

**PIT LATRINE USE IN THE PREVENTION OF DIARRHEAL DISEASES IN
MUTWOT LOCATION, NANDI COUNTY, KENYA**

BY

KORIR CHARLES CHERUIYOT

**A THESIS SUBMITTED IN PARTIAL FULFILLMENT OF THE
REQUIREMENTS FOR THE AWARD OF THE MASTER OF PUBLIC HEALTH
DEGREE OF THE DEPARTMENT OF HEALTH POLICY, MANAGEMENT
AND HUMAN NUTRITION, SCHOOL OF PUBLIC HEALTH, MOI
UNIVERSITY.**

©2024

DECLARATION

Student;

This thesis is my original work and has not been submitted for the award of a degree in any institution of higher learning. No part of this thesis may be reproduced without the prior written permission of the author and/or Moi University.

Signature: _____ **Date:** _____

Name: Korir Charles Cheruiyot

Registration Number: SPH/PGH/03/12

Declaration by supervisors;

This thesis has been submitted for examination with our approval as university supervisor(s)

Signature: _____ **Date:** _____

Name: Prof. Robert Kei, (PhD)

Department of Public Health

School of Health Sciences

Meru University of Science and Technology, Kenya

Signature: _____ **Date:** _____

Name: Dr. Samuel Tororei, (PhD)

Department of Health Policy, Management and Human Nutrition

School of Public Health

Moi University, Eldoret, Kenya

DEDICATION

This thesis is dedicated to my mother, Lucy Chesang who took care of me during my childhood and ensured that I got the best education she could afford.

To my spouse Nancy and our children: Erick, Valerie and Emmanuel for their social support and encouragement.

ABSTRACT

Background: Globally, achieving universal access to adequate and equitable sanitation and hygiene by 2030 is a major challenge in many parts of the world. This sanitation crisis means untreated human waste is spreading diseases through water supplies and the food chain for billions of people. The Kenya Health Information System (KHIS,2015) indicates that, 37% of households in Chesumei Sub-County lack pit latrines. Health records available for Mutwot Location show that diarrheal diseases are the fifth most common cause of morbidity.

Objectives: To determine pit latrine coverage, assess the use of pit latrines, and determine the association between the type of pit latrine and diarrheal diseases in Mutwot Location, Nandi County.

Methods: A descriptive cross-sectional study was carried out in Mutwot Location covering a sample of 324 households. Stratified and simple random sampling techniques were used to obtain the respondents. Interviewer-administered structured questionnaires to household heads and observation checklists on the type, state, and use of pit latrines were the data collection instruments. Descriptive data were analysed using frequencies, while relationships between variables were analysed using Chi-square tests and multiple correspondence analysis.

Results: A total of 324 questionnaires were administered to household heads or representatives, with 100% response rate. An observation checklist was used to establish consistency or otherwise with the findings in the questionnaire. Pit latrine coverage in Mutwot Location was 80% ($n=259$). Respondents' education level ($\chi^2(3) = 83.35, p<0.0001$) and occupation ($\chi^2(3) = 28.89, p<0.0001$) influenced ownership of pit latrine. High cost of construction 58% ($n=36$) and lack of construction materials 42% ($n=26$) were strong antecedents in the lack of ownership of pit latrines. Among those who had pit latrines, 98% ($n=255$) used them. Amongst households which had latrines, one out of every ten latrines (12%, $n=31$) could not be used by children, the elderly, and persons with disabilities. The latrines consisted of mostly simple pits (41%, $n=118$), followed by ventilated improved types (35%, $n =101$) and shallow pits (8%, $n=22$) while a significant segment (16%, $n=46$,) of the population practiced open defecation. These findings were counter-checked with an observation checklist and similar results were obtained. The study found a significant relationship ($\chi^2(3) = 103.21, p<0.0001$) between diarrheal episodes and the practice of open defecation and use of shallow pit latrine.

Conclusion: Pit latrine coverage in the location was significantly higher relative to the national and greater Nandi County, but still off-target in achieving universal access to adequate sanitation. Low literacy levels, high cost, and lack of construction materials were strong antecedents in the lack of ownership of pit latrines. Most households with pit latrines used them, but some still practiced open defecation. The diarrheal disease prevalence was highly correlated with open defecation and use of shallow pit latrines.

Recommendations: Health care personnel should initiate Community-Led Total Sanitation (CLTS) approaches to scale up efforts with community members to adopt the use of cheap and locally available materials to construct pit latrines. Health promotion providers should sensitize those with low education level on the importance of a pit latrine and the relationship between poor disposal of human excreta and diarrheal diseases. County health department should ensure that pit latrines are constructed in a way that allows children, the elderly, and persons with disabilities to comfortably use them.

TABLE OF CONTENTS

DECLARATION	ii
DEDICATION	iii
ABSTRACT.....	iv
LIST OF TABLES	ix
LIST OF FIGURES	x
ABBREVIATIONS AND ACRONYMS	xi
OPERATIONAL DEFINITION OF TERMS	xiv
ACKNOWLEDGEMENT	xvi
CHAPTER ONE	1
INTRODUCTION	1
1.0 Introduction	1
1.1 Background	1
1.2 Problem Statement	3
1.3 Justification of the Study.....	4
1.4 Significance of the Study	5
1.5 Research Questions	6
1.6 Objectives.....	6
1.6.1 Broad Objective.....	6
1.6.2 Specific Objectives.....	6
1.7 Assumptions of the Study	6
1.8 Scope and Limitation	7
CHAPTER TWO	8
LITERATURE REVIEW	8
2.0 Introduction	8
2.1 Pit Latrine Coverage.....	8
2.1.1 The Pit.....	9
2.1.2 The Slab.....	10
2.1.3 The Superstructure.....	11

2.1.4 How Pit Latrines Work.....	12
2.1.5 Siting.....	13
2.1.6 Advantages and Disadvantages of Pit Latrines	14
2.2.1 Sanitation Systems.....	15
2.2.2 Latrine Structure, Design and Conditions	16
2.2.3 Water supply.....	16
2.2.4 Hand Washing	16
2.2.5 Environmental considerations	17
2.2.6 Safe Latrine Management.....	18
2.2.7 Determinants of Latrine Use.....	18
2.2.8 Pit latrine Use by Children, the aged and Persons with Disability.....	19
2.2.9 Barriers to Latrine Use	20
2.2.10 Interventions to Promote Latrine Use.....	24
2.3 Type of Pit Latrine and Diarrheal Diseases	27
2.3.1 Shallow Pit.....	28
2.3.2 Simple Pit Latrine.....	28
2.3.3 Ventilated Improved Pit (VIP) Latrine	29
2.3.4 Pour-flush Latrine.....	30
2.3.5 Communal Latrines	31
2.3.6 Role of Excreta in Spread of Diseases.....	31
2.3.9 Open Defecation.....	33
2.3.10 Diarrheal Diseases	33
2.4 Participatory Methods for Hygiene Education and Sanitation.....	35
2.5 Traditional Approaches to Sanitation.....	37
2.6 Theoretical Framework	37
2.7 Conceptual Framework	39
CHAPTER THREE	40
METHODOLOGY	40
3.0 Introduction	40
3.1 Study Area.....	40
3.3 Study Design	40

3.2 Study Population	41
3.4 Study Variables	42
3.5 Sampling and Sample Size Determination.....	42
3.5.1 Sample Size	43
3.5.2 Sampling Procedure.....	45
3.6 Data Collection.....	47
3.6.1 Types and Sources of Data	47
3.6.2 Data Collection Instruments	47
3.6.3 Data Collection Methods	48
3.7 Validity and Reliability of Research Instruments	49
3.8 Data Analysis Procedure	50
3.9 Inclusion Criteria.....	52
3.10 Exclusion Criteria.....	53
3.11 Ethical Considerations.....	53
CHAPTER FOUR.....	54
RESULTS	54
4.0 Introduction	54
4.1 Socio-demographic Profile of Respondents	54
4.2 Pit latrine coverage in Mutwot Location.....	56
4.3 Use of pit latrines in Mutwot Location	59
4.3.1 Usage and depth of latrines	59
4.3.2 Cleanliness of pit latrines	62
4.3.3 Location of pit latrines.....	64
4.4 Association between type of pit latrine and Diarrheal diseases	67
4.4.1 Type of pit latrine	67
4.4.2 Prevalence of diarrhea	69
4.4.3 Relationship between type of pit latrine and diarrheal diseases	72
4.5 Test of the conceptual framework.....	74
CHAPTER FIVE	76
DISCUSSION.....	76
5.0 Introduction	76
5.1 Pit latrine coverage.....	76

5.2 Pit latrine use.....	78
5.3 Association between type of pit latrine and diarrheal diseases.....	84
CHAPTER SIX.....	87
CONCLUSIONS AND RECOMMENDATIONS	87
6.1 Conclusion.....	87
6.2 Recommendations	88
6.3 Further research.....	89
REFERENCES	90
APPENDICES	97
Appendix I: Consent Form.....	97
Appendix II: Questionnaire.....	98
Appendix III: Observation Checklist	103
Appendix IV: IREC Formal Approval.....	106
Appendix V: Research Authorization - Nandi County Department of Health and Sanitation	107
Appendix VI: Research Authorization - Nandi County Department of Education	108

LIST OF TABLES

Table 3.1 Distribution of households in Mutwot Location.....	41
Table 3.2 Target population and sample size for each sub-location and village in Mutwot location	46
Table 4.1 Socio-demographic profile of respondents	55
Table 4.2 Relationship between pit latrine ownership and biographical variables.....	57
Table 4.4 Cleaning methods and state of latrine cleanliness	62
Table 4.5 Relationship between cleaning methods and latrine cleanliness	63
Table 4.6 Determinants of pit latrine location	64
Table 4.7 Location of pit latrines	65
Table 4.8 State of pit latrine.....	66
Table 4.9 Materials used in pit latrine construction.....	68
Table 4.10 Causes of diarrhea.....	70
Table 4.11 Relationship between human excreta and diarrheal diseases	71
Table 4.12 Prevention of diseases caused by faecal contamination	71
Table 4.13 Chi-square analysis of the association between type of pit latrine and diarrheal diseases	73

LIST OF FIGURES

Figure 2.1 The faecal-Oral transmission route (Nordberg, 1999)	32
Figure 2. 2 Breaking the faecal-Oral transmission cycle (Nordberg, 1999).....	35
Figure 2.3 Conceptual framework (Researcher, 2018).....	39
Figure 4.1 Pit latrine ownership.....	56
Figure 4.2 Pit latrines currently in use	59
Figure 4.3 Depth of Pit latrines.....	60
Figure 4.4 Duration of use of latrines	61
Figure 4.5 Types of pit latrines in use.....	67
Figure 4.6 Prevalence of diarrhea in the study area.....	69
Figure 4.7 Relationship between diarrhea and elements of the study's conceptual framework.....	75

ABBREVIATIONS AND ACRONYMS

AFRO	African Regional Office
ASAL	Arid and Semi-Arid Land
CATS	Community Approaches to Total Sanitation
CAWST	Centre for Affordable Water and Sanitation Technology
CHEW	Community Health Extension Worker
CHW	Community Health Workers
CLTS	Community-Led Total Sanitation
DCC	Deputy County Commissioner
DHIS	District Health Information System
GCI	Galvanized Corrugated Iron
GHP	Global Handwashing Partnership
GHP	Good Hygiene Practices
GLAAS	Global Analysis and Assessment of Sanitation and Drinking-Water
HBM	Health Belief Model
IIED	International Institute for Environment and Development
IREC	Institutional Research and Ethics Committee
JMP	Joint Monitoring Program
KDHS	Kenya Demographic and Health Survey
KEHSP	Kenya Environmental Sanitation and Hygiene Policy
KESSF	Kenya Environmental Sanitation and Hygiene Strategic Framework
KHIS	Kenya Health Information System
KNBS	Kenya National Bureau of Statistics

KPHC	Kenya Population and Housing Census
LDC	Least Developed Countries
LRC	Learning Resource Centre
MCA	Multiple Correspondence Analysis
MDG	Millennium Development Goal
MOH	Ministry of Health
MOPHS	Ministry of Public Health and Sanitation
NGO	Non-Governmental Organization
OD	Open Defecation
ODF	Open Defecation Free
PHAST	Participatory Hygiene and Sanitation Transformation
PRA	Participatory Rural Appraisal
RuSH	Rural Sanitation and Hygiene
SARAR	Self Esteem, Associative Strengths, Resourcefulness,
SASS	School of Arts and Social Sciences
SDG	Sustainable Development Goal
SPH	School of Public Health
UN	United Nations
UNCRPD	United Nations Convention on the Rights of Persons with Disabilities
UNDP	United Nations Development Program
UNICEF	United Nations International Children's Education Fund.
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
WRI	World Resources Institute
WSP	Water and Sanitation Program
IEC	Information, Education and Communication

OPERATIONAL DEFINITION OF TERMS

Adequate Sanitation: This means the pit latrine provides privacy and safe disposal of human waste without human contact.

Basic sanitation: Refers to availability and use of pit latrines to dispose human excreta to ensure a clean and healthy environment within the household and any other living environment.

Diarrheal Diseases: Refers to diseases caused by poor disposal of human excreta, characterized by the passage of three or more loose or liquid stools per day (or more frequent passage than is normal for the individual).

Equitable Sanitation: Means enhancing access to latrines for all, including the poor, vulnerable and socially excluded households.

Household head: An individual in one family setting who provides actual support and maintenance to one or more individuals who are related to him or her through, blood, or marriage. He/she manages the household and looks after dependent(s).

Household: A domestic unit consisting of the members of a family who live together, along with non-relatives such as servants.

Open Defecation Free: This means all households have functional latrines with evidence of being used and no faeces are openly exposed in the fields, bushes or water bodies.

Open Defecation: Refers to disposal of human excreta in the fields, forests, bushes or other open spaces as opposed to using a pit latrine.

Pit Latrine Coverage: The extent to which pit latrines are available or the distance/area over which pit latrines have been provided to the community.

Pit Latrine use: This means how the community utilizes the pit latrine in the disposal of human excreta.

Pit Latrine: Is an excavated pit, with a base slab and superstructure used for the disposal of human excreta.

Poor Sanitation: Means unhygienic disposal of human waste.

Sanitation: this means collecting and disposing of human waste (faeces and urine) in a hygienic way so as not to endanger the health of individuals and the community as a whole.

ACKNOWLEDGEMENT

First and foremost, my gratitude goes to the Almighty God for the gift of life and health that enabled me to complete this thesis. Special cognizance goes to my supervisors, Prof. Robert Kei, Dr. Samuel Tororei and the late Prof. Omar Egesah, who were supportive and resourceful in providing the much needed guidance. Similarly, I wish to sincerely thank other faculty members at the School of Public Health for their encouragement and advise. Also, the Librarians at the Learning Resource Centre (LRC) at the College of Health Sciences, deserve special mention for providing the desired materials for literature search. Lastly, I greatly appreciate the direct and indirect support of my classmates towards the success of this thesis.

CHAPTER ONE

INTRODUCTION

1.0 Introduction

The purpose of this study was to assess pit latrine use in the prevention of diarrheal diseases in Mutwot Location, Nandi County, Kenya. The chapter provides background information, research problem, objectives, justification, significance and scope of the study.

Lack of latrines forces people to practice open defecation, hence increasing the risk of contamination of water sources and food by human excreta. Adequate pit latrine coverage, maintenance and proper use have significant health benefits by reducing the risk of diarrheal and other communicable diseases transmitted through oral-faecal route.

1.1 Background

The United Nations (2018), Sustainable Development Goals (SDG) report indicates that, in 2015, 61% of global population lacked safely managed basic sanitation services, with majority (70%) residing in rural areas. In addition, 892 million continued to practice open defecation (defined as defecation in fields, forests, bushes, bodies of water or other open spaces), out of which 90% lived in rural areas, with 220 million in sub-Saharan Africa.

Open defecation in rural areas persists in every region of the developing world, even among those who have otherwise reached high levels of improved sanitation use (WHO/UNICEF, 2012). Achieving universal access to adequate and equitable sanitation and hygiene by 2030 is a major challenge in many parts of the world (UN, 2018). Eliminating open defecation is the first SDG priority on sanitation. SDG number 6 calls for countries to end open defecation, to ensure that everyone has access to a basic toilet and to put in place systems for safe management of excreta. Failure to achieve this goal risks the entire 2030

Agenda for Sustainable Development. Globally, the world is off track to meet the goal of ensuring sanitation and water for all by 2030. This sanitation crisis means untreated human waste is spreading diseases into water supplies and the food chain for billions of people (WHO/UNICEF, 2019).

According to Ethiopia Demographic and Health Survey (2016), the most common type of toilet facility in both urban and rural households is a pit latrine without a slab or open pit (41 percent in urban areas and 55 percent in rural areas). Overall, a third of households have no toilet facility at all, with rural households accounting for 39 percent. Furthermore, up to 60% of the current disease burden in Ethiopia is attributed to poor sanitation, where 15% of total deaths are from diarrhea, particularly among children under-five years (Dagne *et al*, 2019). In addition to diarrheal diseases, there is a high prevalence of worm infestations contributing to the high levels of malnutrition.

In Kenya, the Impact Report on Water, Sanitation and Hygiene (WASH), indicates that, only 30 per cent have access to basic sanitation at home (UNICEF/Kenya, 2018). Open defecation, is still practiced by 12 per cent of the population. Open defecation is largely a rural issue, practiced by 15 per cent of the rural population, compared to 3 per cent in urban areas.

The national open defecation rate is about 14 percent (MOH, 2016), which masks massive regional disparities. In some counties, open defecation remains the norm with the northern counties hardest hit with Turkana (82.2 percent), Wajir (76.7 percent) and Samburu (73.4 percent). Even in counties with lower rates of open defecation, children's faeces are often not contained, due to parental perception that children may fall in latrines, and also the perception that children's faeces are harmless.

The Ministry of Health (MOH) has embarked on the eradication of open defecation (OD) as part of the realization of sanitation related SDGs. In the past, rural sanitation programs focused on toilet construction, rather than motivating its usage. In contrast, the newer approaches advocate for a community led and demand driven approach (Plan and Water Institute-University of North Carolina, 2015). In 2011, the Ministry of Public Health and Sanitation (MOPHS) established Community Led Total Sanitation (CLTS) as the national rural sanitation strategy and defined a national target to reduce open defecation, which would provide a means of measuring progress (Plan and Water Institute-University of North Carolina, 2015).

Inadequate sanitation is a key contributor to diarrheal disease, the second leading cause of death in children under the age of five worldwide (UN, 2018). The most severe threat posed by diarrhea is dehydration, but it is also a leading cause of malnutrition. Poor drinking water, sanitation and hygiene access directly accounts for 882,000 diarrheal deaths every year. About 1.8 million people die every year due to diarrhea diseases, and children under the age of 5 years account for 90% of diarrhea deaths. Moreover, 88% of diarrhea diseases are attributed to unsafe water supply, inadequate sanitation, and poor hygiene (Beyene, *et al*, 2019).

1.2 Problem Statement

The Kenya Demographic and Health Survey (KDHS) report (2014) indicates that, 66% of rural households lack an improved toilet facility. The most common type of toilet facility in rural areas is an open pit latrine or one without a slab (48% of households), while 16 percent have no toilet facility at all.

The Water and Sanitation Program (WSP, 2014) county sanitation benchmarking report, ranked Nandi County at number 15 out of 47. In addition, the county loses 483 million Kenya Shillings each year due to poor sanitation.

The Kenya Health Information System (KHIS, 2015) indicates that, 37% of households in Chesumei Sub-county lack a pit latrine. However, the pit latrine coverage and use in Mutwot location was not known. According to the Health Records (2015) at Mosoriot Sub-county Hospital, which serves Mutwot Location, diarrheal diseases are the fifth most common cause of morbidity after Malaria, Upper Respiratory Tract Infections, Urinary Tract Infections and Injuries.

The above figures highlight the importance of the need for greater attention to sanitation as a human rights issue and a basic human need. Poor sanitation due to lack of latrines forces people to practice open defecation, hence increasing the risk of contamination of water sources and food by human excreta. Low pit latrine coverage, poor maintenance and improper use increases the risk of diarrheal diseases transmitted through oral-faecal route. Providing access to adequate sanitation in rural areas, such as Mutwot Location, is one of the most important ways of reducing diarrheal diseases and improving health and development. In addition, available literature has no study on pit latrine use in Nandi County.

1.3 Justification of the Study

Lack of access to adequate and appropriate sanitation and hygiene poses a serious threat to public health. Documented evidence has shown that, lack of access to basic sanitation, low latrine coverage and use contributes to the burden of diarrhea, particularly in the

developing world, including Kenya (WSP, 2012). Furthermore, the Kenya Environmental Sanitation and Hygiene Strategic Framework (KESSF) 2016-2020, shows that due to poor sanitation, particularly open defecation, 35% of children in Kenya suffer from moderate to severe stunting, which affects both educational and long-term productivity outcomes (MOH, 2016).

Enhanced access to basic sanitation promotes economic and social benefits, including higher productivity, dignified lifestyles, improved quality of life, better performance in school, safety and healthier environments that reduce the risk of disease outbreaks, hence lower medical costs (MOH, 2016). The study sought to inform the provision of appropriate sanitation facilities and eradication of open defecation, which is essential to ensure people's dignity, privacy, safety, health and well-being. All these are geared towards the realization of SDG number 6.2 on access to sustainable sanitation and hygiene for all in Kenya.

1.4 Significance of the Study

The study will contribute to knowledge on hygienic disposal of human excreta. This is important because the infective organism for many diseases leave the human body in faeces and urine. The ownership of a pit latrine, location, its state, use and disposal of wastes are challenges that if overlooked can have serious health consequences to a community.

This study will be useful because: the findings will inform policy makers in improving access to basic sanitation in Mutwot Location as part of efforts to achieve the SDG number 6 for adequate and equitable sanitation for all and ending open defecation by 2030. It will provide necessary information for health personnel to initiate or scale-up community led total sanitation (CLTS) approaches for elimination of open defecation. This could

significantly reduce diarrheal diseases; In addition, the findings could form the basis for future studies using other designs, such as longitudinal studies, to evaluate the impact of universal access to pit latrines.

1.5 Research Questions

- i. What is the pit latrine coverage in Mutwot Location?
- ii. What is the extent of pit latrine use in Mutwot Location?
- iii. What is the association between type of pit latrine and diarrheal diseases in Mutwot Location?

1.6 Objectives

1.6.1 Broad Objective

To assess pit latrine use in the prevention of diarrheal diseases in Mutwot Location.

1.6.2 Specific Objectives

The specific objectives were to:

- i. Determine pit latrine coverage in Mutwot Location.
- ii. Assess pit latrine use in Mutwot Location.
- iii. Determine the association between type of pit latrine and diarrheal diseases in Mutwot Location.

1.7 Assumptions of the Study

It is expected that, the respondents will provide adequate and valid information for the study.

1.8 Scope and Limitation

The geographical scope of this study was limited to Mutwot Location in Nandi county. It was conducted between the months of March and May 2018. The study targeted 2,052 households covering three sub-locations where 324 households were sampled randomly. Mutwot Location, as a rural location has similar characteristics to other locations in the county. The design of the study, meant that no follow-up was conducted to determine if households which lacked pit latrines later on constructed and used them.

CHAPTER TWO

LITERATURE REVIEW

2.0 Introduction

This chapter highlights existing information on pit latrines and various sanitation systems. It reviews previous studies of how methods used in human excreta disposal contribute to the spread of communicable diseases. It includes the theoretical and conceptual frameworks guiding this study.

2.1 Pit Latrine Coverage

A study commissioned by the World Health Organization (WHO), reported that latrine coverage and ownership do not necessarily translate into latrine use. Even among households with latrines, open defecation is still practiced (Nunbogu *et al*, 2019). The construction of a latrine is a relatively simple technology that is used to prevent the spread of infectious diseases. Studies have shown that latrine coverage has to reach 90% of a population to have a positive impact on community health (Beyene, *et al*, 2019). However, 2.4 billion people, 40% of the total world population, lack improved sanitation worldwide and 80% of these people live in rural areas.

According to the World Bank (2017), Water and Sanitation Program (WSP) report, the number of people practicing open defecation declined from 1.229 billion to 892 million, between 2000 and 2015, an average decrease of 22 million people per year. Achieving the SDGs for access to adequate and equitable sanitation and hygiene for all and ending open defecation by 2030 will require global cooperation.

The Kenya Environmental Sanitation and Hygiene Policy (KESHP) 2016-2030 (MOH, 2016) aims at ensuring that all Kenyans have sustainable access to improved sanitation and

a clean and healthy environment by 2030. The Ministry of Health has embarked on the eradication of open defecation (OD) and the realization of sanitation related SDGs in Kenya. The KESHP (MOH,2016) recognizes that almost half of rural Kenyans do not have access to basic sanitation, with open defecation being the norm for a significant proportion of the rural population. Previously, rural sanitation programs adopted a supply-driven approach that focused on toilet construction rather than motivating its usage. The current approach encourages households in rural areas to own and have access to safe sanitary facilities with improvements to reduce flies and odours. These facilities maybe an upgraded pit latrine, VIP latrines or pour flush latrines connected to a septic tank linked to soak-away pits and/or collection system (MOH,2016).

2.1.1 The Pit

The pit can be square, rectangular or circular, usually 1.0-1.5 metres wide, while the depth depends on the soil and groundwater conditions, but is usually 3-5 metres deep (WEDC, 2014). The sides of the pit may collapse due to weak surface soil, causing the slab to fall into the pit. As a precautionary measure, in unstable soil, the walls of the pit is lined with oil drums or stones. The lining of pit walls and to construction of structurally strong foundations is recommended to support the weight of the latrine slab and superstructure and prevent collapse. As a general rule, pits should be at least 15-30 metres away from sources of drinking-water deep (WEDC, 2014). The actual distance will depend on local hydrogeological conditions, such as soil characteristics, and groundwater depth and flow. When groundwater levels are high, or when the soil is too hard to dig, the pit latrine may have to be raised above ground level.

The pit is not designed to remove pathogens, but to contain faecal matter and reduce human contact (Orner, *et al*, 2018). The purpose of the pit is to receive excreta deposits which are decomposed by anaerobic bacteria and rendered harmless. The larger the pit, the longer it will take to fill-up (WEDC, 2014). Flies and foul odour is a common problem in shallow pits than deep ones. The pit is presumed filled if the contents are about one metre from the surface.

2.1.2 The Slab

The slab is placed directly on top of the pit lining about 15cm above the surrounding ground level (WEDC, 2014). It is provided above the pit to form the floor of the latrine, and support the user. It is elevated above the surrounding ground to prevent surface water from entering the pit. The slab should be strong to offer a secure platform over the vault and without the risk of tripping or slipping when using it. The slab should be designed and constructed from a durable material that can be cleaned easily such as concrete, fiberglass, porcelain, stainless steel, durable plastic or smooth wood (WHO, 2018). A concrete slab lasts longer and is easily kept clean. To facilitate deposition of excreta into the pit, a squat hole or aperture is provided at the center. It may be rectangular, oval or round. To maintain cleanliness, the floor should slope towards the aperture, with a smooth finish for easy cleaning.

Many latrines smell because the floor itself is soiled or the cement is filled with stale urine (Morgan, 1994; WEDC, 2014). The slab should meet the users' needs and preferences, allowing them to use the latrine without getting their feet and clothes wet or dirty. Foot-rests can be fitted on the floor. Tight fitting lids are used on squat-hole to minimize odors and flies. Ideally, the cement floor should have a smooth finish, with a thick layer of water-

proof paint. The most important aspect of the floor is that it is frequently washed down with water. This helps to keep the interior of the latrine fresh and the pit contents moist.

The Centre for Affordable Water and Sanitation Technology (CAWST, 2011), has identified the following as the most important features of a latrine slab: Strong enough to support the loads placed on it; safely span the pits they are designed for; and durable and easy to clean.

2.1.3 The Superstructure

The superstructure is a shelter for privacy and protection of the latrine user (WEDC, 2014).

The superstructure has a roof, door and walls. It can be circular, square, and rectangular or spiral in shape. It can be made from materials such as, bricks, stones, Iron sheets, timber, mud, plastic, sack-cloth or thatch. The superstructure should be designed and constructed so that it prevents intrusion of rainwater, storm water, animals, rodents or insects. It should provide safety and privacy for the user, with doors that are lockable from the inside (WHO, 2018).

The wall should have a height of 2 metres at the shortest part. It should have sufficient ventilation and lighting for the inside of the latrine and adequately fly proofed. The roof should be sloped to allow rain runoff and protect the user from rain and sun. However, corrugated iron may be damaged by corrosion due to natural weathering whilst cardboard and cloth often became saturated, especially during the rainy season and leading to damp conditions within the latrine (Grimason, *et al*, 2000). In addition, it may be difficult to clean the walls and roofs of such latrines.

The superstructure floor should be about 0.8 metres wide and 1.2 metres long, with the door opening outwards to increase the usable space inside the latrine (WEDC, 2014). Many

latrine doors are left open (Morgan, 1994), allowing flies emerging from the pit to pass through the squat hole instead of the vent-pipe. Under these conditions, there is no control of flies. It is important therefore to design a self-closing door. When the door is closed, then the interior is darkened, thus flies will be attracted to light passing down the vent-pipe and will be trapped there. One technique which works well is to cut a piece of rubber tyre and attach it to the frame of the door in such a way that it bends backwards when the door is opened. The rubber can be screwed or nailed into the door frame. It is advisable to use designs and materials that local artisans understand and have skills to construct and maintain (WEDC, 2014). This will increase the chances of acceptance and adoption by local communities.

2.1.4 How Pit Latrines Work

Human excreta and anal cleansing materials or other refuse are released into the pit or ground hole (WEDC,2014), where: faeces and other organic material decompose through bacterial action, fungal attack and consumption by other organisms; Fresh excreta are initially decomposed aerobically (with oxygen), but over time, it is covered by new layers of excreta, leading to anaerobic (without oxygen) decomposition; Ammonia, methane, carbon dioxide and nitrogen gases are produced and released into the atmosphere through the top of the pit or absorbed into surrounding soil; Urine and other soluble materials leak into surrounding soil; Organisms that may cause disease are destroyed because conditions in the pit are not conducive for their survival; and the residual material is compressed and compacted and slowly fills the pit (WEDC,2014).

2.1.5 Siting

The best place for construction of a pit latrine should be at least 30 meters and downhill from a ground water source, such as a well so that waste from the latrine does not filter to contaminate the ground water supply (USAID, 2018). In addition, be on slightly raised ground to enable rain water drain away easily. Building a pit latrine on firm soil reduces the risk of it collapsing. Black cotton may collapse during rains. Sandy soil may present problems when digging as it cannot hold without caving-in. Avoid areas prone to flooding as much as possible or select an appropriate design (either flood resistant and/or raised latrine) (USAID, 2018).

It should be near the house at about 10 – 15m away to allow everyone (including the young, sick and aged) easy access to the latrine, even at night. Long distances may discourage certain users (e.g. children) from returning to the house to wash their hands after defaecation, particularly when playing, with the obvious potential for the transmission of faecal-oral disease. Irrespective of the distances involved most people refrained from using the latrine after darkness mainly for fear of being attacked by robbers and tripping due to the uneven and rocky terrain underfoot (USAID, 2018; Grimason, *et al*, 2000).

The door should face the windward direction, but on the leeward side of the house and away from dense vegetation. This allows as much air as possible to blow into the latrine and easy flow of air over the vent pipe, hence smell from the latrine is blown away from home (USAID, 2018). When properly sited and built according to recommendations, it should require very little maintenance apart from daily cleaning.

2.1.6 Advantages and Disadvantages of Pit Latrines

2.1.6.1 Advantages of Pit Latrines

Pit latrines have the following advantages (WEDC,2014; Wood *et al* 2008): Simple to build; local materials and technologies can be used to build them; Can be constructed to suit a wide range of physical and human environments; Designs are easy to copy (replicable); Easy and safe to use, operate and maintain (reduces faecal contamination around homes); Do not need a piped water supply (water is not required to flush it; when full, can be covered over and abandoned and another one made without much expense (cheapest technology for the safe disposal of excreta); Filled and covered pit fertilizes the soil and plants can grow well on it; and can be used for a long time because decomposition takes place continually in pits (WEDC,2014; Wood *et al* 2008).

2.1.6.2 Disadvantages of Pit Latrines.

Pit latrines have the following disadvantages: Frequent unpleasant odours; when almost full, provides a good place for insects to breed; superstructure may collapse if poorly maintained; children may be reluctant to use, because they are afraid of falling into the pit; and if fouled, latrines become unhygienic for users (Rukunga, 2001).

2.2 Pit Latrine Use

Latrines should be available, accessible and affordable to all, and at least separate excreta from human contact (WHO, 2018). Their design should be culturally appropriate, suitable to locally-available materials and physical conditions such as water availability and ground/soil conditions. Barriers to community latrine access and use should be addressed, including structural barriers, such as inappropriate or failed design, poor quality construction and operation, full pits, lack of privacy, lack of water and behavioral barriers

(cultural or societal preferences, locked facilities at night and burden of maintenance) (WHO, 2018).

The Kenya Environmental Sanitation and Hygiene Strategic Framework (MOH, 2016) envisages that each household and community shall shoulder the responsibility of maintaining an open defecation free (ODF) environment through collective decision-making. It anticipates that, each household shall be responsible for the environmental sanitation tasks in its compound. However, the national and county governments shall have the responsibility for creating awareness and demand in the community for all environmental sanitation measures. Community-based and demand-responsive approaches shall be applied at household, community and government levels to fulfil their respective responsibilities in the drive toward total environmental sanitation and ODF environment (MOH, 2016).

2.2.1 Sanitation Systems

According to WHO, sanitation generally refers to the provision of facilities and services for the safe disposal of human urine and faeces. It is all conditions that affect health, with regard to the drainage and disposal of sewage and refuse from houses. According to Kenya's MOH, adequate sanitation refers to one that provides privacy and separates human excreta from human contact (MOH, 2016). As a human rights issue, people have a right to access a latrine or toilet, and also a right not to be harmed by unmanaged faecal waste.

In many areas, sanitation is the most urgent health need and those concerned with the control of intestinal parasitic infections are urged to promote inter-sectoral collaboration between health care authorities and those responsible for the provision of sanitation facilities and water supply at the community level.

2.2.2 Latrine Structure, Design and Conditions

Kenya, faces major sanitation challenges. Statistics shows that 39% of Kenyans use unimproved sanitation facilities (Busienei, *et al*, 2019). These majorly involves the use of uncovered pit latrines often in poor structural designs and conditions such as poor flooring material, stagnant water on latrine floors, presence of human feces on floors, odour, filled-up latrines, lack of a latrine roof or latrine walls which do not provide privacy and incomplete latrines are some of the reported deterrents to latrine use. Such conditions make latrines unpleasant to clean and may revoke reversion to open defecation. Good latrine flooring materials and superstructure lead to their increased usage.

The WHO (2018) has highlighted the following features as having an influence on adoption and use of latrines: Availability (sufficient facilities that limit waiting to an acceptable length of time that does not discourage use or cause inconvenience); Accessibility (accessible at all times for all users, considering age, gender and physical disabilities; and Acceptability (should provide privacy and safety for the user).

2.2.3 Water supply

Access to adequate water supplies is a vital part of ensuring a safe sanitation service chain for operation, maintenance and cleaning of facilities (WHO, 2018). In some cultures, water is necessary for cleansing after defecation, so its absence may encourage open defecation near surface water bodies.

2.2.4 Hand Washing

Handwashing with soap and water is widely recognized as a top priority for reducing disease transmission. According to SDG Goal 6 report on water and sanitation (UN, 2018), the least developed countries (LDCs) had the lowest coverage, where, 27 per cent had basic

handwashing facilities. Good Hygiene Practices (GHP, 2020) guidelines states that handwashing interrupts the transmission of disease-causing pathogens by providing a barrier in the fecal-oral route of exposure to pathogens contained in human feces, which is the main source of diarrheal. Handwashing with soap after defecation and any potential contact with faeces should be promoted and supported by the availability of soap and water close to sanitation facilities (WHO, 2018). If people use a latrine, but fail to wash their hands, then they are likely to eat their own excreta and spread bacteria (IIED, 2010). Having a handwashing station close to toilet facilities encourages handwashing behavior. People should wash their hands with soap after using the toilet, after cleaning or changing a child's diapers (or any other contact with excreta), and before any contact with food, such as eating, preparing food, and feeding others. This is in addition to washing hands after playing, working or touching animals.

2.2.5 Environmental considerations

Sanitation interventions should be developed considering the full range of relevant transmission pathways of excreta-related diseases. These should include safe disposal of child faeces, measures for fly control, consideration of mechanical vectors (flies and animals) of human faeces, and food hygiene (WHO, 2018). Flies land on or breed in exposed human faeces, including on toilet surfaces, and transport faecal matter and pathogens onto surfaces, food and people. Household and livestock animals may spread faecal matter around households and water sources, through contact with exposed faeces and faecal sludge.

Measures for reducing these transmission pathways should be considered alongside all other sanitation service chain aspects, and include household waste management, removal

of animal faeces, keeping livestock away from living quarters, and use of drying racks to reduce flies, and restricting animals from entering household living and cooking areas and water sources (WHO, 2018).

2.2.6 Safe Latrine Management

The key principle for safe latrine management is that the design, construction, management and use is arranged so that users are safely separated from excreta, avoiding both active contact (from soiled surfaces) and passive contact (via flies or other vectors) (WHO, 2018).

Toilets should be maintained through cleaning to remove faecal material and pathogens, so that the risk for users is minimized.

2.2.7 Determinants of Latrine Use

Latrine coverage alone does not lead to increased use of latrines or reduced faecal exposure. Latrine use depends on multiple contextual factors driven by supply and demand (Lahiri, *et al*, 2017).

Socio-cultural beliefs, such as ritual purity, caste, disgust and latrine emptying can be seen as the work of those belonging to lower castes. Gendered determinants such as masculinity, strength and intra-household power may encourage open defecation. Additionally, perceived latrine cost and availability can influence the decision to use a latrine (Lahiri, *et al*, 2017). Demographic characteristics such as age and sex are associated with differential latrine use patterns. Infrastructure quality and design are intimately linked with use. Government sponsored latrines are prone to disuse. This may happen due to non-involvement of beneficiary communities in the design, construction and maintenance of the latrines.

2.2.8 Pit latrine Use by Children, the aged and Persons with Disability

In many developing countries, poor environmental conditions have contributed to health concerns, especially among children under the age of five years who are most vulnerable compared to adults (Omotayo, *et al*, 2021). The Water and Sanitation Program (WSP) (World Bank, 2017), report shows that, since 2000, open defecation rates have fallen resulting in more children growing up free from disease and thus having better lives and brighter futures. Good sanitation has a significant influence on health of under-five children in the households (Omotayo, *et al*, 2021). Incidence of diarrhea among under-five children, in households with access to adequate sanitation is lower compared to households without access.

More often, sanitation facilities for the elderly may not meet the accessibility requirements that enable them to successfully realize their rights and dignity (Cavill, *et al*, 2022). Provision of appropriate sanitation facilities for the elderly promotes their dignity, feeling of inclusion and independence. As people get older, sanitation facilities must be adapted to their changing requirements. The aged find it difficult to squat on the latrine due to their weak physical state, forcing them to engage in open defecation. This may get worse if they lack the necessary social support to walk to and use latrines.

The United Nations Convention on the Rights of Persons with Disabilities (UNCRPD) (2007) seeks to promote, protect and ensure the full and equal enjoyment of all human rights and fundamental freedoms by all persons with disabilities, and to promote respect for their inherent dignity. These rights include access to safe and dignified sanitation facilities.

It is challenging for people with disabilities to access sanitation facilities without either themselves or their clothing coming into contact with faeces (Mactaggart, *et al*, 2017). Within the household, most people with disabilities used the same sanitation facility as other members of their family, and frequently reported coming into direct contact with faeces when they did so. Environmental barriers force some physically disabled people to crawl on the floor to use a toilet or defecate in the open. Inability to use a safe, clean and private toilet is degrading and dangerous (Wilbur, 2011). This has implications for health and safety, and negatively affects a person's self-esteem. Children, the elderly and persons with disability have a right to sufficient, safe, physically accessible, and affordable sanitation facilities.

2.2.9 Barriers to Latrine Use

2.2.9.1 Lack of awareness of sanitation and hygiene

There is a relationship between improvements in education, health and hygiene awareness and the demand for sanitation facilities. The Water and Sanitation Program (WSP) 2004 report indicates that, households with members who had a higher level of literacy are most likely to demand and adopt safer methods of excreta disposal than those with low levels of literacy. The higher level of literacy is also associated with a high premium placed on health status, which will lead to a demand for safer sanitation methods. Some communities may prefer open defecation, citing inconvenience and that it is more pleasurable than using a pit latrine (Lahiri, *et al*, 2017).

2.2.9.2 Lack of knowledge and skills on pit latrine construction and maintenance

Human capacity, in terms of staff numbers and skills, is not adequate to meet the needs on the ground. This situation may result in non-compliance with public health laws in construction of latrines, leading to poor sanitation practises. In some instances, human capacity is not optimally utilized to maximize results. Particularly in the context of devolution, having a set of standard operating procedures and building capacity in a set of key skills and competencies could transition rural sanitation implementation from adhoc practice to a trackable system that can accelerate progress in sanitation coverage (MOH, 2016). Lack of knowledge and skills has resulted in poor quality construction, basic design faults, unsafe pits and poor maintenance. There is a general demand for technologies that employ locally and easily available construction materials. Poor construction may discourage the use of latrines. This may be prone to foul odours and stagnant water on the slab (Lahiri, *et al*, 2017).

2.2.9.3 Financial Barriers

The inability of a household to raise sufficient funds to construct sanitation facilities is a hindrance to the construction of better facilities than those currently used (WSP, 2004). A household would find it more useful to have its members to engage in activities that will lead to the acquisition of other basic necessities as opposed to concentrating their resources (money, time and energy) towards sanitation facilities. Filled up pit latrines are left to overflow due to lack of funds to construct new ones.

Currently, many counties do not allocate or appropriate budgets on sanitation activities due to lack of assigned budget line. Lack of clear mechanism for planning, monitoring and

coordinating total financing of sanitation function is therefore a major bottleneck to accelerated progress (MOH, 2016).

2.2.9.4 Legislative and regulatory environment

The legislative and regulatory environment remains fragmented with sanitation related laws scattered in various legal instruments (MOH, 2016). A key challenge in the sanitation sector has been the institutional fragmentation, unclear allocation of roles and responsibilities, weak institutional alignment and poor coordination within and across the sector especially in the context of a devolved system of government.

At the national level, this is complicated by an institutional context in which policy and strategy development and implementation is shared between the Ministry of Health, Ministry of Water and Irrigation and Ministry of Environment and Natural Resources (MOH, 2016). There is need for legislative and regulatory framework that define a set of principles, institutional and regulatory structures for sanitation that reflect the current developments in the international, constitutional and policy spheres.

2.2.9.5 Cultural factors

Cultural and religious factors have been shown to influence the construction and use of latrines in some rural areas. Restrictions on sharing sanitary facilities between adults and children, men and women and in-laws, and outsiders in general has been mentioned as a factor restricting latrine ownership. However, the low priority accorded to this and the general high level of sanitation coverage indicate that such cultural barriers and myths are held by a minority and are continuing to decline (WSP, 2004).

In areas where custom frowns upon the use of the same latrine by daughters-in-law and fathers-in-law or sons-in-law and mothers-in-law, the provision of separate latrines is

favoured rather than attempting to change people's attitude. However, defecating in the bush is taken as the easiest and cheapest way of protecting cultural practices.

2.2.9.6 Adverse geo-hydrological conditions

Pit latrine construction becomes both difficult and expensive in rocky ground or in areas of high basement rock (WSP, 2004). The temptation in rocky ground is to build shallow pits, which quickly become filled so that frequent construction is required. Pits dug in loose and unconsolidated soils (weak soil structure) are liable to collapse, especially during the rainy season (WSP, 2004). They will therefore need to be supported with internal lining.

Where the level of water in the ground is high, the construction of pit becomes difficult, resulting in shallow pit latrines (WSP, 2004). They tend to collapse in the wet season, and there is a danger of mosquitoes breeding in pits with high water levels. In such circumstances, a built-up pit is appropriate. The raised part of the plinth should be plastered on the inside and soil from the pit placed against the outside, to prevent leakage of fluids above ground and erosion by storm water.

2.2.9.7 Flooding in low lying areas

Flooding is a major constraint as latrines fill up and overflow during the rainy season. Quite often the latrines collapse making it difficult and expensive to rebuild after the rains. In such cases, household members are forced to practice open defecation (WSP, 2004). Furthermore, latrines located on flat and poorly drained land, may expose users to significant health and environmental hazards such as fly and mosquito breeding, vermin infestation, and offensive odours.

2.2.9.8 Poor Hygiene

Inadequate and inefficient cleaning methods permit the accumulation of foul waste-water, urine and faecal contamination within the latrine. Contamination of the latrine floor with faeces and urine may result in cross-transmission of disease (e.g. hookworm), especially between people who use the latrine barefooted (Grimason, *et al*, 2000). Soiled and foul smelling latrines discourage people from using and instead defecate in the surrounding environment, either around the latrine or indiscriminately elsewhere.

2.2.10 Interventions to Promote Latrine Use

Significant efforts have been made in Kenya to eliminate open defecation (MOH, 2023). However, slow progress is still reported at the community level, with only 25% of rural communities certified as Open Defecation Free (ODF) by 2021. This situation is worse within the Arid and Semi-Arid Land (ASAL) counties.

The Kenya Environmental, Sanitation and Hygiene Policy (KESHP) (MOH,2016) adopted six building blocks for scaling up environmental sanitation and hygiene: Construction and proper use of clean latrines; Safe treatment and disposal of faecal sludge; Sustained handwashing practices; Food hygiene; Safe water handling; and proper use and Maintenance of a clean home environment.

2.2.10.1 Community-Led Total Sanitation (CLTS)

Community-Led Total Sanitation (CLTS) refers to community mobilization that brings together members of a community aimed at sustained behavior change amongst rural people by a process of triggering disgust and shame (Lahiri, *et al*, 2017). Kar and Chambers (2008) introduced the concept of CLTS for rural communities in Bangladesh. In 2011, it gained international acceptance as an important intervention to address sanitation

challenges in rural communities. It is an integrated approach to achieving and sustaining open defecation free (ODF) status. Subsequently, this has been adopted and replicated in Kenya as a social movement and innovative approach for addressing sanitation and hygiene issues in the country (MOH, 2012, MOH, 2014)

It entails the facilitation of the community's own analysis of their sanitation profile, their practices of defecation and the consequences, leading to collective action to become ODF. CLTS processes can come before, or occur simultaneously with, improvement of latrine design; the adoption of hygienic practices; solid waste management; waste water disposal; care; protection and maintenance of drinking water sources; and other environmental measures (Kar and Chambers, 2008).

The strategy targets communities and not individuals. As long as even a minority still defecates in the open, all members of a community are in danger of "eating each other's excreta". It uses participatory rural appraisal (PRA) tools to help communities recognize the problems of open defecation and take collective action to become open defecation free (IIED, 2010). It encourages talking about human excreta that is normally hidden beneath taboos and polite language. It involves participatory mapping of households and defecation areas. Communities calculate the amount of faeces produced per day, week, month and year, for both individual households and the entire village. They then estimate medical expenses for treatment of diarrheal diseases.

During a "transect walk" to common areas of open defecation, the problem stares people right in the face: faeces is everywhere and seeing it, smelling it and stepping on it, is highly unpleasant. Some turn their heads away in embarrassment, others vomit and some laugh nervously (IIED, 2010). This is combined with demonstrations on the paths from shit to

mouth and the way food and water gets contaminated. This triggers the community to realize that they are all indirectly eating each other's faeces and decide to take collective action. Action plans for latrine construction are drawn up by village health committees.

2.2.10.2 Rural Sanitation and Hygiene Protocol (RuSH)

The Rural Sanitation and Hygiene (RuSH) Protocol builds on the CLTS approach to eliminate open defecation, achieve universal access to improved sanitation and a clean and healthy environment by 2030 (MOH, 2023). It sets out a phased approach to eliminate challenges facing rural sanitation and hygiene: Open defecation free (Grade 1); Safe and sustainable environment (Grade 2); and Clean and healthy environment (Grade 3). The three grades are focused on the following areas:

Grade 1: Open Defecation Free (ODF) is focused on behavior change and the elimination of the unsafe return of excreta to the open (e.g. unsafe excreta return through open defecation or unsafe disposal of child excreta.).

Grade 2: Safe and sustainable environment is focused on the safe management of toilets, hands, food, water and animal wastes to block the primary routes of faecal exposure and faecal-oral contamination; and on more sustainable services.

Grade 3: Clean and healthy environment is focused on more permanent and safely managed services and other aspects of environmental sanitation and hygiene, to create a “clean and healthy environment” for rural communities in Kenya.

2.2.10.3 Subsidies in Construction of Latrines

This should be a supply-driven intervention aimed at providing communities with household or community latrines (Lahiri, *et al*, 2017). This intervention can target schools, workplaces, childcare centres or markets. The government or development agency may subsidize construction of latrines by giving a specified amount of money to support households or communities in meeting the costs related to latrine construction. (Lahiri, *et al*, 2017). The aim of this intervention is to keep the cost of constructing latrines and related services affordable.

2.2.10.4 Information, Education and Communication (IEC) campaigns

This is an approach which attempts to change or reinforce a set of behaviors in a target audience (households or individuals) regarding a specific sanitation problem in general and open defecation in particular (Lahiri, *et al*, 2017). The aim is to raise awareness of the target population, with subsequent expectation that its behavior will change positively. This can be done through training, home visits or mass campaigns.

2.3 Type of Pit Latrine and Diarrheal Diseases

The provision of appropriate facilities for defecation is an essential response for people's dignity, safety, health and well-being. However, sanitation issues have not in the past received the high-level political attention that it deserves (WHO/UN, 2012). In order to improve access to adequate sanitation it is necessary to meet standards of privacy and safety using sanitation structures that are locally available and culturally acceptable.

2.3.1 Shallow Pit

A simple improvement on open defecation fields is to provide shallow trenches in which people can defecate. This allows users to cover faeces and improves the overall hygiene and convenience of an open defecation system. Trenches can be 20–30 cm wide and 15 cm deep. This should be a temporary measure only and people may dig a small hole each time they want to defecate and then cover the faeces with soil. Pits about 300 mm deep may be used for several weeks (Franceys, *et al*, 1992). Shallow pits may also be constructed when rock is close to the surface. If there is only a thin layer of soil covering rocky ground it will not be possible to dig a conventional pit. The volume of the pit can be increased by extending the pit walls above the ground (WEDC, 2017). Similar sanitation solution will be used where ground water is very close to the surface.

Decomposition in shallow pits is rapid because of the large bacterial population in the top soil, but flies breed in large numbers and hookworm larvae spread around the holes and can migrate upwards from excreta buried less than 1-metre-deep, to penetrate the soles of the feet of subsequent users (Franceys, *et al*, 1992).

In Nandi North, these kinds of pits are not common, but are at times used by initiates who have undergone circumcision and are in seclusion. The pits are filled up with soil once the initiates graduate.

2.3.2 Simple Pit Latrine

The simple pit latrine was introduced in Kenya by the colonial administration and the missionaries (MOH, 2007). The main purpose was to prevent outbreaks of diseases such as cholera and its construction was enforced through the chief's authority, particularly during disease outbreaks. The simple pit latrine consists of a slab over a pit which may be

2 or more metres in depth. The slab should be firmly supported on all sides and raised above the surrounding ground so that surface water cannot enter the pit. A squat hole in the slab or a seat is provided so that the excreta fall directly into the pit.

Majority (73%), of all excreta disposal facilities in Kenya are simple pit latrines providing varied degrees of safety, hygiene and privacy. The locally available materials used in the construction of pit latrines include thatch, iron sheets, sackcloth, mud or any other leftover materials (WSP, 2004). This is also the case in Chesumei Sub-County.

2.3.3 Ventilated Improved Pit (VIP) Latrine

The simple pit latrine has two major problems: bad odour and flies. These problems can be minimized by use of a vent pipe to enhance ventilation (WEDC, 2014; Rukunga, 2001).

The vent pipe is fixed through the latrine slab and extends vertically to over 150 mm above the highest part of the roof. At the top of the pipe, a fly screen is fixed. This is known as the Ventilated Improved Pit (VIP) latrine, because of the reduced odour and flies. It can be located near a dwelling.

The principal mechanism of ventilation in VIP latrines is the action of wind blowing across the top of the vent pipe, which acts as odor and insect control mechanism. The wind creates a strong circulation of air through the superstructure, down through the squat hole, across the pit and up and out of the vent pipe (WEDC, 2014; Rukunga, 2001). Unpleasant odors from the pit contents are thus sucked up and exhausted out of vent pipe, leaving the superstructure odor-free.

Flies, searching for an egg-laying site are attracted by faecal odors coming from the vent pipe, but they are prevented from entering by the fly-screen at the outlet of the vent pipe. Some flies may enter into the pit via the squat hole and lay their eggs there. When new

adult flies emerge they instinctively fly towards light (Rukunga, 2001). However, if the latrine is dark inside, the only light they can see is at the top of the vent pipe. Since the vent pipe is provided with a fly-screen at the top, flies will not be able to escape and eventually die and fall back into the pit. To ensure that there is a flow of air through the latrine there must be adequate ventilation of the superstructure. This is usually achieved by leaving openings above and below the door, or by constructing a spiral wall without a door.

Ministry of Health introduced Ventilated Improved Pit (VIP) latrines (MOH, 2007), but could not be scaled up as the designs that were being promoted were not affordable to the majority of Kenyans. When VIPs were introduced, they were mostly found in areas where project assistance provided materials for construction. The conventional VIP, as promoted by externally supported programs, was too expensive to be adopted by rural communities. This explains why VIP latrines are not common in many communities.

2.3.4 Pour-flush Latrine

Pour-flush latrine is an improvement of a simple pit latrine in terms of construction, use, and maintenance. A latrine may be fitted with a trap or pan providing a water seal, which is cleared of faeces by pouring in sufficient quantities of water to wash the solids into the pit and replenish the water seal (WEDC, 2014). A water seal prevents flies, mosquitoes and odours reaching the latrine from the pit. The pit may be offset from the latrine by providing a short length of pipe or covered channel from the pan to the pit. The pan of an offset pouring flush latrine is supported by the ground and the latrine may be within or attached to a house. The flushing: ensures access to the pit is concealed, hence children, the elderly and disabled feel more secure; pan with water trap reduces foul smell from the pit; and users feel pleasant because they cannot see the inside of the pit (WEDC, 2014).

2.3.5 Communal Latrines

Communal latrines are usually cheaper per capita to build than individual household latrines (Cairncross & Feachem, 1993). However, they have many disadvantages: little commitment by individual users to keep them clean and operating properly, lack of privacy, the difficulty of their use at night and in bad weather, (especially by children, the sick and the old), the requirement for public land (may be difficult to avail) and cannot be upgraded to individual household latrines.

2.3.6 Role of Excreta in Spread of Diseases

Human beings get rid of their excreta every day. Excreta include both faeces and urine from the human body. The methods for excreta disposal vary from community to community depending on habits and practices, such as wiping or washing the anal areas, socio-economic status of the individual, availability of water and the method of water supply (Rukunga, 2001).

The inadequate and insanitary disposal of infected human faeces leads to the contamination of the ground and of sources of water (Franceys, *et al*, 1992). Often it provides the sites for certain species of flies and mosquitoes to lay their eggs, to breed, or to feed on the exposed material and to carry infection. It also attracts domestic animals, rodents and other vermin which spread the faeces and with them the potential for disease. In addition, creates intolerable nuisance of both odour and sight.

The causative organisms are excreted in the stools of infected persons. The portal of entry for these organisms is the mouth. The organisms pass through the environment from the faeces of an infected person to the gastro-intestinal tract of a susceptible person (Nordberg,

1999). This is known as *faecal-oral transmission route*. This occurs mainly through faecal contamination of food, water and hands.

Food can be contaminated through polluted water, dirty hands, contaminated soil, flies, animals or animal products, as shown in Figure 2.1.

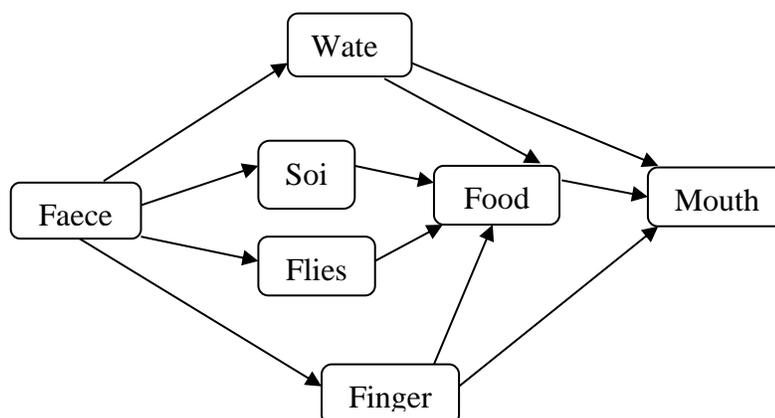


Figure 2.1 The faecal-Oral transmission route (Nordberg, 1999)

2.3.8 Relationship Between Health and Excreta Disposal Method

The provision of a latrine is considered a major step in breaking the faecal-oral transmission of pathogens (Grimason, *et al*, 2000). However, there are other conditions that must be met to avoid human contact with excreta, including cleanliness of the latrine and provision of soap and water to wash hands after using the toilet.

The objective of sanitary excreta disposal is to isolate faeces, so that the infectious agents in them cannot reach a new host. The method chosen for any area or region will depend on factors such as: local geology, hydrogeology, the culture and the preferences of the communities, the locally available raw materials and skills, the cost, simplicity of the design and construction, operation and maintenance (Franceys, *et a.l*, 1992). The types of diseases that are endemic in an area should also be considered. The survival of endemic

pathogens (cysts, eggs, infectious agents) and the destination or reuse of products of disposal or treatment can have a great effect on incidence of disease in the area.

Proper excreta disposal methods provide safe disposal of excreta to stop it from contaminating the environment (Rukunga, 2001). Methods selected for disposal of excreta should be: Simple, cheap and easy to use; Constructed of locally available materials; Easy to maintain; Fly proof; Acceptable to users; Odourless; Private; and Non-polluting.

2.3.9 Open Defecation

Where there are no latrines, people resort to defecation in the open. Open defecation refers to the practice of defecating in a field, a forest, behind a tree, in the street, in a water body (lake, river or pond) in an open drain, or out in the open; that is not using a latrine or covered pit (MOH, 2016). Open defecation encourages flies, which spread faecal-related diseases. In moist ground, the larvae of intestinal worms develop, and faeces and larvae may be carried by people and animals. Surface water run-off results in water pollution (MOH, 2016). Open defecation in Mutwot location is common among young children who fear falling into pit latrines, especially if the squat hole is large.

2.3.10 Diarrheal Diseases

The WHO has defined diarrhea as the passage of three or more loose or liquid stools per day (or more frequent passage than is normal for the individual). Diarrhea is usually a symptom of an infection in the intestinal tract, which can be caused by a variety of bacterial, viral and parasitic organisms. Infection is spread through contaminated food or drinking-water, or from person-to-person as a result of poor hygiene. Diarrheal disease is a leading cause of child morbidity and mortality in the world, and mostly results from contaminated food and water sources. Diarrhea due to infection is widespread throughout developing

countries (Marcia and Lancaster, 1996). According to WHO, children less than three years old in developing countries experience on average three episodes of diarrhea every year. Each episode deprives the child of the nutrition necessary for growth. As a result, diarrhea is a major cause of malnutrition, and malnourished children are more likely to fall ill from diarrhea.

Dehydration is an immediate result of diarrhea and leads to loss of fluid and electrolytes. The loss of upto 10 % of the body's electrolytes can lead to shock, acidosis, stupor and failure of the body's major organs, such as the kidneys and the heart. Persistent diarrhea often leads to loss of body protein and increased susceptibility to infection (Marcia and Lancaster, 1996).

2.3.10.1 Prevention and Control of Diarrheal Diseases

Prevention of diarrheal diseases depends on breaking through the faecal-oral transmission cycle. Control of diarrheal diseases is only possible when the methods of excreta disposal are improved (use of properly constructed pit latrines). Hand washing facilities should be provided immediately outside toilets and latrines. The facility should have soap and clean running water (such as a container with a tap). Wash hands after using the toilet, before cooking or eating food (Nordberg, 1999).

If transmission is blocked at one or more points, excreta-related diseases can be controlled or possibly eradicated. Sanitation provides one such block. Example: water-seal slabs in latrines reduce the breeding sites for mosquitos, vectors of filariasis; treatment of the excreta prior to its disposal can kill the eggs and cysts of many human parasites (*Ascaris*, *Entamoeba*, and *Schistosoma* spp), thus preventing contamination of both ground and

water (Franceys, *et al*, 1992). The figure below (Fig.2.2) shows how the faecal-oral transmission cycle can be broken.

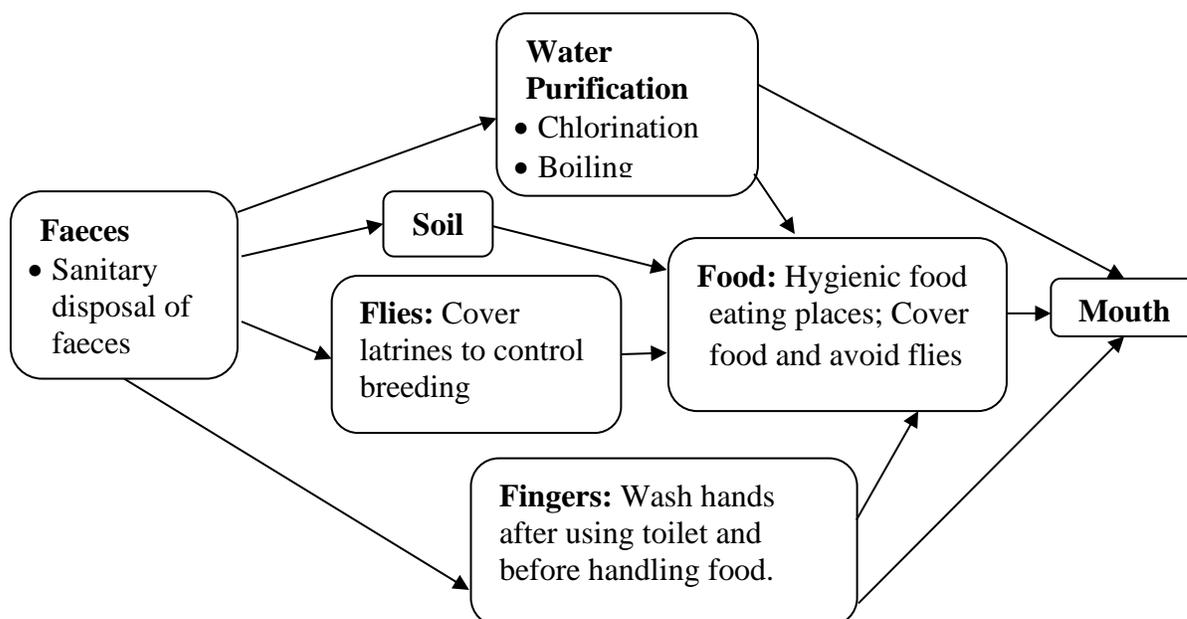


Figure 2. 2 Breaking the faecal-Oral transmission cycle (Nordberg, 1999)

2.4 Participatory Methods for Hygiene Education and Sanitation

Human behaviors lie at the roots of most illnesses caused by poor environmental sanitation (WHO/AFRO, 2000). Improving sanitation conditions, which are the responsibility of households, and changing human behaviors, which are linked to personal choices, have always been the most difficult aspects of water and sanitation development.

The most notable of these approaches is Participatory Hygiene and Sanitation Transformation (PHAST). PHAST is a joint project of WHO and UNDP-World Bank Water and Sanitation Program initiated in 1993 in collaboration with health, water and sanitation ministries of the governments of Botswana, Kenya, Uganda and Zimbabwe.

PHAST uses participatory techniques to promote beneficial hygiene behaviors, sanitation improvements and community management of water and sanitation facilities. It builds on people's innate ability to address and resolve their own problems. By promoting health awareness and understanding, it helps to empower communities to manage their water uses and to control sanitation related diseases.

PHAST is adapted from the Self Esteem, Associative Strengths, Resourcefulness, Action-Planning and Responsibility (SARAR) methodology of participatory development, developed in the 1970s and 1980s in order to enable people to identify their problems, plan for change, implement and monitor that change (WHO/AFRO, 2000). Its two main principles are that people solve their own problems best in a participatory group process and that the group collectively has enough information and experience to begin to address its own problems. SARAR is applicable to a wide range of developmental concerns.

PHAST takes the principles and techniques of SARAR and applies them to problems of sanitation and hygiene behaviors at the community level. Its basic purpose is to help communities develop the capacity: To take charge of their environmental sanitation needs; To control sanitation-related diseases; To promote health awareness and understanding; To promote new awareness of the complex interaction between technological and behavioral elements.

It does not promise rapid change, but rather leads to sustainable benefits through a series of incremental improvements. In the process, PHAST leads to sanitary environmental improvements and positive behavioral changes in order reduce sanitation-related diseases.

2.5 Traditional Approaches to Sanitation

Traditional approaches to sanitation are based on two assumptions: the first is that people do not know about sanitation and hygiene, but if they are educated they will change their behavior (IIED, 2010). The second is that people will use toilets if they are given assistance to build them, because they are too poor to build them on their own (IIED, 2010). However, studies have shown that knowledge about the health-related risks of poor sanitation does not necessarily trigger changed behavior. A high proportion of latrines constructed with subsidies are never used as toilets, but as stores, or animal shelters.

2.6 Theoretical Framework

According to social psychology theories of behavior change (Naidoo and Willis, 2009), people's behavior is partly determined by their attitude to that behavior. An individual's attitude to a specific action and the intention to adopt it are influenced by beliefs. Beliefs are motivations which come from the person's values, attitudes and instincts, and the influences from social norms.

The study will utilize the Health Belief Model (HBM) of behavior change. The model was originally proposed by Rosenstock (1966) and modified by Becker (1974), and is used to predict health behavior. The model suggests that individuals only change if the benefits of change outweigh the costs (cost-benefit analysis).

The HBM theory is based on the idea that an individual's behavior will be influenced by his/her beliefs. A belief is based on the information a person has about an object or action. It relies on the premise that for a behavioural change to succeed, individuals must have the incentive to change, feel threatened by their current behaviour, and feel that a change will

be beneficial and is at an acceptable cost. They must also feel competent to implement that change.

Based on this model, individuals who have not suffered from diarrheal disease may not use safe methods to dispose of human excreta, unless they accept that, though they have never contracted diarrhea, they do in fact are at risk (perceived susceptibility). They must understand that diarrhea can lead to dehydration (perceived severity). Having and using a pit latrine that adequately separates human excreta from human contact will reduce the risks (perceived benefits), without worrying about extra costs after construction (perceived barriers). Continuous health education from health care personnel on the importance of appropriate disposal methods of human excreta, reminds and encourages community members to correctly use pit latrines (cues to action). For those who, (themselves or their children) have, in the past, suffered from diarrhea need to provide or be provided with social support to build confidence on their ability to prevent diarrheal diseases (self-efficacy).

People's perception and assessment of risk are central to the application of this model. People's assessment of their risk is influenced by four factors; Personal experience, ability to control the situation, a feeling that the illness or danger is rare and any outcomes in the distant future.

This theory facilitates the process of behavior change, to ensure that an individual is able to take proactive action to protect their health, with minimal costs.

2.7 Conceptual Framework

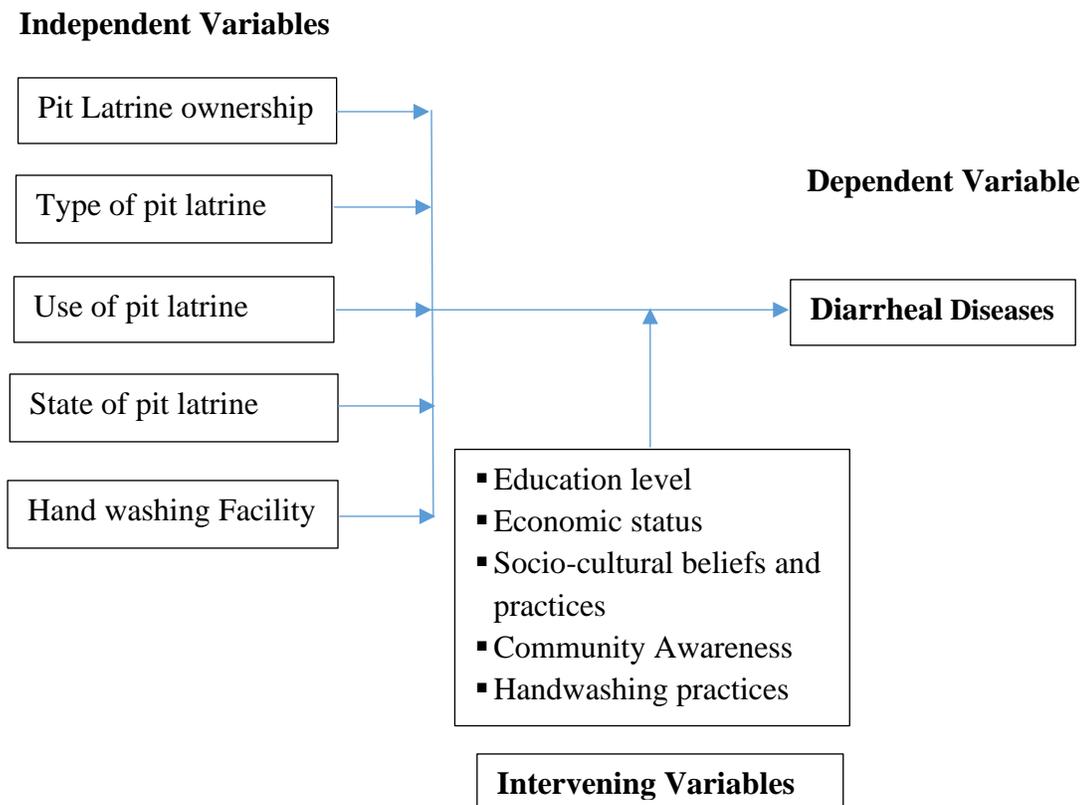


Figure 2.3 Conceptual framework (Researcher, 2018)

If the pit latrine coverage in the community is high, are in a good working condition and are correctly used to dispose human excreta, then the incidence of diarrheal diseases is likely to be lower and vice versa.

CHAPTER THREE

METHODOLOGY

3.0 Introduction

This chapter covers research design, study variables, target population, sample frame, sample size determination, sampling techniques, data collection instruments, and data collection procedures and data analysis.

3.1 Study Area

Mutwot Location is one of the seventeen locations in Chesumei Sub-County. It is centrally situated among the seven locations forming Kosirai division, with an area of 37.8Km². It comprises three sub-locations: Mutwot, Mosoriot and Cheptarit Sub-locations.

Mutwot Location is a gentle sloppy plateau, with a cool and moderately wet climate. This being an agricultural area, the residents are involved in crop and dairy farming. The location has one government health facility, Mosoriot Sub-county hospital. The community is also served by several private clinics. The tarmacked Eldoret-Kisumu road cuts across the location. However, most of the area is served by poorly maintained murram roads, which are impassable during long rainy seasons.

This Location was chosen due to its relevance to the research questions and the potential generalizability of the findings to the sub-county. In addition, it had characteristics similar to most of the locations in the sub-county.

3.3 Study Design

This was a descriptive cross-sectional study in Mutwot Location, comprising of three sub-locations. This study design was appropriate for answering the research questions by

collecting data on the multiple variables of interest, and was cost effective in time and logistics.

3.2 Study Population

The study targeted 2,052 households distributed to the sub-locations as follows: Mutwot Sub-location: 194 households, Mosoriot Sub-location: 904 households and Cheptarit Sub-location: 954 households (KNBS, 2009). Table 3.1 presents the distribution of households in sub-locations and villages of Mutwot Location.

Table 3.1 Distribution of households in Mutwot Location

Sub-Location	Village	Population	Households	
Cheptarit	1	Cheptarit A	2,027	487
	2	Cheptarit B	428	98
	3	Kapteldon	348	83
	4	Kipchirindet	308	71
	5	Sebetet	306	93
	6	Kapkorio	389	68
	7	Tironin	148	31
	8	Kapkemel	125	23
Sub-Total		4,079	954	
Mutwot	1	Mutwot Gaa	303	56
	2	Mutwot	115	26
	3	Mogoget	140	28
	4	Kapsile	127	23
	5	Simotwet	180	36
	6	Chepkoiyo B	125	25
Sub-Total		990	194	
Mosoriot	1	Mosoriot	462	91
		Naikaba		
2	Mosoriot	202	39	

	3	Nduroto	412	81
	4	Kondamet	272	53
	5	Chepkoiyo A	207	40
Mosoriot	6	Kapnyamisa	347	68
	7	Chemarot	472	93
	8	Kapkorio	387	76
	9	Kaptien	312	61
	10	Kapmenjeiwa	567	112
	11	Kapnyamisa Gaa	397	78
	12	Kapngorom	262	51
	13	Saroiyot	311	61
		Sub-Total	4,610	904
		Grand Total	9,679	2,052

Source: KNBS (2009)

3.4 Study Variables

Independent variables were: Pit latrine ownership; type of pit latrine; state of pit latrine; use of pit latrine; and handwashing facility. Intervening variables were: education level; economic status; socio-cultural beliefs; community awareness and handwashing practices. Dependent variable was diarrheal diseases.

3.5 Sampling and Sample Size Determination

This section presents how the sample size was computed and how the sample was chosen.

3.5.1 Sample Size

According to Mugenda and Mugenda (2003), the sample size, n , can be determined using the following fisher's formula:

$$n = \frac{Z^2 pq}{d^2}$$

Where, n = the desired sample size

Z = the standard normal deviate at the required confidence level (1.96)

P = the proportion in the target population estimated to have characteristics being measured.

Since this proportion could not be obtained from previous studies, this study used a proportion of 0.5, which assumes maximum variability in the population. Thus, the estimated sample size was likely to be more conservative, that is, the sample size was likely to be more than what was required.

$q = (1 - p)$, the proportion without desired characteristics.

d = the level of statistical significance set (degree of accuracy), 0.05

$$n = \frac{(1.96)^2 (0.5 \times 0.5)}{(0.05)^2}$$

$$n = \mathbf{384}$$

Since the number of households was less than 10,000, the following correction for small and finite population was used to compute the final sample estimate (nf). This is because a given sample size provides proportionately more information for a small population than for a large one (Noordzij et al., 2010).

$$nf = \frac{n}{1 + (n/N)}$$

Where,

nf = desired sample (population < 10,000)

n = desired sample (population > 10,000)

N = the estimate of population size

Hence,

$$nf = \frac{384}{1 + (384/2,052)}$$

$$nf = \mathbf{324}$$

The study sampled 324 households in Mutwot Location.

3.5.2 Sampling Procedure

Sampling is the process of selecting a few elements (a sample) from a bigger group (target population) to become a basis for estimating or predicting the prevalence of unknown piece of information, situation, or outcome regarding the bigger group (Creswell,2014). Stratified random sampling was used to obtain the study respondents. This method was chosen because the population was not homogenous, with different number of households in sub-locations and villages. The method, therefore, allowed the study to select households from every sub-group in the population, enhancing its external validity (Creswell, 2014; Mugenda & Mugenda, 2003).

Stratification was done at two levels: first, sub-location and then, village. In the first stage (first sub-group), the number of households in each of the three sub-locations was determined. To ensure a proportionate representation of the sub-locations, the sample contributed by each group was weighted according to the stratum's (sub-location's) target population. For example, the target population of households in Cheptarit Sub-location was 954 against a total population of 2,052 households. Thus, the number of households selected from Cheptarit was 150 ($954/2,052 * 324$). Thus, the number of households selected from each Sub-location was computed as follows:

Mutwot Sub-location: $194/2,052 \times 324 = 31$ Households.

Mosoriot Sub-location: $904/2,052 \times 324 = 143$ Households.

Cheptarit Sub-location: $954/2,052 \times 324 = 150$ Households.

In the second stage (second sub-group) of stratification, the number of households was selected from every village in each Sub-location, again weighing the sample contributed by each group with respect to the stratum's target population. For example, the target population of households in Cheptarit A village was 487 against a total of 954 households in the

sub-location while the sample size of Cheptarit Sub-location was 150 (see first stage of stratification). Consequently, the study sampled 77 households ($487/954 \times 150$) in Cheptarit A Village. This was repeated for other villages and sample population for each village is shown in Table 3.2.

Table 3.2 Target population and sample size for each sub-location and village in Mutwot location

Sub-Location	Village	Households	Sample Size
Cheptarit	1 Cheptarit A	487	77
	2 Cheptarit B	98	15
	3 Kapteldon	83	13
	4 Kipchirindet	71	11
	5 Sebetet	93	14
	6 Kapkorio	68	11
	7 Tironin	31	5
	8 Kapkemel	23	4
Sub-Total		954	150
Mutwot	1 Mutwot Gaa	56	9
	2 Mutwot	26	4
	3 Mogoget	28	4
	4 Kapsile	23	4
	5 Simotwet	36	6
	6 Chepkoiyo B	25	4
Sub-Total		194	31
Mosoriot	1 Mosoriot Naikaba	91	14
	2 Mosoriot	39	6
	3 Nduroto	81	13
	4 Kondamet	53	8
	5 Chepkoiyo A	40	6
	6 Kapnyamisa	68	11
	7 Chemarot	93	15
	8 Kapkorio	76	12
	9 Kaptien	61	10
	10 Kapmenjeiwa	112	18
	11 Kapnyamisa Gaa	78	12
	12 Kapngorom	51	8
	13 Saroiyot	61	10
Sub-Total		904	143
Grand Total		2,052	324

Simple random sampling was then used to select households from each of the strata, that is, from village. Saunders et al. (2009) defined simple random sampling as a process of selecting participants such that every subject in the study population has an equal chance of being selected. A sampling frame of all the respondents was obtained from local administrators (chief, sub-chiefs, and village elders) and used to select households in the study using simple random sampling that was conducted with a table of random numbers. A sampling frame is a complete list of all the members of the population that the researcher wishes to study (Tabachnick & Fidell, 2013)

Random sampling was appropriate for this study because since it was representative, the findings have greater external validity and generalizability. In addition, random sampling is a necessary assumption of many statistical tests (Creswell, 2014).

3.6 Data Collection

This section describes procedures that were used to collect data, namely, types and sources of data, data collection instruments, and data collection methods.

3.6.1 Types and Sources of Data

The study employed exclusively primary data. Primary data are those that are collected for the first time and have not been subjected to statistical analysis (Booth *et al.*, 2008). The sources of primary data for this study were answers given by household heads or their representatives with respect to questionnaires administered to them (Appendix II).

3.6.2 Data Collection Instruments

The data collection tools used were Researcher-administered questionnaires to household heads or their representatives to determine the coverage and use of pit latrine and prevalence of diarrheal diseases. A questionnaire is a research instrument consisting of a

series of questions for the purpose of gathering information from respondents (Kabir, 2016). A Questionnaire was chosen due to its ability to obtain standardized answers that make it simple to compile data.

An observation checklist was used to record the availability, type, location, construction materials used, maintenance and level of cleanliness of pit latrines. An observation checklist is a tool with a list of things that an observer is going to look at when collecting information (Pandey and Pandey, 2015). Observation was used to countercheck the verbal information provided by the respondent through the questionnaire. It was chosen because it is a simple and direct technique to study an object, since it is based mainly on visual sense.

3.6.3 Data Collection Methods

This involved taking the research instruments to the field/Mutwot location for the purpose of data collection. Three research assistants were trained for one day to familiarize them with the data collection instruments and the sampling method to ensure that they collected credible information.

During data collection, the researcher/assistant visited each selected household, carrying research permits from the local administration. The researcher/assistant explained to the household head/representative the purpose of the study, how the recruitment process was conducted, and the meaning and purpose of informed consent. The household head/representative was then asked to sign the consent form if he/she agreed to participate in the study. Those respondents who agreed to participate in the study, but could not sign the consent form, were requested to put a thumb print on the space designated for signature. The researcher/assistant read the questions to the respondents and filled the questionnaire.

In instances where the respondent could not understand English, the researcher/assistant translated the questions into Kiswahili or the vernacular language understood by the respondent. The researcher/assistant also toured the home, filling the observation checklist. The researcher/assistant then thanked the respondents.

3.7 Validity and Reliability of Research Instruments

Validity refers to the extent to which a variable is accurately measured by an instrument (Creswell, 2014). Content validity, which refers to the instrument adequately covering all the variables being measured (Saunders, *et al*, 2009), was achieved by literature review and discussion of instruments with supervisors. Construct validity, the theoretical relationship of a variable to other variables (Creswell, 2014) was established by using constructs developed by other researchers.

Reliability is a measure of the degree to which a research instrument yields consistent results upon repeated trials (Booth *et al.*, 2008).

The data collection instruments were pretested at Ndongyongaria, which is a village neighboring the study site and with similar population characteristics. The similarities with the study area included, population density, economic activities, cultural beliefs, weather and topographical conditions. Pretesting was done to: Determine if the instruments are clear and easily understood; Assess whether the respondents are able and willing to provide the desired information; Determine whether the instruments obtain the information the researcher intended to collect. This was done to determine content and construct validity and reliability of the research instruments.

3.8 Data Analysis Procedure

Data was analyzed with the help of both descriptive and inferential statistics. Descriptive statistics were used to describe, summarize and organize the data. Frequency distributions are ordered arrangement of all variables, showing the number of occurrences in each category. The data was then displayed using tables, bar graphs and pie charts.

Relationships in the study were tested using either Chi-square (χ^2) cross tabulations and Multiple Correspondence Analysis (MCA), since the data was either nominal or ordinal. MCA transforms observed data in a non-linear way in order to obtain transformed objects, which are as much homogeneous as possible (Gifi, 1990). MCA analyses variables that are in a single set. The fit of the model was measured by the amount of variance (also, referred to as inertia). The model could explain in the original values (lowest: 0% and highest: 100%). Variance (in absolute value) which is ≤ 0.30 is generally considered low, 0.31 to 0.67 moderate while 0.68 to 1.0 is strong (Field, 2005).

MCA was used because it allows relationships between variables to be presented in an aesthetically appealing pictorial/graphical representation. Relationships were then visualized by the nearness of variables on the graph: strong relationships were signified by variables being very close on the graph; whereas weak relationships were shown by the variables being very apart on the graph (Gifi, 1990). This was a better way to visualize relationships than when presented using abstract numerals, as in other correlation methods.

Observation checklist data were analyzed using frequencies. This was because any observation would ultimately yield data of the form: an entity was present or absent.

All statistical tests were analyzed with the Statistical Package for Social Sciences (SPSS), version 21. Significant levels were measured at 95% confidence level with significant

differences recorded at $p < 0.05$. Descriptive statistics and frequency distributions were generated and presented in tables and figures.

3.8.1 Point of convergence of the data obtained in this study

This study used an embedded design in which data from the questionnaires and observation checklist were collected and analyzed simultaneously. The major source of data were questionnaires, while observation checklist was used to countercheck the verbal information provided by the respondent through the questionnaire. Checklist data was therefore a minor source. Therefore, for every question, the study first analyzed questionnaire data, followed by analysis of observation checklist data, and then, findings from the latter data were embedded with the findings from the former data.

Thus, in this study, data from the checklist was nested within a larger design (questionnaire) data, allowing the smaller dataset to supplement and support the larger one (Creswell, 2014). This is unlike triangulation, in which similar variables are used for quantitative and qualitative data.

3.8.2 Data Analysis Plan

The following Table 3.3 shows the data analysis plan used in the study.

Table 3.3 Data Analysis Matrix

Objective	Independent Variable	Dependent Variable	Research Instrument	Type of Data	Analysis Technique
Determine pit latrine coverage	Biographical variables	Pit latrine ownership	Questionnaire; and Observation checklist	Nominal; Ordinal; and Ratio	Frequencies; and Chi-square (χ^2)
Assess pit latrine use	Socio-cultural beliefs; Latrine cleanliness; Latrine location;	Pit latrine use	Questionnaire; and Observation checklist	Nominal; Ordinal; and Ratio	Frequencies
Determine the association between type of pit latrine and diarrheal diseases	Pit latrine ownership; Pit latrine use; Type of pit latrine	Prevalence of diarrheal diseases	Questionnaire; and Observation checklist	Nominal; Ordinal; and Ratio	Frequencies; Chi-square (χ^2); and Multiple Correspondence Analysis

Source: Researcher's own conceptualization (2018)

3.9 Inclusion Criteria

Only those households and household-heads that had been selected participated in the study. In addition, only subjects that were adults (above 18 years) and who gave informed consent.

3.10 Exclusion Criteria

Subjects who had been selected, but declined to give informed consent were excluded. In addition, those who were unwell to fill the questionnaire did not participate.

3.11 Ethical Considerations

Data was collected after the proposal had been approved by the Moi University, Institutional Research and Ethics Committee (IREC), Approval Number 0001360 (Appendix IV). A Research Authority was obtained from Nandi County, Department of Health and Sanitation, Ref: CO/NCGENH&S/1/VOL.I/15/41 (Appendix V) and from Nandi County Director of Education, Ref: NCD/CDE/GEN/1/VOL.11/13 (Appendix VI). Further, permission for the study was obtained from Assistant County Commissioner and the Chief for Kosirai Division and Mutwot Location respectively. The participants were informed that there was no risk involved in the study, and were requested to sign an informed written consent after the purpose of the study had been explained to them.

CHAPTER FOUR

RESULTS

4.0 Introduction

This chapter provides findings from the data collected on pit latrine use in the prevention of diarrheal diseases in Mutwot Location of Chesumei Sub- County, Kenya. The purpose of data analysis was to reduce data to intelligible and interpretable form so that the relations of the research problems can be studied and tested Kerlinger (1986).

All the 324 questionnaires administered to the household heads in the study, were answered and returned to the researcher. The perfect return rate of the questionnaires was attributed to the simplicity of questions, appropriate community entry process and the researcher's personal administration and management of the research instruments and close supervision of research assistants. The response rate reflected the view of Mugenda and Mugenda (2003) who indicated that a response rate of 70% gives a representative sample for meaningful generalization and minimizes errors.

4.1 Socio-demographic Profile of Respondents

Data from this section gives the socio-demographic information of the participants in the study in order to understand their profile. The information sought included the respondents' gender, education level, occupation, and religion.

Descriptive results (Table 4.1) showed that the study sampled slightly more female (58%) compared to male (42%) household heads or their representatives. This could have been because the field work was conducted during daytime, a time when most male household heads were out of their homes to earn a livelihood. However, the fact that the study sampled both male and females suggested that results from this study were largely

reflective of the opinions from both gender. In addition, data from questionnaires were augmented with an observation checklist conducted by the researcher and was therefore relatively independent of the type of household head or their representatives.

The results indicated that most of the respondents had primary education (49%), followed by those with secondary (28%) and college (18%) education. The least were those with university education (5%). This indicated that most residents in the study area had modest education. Farming was the most important economic activity in the study area, with four out of every 10 respondents stating that it was their occupation. Only 17% of the respondents were in formal employment, whereas 19% of them were in self-employment (operating small businesses) and 23% were housewives. The respondents were predominantly Christians (99%). A tiny (1%) belonged to other faiths.

Table 4.1 Socio-demographic profile of respondents

Demographic information	Categories	Frequency (<i>n</i> = 324)	Percent (100 %)
Gender	Male	136	42
	Female	188	58
Level of education	Primary	160	49
	Secondary	90	28
	College	57	18
	University	17	5
Occupation	Employed	56	17
	Self – employed	62	19
	Farmer	132	41
	House wife	74	23
Religion	Christian	322	99
	Muslim	0	0
	Others	2	1

4.2 Pit latrine coverage in Mutwot Location

The respondents were asked whether they had a pit latrine in the home. The results (Figure 4.1) showed that two out of every 10 households lacked a latrine ($n=65$, 20%) while eight out of every 10 households possessed one ($n=259$, 80%).

Observation data from the checklist were largely consistent with the above results, showing that 260 homes (80%) had latrines whereas 64 (20%) did not have. This suggests further that, answers given in the questionnaire were reliable. The results indicate that although pit latrine coverage in Mutwot Location is substantial, a significant proportion of homesteads lack toilets, based on WHO requirements on universal access to basic sanitation.

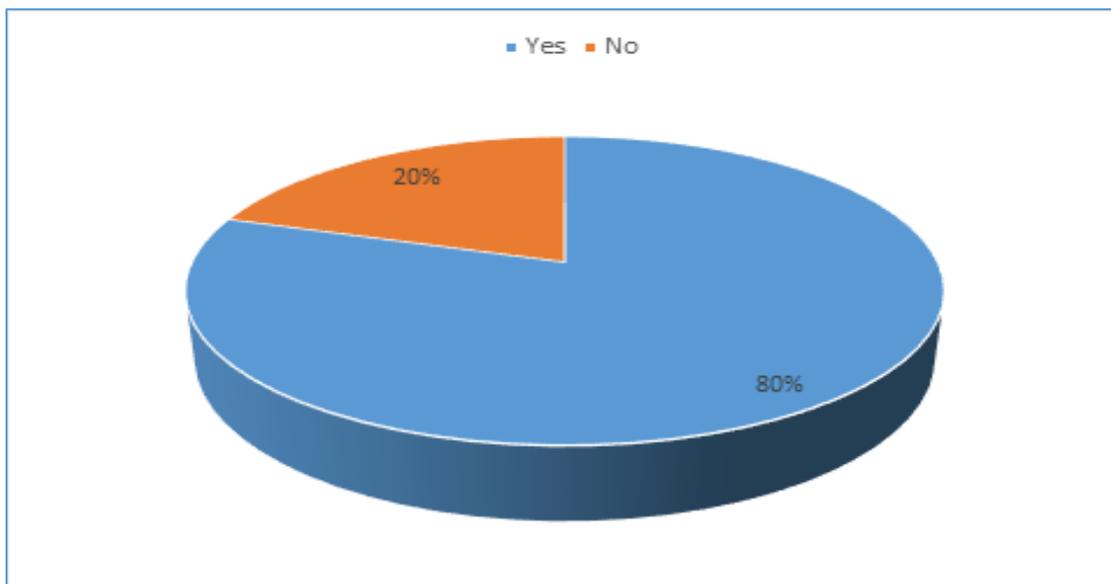


Figure 4.1 Pit latrine ownership

Chi-square (χ^2) cross tabulations were used to test if there were any significant relationship between the respondents' gender, education level and occupation, with having a pit latrine in a home and Table 4.2 presents these results.

Table 4.2 Relationship between pit latrine ownership and biographical variables

Variable	Respondents , category	Ownership of latrine			χ^2 Value	
		Has latrine	No latrine	Total		
Gender	Male	Frequency	104	32	$\chi^2 (1) = 1.76,$ $p = 0.19$	
		%	76.5	23.5		
	Female	Frequency	155	33		
		%	82.4	17.6		
	Total	Frequency	259	65		324
Education	Primary	Frequency	95	65	$\chi^2 (3) = 83.35,$ $p < 0.0001$	
		%	59.4	40.6		
	Secondary	Frequency	90	0		
		%	100.0	0.0		
	College	Frequency	57	0		
		%	100.0	0.0		
	University	Frequency	17	0		
		%	100.0	0.0		
	Total	Frequency	259	65		324
	Total	%	79.9	20.1		100.0
Occupation	Employed	Frequency	55	1	$\chi^2 (3) = 28.89,$ $p < 0.0001$	
		%	98.2	1.8		
	Self-employed	Frequency	47	15		
		%	75.8	24.2		
	Farmer	Frequency	90	42		
		%	68.2	31.8		
	House wife	Frequency	67	7		
	%	90.5	9.5			
Total	Frequency	259	65	324		
	%	79.9	20.1	100.0		

The results showed that respondents' educational level, $\chi^2 (3) = 83.35, p < 0.0001$ and occupation, $\chi^2 (3) = 28.89, p < 0.0001$ influenced ownership of pit latrine. Residents with secondary, college or university education (Table 4.2) were likely to have latrines (the study found that each of them owned a latrine) while those lacking latrines were likely to have primary education (41% of them had no latrines). On the other hand, residents with no latrines were likely to be either farmers (32%) or self-employed (24%). Employed people and housewives were likely to have latrines in their homesteads (98% and 91% had latrines, respectively).

The study found that respondents' gender, $\chi^2 (1) = 1.76, p = 0.19$ had insignificant role on ownership of pit latrines. This implied that possession of latrines was similar in both female and male headed households.

Respondents without latrines (n=64) were asked why they did not have them and responses are summarized in Table 4.3. A majority (58%) of respondents felt that latrines were too expensive to construct while 42% of them cited the absence of construction materials for their inability to construct the structures. Cultural beliefs and lack of construction skills were not found to influence the inability to build latrines. The results suggested that poor education and economic constraints were strong antecedents in the lack of ownership of pit latrines in the study area.

Table 4.3 Reasons for lack of ownership of latrines

Reason for not having a toilet	Frequency	Percent
It is expensive to construct	37	58.06
Cultural beliefs do not allow	0	0.00
Lack of construction materials	27	41.94
Lack of construction skills	0	0.00
Total	64	100.0

4.3 Use of pit latrines in Mutwot Location

This section presents findings on how pit latrines are used in the study area.

4.3.1 Usage and depth of latrines

Respondents who had pit latrines were found to predominantly use them (n=255, 98%) compared to only four (2%) who did not use them (Figure 4.2).

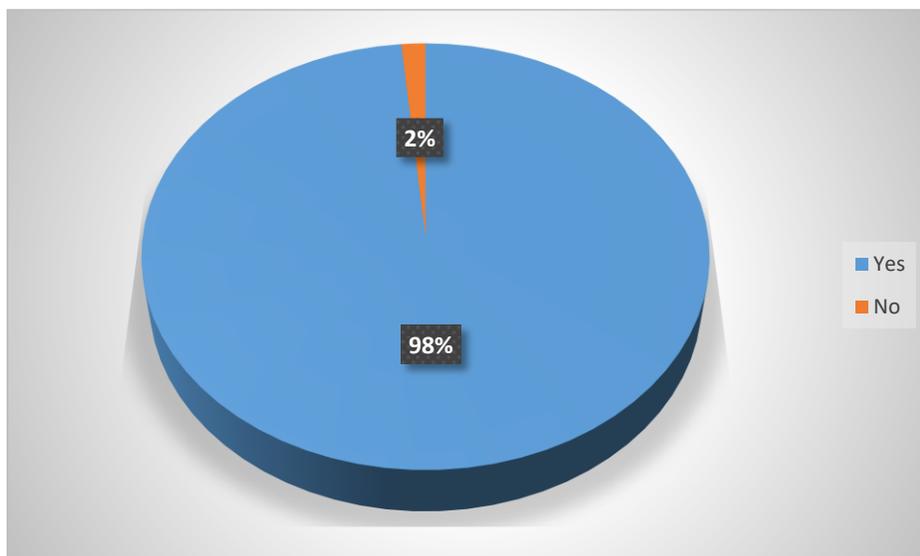


Figure 4.2 Pit latrines currently in use

Observation data from the checklist largely supported this finding. The footpaths to the latrines were generally visible ($n=250$, 97%) against those that were not ($n=9$, 3%). In addition, the entrance to the latrines were not overgrown by grass ($n=246$, 95%) relative to those that had grass ($n=13$, 5%). This suggested that households with latrines in the study area widely used them.

One out of every ten latrines ($n=31$, 12%) were found to be unable to be used by children, the aged and persons with disabilities due to unstable slabs, compared to 88% ($n=228$) of households whose latrines could be used by these group of individuals. The results suggest that a sizeable proportion of latrines in the study area cannot be used by everyone in the home. Two out every ten households were found to share their latrines with other households ($n=59$, 18%) relative to 81% ($n=262$) who did not.

The study also asked respondents about the depth of their latrines and the length of their use. Figure 4.3 presents the depth of latrines in the study location.

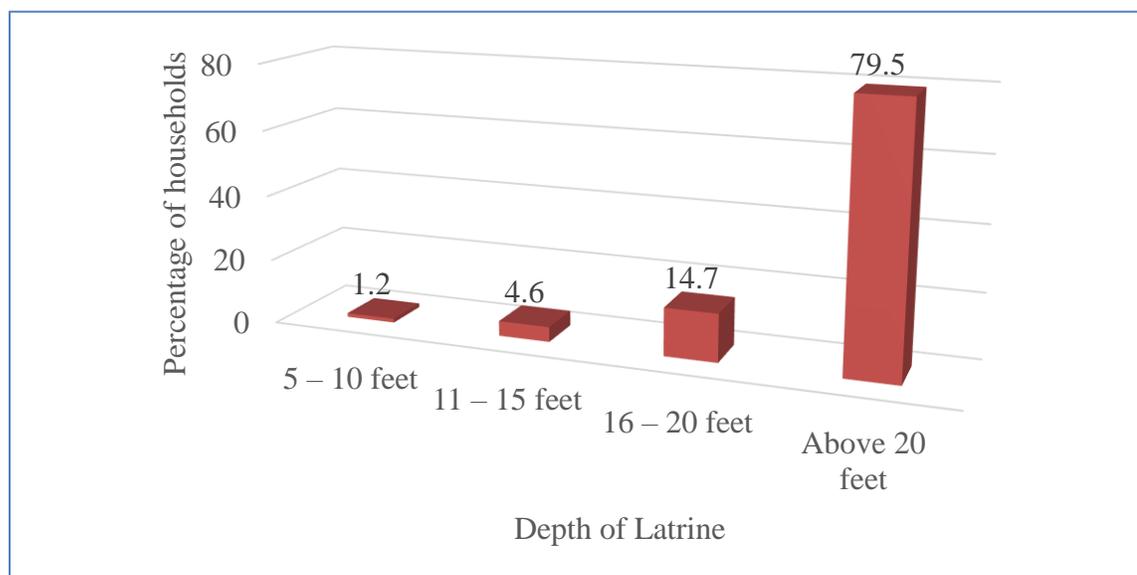


Figure 4.3 Depth of Pit latrines

Eight out of every ten latrines had a depth of over 20 feet ($n=206$, 80%), followed by those between 16 and 20 feet (15%) and between 11 and 15 feet (5%). The results suggested that most latrines in the study area were reasonably deep. Most of the latrines had been in use for a relatively short period, with 60% and 24% of them having been in use for up to five years, and between six and ten years, respectively (Figure 4.4).

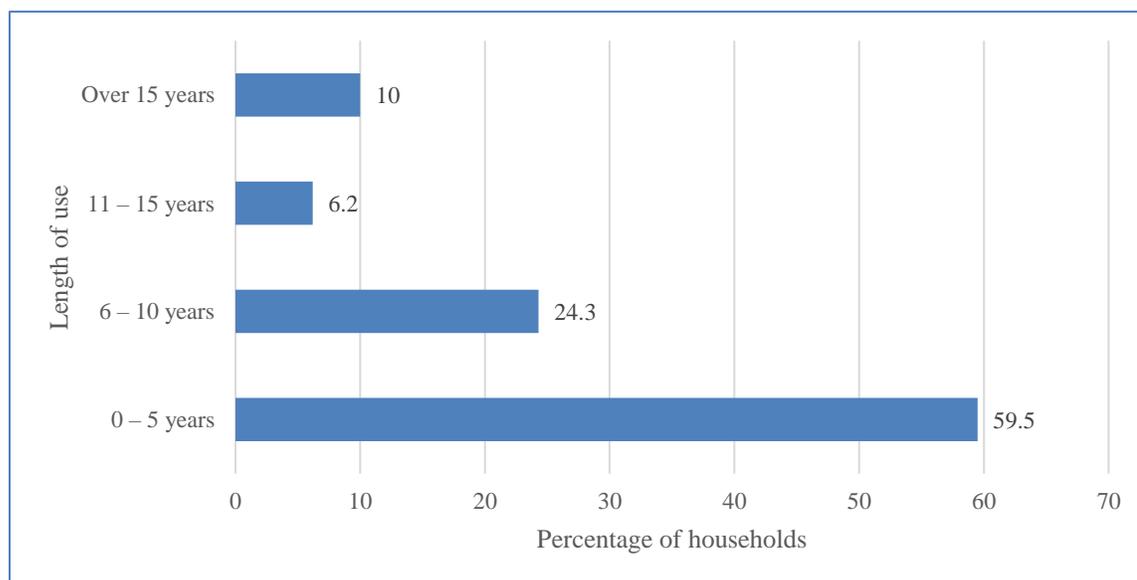


Figure 4.4 Duration of use of latrines

The study also sought to know whether socio-cultural beliefs affected the use of pit latrines in the area. The study predominantly ($n=296$, 95%) found that socio-cultural beliefs in the study area did not influence the usage of pit latrines with only 5% ($n=17$) of the respondents answering that they did. Amongst those who felt that socio-cultural mores were pertinent, 75% ($n=9$) averred that adults and children should not share a latrine whereas 25% ($n=3$) were of the opinion that in-laws of opposite sex could not share a toilet.

4.3.2 Cleanliness of pit latrines

The participants were also asked on how they cleaned their latrines and this was augmented by an observation checklist item on toilet cleanliness.

Table 4.4 Cleaning methods and state of latrine cleanliness

	Variable	Responses	
		<i>N</i>	%
Latrine cleaning methods	Sweep with broom	68	26.2
	Use chemicals	78	30.0
	Use soap and water	96	36.7
	Do not clean	18	7.0
	Total	260	100.0
Latrine cleanliness (Observation)	Faecal matter on floor	18	7.0
	Urine on floor	21	8.0
	Flies on floor	26	10.0
	Floor is clean	195	75.0
	Total	260	100.0

The results (Table 4.4) indicated that the major modes of cleaning were using soap and water (37% of the 260 responses), chemicals (30% of the responses), and sweeping with brooms (26% of the responses). However, some residents (7% of the responses) never bother to clean their toilets. Other methods used to clean toilets included use of ash, mud, soil and plain water. On the other hand, an observation checklist indicated that, most latrine

floors were found to be clean (75% of the responses) relative to those that had faecal matter (7%), urine (8%) and flies (10%) on the floor.

Table 4.5 presents a cross tabulation between latrine cleanliness and the method used in cleaning. The results show that faecal matter was highest in latrines where no cleaning occurred (47%) and where floors were just swept (44%) compared to where chemicals or soap were used (3% and 6%, respectively).

Table 4.5 Relationship between cleaning methods and latrine cleanliness

Latrine cleanliness		Methods of cleaning latrine				Total
		Sweeping	Chemicals	Soap	No cleaning	
Faecal matter	Frequency	8	2	2	6	18
	%	44	3	6	47	
Urine on floor	Frequency	8	4	3	6	21
	%	36	3	10	51	
Flies on floor	Frequency	15	0	6	5	26
	%	58	0.0	8	34	
Floor is clean	Frequency	34	72	88	1	195
	%	17	37	45	1	
Total	Frequency	68	78	96	18	260

Similarly, urine faecal matter and flies were highest with no cleaning (51%, 47% and 34%, respectively) and sweeping (36%, 44% and 58%, respectively) relative to chemicals (3%, 3% and 0.0%, respectively) or soap (10%, 6% and 8%, respectively). On the other hand,

clean floor was associated with use of soap (45%) and chemicals (37%), but not with sweeping (17%) or not cleaning (1%).

Respondents were also asked whether the latrines had hand washing facilities. Most of the pit latrines ($n=156$, 60%) had no hand washing facilities against only 40% ($n=104$) that had. For those with the facilities, most of them ($n=93$, 89%) were located next to latrines compared to only 11% ($n=11$) that were found in houses. Most compounds had no faeces ($n=308$, 95%) relative to only 5% ($n=16$) of them that had faecal matter.

4.3.3 Location of pit latrines

Table 4.6 presents results on factors that influenced the siting of pit latrines.

Table 4.6 Determinants of pit latrine location

Reason for latrine location	Responses	
	N	%
Distance from house	88	34
Distance from source of water	145	55.8
Type of soil	1	0.3
Direction of wind	26	9.9
Total	260	100.0

The most important factors in influencing location of the latrine were distance from source of water (56% of the 260 responses) and distance from the house (34% of the responses). Less considered were the direction of wind (10% of the responses) and the type of soil (0.3%).

An observation checklist (Table 4.7) indicated that eight out of every 10 latrines were located on the leeward side with the remaining ones on the windward side.

Table 4.7 Location of pit latrines

Pit latrine location characteristic	Respondents' rating	Frequency	Percent
Location from dwelling place	Leeward side	208	79.9
	Windward side	52	20.1
	Total	260	100.0
Distance from dwelling place	0 – 10 metres	33	12.7
	11 – 20 metres	62	23.9
	21 – 30 metres	68	26.3
	Over 30 metres	97	37.1
	Total	260	100.0
Distance from source of water	0 – 10 metres	5	1.9
	11 – 20 metres	24	9.2
	21 – 30 metres	123	47.1
	Over 30 metres	108	41.6
	Total	260	100.0

Most latrines were found to be located far from dwelling places (26% and 37% for 21-30 metres and over 30 metres away, respectively) and sources of water (47% and 42% for 21-30 metres and over 30 metres away, respectively). This was consistent with results in Table 4.6 in which most respondents considered the distance from homes and source of water as pertinent factors in the location of latrines.

The observation checklist (Table 4.8) also revealed that only one toilet out of every three toilets provided adequate sanitation (30% of the 260 responses). A significant proportion

of latrines were found to have no cover for squat holes (34% of the 699 responses) and no vent pipes (22% of the 260 responses).

Table 4.8 State of pit latrine

State of latrine	Responses	
	Frequency	%
Adequate sanitation	78	29.9
No superstructure	4	1.6
No door	15	5.9
Slap is not stable	3	1.0
No roof	9	3.6
Filled (contents <1 m from surface)	7	2.6
No vent pipe	56	21.7
No cover for squat hole	88	33.8
Total	260	100.0

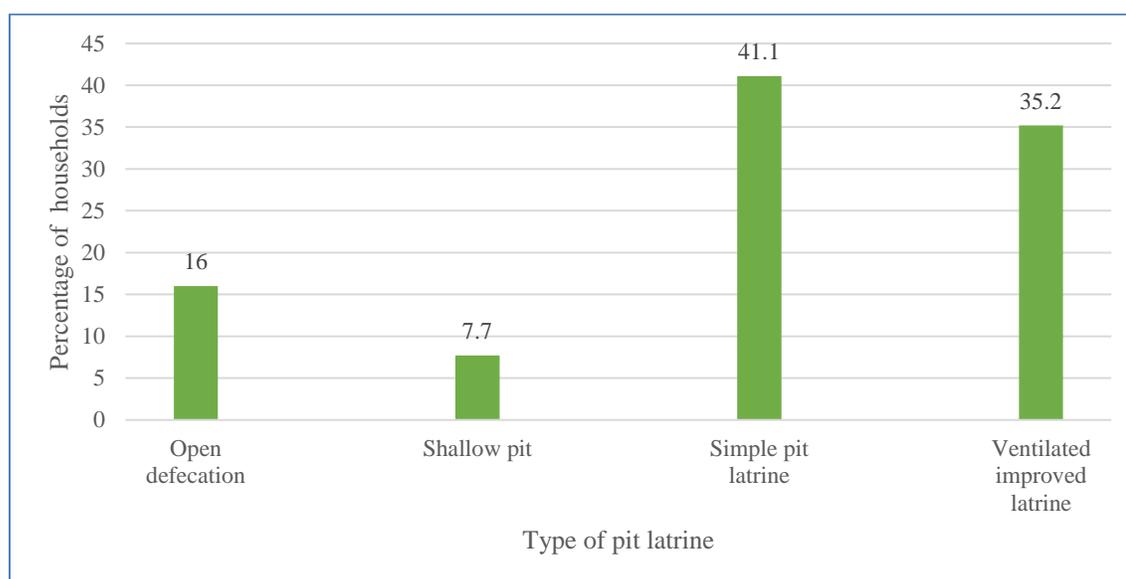
Some latrines also lacked doors (6%), roofs (4%), and superstructures (2%). That less than 3% of the latrines were filled was in line with results presented in Figure 4.4 which showed that most latrines in the study area were in use for less than five years.

4.4 Association between type of pit latrine and Diarrheal diseases

This section presents findings on the relationship between the type of pit latrine in the study area and diarrheal diseases.

4.4.1 Type of pit latrine

Respondents were asked on the type of pit latrine they used. The results (Figure 4.4) showed that most latrines were of simple types ($n=107$, 41%) and ventilated improved types ($n=91$, 35%).



8Figure 4.5 Types of pit latrines in use

However, significant number of homes practiced open defecation ($n=41$, 16%) and used shallow pits ($n=20$, 8%). These results were largely in concert with those from the observation checklist, which indicated 111 (42%) simple latrines, 88 (34%) ventilated improved latrines, 41 (16%) open defecation, and 20 (8%) shallow pits.

Table 4.9 presents results from the observation checklist on the materials used to construct pit latrines.

Table 4.9 Materials used in pit latrine construction

	Pit latrine structure	Responses	
		N	%
Slab	Stones	0	0.0
	Bricks	6	2.3
	Timber	72	27.8
	Iron sheets	4	1.5
	Thatch grass	2	0.8
	Reinforced concrete	171	65.6
	Mud	5	1.9
	Total	260	100.0
Superstructure	Stones	1	0.4
	Bricks	102	39.0
	Timber	42	16.2
	Iron sheets	99	38.2
	Thatch grass	2	0.8
	Reinforced concrete	1	0.4
	Mud	12	4.6
	Reeds	1	0.4
	Total	260	100.0
Roof	Stones	0	0.0
	Bricks	3	1.2
	Timber	2	0.8
	Iron sheets	245	94
	Thatch grass	10	4
	Reinforced concrete	0	0.0
	Mud	0	0.0
	Reeds	0	0.0
	Total	260	100.0

Slabs were predominantly constructed from reinforced concrete (66% of the responses) and timber (28%). Bricks (2%), iron sheets (2%), mud (2%), and grass (1%) were seldom used whereas stones were never used.

Bricks (39% of the responses), iron sheets (38%), and to a lesser extent, timber (16%) were the dominant materials in making latrine superstructure. Materials less commonly used were mud (5%), thatch grass (1%), and stones, concrete, and reed (each less than 1%).

For roofs, the chief material for their construction was iron sheets (94% of the responses). Other materials included grass (4%), bricks and timber (each 1%).

4.4.2 Prevalence of diarrhea

The respondents were asked whether any member of their household had suffered from diarrhea in the past month before the fieldwork for the study. Most respondents ($n=258$, 80%) answered that none of the household members had any case of diarrhea, while some proportion ($n=66$, 20%) said they had (Figure 4.6).

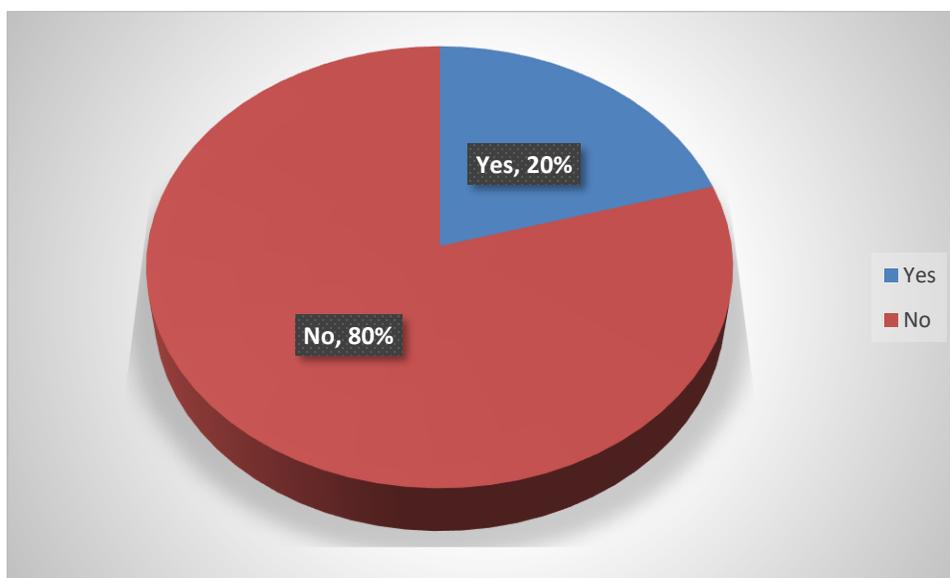


Figure 4.6 Prevalence of diarrhea in the study area

The participants who answered ‘yes’ to the above question were further asked on the probable cause of the diarrhoea and Table 4.10 presents these results.

Table 4.10 Causes of diarrhea

Cause	Responses	
	N	%
Polluted water sources	0	0.0
Poor disposal of human excreta	17	25.0
Contaminated food	38	57.8
Poor hygiene practices	8	12.5
Worm infestation	3	4.7
Total	66	100.0

The results indicated that most respondents thought diarrhoea was caused by contaminated food (58% of the responses), and to a lesser extent, poor disposal of human excreta (25%) and poor hygiene (13%). However, participants did not think that polluted water caused diarrhea while a few (5%) thought that worms could cause the disease.

On the relationship between human excreta and diarrheal diseases (Table 4.11), most (35%) of the respondents stated that houseflies from pit latrines can contaminate food, faeces could contaminate water sources (27% of the 324 responses), and faecal matter provides sites for flies to breed (17%).

Table 4.11 Relationship between human excreta and diarrheal diseases

Factor	Responses	
	N	%
Houseflies from pit latrines contaminate food	112	34.6
Contamination of water by faeces	89	27.4
Poor disposal of faeces attracts animals	67	20.8
Faeces are breeding sites for flies	56	17.2
Total	324	100.0

In addition, 21% of participants (21%) thought that poor disposal of excreta attracts domestic animals that aid in spread of faeces and diseases.

The respondents were also asked on how they could prevent transmission of diseases caused by faecal contamination and the results are presented in Table 4.12.

Table 4.12 Prevention of diseases caused by faecal contamination

Factor	Responses	
	N	%
Sanitary disposal of faeces	80	24.6
Purification of drinking water by chlorination or boiling	58	18.0
Hygienic food storage and preparation	70	21.5
Washing hands after visiting toilet and before handling food	87	26.9
Cover latrines to control breeding of houseflies	29	9.0
Total	324	100.0

The major prevention methods were found to be washing hands after visiting the toilet and before handling food (27% of the 324 responses), sanitary disposal of faeces (25%), hygienic food storage and preparation (22%), and purification of drinking water (18%). Less important was covering latrines to control breeding of houseflies (9%), a result that was consistent with the finding that most residents do not cover squat holes of their latrines. Other participants thought the diseases could be prevented by cleaning toilets using disinfectants and ash and ensuring general hygiene of environment.

4.4.3 Relationship between type of pit latrine and diarrheal diseases

A chi-square (χ^2) cross-tabulation was conducted to test the relationship between the type of pit latrine and diarrheal diseases in the study area. The types of pit latrines were: 'open defecation', 'shallow pit', 'simple pit latrine', and 'ventilated improved latrine'. Diarrheal diseases were classified into whether any member of the household had suffered an episode of diarrhoea in last one month or not. The χ^2 was found to be significant, $\chi^2 (3) = 103.21$, $p < 0.0001$. The cross-tabulation between type of pit latrine and the incidence of diarrhea is shown in Table 4.13.

Table 4.13 Chi-square analysis of the association between type of pit latrine and diarrheal diseases

		<i>n</i> =324	Type of pit latrine				Total
			Open defecation	Shallow pit	Simple pit latrine	VIP Latrine	
Diarrheal attack	Frequency		22	7	112	117	258
	No	%	8.6	2.5	43.6	45.4	100
	Frequency		32	25	6	3	66
	Yes	%	47.7	38.6	9.1	4.5	100
Total	Frequency		54	32	118	120	324
		%	16.9	10.1	36.2	36.7	100

$$\chi^2 (3) = 103.21, p < 0.0001$$

The results showed that amongst the respondents who had diarrhoea, 48% and 39% of them practised open defecation and used shallow pits, respectively, compared to only 9% and 5% who used simple pit and ventilated improved pit latrines, respectively, to dispose of their faeces. Amongst households with no diarrhoea, 45% and 44% used ventilated and simple pit latrines, respectively, while 9% and 3% had open defecation or used shallow pits, respectively. The results showed that, both simple pit latrines and ventilated latrines were not associated with diarrheal diseases whereas open defecation and shallow pits usage were highly correlated with diarrheal incidence.

4.5 Test of the conceptual framework

The conceptual framework of the study theorised that, if pit latrine coverage in the community is high, and in a good working condition and are correctly used to dispose human excreta, then the incidence of diarrheal diseases is likely to be lower and vice versa. In addition, ownership of pit latrines could be influenced by the respondents' education, socio economic factors, cultural beliefs and handwashing practices.

A Multiple Correspondence Analysis (MCA) was conducted to determine the relationship between diarrhea cases (Yes or No) and the household's demographic factors (education and occupation), latrine's sanitation (dirty or clean toilet), ownership of latrine (has or no latrine), and type of latrine (open defecation, shallow pit, simple pit and improved type). The model could explain about 56% of the variance in the original variables (inertia=0.55.55), with dimension one and two accounting for 57% and 55% of the variability, respectively while mean Cronbach's Alpha was 0.73. This suggested that the model fitted the data. The joint plot of category points is presented in Figure 4.7.

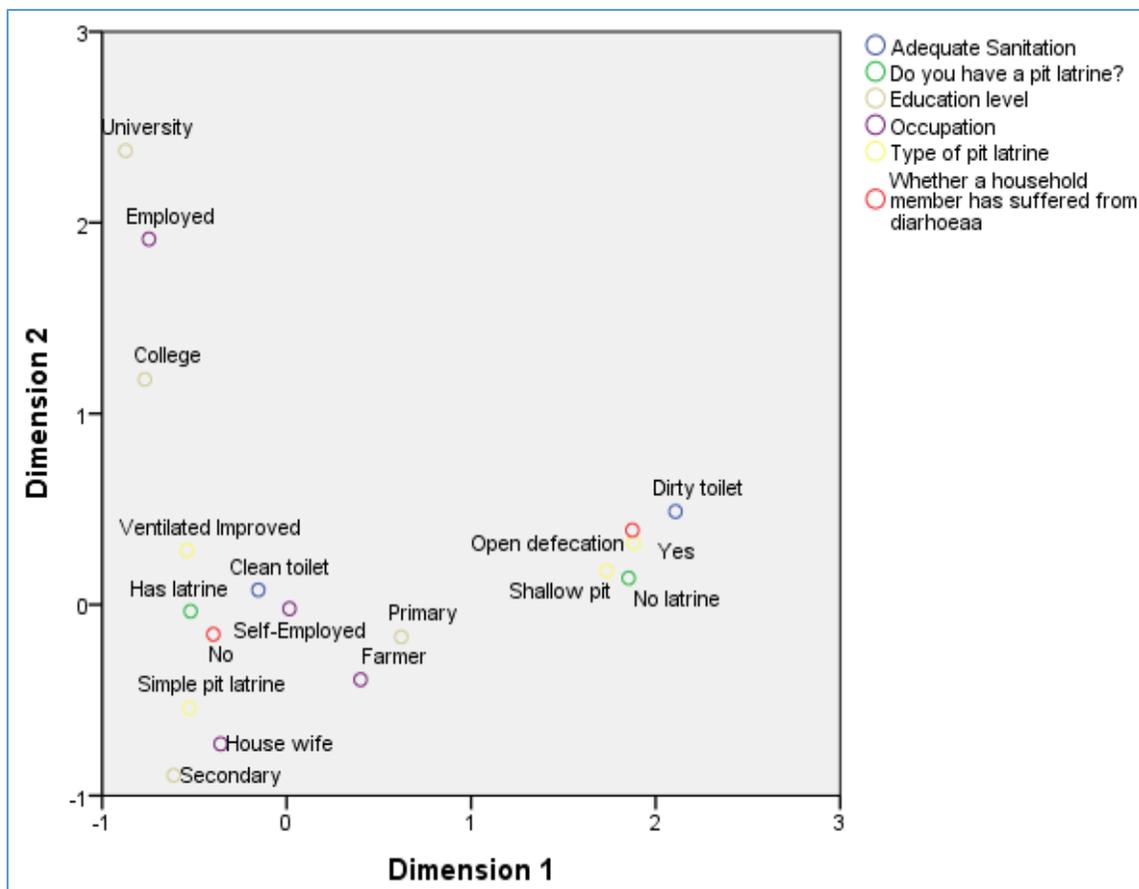


Figure 4.7 Relationship between diarrhea and elements of the study's conceptual framework

'Yes' congregated near 'dirty toilet', 'no latrine', 'open defecation', 'shallow pit', and 'primary' suggesting that diarrhea was associated with residents having primary education, dirty latrines, or those lacking latrines. On the other hand, using clean latrines was associated with lower incidence of diarrhea.

CHAPTER FIVE

DISCUSSION

5.0 Introduction

This chapter discusses the research findings in relation to the study objectives and in context with other studies. The general objective of this study was to assess the use of pit latrine and its association with diarrheal diseases in Mutwot Location of Nandi County, Kenya. Specifically, the study aimed to determine pit latrine coverage, pit latrine use and the association between the type of pit latrine and diarrheal diseases in Mutwot Location.

5.1 Pit latrine coverage

The study found a latrine coverage of 80%, suggesting that although pit latrine coverage in Mutwot Location is substantial, a significant proportion of homesteads lack latrines. This finding is similar to the Kenya Population and Housing Census (KNBS, 2019) report, which showed that, the number of rural households with pit latrines was 73%, 84% and 87% nationally, Nandi county and in Chesumei sub-county respectively. Thus, pit latrine coverage in the location is slightly higher than the national average. Furthermore, it has twice as high latrine coverage compared to KDHS findings of 41% and 37%, of rural households with access to a basic sanitation service, nationally and in Nandi county respectively (KNBS, 2022).

The latrine coverage is also higher compared to the one given by Beyene, *et al*, (2019) which put it at 40% of the total world population and majority (80%) of these people live in rural areas. The coverage extent in the location was found to be similar to the one in

Taita Taveta County, where approximately 86 % of the households in the county had access to toilet facilities (Taita Taveta County Government, 2012).

The JMP report (WHO/UNICEF, 2023), indicates that no country in Africa is on track to achieve universal access to basic sanitation by 2030. It reported that in 2022, only 9% of rural households in Africa have access to basic sanitation. This is an indication that investments on sanitation and hygiene has not been marched by the demand.

The results suggest that Mutwot Location could be doing better with regard to provision of pit latrines. However, given the crucial importance of latrines in minimizing millions of childhood deaths from diarrhea arising from faecal contamination of water and food (Salvato *et al*, 2003), it is important for both the national and county governments and local communities to scale up latrine coverage in the area. For instance, the Water and Sanitation Program (WSP) in 2012 estimated that poor sanitation costs the country about Kshs 27 billion annually, equivalent to US\$8 per person in Kenya per year or 0.9 per cent of the national Gross Domestic Product (GDP). The Kenya Environmental Sanitation and Hygiene Policy (KESHP) 2016-2030, estimated an annual GDP loss of 1-2% due to poor sanitation-related issues (MoH, 2016). KESHP proposes the adoption of sanitation technologies that suit the user's needs and capabilities. For these technologies to gain wider acceptance and adaptability, it should be cost-effective, affordable and appropriate to the needs of population groups including children, women, men, displaced people and persons with disabilities. They must also be environmentally friendly and sustainable, with manageable and affordable operation and maintenance requirements.

This study found that low education levels and economic constraints related to construction costs and acquisition of construction materials, rather than cultural beliefs and lack of

construction skills were strong antecedents in the lack of ownership of pit latrines in the area. Similar results were obtained by Ajemu *et al* (2020); Waithaka (2015), which reported that increased educational attainment of the head of the household positively influenced the households to own latrine at community level. In addition, financial constraints of raw materials needed to construct latrine was a factor in lack of latrines (Ajemu *et al* 2020; Awoke and Muche, 2013; Waithaka, 2015). Similarly, Musyoki (2010) reported that in order to expand coverage; latrines ought to have characteristics of cultural acceptability, affordability, efficiency, sustainability, accessibility, comfortability, hygiene, simplicity, and users' involvement in design. This implied that costly latrines could slow down their adoption by poor segments of society. Significant proportion (58%) of respondents answered that latrines were too expensive to build. The fact that participants cited lack of construction materials as a factor for not putting up toilets could also be adduced to their economic constraints. The slow uptake of Ventilated Improved Pit (VIP) latrines introduced by the Ministry of Health (MOH), could imply that, the designs were not affordable to the majority of Kenyans (MOH, 2007). The lack of cultural reasons in explaining construction of toilets suggested that participants generally accepted that latrines were the best facilities for disposing human excreta.

5.2 Pit latrine use

The study found that respondents who had pit latrines predominantly (98%) used them, with footpaths to the latrines generally visible and not overgrown by grass. This was in line with the findings of Ajemu *et al*, (2020); Awoke and Muche (2013) which reported that majority of constructed latrines were utilized by household members. The results suggest that residents in the location had minimal cultural disincentives for not using the

toilets, which was similar to findings by Jimenez *et al.* (2014). Although socio-cultural beliefs did not significantly influence the use of pit latrines, those who felt they were pertinent were of the opinion that the following groups should not share toilets: adults and children, and in-laws of opposite sex. This finding was consistent with Cairncross & Feachem (1993) who found that sons-in-law and mothers-in-law avoid using the same toilet. Similarly, findings by Nkatha, *et al.*, (2020), suggest that, sharing toilets among males and females was a taboo. This practice was more pronounced among newly circumcised young men, who feel they cannot use the same toilets with their mothers.

A sizeable proportion of latrines could not be used by children, the aged and persons with disabilities. Considering that, children under the age of five years are the most vulnerable with respect to diarrheal diseases caused by unsafe disposal of stool, (Bawankule, *et al.*, 2017) and subsequent contamination of water and food, this could be a possible contribution to the cases of diarrhea observed in the location.

The KDHS (2022) report, indicated that majority (72% and 92% nationally and in Nandi county respectively) of children's stool in rural areas was disposed of appropriately. The child's stool was either put or rinsed into a latrine or child used a latrine. Furthermore, the report showed that, some households practiced poor disposal methods for children's stool, with 6% leaving it in the open and 9% throwing it with other household garbage. This finding was in line with the KDHS (2014) report, where 81% of children's stool among rural households were safely disposed. Poor disposal of children's stool can be an easy source of contamination of household environment, food and drinking water.

The elderly may encounter difficulties in carrying out some self-care activities, such as walking to a latrine and squatting to defecate. Hans (2023) stated that water and sanitation

services must be sufficient, safe, physically accessible, and inexpensive for older persons. Environmental, institutional, attitudinal, and social hurdles can prohibit older individuals from accessing routine sanitation services. Furthermore, this finding was in line with that of Mactaggart, *et al*, (2018) which stated that most people with disabilities faced the risk of coming into direct contact with faeces when they used the same sanitation facility as other household members. They therefore resorted to open defecation, increasing the risk of both diarrheal disease and hygiene-related stigma.

This study found that two out of every ten households shared their latrine with other households. This finding was consistent with previous studies, for instance, KDHS (2022) findings which showed that, 16% and 19% of households shared latrines, nationally and in Nandi county respectively. It further categorised households with shared latrines as having limited access to sanitation facilities, hence off-target of SDGs. Similarly, the KDHS (2014) indicated that 15% of rural households used shared sanitation facilities.

This was further reflected in the WHO/UNICEF (2012), MOH (2007) and WRI (1998) which have reported that shared sanitation was largely an urban phenomenon, with over 60% of urban dwelling people using this type of facility. This result was also in conformity with the findings of Simiyu, *et al* (2020) who reported that, shared latrines is a common practice in poor settlements of Kisumu city in Kenya. Such shared sanitation is faced with challenges such as high number of users and high fill up rates and uncleanness. Dirty latrines resulted from improper use or disposal of human faecal matter on the slab, with accompanying foul odour, which discouraged others from using the latrines.

The JMP (WHO/UNICEF, 2002), considers shared sanitation facilities as unimproved, due to lack of privacy and associated poor hygiene. In sparsely populated rural areas, the

distance from one home to the next might be great, making sharing of latrines impractical, especially at night (Musyoki, 2010). Sharing of latrines were observed especially in homes with extended families. Shared sanitation facilities could also be a sign of low income levels within households, who prefer to pull resources for construction of latrines. However, the Kenya Rural Sanitation and Hygiene (RuSH) protocol (MOH,2023) accepts shared use of a latrine/toilet provided the total number of users is less than 10-15 people (adults and children).

Latrines in the study were found to be fairly deep, with most of them having a depth of over 20 feet. The recommended depth for a pit latrine is a minimum of 5 metres or 16 feet, depending on the nature of the soil and the level of ground water (Rukunga, 2001). Given the per capita excreta output of between 0.02 m³ for a slightly wet pit (mixture of excreta and water) (Morgan, 1994), it follows that a family consisting of ten members will produce an excreta volume of about 1m³ in five years (0.02 m³ x 10 members x 5 years). Thus, a latrine with a depth of over 20 feet would be expected to cater for single family for several years. Nevertheless, most toilets in the study area were found to have been in use for a relatively short period of less than five years. This suggested that most latrines were of recent construction, implying that toilet expansion in the area might be a recent phenomenon. This was comparable to a study by Awoke and Muche (2013) which found out that 53% of latrines had been in use for two or more years. In addition, the reasonable depth of the toilets in the area reduces breeding of flies due to less light (Morgan, 1994). A pit is considered full when the deposited excreta reaches approximately 0.5 - 1.0 m below the slab (Orner, *et al*, 2018). When the filled level of the pit is reached, the contents (faecal sludge) can either be removed, or filled with soil and another latrine constructed.

The study found a strong correlation between methods used in cleaning latrines and their cleanliness. For example, faecal matter on the floor, urine and flies were highest in latrines where no cleaning occurred and where floors were just swept compared to where chemicals or soap were used. This was in tandem with findings by Rukunga (2001), Morgan (1994) and Franceys, *et al.* (1992). Simiyu, *et al* (2020) obtained similar findings on the use of materials such as water, brooms and detergent to facilitate cleaning. Latrines were cleaned to prevent foul smell from infiltrating into the houses, especially when the houses were next to the toilets and to reduce the risk of spread of diarrheal disease.

Most of the latrines were found to have no hand washing facilities (whether next to latrines or in houses), suggesting that some residents do not wash their hands after visiting the toilet. This result was in conformity with the finding of Awoke and Muche (2013), in which an overwhelming majority of households had no handwashing facility. Yet this is important in breaking the oral-faecal transmission cycle by ensuring that pathogens on dirty hands emanating from latrines do not contaminate food, water, or are inadvertently transferred to the mouth (Nordberg, 1999). Similar findings were made by KDHS (2022), where 57% and 34% of rural households nationally and in Nandi county respectively, lacked a basic handwashing facility. Previous studies have shown that, handwashing with soap and water, significantly reduces the risk of leading causes of child mortality, including diarrhoea (UNICEF, 2013; GHP, 2020; Awoke and Muche, 2013). Handwashing is an easy and cost-effective practice that can greatly improve people's health and avert preventable deaths.

The study found that distance from source of water and house were crucial factors in siting of latrines. This was in conformity with environmental protection norms (USAID, 2018),

which recommends a distance of at least 30 metres and 10 to 15 metres from the source of ground water and from the house respectively. This distance will reduce the risk of ground water contamination and allow the young, the elderly and the sick easy access to the latrines. Less considered was direction of wind and soil type. Nevertheless, the results indicated that eight out of every ten latrines were located on the leeward side. Given that most residents did not consider the direction of wind in the location of latrines, the results suggested that the location of most toilets on the leeward side could be inadvertent.

Latrine slabs were constructed mainly from reinforced concrete and timber while bricks and iron sheets were the major materials making up the superstructure. For roofs, the chief material for their construction was iron sheets. A greater number of ventilated improved latrines in the study area might explain the common use of these materials. The design, construction, management and use should ensure that users are safely separated from excreta (WHO, 2018 and MOH, 2016). The slab should be raised, with a smooth, impervious floor, without cracks and made of durable material that can be easily cleaned. The superstructure should not allow for intrusion of rain or storm water run-off, animals or insects. Pit latrines should provide privacy and dignity for the user, without getting their feet or clothes dirty. It should be easy to be cleaned and maintained for proper and long-term functioning.

The study revealed that only a third of latrines provided adequate sanitation. The KESHP (MOH,2016) defines adequate sanitation facility as one that confers privacy to the user and allows for safe disposal of human waste without human contact (MOH, 2016). This result conforms with a similar study (WHO/UNICEF, 2023) in which 31% of rural population in

Africa used safely managed sanitation. This indicates that the attainment of SDG targets on sanitation and hygiene is off-track.

5.3 Association between type of pit latrine and diarrheal diseases

The study found that latrines in the area consisted of mostly simple pits, followed by ventilated improved types, but significant number of households practiced open defecation and used shallow pits. This trend supported the finding by the MOH (2007), which reported that a majority of all excreta disposal facilities in Kenya were simple pit latrines. In addition, this result is in conformity with the findings of both Kenya Population and Housing Census (2019) and KDHS (2022) which showed that most of the toilets comprised a pit latrine with a slab (simple pit). It is also in line with the findings of Shama *et al* (2023), where majority of households had a pit latrine with a slab, followed by those with VIP latrines, while the rest had unimproved latrines.

However, the results from this study showed a greater proportion of ventilated improved latrines relative to simple pit, suggesting that more people might have put up the improved types. This is important as improved latrines reduce odours and flies that spread diseases (Rukunga, 2001; MOH, 2007). The percentage of respondents who reported open defecation reflected the finding by KDHS (2014) which indicated that 16% of Kenyan households have no toilet facility and Musyoki (2010) who approximated that 18% of Kenyan rural populations practice open defecation. The results show that Mutwot Location, and the larger County have considerable work to do before they can qualify as Open Defecation Free (ODF), a Sustainable Development Goal. In Kenya, Busia County

was the first to be certified as ODF while Isiolo, Siaya and other counties, have made good progress towards becoming ODF (UNICEF and WHO, 2015).

The KESHP (MOH, 2016) bestows the responsibility for rural sanitation and hygiene upon households and communities towards an open defecation free (ODF) environment. Government agencies and sector partners, are expected to support demand creation through sensitization and awareness for appropriate excreta disposal. The policy further encourages the adoption of sustainable, affordable and appropriate technology options that meet the needs of all population groups in communities, including children and persons with disabilities.

The study found a diarrheal prevalence of 20% in the area. This finding was comparable to the study by Awoke and Muche (2013) which showed that 13% of children under five years suffered from diarrheal diseases. The respondents correctly thought that diarrhoea was caused by contaminated food, poor disposal of human excreta and poor hygiene. This result was consistent with that of Waithaka (2015), which found out that a person was at risk of diarrheal disease if the neighbour practiced open defecation. However, participants did not think that polluted water caused diarrhoea, while a few thought that worms could cause the disease. The results suggested that some residents are ignorant of the mode of transmission of sanitation-related diseases, for instance, diarrhoea. Public health education is important for such people since the National Environmental Sanitation and Hygiene Policy (MOH, 2007), shows that, about 50% of all preventable illnesses, seen in hospitals are water, sanitation and hygiene related. It may be no wonder then, that UNICEF and WHO (2015) estimated that only 5% of the Kenyan population wash their hands with soap and water after visiting the toilet. The low proportions of participants who correctly named

methods for preventing diarrhoea (washing hands after latrine visit; sanitary disposal of faeces; and hygienic food storage and preparation) supported this finding.

A chi-square test found that simple pit latrines and ventilated latrines were not associated with diarrheal diseases, whereas open defecation and shallow pits usage were highly correlated with diarrheal incidence. This finding is in line with that of Waithaka (2015), which showed that, majority of household members without latrines suffered from sanitation related diseases. The relationship between unsanitary disposal of faeces and diarrheal diseases is well-documented (Rukunga, 2001; Nordberg, 1999; Franceys, *et al*, 1992). Briefly, when open defecation or shallow pits are used, pathogen stages (cysts, eggs, infectious agents) in faeces released by infected individuals contaminate water sources, food, soils, hands, animals or animal products. When susceptible individuals ingest contaminated food or water, the pathogens pass into their bodies, initiating new infections. Flies, by moving from open excreta and hopping on human food, spreads pathogens to food, which are then ingested. The study also found that diarrhoea tended to be associated with residents having primary education, dirty toilets, or those lacking latrines. Dirty toilets or absence of latrines causes diarrhoea because of the inevitable unsanitary disposal of faeces. Respondents with primary education were correlated with diarrheal diseases because most of them are likely to lack latrines in their homesteads.

CHAPTER SIX

CONCLUSIONS AND RECOMMENDATIONS

6.1 Conclusion

This study assessed the availability and use of pit latrine and its association with diarrheal diseases in Mutwot Location of Nandi County, Kenya. The pit latrine coverage in the Location was substantial. However, a significant proportion of households still lacked latrines. Low levels of education and economic constraints related to construction costs and acquisition of construction materials, were strong antecedents in the lack of ownership of pit latrines in the area.

An overwhelming majority of the latrines were in use. However, some latrines could not be used by children, the elderly and persons with disability. Latrine design and physical state of the latrines increases the risk of these set of individuals from coming into direct contact with excreta, when they used the same sanitation facility as other household members. They therefore resort to open defecation, increasing the risk for both diarrheal disease and hygiene-related stigma.

Most of the latrines lacked a basic handwashing facility, implying that some respondents do not wash their hands after using the latrines, yet this is an easy and cost-effective practice that can improve people's health by breaking the oral-faecal transmission cycle. There is a strong correlation between latrine cleaning methods and their cleanliness. Use of chemicals and soap reduces flies and foul smell infiltrating the dwelling places, hence reducing the risk of spread of diarrheal disease. In addition, clean latrines encourage their use, boosts self-esteem and reduces the chances of open defecation.

The location or siting of most latrines was in conformity with environmental protection norms, especially in regard to distance from the source of water, dwelling places and direction of wind. Even though the physical state of most latrines was good, only a third of latrines provided adequate sanitation (providing privacy to the user and allows for safe disposal of human waste without human contact).

The major sanitation facility were simple pit latrines, followed by ventilated improved types, but some households practiced open defecation and use of shallow pits. The area has considerable work to do before they can qualify as Open Defecation Free (ODF), a Sustainable Development Goal. A significant proportion of the residents are at risk and ignorant on the mode of transmission of diarrheal diseases. Simple pit latrines and ventilated latrines were not associated with diarrheal diseases, whereas open defecation and shallow pits usage were highly correlated with diarrheal incidence.

6.2 Recommendations

This study recommends the following:

Health care personnel should initiate Community-Led Total Sanitation approaches to scale up efforts towards an open defecation free environment by encouraging community and household members to adopt sustainable, affordable and appropriate technology options using cheap and locally available materials in the design, construct and maintenance of pit latrines.

Health promotion providers should sensitize community members with low education level with key messages on the importance of a pit latrine and the relationship between poor disposal of human excreta and diarrheal diseases.

Universal access to basic sanitation is a human rights issue, therefore the Nandi County health department should ensure that pit latrines are constructed in a way that allows children, the elderly, and persons with disability to comfortably use them. This may include support for development of sanitation facilities for indigent households.

The County Government of Nandi should integrate the Kenya Environmental, Sanitation and Hygiene Policy (2016–2030) into the County Integrated Development Plan (CIDP). This will ensure appropriate and adequate financing to promote access to environmental, sanitation and hygiene services across the county.

6.3 Further research

The study assessed pit latrine use in the prevention of diarrheal diseases in Mutwot Location of Nandi County. Studies could be conducted in other locations within the county in order to determine the extent of pit latrine coverage and use. This study used a descriptive cross-sectional design in collecting the relevant data. Other designs, such as, longitudinal studies, might be conducted to monitor the long-term performance of the area with respect to construction of latrines.

REFERENCES

- Abubakar, I. S. (2017). Access to Sanitation Facilities among Nigerian Households: Determinants and Sustainability Implications. Retrieved from: <https://www.mdpi.com/2071-1050/9/4/547>
- Ajemu, K. F., Desta, A. A., Berhe, A. A., Woldegebriel, A. G., and Bezabih, N. M. (2020). Latrine Ownership and its Determinants in Rural Villages of Tigray, Northern Ethiopia: Community-Based Cross-sectional Study. Retrieved from: <https://www.researchgate.net/publication/343720815>
- Awoke, W. and Muche, S. (2013). A cross sectional study: Latrine Coverage and Associated Factors Among Rural Communities in the District of Bahir Dar Zuria, Ethiopia. *BMC Public Health* **13**, 99 (2013). Retrieved from: <https://bmcpublikealth.biomedcentral.com/articles/10.1186/1471-2458-13-99#>
- Bawankule, R., Singh, A., Kumar, K. and Pedgaonkar, S. (2017). Disposal of children's stools and its association with childhood diarrhea in India. Retrieved from: <https://bmcpublikealth.biomedcentral.com/articles/10.1186/s12889-016-3948-2>
- Beyene, D. T., Tucho, A. E. and Moga, T.T (2019). Effect of latrine utilization on diarrhea diseases in Abukako Kebele, Jimma, South west, Ethiopia. Retrieved from: <https://www.interestjournals.org/-18302.html>
- Booth, W., Colomb, G. and Williams, J. (2008). *The craft of research*, 3rd Edition. The University of Chicago Press: Chicago. ISBN 0226065650, 9780226065656, Retrieved from: <https://books.google.co.ke/books/>
- Busienei, P.J., Ogendi, G.M and Mokuu, M.A. (2019). Latrine Structure, Design, and Conditions, and the Practice of Open Defecation in Lodwar Town, Turkana County, Kenya: A Quantitative Methods Research. Retrieved from: <https://journals.sagepub.com/doi/10.1177/1178630219887960>
- Cavill, S., Chuktu, N., Farrington, M., Hiscock, D., Muturi, C., Nath, P. and Staunton, M. (2022). Wash and Older People. SLH Learning Paper. Issue 12. SHL Learning Paper. Retrieved from: <https://reliefweb.int/report/world/wash-and-older-people-march-2022-issue-12>
- Centre for Affordable Water and Sanitation Technology (2011). Introduction to Low Cost Sanitation. Latrine Construction. Retrieved from: https://sswm.info/sites/default/files/reference_attachments/CAWST%202011
- Coffey, D., Gupta, A., Hathi, P., Spears, D., Srivastav, N. and Vyas, S. (2016). Understanding open defecation in rural India: Untouchability, pollution, and latrine pits. F-35114-INC-2. Retrieved from: <https://www.theigc.org/sites/default/files/2017/07/coffey-et-al-2016-working-paper.pdf>

- Creswell, J. W. (2014). *Research design: Qualitative, quantitative, and mixed methods approaches*, 4th edition. ISBN 1916-4742. Thousand Oaks, CA: Sage. Retrieved from: <https://www.researchgate.net/publication/332246566>
- Dagneu, G. G., Abebaw, A. F., Wake, S. L. and Derso, A. G. (2019). Assessment of Latrine use and Associated Factors among Rural Community Members in Chiro Zuria Woreda Particularly in Kilinso and Nejebas Kebele. Retrieved from: <https://www.walshmedicalmedia.com/open-access>
- Field, A. (2005). *Discovering statistics using SPSS (2nd Edition)*. London: Sage.
- Franceys R., Pickford J. and Reed R. (1992). *A Guide to the Development of On-Site Sanitation*, World Health Organization, Geneva.
- Gifi, A. (1990). *Nonlinear Multivariate Analysis*, John Wiley and Sons.
- Global Handwashing Partnership (2020). *The Handwashing Handbook*. Retrieved from https://globalhandwashing.org/wp-content/uploads/2020/10/GHP_Handwashing-Handbook_FINAL.pdf
- Grimason, A. M, Davison, K., Tembo, K. C, Jabu, G.C, and Jackson, M.H (2000). Problems associated with the use of pit latrines in Blantyre, Republic of Malawi. Retrieved from: <https://www.researchgate.net/publication/12249542>
- Hans, V.B. (2023). *Elderly Sanitation*. Retrieved from: <https://papers.ssrn.com/sol3/papers>.
- Hartmann, M., Krishnan, S., Rowe, B., Hossain, A., and Elledge, M. (2015). *Gender-Responsive Sanitation Solutions in Urban India*. Retrieved from: <https://www.ncbi.nlm.nih.gov/books/NBK512957/>
- International Institute for Environment and Development (2010). *61 Participatory Learning and Action. Tales of Shit: A Community-Led Total Sanitation in Africa*. ISBN: 9781843697824. Retrieved from: <https://www.iied.org/14579iied>
- Jimenez A., Cortobius M. and Kjellen M. (2014). Water, Sanitation and Hygiene and Indigenous Peoples: A Review of the Literature. *Water International*, 39, 277-293. Retrieved from: <https://www.researchgate.net/publication/262344841>
- Kabir, S.M.S (2016). *Basic Guidelines for Research: An Introduction Approach for All Disciplines*. Book Zone Publication, ISBN: 978-984-33-9565-8, Chittagong-4203, Bangladesh. Retrieved from: <https://www.researchgate.net/publication/325390597>
- Kar, K. and Chambers, R. (2008). *Handbook on Community-Led Total Sanitation*. Retrieved from: <https://plan-international.org/uploads/2022/01/2008>
- Kenya National Bureau of Statistics (2008-09). *Kenya Demographic and Health Survey*.

- Kenya National Bureau of Statistics (2009). Housing and Population Census
- Kerlinger, F.N (1986). Foundations of behavioural research. Harcourt Brave Jovanovich.
- Lahiri, S., Yegbemey, R.N, Goel, N., Mathew, L and Puri, J. (2017). Promoting Latrine Use in Rural India. Scoping Paper 8. New Delhi. International Initiative for Impact Evaluation (3ie). Retrieved from: <https://www.researchgate.net/publication/319349582>
- Mactaggart, I., Schmidt, W.P., Bostoan, K., Chunga, J., Danquah, L., Halder, A.K., Jolly, S.P., Polack, S., Rahman, M., Snel, M., Kuper, H., Biran, A. (2018). Access to Water and Sanitation Among People with Disabilities: Results from Cross-sectional Surveys in Bangladesh, Cameroon, India and Malawi. Retrieved from: <https://bmjopen.bmj.com/content/8/6/e020077>
- Ministry of Health (2012). Community-Led Total Sanitation (CLTS): Facilitators Manual, 3rd Edition. Ministry of Health, Nairobi.
- Ministry of Health (2014). Protocol for Implementation of CLTS in Kenya
- Ministry of Health (2016). Kenya Environmental Sanitation and Hygiene Policy (KESHP) 2016–2030
- Ministry of Health (2016). Kenya Environmental Sanitation and Hygiene Strategic Framework (KESSF) 2016–2020. *Towards Universal Access to the Highest Standard of Sanitation.*
- Ministry of Health (2023). Kenya Rural Sanitation and Hygiene Protocol
- Morgan P. (1994). Rural Water Supplies and Sanitation. A Text from Zimbabwe's Blair Research Laboratory. Macmillan Publishers, Harare.
- Mugenda, M. And Mugenda G. (2003). *Research methods: quantitative and qualitative approaches.* Nairobi, Kenya: ACTS Press.
- Musyoki S.M. (2010). Scaling Up CLTS in Kenya: Opportunities, Challenges and Lessons. Retrieved from: <https://www.iied.org/sites/default/files/pdfs/migrate/G02806>.
- Naidoo J. and Willis J. (2009). *Foundations for Health Promotion: Public Health and Health Promotion Practice.* Third Edition. Bailliere Tindall Elsevier, London
- Nkatha, S., Muteti, P., Muchiri, E. and Ruto, J. (2020). Effect of Knowledge and Culture on Utilization of Pit Latrines in Tigania East, Meru County, Kenya. Retrieved from: <https://www.researchgate.net/publication/34490593>
- Noordzij, M., Tripepi, G., Dekker, F., Zoccali, C., Tanck, M., & Jager, K. (2010). Sample size calculations: Basic principles and common pitfalls. Retrieved from: <https://pubmed.ncbi.nlm.nih.gov/20067907/>

- Nordberg E. (1999). *Communicable Diseases. A Manual for Health Workers in Sub-Saharan Africa*, Third Edition. Rural Health Series No. 7. African Medical and Research Foundation.
- Nunbogu, A. M., Harter, M. and Mosler, H. (2019). Factors Associated with Levels of Latrine Completion and Consequent Latrine Use in Northern Ghana. *Retrieved from: <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6466048/>*
- Omotayo, A.O., Olagunju, K.O., Omososo, A.B., Ogunniyi, A., Otekunrin, O.A. and Daud, A.S. (2021). Clean Water, Sanitation and Under-Five Children Diarrhea Incidence: Empirical Evidence from The South Africa's General Household Survey. *Retrieved from: https://www.researchgate.net/publication/352998401_*
- Orner, K., Naughton, C. and Stenstrom, T. (2018). Pit Toilets (Latrines). Part Four, Management of Risk from Excreta and Wastewater. Global Water Pathogen Project. *Retrieved from: [https://www.waterpathogens.org/sites/default/files/Pittoilets \(latrines\)_0.pdf](https://www.waterpathogens.org/sites/default/files/Pittoilets%20(latrines)_0.pdf)*
- Pandey, P. and Pandey, M.M (2015). *Research Methodology: Tools and Techniques*. Bridge Center, ISBN: 978-606-93502-7-0. *Retrieved from: <https://www.euacademic.org/BookUpload/9.pdf>*
- Plan and Water Institute-University of North Carolina (UNC) (2015). *Community-led Total Sanitation in Kenya: Findings from a Situational Assessment*. *Retrieved from: <https://archive.ids.ac.uk/clts/sites/>*
- Rukunga G. K. (2001). *Environmental Health for East Africa: Rural Health Series, No. 16*. African Medical and Research Foundation (AMREF).
- Salvato A. J, Nemerow L. N. and Agardy J. F. (2003). *Environmental Engineering*, 5th Edition, John Wiley & Sons, New Jersey. *Retrieved from: <https://books-library.net/files/download-pdf-ebooks.org-1494689915.pdf>*
- Sara, S. and Graham, J. (2014). Ending Open Defecation in Rural Tanzania: Which Factors Facilitate Latrine Adoption? *Retrieved from: <https://www.researchgate.net/publication/265876949>*
- Saunders, M., Lewis, P., & Thornhill, A. (2009). *Research Methods for Business Students*. London, UK: Pearson Education.
- Shama, A. T., Terefa, D. R., Geta, E.T., Cheme, M.C, Biru, B., Feyisa, J.W., Lema, M., Desis, A.E., Feyisa, B.R., and Gebre, D.S. (2023). Latrine Utilization and Associated Factors Among Districts Implementing and Not-Implementing Community-Led Total Sanitation and Hygiene in East Wollega, Western Ethiopia: A Comparative Cross-Sectional Study. *Retrieved from: <https://pubmed.ncbi.nlm.nih.gov/37440482/>*

- Simiyu, S.N., Kweyu, R.M., Antwi-Agyei, P. and Adjei, K.A (2020). Barriers and opportunities for cleanliness of shared sanitation facilities in low-income settlements in Kenya. Retrieved from: <https://bmcpublihealth.biomedcentral.com/articles/10.1186/s12889-020-09768-1>
- Tabachnick, B. G. and Fidell, L.S. (2013). Using multivariate statistics (5th ed.). Allyn & Bacon. Pearson Education.
- Taita Taveta County Government, (2012). The first Taita Taveta County integrated development plan. “Supporting quality of life for the people of Taita Taveta.” Retrieved 18th January 2018 from <http://ke.boell.org/sites/default/files/uploads>
- UNESCO (2013). Education transforms lives
- UNICEF (2013). Handwashing Promotion. Monitoring and Evaluation Module. Retrieved from <https://www.unicef.org/media/91326/file/Handwashing-MandE-Module.pdf>
- UNICEF (2015). Water, sanitation and hygiene. The case for support. Retrieved from: <https://library.alnap.org/help-library/>
- UNICEF and WHO (2015). Progress on Sanitation and Drinking Water. 2015 update and MDG Assessment. UNICEF and World Health Organization, New York. Retrieved from: https://iris.who.int/bitstream/handle/10665/177752/9789241509145_eng.pdf
- UNICEF/Kenya (2018). Water, Sanitation and Hygiene (WASH) Programme: Impact Report.
- United Nations (2018). Sustainable Development Goal 6 Synthesis Report 2018 on Water and Sanitation: Retrieved from: <http://www.unwater.org/un-reports-thatworld-is-off-track-on-water-and-sanitation-goal/>
- United States Agency for International Development (USAID), 2018. Latrine Construction Manual (Retrieved from: <https://pdf.usaid.gov>)
- Viswanathan, S., Saith, R., Chakraborty, A., Purty, N., Malhotra, N., Singh, P., Mitra, P., Padmanabhan, V., and Datta, S (2020). Improving Households’ Attitudes and Behaviours to Increase Toilet Use in Bihar, India. Impact Evaluation Report 118. International Initiative for Impact Evaluation. Retrieved from: <https://3ieimpact.org/sites/default/files/2020-04/IE118-TW14.1005->
- Waithaka, R.W. (2015). Latrine Use and Associated Factors Among Rural Community Members in Samburu East Sub-county, Samburu County, Kenya. Retrieved from: <https://ir-library.ku.ac.ke/handle/123456789/13234>
- Water Aid (2015). WASH and Gender Equality. Retrieved from: [https://www.google.com/=Water+Aid+\(2015\)](https://www.google.com/=Water+Aid+(2015))

- Water and Sanitation Program (2012). Economic Impacts of Poor Sanitation in Africa. Retrieved from: <https://documents1.worldbank.org/curated/en/820501468272057686/pdf/681230WSP0ESI007B00PUBLIC00brochure.pdf>.
- Water, Engineering and Development Centre (2014). Pour-flush Latrines. Loughborough University. Guide 26. ISBN 978 1 84380 157 3. Retrieved from: <https://wedc-knowledge.lboro.ac.uk/resources/booklets/G026>
- Water, Engineering and Development Centre (2014). Simple Pit Latrines. Loughborough University. Retrieved from: <https://wedc-knowledge.lboro.ac.uk/resources/booklets/G025>
- Water, Engineering and Development Centre (2014). Ventilated Improved Pit Latrines. Loughborough University. ISBN 978 1 84380 175 7. Retrieved from: <https://wedc-knowledge.lboro.ac.uk/resources/booklets/G027>
- Water, Engineering and Development Centre (2017). Pit Latrines for Special Circumstances. Loughborough University. Mobile Note 25. Retrieved from: <https://wedc-knowledge.lboro.ac.uk/resources/e/mn/025>
- Wendland, C., Yadav M., Stock, A. and Seager, J. (2017). Gender, Women and Sanitation: Retrieved from: <http://www.unesco.org/openaccess/terms-use-ccbysa-en>.
- WHO (2018). Guidelines on Sanitation and Health. ISBN 978-92-4-151470-5. Retrieved from: <https://iris.who.int/bitstream/handle/10665/274939/9789241514705eng.pdf>
- WHO/UN, (2012). *UN-Water Global Analysis and Assessment of Sanitation and Drinking-Water (GLAAS): The Challenge of Extending and Sustaining Services*. Retrieved from, <http://www.un.org/waterforlifedecade>.
- WHO/UNICEF (2019). Factsheet: World Toilet Day. Retrieved from: <https://www.globalwaters.org/events/world-toilet-day-2019-leaving-no-one-behind>
- WHO/UNICEF, (2012). Progress on Drinking Water and Sanitation. Global Water and Sanitation Assessment Report. The Joint Monitoring Programme (JMP) For Water Supply and Sanitation. Retrieved from, http://www.unicef.org/media/files/JMPreport_2012
- WHO/UNICEF, (2023). Progress on Sanitation and Hygiene in Africa (2000-2022). Global Water and Sanitation Assessment Report. The Joint Monitoring Programme (JMP) For Water Supply and Sanitation. (Retrieved from, JMP_GLAAS_2023_regional_snapshot_Africa.pdf)
- Wilbur, J. (2011). Principles and practices for the inclusion of disabled people in access to safe sanitation: A case study from Ethiopia. Retrieved from: <https://www.researchgate.net/publication/293081363>

- Wood C, Ngatia P, Nyakwana T, Oirere B, Rabar B. and Waithaka M. P. (2008). Community Health, Third Edition. AMREF, Nairobi.
- World Bank/Water and Sanitation Program (2017). End of Year Report, Fiscal Year 2017. Retrieved from: <https://thedocs.worldbank.org/en/doc/789471524857588277-0090022018/original/WSPFY17>
- Yassi A., Kjellstrom T., de Kok T. and Guidotti L. T. (2001). Basic Environmental Health, Oxford University Press, New York.
- Yazici, A., Ogus, E., Ankarali, H. and Gurbuz, F. (2010). An application of nonlinear canonical correlation analysis on medical data. *Turk J Med Sci*, 40 (1):1-7.
- Yimam, Y.T., Gelaye, K. A., and Chercos, D. H. (2014). Latrine utilization and associated factors among people living in rural areas of Denbia district, Northwest Ethiopia, 2013, a cross-sectional study. Retrieved from: <https://pubmed.ncbi.nlm.nih.gov/25478055/>

APPENDICES

Appendix I: Consent Form

Study Title: Pit Latrine Use in the Prevention of Diarrheal Diseases in Mutwot Location, Nandi County, Kenya.

Investigator: Korir Charles Cheruiyot; Master of Public Health Graduate Student of Moi University, College of Health Sciences, School of Public Health, Department of Health Policy, Management and Human Nutrition.

Purpose: The research intends to assess whether pit latrine coverage, status, type and use by community member's influences prevention of diarrheal diseases.

Procedure: The research will involve the use of Researcher-administered questionnaires to household heads or their representatives to determine the coverage, use of pit latrine and prevalence of diarrheal diseases. An observation checklist will be used to record availability, type, location, construction materials used, maintenance and level of cleanliness of pit latrines.

Benefits: There will be no direct benefit from participating in the study. However, the findings and recommendations from the study will benefit healthcare stakeholders (Community and Health care providers) in making decisions on human waste disposal.

Risks: There is no risk associated with participating in this study.

Confidentiality: All the information will be considered confidential.

Right to refuse: Your participation in this study is entirely voluntary. If you consent, please indicate so by signing this form:

Signature (Thumb Print) of participant:**Date**.....

Appendix II: Questionnaire

Pit Latrine Use in the Prevention of Diarrheal Diseases in Mutwot Location.

Serial Number.....

Note: This questionnaire is for academic purposes only. All information obtained will be treated with utmost confidentiality.

Instructions

- a). Mark or write where appropriate.
- b). Do not write your name on the questionnaire.

A. Socio-Demographic Information

1. Gender

a). Male b). Female

2. Level of Education

a). Primary b). Secondary

c). College d). University

e). Others (specify).....

3. Occupation.

a). Employed b). Self-employed

c). Farmer d). Housewife

e). Others (specify).....

4. Religion

a). Christian b). Muslim

c). Others (specify).....

B. Pit Latrine Coverage

5. Do you have a pit latrine?

- a). Yes b). No

6. If no to question 5, why?

- a). It is expensive to construct
- b). Cultural beliefs do not allow
- c). Lack construction materials
- d). Lack construction skills
- e). Others (specify).....

C. Use of Pit Latrine

7. Is your pit latrine currently in use?

- a). Yes b). No

8. If yes to question 7, can children, the elderly and persons with disabilities use it?

- a). Yes b). No

9. Do you share your pit latrine with other households?

- a). Yes b). No

10. What is the depth of the pit latrine?

- a). 5 – 10 feet b). 10 – 15 feet
- c). 15 – 20 feet d). Above 20 feet
- e). Others (specify).....

11. How long have you used your pit latrine?

- a). 0 - 5 years b). 5 - 10 years

c). 10 - 15 years d). Over 15 years

e). Others (specify).....

12. How do you keep your latrine clean?

a). Sweep with broom

b). Use chemicals

c). Use soap and water

d). Others (specify).....

13. What made you put-up the pit latrine where it is?

a). Distance from the house

b). Distance from the source of water

c). Type of soil

d). Direction of wind

e). Others (specify).....

14. Are there any social and cultural beliefs that define how pit latrines are used?

a). Yes b). No

15. If yes to question 14, what are some of the beliefs?

a). In-laws of opposite sex cannot share a pit latrine

b). Men and women cannot share a pit latrine

c). Adults and children cannot share a pit latrine

d). Pregnant mothers may not give birth if they use a pit latrine

e). Others (specify).....

D. Association Between Type of Pit Latrine and Diarrheal Diseases

16. Which type of pit latrine are you using?

- a). Ventilated Improved Pit (VIP) latrine
- b). Simple pit latrine
- c). Shallow pit
- d). Open defecation
- e). Others (specify).....

17. In the last one month, has any of your household members suffered from diarrhea?

- a). Yes b). No

18. If yes to question 17, what do you think was the probable cause of the diarrhea?

- a) Polluted water sources
- b) Poor disposal of human excreta
- c) Contaminated food
- d) Poor hygiene practices
- e) Worm infestation
- f) Others (specify).....

19. What is the relationship between human excreta and diarrheal diseases?

- a) Houseflies from pit latrines can contaminate food.
- b) Contamination of water sources by faecal matter
- c) Poor disposal of excreta attracts domestic animals that aid in spread of faeces and diseases.
- d) Faecal matter provides sites for flies to breed and spread infection
- e) Others (specify).....

20. How do you prevent transmission of diseases caused by faecal contamination?

- a) Sanitary disposal of faeces
- b) Purification of drinking water by chlorination or boiling
- c) Hygienic food storage and preparation
- d) Washing hands after visiting the toilet and before handling food.
- e) Cover latrines to control breeding of houseflies
- f) Others (specify).....

Appendix III: Observation Checklist

1. Availability of pit latrine.

a). Yes

b). No

2. Type of pit latrine.

a). Ventilated Improved Pit (VIP) latrine

b). Simple pit latrine

c). Shallow pit

d). Open defecation

e). Others (specify).....

3. State of pit latrine.

a). Can provide adequate sanitation

b). No superstructure

c). No door

d). Slab is not stable

e). No roof

f). Filled (contents < 1 m from surface)

g). No vent-pipe

h). No cover for the squat-hole

i). Others (specify).....

4. Construction materials used.

Part of Pit Latrine

Material Used	Slab	Superstructure	Roof		Door	
			Present	Absent	Material Used	Used
a).Stones						
b). Bricks						
c). Timber						
d). Iron sheets						
e). Thatch grass						
f). Reinforced concrete						
g). Mud						
h). Sacks						
i). Reeds						
j). Others (specify)						

5. Location from dwelling place.

a). Leeward side b). Windward side

c). Others (specify).....

6. Distance from the dwelling place.

a). 0 – 10 metres b). 10 – 20 metres

c). 20 – 30 metres d).Over 30 metres

e). Others (specify).....

7. Is there a visible footpath to the pit latrine?

- a). Yes b). No

8. Is the entrance to the pit latrine overgrown with grass?

- a). Yes b). No

9. Distance from source of water.

- a). 0 – 10 metres b). 10 – 20 metres

- c). 20 – 30 metres d). Over 30 metres

e). Others (specify).....

10. Latrine cleanliness.

- a). Faecal matter on the floor

- b). Urine on the floor

- c). Flies on the floor

- d). Floor is clean

e). Others (specify).....

11. Availability of hand washing facilities.

- a). Yes b). No

12. Location of hand washing facilities.

- a). Next to latrine b). In the house

c). Others (specify).....

13. Faeces on the compound.

- a). Yes b). No

Appendix IV: IREC Formal Approval



MOI TEACHING AND REFERRAL HOSPITAL
P.O. BOX 3
ELDORET
Tel: 334711/2/3
Reference: IREC/2014/172
Approval Number: 0001360



MOI UNIVERSITY
SCHOOL OF MEDICINE
P.O. BOX 4606
ELDORET
23rd February, 2015

Korir Charles Cheruiyot,
Moi University,
School of Public Health,
P.O. Box 4606-30100,
ELDORET-KENYA.



Dear Mr. Korir,

RE: FORMAL APPROVAL

The Institutional Research and Ethics Committee has reviewed your research proposal titled:-

"Extent of Pit Latrine Use in the Prevention of Diarrheal Diseases in Mutwot Location, Nandi North Sub-County."

Your proposal has been granted a Formal Approval Number: **FAN: IREC 1360** on 23rd February, 2015. You are therefore permitted to begin your investigations.

Note that this approval is for 1 year; it will thus expire on 22nd February, 2016. If it is necessary to continue with this research beyond the expiry date, a request for continuation should be made in writing to IREC Secretariat two months prior to the expiry date.

You are required to submit progress report(s) regularly as dictated by your proposal. Furthermore, you must notify the Committee of any proposal change (s) or amendment (s), serious or unexpected outcomes related to the conduct of the study, or study termination for any reason. The Committee expects to receive a final report at the end of the study.

Sincerely,

PROF. E. WERE
CHAIRMAN
INSTITUTIONAL RESEARCH AND ETHICS COMMITTEE

cc	Director - MTRH	Dean - SOP	Dean - SOM
	Principal - CHS	Dean - SON	Dean - SOD

Appendix V: Research Authorization - Nandi County Department of Health and Sanitation



REPUBLIC OF KENYA

COUNTY GOVERNMENT OF NANDI

Telephone
When replying
Please quote
Ref: CO/NC/GENH&S/1/Vol.I/15/41

Office of Chief Officer
Health and Sanitation
Nandi County
P.O.BOX 802
KAPSABET
5th May 2015

To Korir Charles Cheruyot
Moi University
School of Public Health
Po Box 4606 - 30100

RE: AUTHORITY TO CONDUCT RESEARCH AT MUTWOT - NANDI NORTH SUB- COUNTY

As per your request dated 8/4/2015.

This is to inform you that you have been given authority to conduct the study i.e extent of pit
Latrine use in the prevention of diarrhea in Mutwot Location, Nandi North Sub - County.

We hope you will share your findings with us.



Dr. Serem Edarwd
Chief Officer
Health and Sanitation
Nandi County

Appendix VI: Research Authorization - Nandi County Department of Education

MINISTRY OF EDUCATION

Telephone: Kapsabet 0773044624
 E-mail: cdenandicounty@yahoo.com
 Fax: 05352084
 When replying please quote



County Director of Education
 Nandi County,
 P. O. Box 36,
KAPSABET.
 28/4/2015

Ref: NCD/CDE/GEN/1/VOL.11/13

Korir Charles Cheruiyot
 Moi University
 P.O Box 4606-30100
ELDORET.

RE: RESEARCH AUTHORIZATION.

The above named person has been given permission by the CDE to carry out research on "*Extent of pit latrine use in the prevention of diarrheal in Mutwot location, Nandi North Sub- County.*" In Nandi County

Kindly provide him all the necessary support him requires.

For: *County Director
 of Education
 NANDI COUNTY*

**ARITA BWANA
 FOR: COUNTY DIRECTOR OF EDUCATION
NANDI COUNTY.**