As part of this survey, I will observe at the sanitary facilities and related items of the household.

At the end of the survey, the information obtained from all participants will be combined into a comprehensive report. You are assured complete confidentiality as no names and address of any of the participants will be used. Participation in this survey is voluntary. 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 survey.

*** *** *Participant declaration:* *** ***

"The information and objective of the study and the contents of this informed consent form have been explained to me. I have been given an opportunity to ask questions and I am satisfied with the answers to my questions. I agree to participate in this study since I know that the information obtained will be kept confidential and I may withdraw from the study interview."

Signature of participant: _____ Date: _____

Interview language: Afan Oromo……..1 Amharic ……2

ASSESSING ENVIRONMENTAL SANITATION IN URBAN SETTING OF DUKEM TOWN, OROMIA REGION, ETHIOPIA

HOUSEHOLD DATA COLLECTION INTERVIEW AND OBSERVATION SCHEDULE

HOUSEHOLD IDENTIFICATION		
Date of interview: ____/____/_____		Time started: _____
Region: _____	Zone: _____	Woreda: _____
Town: _____	Kebele: _____	House number:_____

NO.	QUESTIONS	CODING CATEGORIES	SKIP
	SOCIO-DEMOGRAPHIC AND ECONOMIC DATA		
1.	Name of the respondent		
2.	Age of the respondent	years	
3.	Gender of the respondent	Male ……1 Female …… 2	
4.	Relationship of respondent with household head:	Husband …… 1 Wife …… 2 Daughter/son…… 3 Relative …… 4 Other (specify) _____ 5	
5.	What is the education level of the respondent?	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 Don't know …… 6	
6.	Main occupation of the respondent	Merchant/trader …… 1 Government employee …… 2 Private sector employed …… 3 Non-government organization employed …… 4 Farmer …… 5 Retiree …… 6 Student …… 7 Unskilled worker …… 8 House wife …… 9 Unemployed …… 10 Others (specify) _____ 11	
7.	Name of the head of the household		
8.	Age of the head of the household	years	
9.	Gender of the head of the household	Male ……1 Female ……2	
10.	Marital status of the head of the household	Single …… 1 Married …… 2 Divorced …… 3 Separated …… 4 Widowed/widower …… 5	
11.	How many people live in this household? [HOUSEHOLD FAMILY SIZE]	Male: _____ Female: _____ Total: _____	
12.	What is the religion of the head of the household?	Orthodox …… 1 Islam …… 2 Catholic …… ...3 Protestant …… 4 Traditional …… 5 Others (specify) _____ 6	

NO.	QUESTIONS	CODING CATEGORIES	SKIP
13.	What is the ethnicity of the head of the household? [RECORD THE MAJOR ETHNIC GROUP]	_____	
14.	What is the education level of the head of the household?	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 Don't know …….. 6	
15.	Main occupation of the head of the household	Merchant/trader …….. 1 Government employee ……..…… 2 Private sector employed …… 3 Non-government organization employed …… 4 Farmer ……..…… 5 Retiree …….. 6 Student …….. 7 Unskilled worker …… 8 House wife …….. 9 Unemployed …….. 10 Others (specify) _____ 11	
16.	What is your family's monthly income?	Monthly Birr:	
17.	Type of house ownership	Private owned …… 1 Rented from *kebele*/government …… 2 Rented from private owner …… 3 Dependent …….. 4 Other (specify) _____ 5	
18.	How many separate rooms are in this household? [INCLUDE ALL ROOMS, INCLUDING KITCHEN, TOILET, SLEEPING ROOMS, SALON, etc.]	NUMBER OF ROOMS	
	WATER		
19.	What is the main source of drinking water for members of your household? [CHECK ONE]	Private piped water inside the house …… 1 Private piped water inside the compound …….. 2 Shared neighbourhood piped water …… 3 Buy from private neighbourhood tap …….. 4 Public tap/standpipe …… 5 Protected dug well …… 6 Unprotected dug well …….. 7 Protected spring …… 8 Unprotected spring …… 9 Rainwater collection …… 10 Surface water (pond or river)…….. 11 Other (specify) _____ 12	→21 →20

NO.	QUESTIONS	CODING CATEGORIES	SKIP
20.	Households that do not have private piped water tap, what is the main reason(s) for not having? [CIRCLE ALL THAT APPLY]	Piped water network/pipeline is not available in the locality ..... 1 Installation too expensive ..... 2 Financial problem ..... 3 Lack of permission for installation ..... 4 Not always reliably available ..... 5 Have private well ..... 6 Because it is impure water and unhealthy ..... 7 Public taps are easily accessible ..... 8 Private piped water vendor easily accessible ..... 9 Use rainwater when it is available ..... 10 Lack of adequate know-how and information ..... 11 The house is rented and the owner didn't installed ..... 12 We have other priorities .... 13 Do not feel its importance ..... 14 Other (specify) _____ 15	
21.	How long does it take to go to your main water source, get water, and come back? [CHECK ONE]	Water on premises..... 1 Less than 15 minutes ..... 2 16-30 minutes ..... 3 31-60 minutes ..... 4 1 hour to 2 hours ..... 5 More than 2 hour ..... 6 Don't know 7	
22.	How far is the main water source from your dwelling? [CHECK ONE]	On premises ..... 1 Less than 50m..... 2 50m – 200m..... 3 201m – 300m..... 4 301 - 500m..... 5 501m - 1km ..... 6 More than 1 km ..... 7 Don't Know..... 8	
23.	Who usually goes to your main water source to fetch the water for your household? [CHECK ONE]	Adult woman (age >15)..... 1 Adult man (age >15) ..... 2 Female child (under 15 years) ..... 3 Male child (under 15 years) ..... 4 Don't know ..... 5 Other (specify) _____ 6	
24.	What is the volume of container in litre which is usually used to collect water? [CHECK BY OBSERVATION]	[ ] litres	
25.	On average, how many times do you collect water per day? [FOR ALL PURPOSE OF THE HOUSEHOLD WATER USE]	[ ] times	
26.	Total amount of water collected daily [VOLUME OF CONTAINER MULTIPLIED BY NUMBER OF TIMES COLLECTED]	[ ] litres	

NO.	QUESTIONS	CODING CATEGORIES	SKIP
27.	What is the main container(s) you use for storing water? [CHECK ONE] [OBSERVE THE VESSEL/S]	Plastic bucket …….. 1 Metallic bucket …….. 2 Plastic drum/barrel …….. 3 Metallic drum/barrel …….. 4 Plastic jerry can …….. 5 Clay water pot …….. 6 Storage tank …….. …….. 7 No water storage container …….. 8 Other (specify) _____ 9	 →30
28.	Are the container(s) covered? [OBSERVE AND CHECK]	Yes..... 1 No 2	
29.	How do you get water from the container? [MULTIPLE RESPONSE POSSIBLE]	Pour water from the container ……..……..…….1 Use dipper without handle ……..……..……2 Use a dipper with handle ……..……..……..3 Container has a spigot/faucet …….. 4 Use tap faucet …….. 5 Other (specify) _____ 6	
30.	What do you usually do to the water to make it safer to drink? [CHECK MORE THAN ONE RESPONSE, IF SEVERAL METHODS ARE USUALLY USED TOGETHER, FOR EXAMPLE, CLOTH FILTRATION AND CHLORINE]	Boil..... 1 Add bleach/chlorine ..... …….2 Filter it through cloth …….. 3 Water filter with sand or other method …….. 4 Solar disinfection ……5 Sedimentation (let it stand and settle) …….. 6 Nothing …….. 7 Don't know …….. 8 Other (specify) _____ 9	
EXCRETA DISPOSAL			
31.	Does your household have private toilet facility?	Yes ..... 1 No 2	→32-34 →35-36
32.	If your household have private toilet facility, what kind of toilet does your household usually use? [CHECK ONE]	Flush/pour-flush toilet …….. 1 Ventilated improved pit latrine …….. 2 Traditional pit latrine …….. 3 Other (specify) _____ 4	→33
33.	If your household use flush/pour flush, where does the flush goes to?	Piped sewer system …….. 1 Septic tank/cesspool …….. 2 Pit latrine …….. 3 River/stream …….. 4 Unknown place …….. 5 Other (specify) _____ 6	
34.	Do you share your private toilet with other households?	Yes ..... 1 No 2	
35.	If your household do not have private latrine, what do you usually use?	Communal latrine …….. 1 Public toilet …….. 2 Field or anywhere …….. 3 Other (specify) _____ 4	

NO.	QUESTIONS	CODING CATEGORIES	SKIP
36.	If your households do not have private latrine, what is the main reason(s) for not having/building toilet facility? [MULTIPLE RESPONSES ARE ALLOWED, DO NOT READ ANSWERS]	Lack of adequate space ..... 1 Land unsuitable to construct latrine ..... 2 Lack of adequate construction materials and tools ..... 3 Financial problem ..... 4 Lack of permission for construction ..... 5 Lack of adequate know-how to build latrine ..... 6 The house is rented ..... 7 We have other priorities ..... 8 Because of bad smell and flies problem ..... 9 No importance ..... 10 Don't know ..... 11 Other (specify) _____ 12	
37.	Is the latrine kept hygienic? [OBSERVATION] **[HYGIENIC (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 communal toilet 3	
38.	Where do usually young children (0-3 years) pass stool?	Used latrine ..... 1 Used potty ..... 2 Used diapers ..... 3 Went in house yard/compound ..... 4 Went outside the premises ..... 5 No children in the household ..... 6 Don't know ..... 7 Other (specify) _____ 8	→40
39.	Where do you usually dispose of your young children (0-3) faeces?	Dropped into toilet facility ..... 1 Thrown away to drainage system ..... 2 Disposed into solid waste ..... 3 Disposed in yard/compound ..... 4 Disposed outside premises ..... 5 Buried ..... 6 Did nothing/left it there ..... 7 Don't know ..... 8 Other (specify) _____ 9	
40.	What do you think is the benefit of having a latrine? [MULTIPLE RESPONSES ARE ALLOWED, DO NOT READ ANSWERS]	Improved hygiene/cleanliness .....1 Avoid bad smell ..... 2 Reduce environmental contamination ..... 3 Minimizes open defecation ..... 4 More comfortable ..... 5 Convenience/save time ..... 6 More privacy ..... 7 Prevents disease and improves health ..... 8 Do not feel its importance ..... 9 Don't know ..... 10 Other (specify) _____ 11	

NO.	QUESTIONS	CODING CATEGORIES	SKIP
	WASTEWATER DISPOSAL		
41.	Where do you usually dispose your domestic liquid waste? [CHECK ONE]	Seepage pit/soak-away pit ..... 1 Cesspit/septic tank ..... 2 Open ditch ..... 3 Drain in closed sewer system .....4 Discharge into premises yard ..... 5 Drain directly to garden ..... 6 Poured or carried into toilet facility ..... 7 Discharge into street surface or empty space outside premises ..... 8 Don't know ..... 9 Other (specify) _____ 10	
42.	Is there any stagnant water near your dwelling house?	Yes ..... 1 No 2	
43.	What problems do inappropriate wastewater disposal causes? [MULTIPLE RESPONSES ARE ALLOWED, DO NOT READ ANSWERS]	Spread germs ..... 1 Provides breeding sites for mosquitoes ..... 2 Causes diarrhoeal and other diseases ..... 3 Pollutes surface water sources ..... 4 Seep to the ground and contaminate ground water ..... 5 Stagnation of wastewater around ..... 6 Makes the locality dirty ..... 7 Causes nuisance by bad smell ..... 8 Causes injury ..... 9 Causes flooding or erosion .... 10 No problem ..... 11 Don't know ..... 12 Other (specify) _____ 13	
	SOLID WASTE DISPOSAL		
44.	What is the principal way you dispose of your household solid waste? [CHECK ONE]	Collected from home by private/association waste collectors ..... 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 Burning of waste within premises ..... 6 Composing of wastes for gardening within premises ..... 7 Recycling of waste ..... 8 Don't know ..... 9 Other (specify) _____ 10	
45.	What type of materials do you use for solid waste storage? [CHECK ONE] [OBSERVE THE MATERIAL/S]	Plastic waste container ..... 1 Bag/sack .....2 Metallic container ..... 3 Barrel ..... 4 Bamboo basket ..... 5 No storage container .....6 Other (specify) _____ 7	
46.	Is the solid waste storage container covered? [OBSERVE ONLY]	Yes ..... 1 No 2	

NO.	QUESTIONS	CODING CATEGORIES	SKIP
47.	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	
48.	What problems do inappropriate solid waste disposal causes? [MULTIPLE RESPONSES ARE ALLOWED, DO NOT READ ANSWERS]	Spread germs ..... 1 Causes diarrhoea and other diseases ..... 2 Bad smells (odour) ..... 3 Clogging of canals/drains ..... 4 Makes the village dirty ..... 5 Piles of wastes causes nuisance to the community ..... 6 Breeding site for flies and dogs ..... 7 Contaminates water sources ..... 8 Burning of wastes cause air pollution ..... 9 No problem ..... 10 Don't know ..... 11 Other (specify) _____ 12	
PERSONAL HYGIENE PRACTICES			
49.	Do you have soap in your house? [OBSERVE]	Yes ..... 1 No 2	
50.	Have you used soap today or yesterday?	Yes ..... 1 No 2	→51 →53
51.	When you used soap today or yesterday, what did you use it for?	Washing clothes ..... 1 Washing my body ..... 2 Washing children's body ..... 3 Washing children's hand ..... 4 Washing my hands ..... 5 Other (specify) _____ 6	→53 →52
52.	If for washing hands is mentioned, what was the occasion? [DO NOT READ THE ANSWER (CIRCLE ALL THAT APPLY)]	Before eating food ..... 1 After eating food ..... 2 After going to toilet ..... 3 Before preparing food/cooking ..... 4 Before and after feeding children ..... 5 After cleaning children's bottom ..... 6 When hands are dirty ..... 7 Other (specify) _____ 8	
53.	Where do you usually wash your hands? [OBSERVE]	Inside or near toilet facility ..... 1 Inside or near kitchen/cooking place ..... 2 Elsewhere in yard/compound ..... 3 Outside yard/compound ..... 4 No specific place ..... 5 Other (specify) _____ 6	

NO.	QUESTIONS	CODING CATEGORIES	SKIP
54.	Is there a handwashing device such as water from tap or container, tippy tap, basin, sink, or other local container materials? [OBSERVE ONLY]	Yes ..... 1 No 2	
55.	What do you usually use to wash your hands? [MULTIPLE RESPONSES ARE ALLOWED]	Water only ..... 1 Water and bar soap ..... 2 Water and detergent ..... 3 Water and ash/soil/sand ..... 4 Water and other cleaning agents ..... 5 Don't know ..... 6 Other (specify) _____ 7	
56.	What do you think are the most important times to wash your hands? [MULTIPLE RESPONSES ARE ALLOWED, DO NOT READ THE ANSWER]	Before eating food ..... 1 After eating food ..... 2 After going to toilet ..... 3 Before preparing food/cooking ..... 4 Before and after feeding children ..... 5 After cleaning children's bottom ..... 6 When hands are dirty ..... 7 Other (specify) _____ 8	
57.	Where do the household members usually take bath? [OBSERVATION]	In-house or in toilet bathing place with shower or bath ....1 In-house or in toilet bathing place with bucket .....2 Use neighbour's shower ..... 3 Communal/public shower facility ..... 4 Open field in the compound ..... 5 Open field outside the house compound ..... 6 Open field in the area of water source ..... 7 Other (specify) _____ 8	
58.	How often did you take shower/bath?	Every day ..... 1 Every alternate day ..... 2 Once a week ..... 3 Twice a week ..... 4 Every two week ..... 5 Once a month ..... 6 As needed ..... 7 Other (specify) _____ 8	
HYGIENE INFORMATION AND EDUCATION			
59.	Have you ever received any health information about water, sanitation or hygiene in the year?	Yes ..... 1 No 2	→60 →No Questions
60.	If you get health information about water, sanitation and hygiene can you mention the topic(s) covered?	Communicable diseases control and prevention ..... 1 Personal hygiene ..... 2 Environmental sanitation ..... 3 Drinking water ..... 4 Food hygiene ..... 5 Solid waste disposal ..... 6 Excreta disposal ..... 7 Liquid waste disposal ..... 8 Housing hygiene ..... 9 Vector control .....10 Don't know ..... 11 Other (specify) _____ 12	

NO.	QUESTIONS	CODING CATEGORIES	SKIP
61.	Where do you get your health information about water, sanitation and hygiene from? [DO NOT READ OUT THE ANSWERS BUT YOU MAY PROBE THE PERSON FOR ADDITIONAL SOURCES OF THE INFORMATION CHANNELS BY SAYING "IS THERE ANY OTHER SOURCE?"]	Family, friends, neighbours or other villagers …… 1 Radio or television …… 2 Health extension worker …… 3 Health workers of the health centre …… 4 Non-governmental organization (NGO) worker …… 5 Development workers …… 6 Community social workers …… 7 Schools/teachers …… 8 At workplace …… 9 Through children that go to school …… 10 Religious leaders /place of worship …… 11 Newspaper or magazine …… 12 Written material …… 13 Traditional healer …… 14 Youth/women or similar group …… 15 Community committee …… 16 Not received any information …… 17 Don't know …… 18 Other (specify) _____ 19	

Time ended: _____

Thank you very much for participating in this research!

Name of interviewer: …… …… Signature……...Date: …../…. /…….
Name of field assistant: …… ..Signature……...Date: …../…. /…….

All questions completed?	Yes …… 1 No …… 2 Partially completed …… 3
If no or partial, why?	Refusal ……1 No person in the house …… 2 No eligible person present..... 3 Dwelling not found…….. 4 Other (specify) _____ 5
If return visit required, enter date and time for next visit:	Date: _____/_____/ _____ Time: _____

ANNEXURE C

INFORMED CONSENT LETTER

ANNEXURE C: INFORMED CONSENT LETTER

ASSESSING ENVIRONMENTAL SANITATION IN URBAN SETTING OF DUKEM TOWN, OROMIA REGION, ETHIOPIA

HOUSEHOLD DATA COLLECTION INTERVIEW AND OBSERVATION SCHEDULE

PARTICIPANTS' INFORMED CONSENT LETTER

Dear Participant

GREETINGS!

My name is _____. Your household has been randomly chosen to participate in a research thesis of student for Master of Public Health in University of South Africa (UNISA), Department of Health Studies. The aim of the research is to assess the environmental sanitation conditions with regard to water, excreta disposal, waste disposal, personal and domestic hygiene of the households of Dukem town.

I would like to ask you a series of questions related to water and environmental sanitation with regard to your household. As part of this survey, I will observe at the sanitary facilities and related items of the household.

At the end of the survey, the information obtained from all participants will be combined into a comprehensive report. You are assured complete confidentiality as no names and address of any of the participants will be used. Participation in this survey is voluntary. 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 survey.

*** *** *Participant declaration:* *** ***

"The information and objective of the study and the contents of this informed consent form have been explained to me. I have been given an opportunity to ask questions and I am satisfied with the answers to my questions. I agree to participate in this study since I know that the information obtained will be kept confidential and I may withdraw from the study interview."

Signature of participant: _____ Date: _____

Interview language: Afan Oromo……..1 Amharic ……2

ANNEXURE D

LETTER TO THE AUTHORITIES REQUESTING PERMISSION TO CONDUCT THE STUDY

ANNEXURE D: LETTER TO THE AUTHORITIES REQUESTING PERMISSION TO CONDUCT THE STUDY

September 2, 2011

Oromia Regional State Health Bureau

ADDIS ABABA

Subject: *Request for permission and cooperation to conduct a research*

I am Abdulwahid Idris Mohammed, a student at University of South Africa (UNISA) in Master of Public Health. I am expected to conduct MPH theses research as requirement for the degree.

The topic of the study is:

"ASSESSING ENVIRONMENTAL SANITATION IN SMALL URBAN SETTING OF DUKEM TOWN, ETHIOPIA".

The purpose of the research is to assess the environmental sanitation conditions with regard to water, excreta disposal, waste disposal, personal and domestic hygiene of the households of Dukem town. In this study, the target source population are residents living in Dukem town and the accessible population are sample of selected households in Dukem town.

I have got the ethical approval from University of South Africa (UNISA), copy of it attached with this letter. In addition, two copies of the research proposal is attached.

Therefore, I request for permission to conduct this study in Oromia region of Dukem town and provide the necessary support and cooperation.

Thanks for your cooperation.

Best regards,

Abdulwahid Idris Mohammed

ANNEXURE E

LETTER FROM THE AUTHORITIES GRANTING PERMISSION TO CONDUCT THE STUDY (IN ETHIOPIAN LANGUAGE OF AFAN OROMO)

ANNEXURE E: LETTER FROM THE AUTHORITIES 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/HBOTH/1-8/124
Guyyaa /Date 27-12-2003

Waajjira Eegumsa fayyaa Magaala Duukamiif

Duukam

Dhimmi: **Xalayaa deegggrsaa ilaala**

Akkuma beekamu Biiroon keenya ogeeyyii akkasumas namoota qorannoo gaggeessuuf piroppoozaala dhiyeeffataniif piroppoozaala isaanii ilaaludhaan waraqaa deeggarsaa ni-kenna. Haaluma kanaan mata duree "**Assessing Environmental Sanitation in Small Urban Setting of Dukem town"** jedhurratti **Obbo Abdulwaahid Idiriis Mahaammad** Magaala Keessan **Magaala Duukam** keessatti gaggeessuuf piroppoozaala dhiyeeffataniiru. Kanaafuu, Koreen "Ethical committee" Biiroo keenyaa ilaalee akka qorannoon kun hojiirra oolu murteessee jira. Waan kana ta'eef hojii qorannoo kanarratti deeggarsa barbaachisaa ta'e akka gootaniif jechaa **Obbo Abdulwaahid Idiriis Mahaammad** fiirii qorannoo kanaa **(Result)** kooppii tokko Biiroo Eegumsa Fayyaa Oromiyaatiif akka galii godhan garagalcha xalayaa kanaatiin isaan beeksifna.

Ani **Obbo Abdulwaahid Idiriis Mahaammad** fiirii qorannichaa kooppii tokko BFEO tiif galii akka godhu mallattoo kiyyaan ni mirkaneessa.

Mallattoo____________________

Maqaa____________________

Guyyaa____________________

Lakk. Mobaayilii____________________

Nagaa wajjin

Tujumaa Guutaa

G/G

- **Obbo Abdulwaahid Idiriis Mahaammadiif**

Bakka jiranitti

Tessoo: Tel: 011-371-72-77, Fax 011-371-72-27 Box. 24341 E-mail: ohbhead@telecom.net.et
Address: ADDIS ABABA/FINFINNE-ETHIOPIA

ANNEXURE F

LETTER BY UNISA REGIONAL CENTRE AT ADDIS ABABA, ETHIOPIA FOR COOPERATION DURING DATA COLLECTION

ANNEXURE F: LETTER BY UNISA REGIONAL CENTRE AT ADDIS ABABA, ETHIOPIA FOR COOPERATION DURING DATA COLLECTION

UNISA university of south africa

August 29, 2011

UNISA-ET/KA/ST/29/ 29-08-2011

To Whom It May Concern

Dear Sir/Madam:

Mr. Abdulwahid Idris Mohammed is a student in Master of Public Health program at University of South Africa (UNISA). The student is currently conducting research to write his masters dissertation. Topic of his research is:

"Assessing Environmental Sanitation in Small Urban Setting of Dukem Town"

The student is going to start data collection for his research. I kindly request your cooperation in assisting the student in facilitating his research and giving him access to data sources. I would like to thank you in advance for your assistance.

Sincerely,

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PO BOX 13836 ADDIS ABABA ETHIOPIA
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