

**HOUSEHOLD HAZARDOUS WASTE MANAGEMENT PRACTICES AMONG
PASTORAL COMMUNITY OF MANDERA COUNTY, KENYA**

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DECLARATION

This thesis is my original work and has not been presented for a degree in any other University.

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DEDICATION

To my father Abdirahman Sheikh who decided to educate me despite living a nomadic lifestyle in the remote villages of northern Kenya.

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TABLE OF CONTENTS

DECLARATION	i
DEDICATION	ii
ACKNOWLEDGEMENT	iii
TABLE OF CONTENTS	iv
LIST OF TABLES	viii
LIST OF FIGURES	ix
ABBREVIATIONS AND ACRONYMS	x
DEFINITION OF OPERATIONAL TERMS	xii
ABSTRACT	xiii
CHAPTER ONE: INTRODUCTION	1
1.1. Background to the Study.....	1
1.2. Problem Statement	3
1.3. Justification of Study	5
1.4. Research questions.....	5
1.5 Objectives of Study.....	6
1.5.1 General Objective.....	6
1.5.2 Specific objectives.....	6
1.6 Significance of study.....	6
1.7 Limitation and Delimitations	7
1.8 Conceptual Framework.....	7
CHAPTER TWO: LITERATURE REVIEW	10
2.1. Introduction.....	10
2.2 Overview of Household Hazardous waste	10
2.3 Types of hazardous waste generated by households.....	11
2.4 Risk Factors of Household Hazardous Waste.....	12
2.5 Knowledge on Household Hazardous Waste.....	13
2.6 Household Hazardous Waste Management Practices.....	13
2.6.1 Importance of managing Household Hazardous Waste	13

2.6.2 Types of Household Hazardous Wastes collections.....	14
2.6.3 Household Hazardous Waste storage and Segregation	15
2.6.4 Household Hazardous Waste disposal methods	16
2.7 Summary of Literature Review.....	16
CHAPTER THREE: MATERIALS AND METHODS	18
3.1 Introduction.....	18
3.2 Study design.....	18
3.3 Variables	19
3.3.1 Independent Variables	19
3.3.2 Dependent variables	19
3.4 Location of Study.....	19
3.5 Inclusion Criteria	20
3.6 Exclusion Criteria	20
3.7 Study Population.....	20
3.8 Sampling Technique	21
3.9 Sample Size Determination.....	22
3.10 Construction of Research Instruments	23
3.11 Pre-Testing.....	23
3.11.1 Validity	24
3.11.2 Reliability	24
3.12 Data Management and Analysis	25
3.12.1 Data Management.....	25
3.12.2 Data Analysis.....	25
3.13 Logistical and Ethical consideration.....	25
CHAPTER FOUR: RESULTS	27
4.1 Introduction.....	27
4.2 Socio Demographic Data of the Research participants.....	27
4.2.1 Number of Household members.....	28

4.2.2	Movement from One location to another	29
4.2.3	Size of the Land for the Pastoral Households.....	29
4.3	Types of Hazardous Waste Generated by Pastoral Households	30
4.3.1	Sources of Household Hazardous Waste.....	31
4.3.2	Generation of Household Hazardous Waste.....	31
4.3.3	Generating same type of HHW in Different Seasons.....	32
4.3.4	Seasons that households generate more household hazardous waste.....	33
4.3.5	Most common household Hazardous waste in the Seasons	34
4.3.6	Buying of household hazardous goods.....	34
4.4	Occurrence of Accidents Related to Household Hazardous Waste	35
4.4.1	Victims of Household Hazardous Waste Related Accidents.....	35
4.4.2	Age of the Household Member Who were Involved in Accidental Mishap	36
4.4.3	Type of Household Hazardous Waste/s that Caused the Reported Accident..	36
4.4.4	Health Problems that Occurred Due to the Accidental Occurrences , Place of Treatment and Outcome of the Incidents	37
4.5	Level of knowledge on Household Hazardous Waste	38
4.5.1	Knowledge Scores	39
4.5.2	Identification of Household Hazardous Wastes	39
4.5.3	Source of Information on Household Hazardous Waste	40
4.5.4	Level of Knowledge on Household Hazardous Waste.....	40
4.5.5	Knowledge on Management of Household Hazardous Waste Practices.....	41
4.6	Household Hazardous Waste Management Practices at Household Level	43
4.6.1	Segregation of Household Hazardous Waste	43
4.6.2	Categories of Household Hazardous Waste Segregated.....	44
4.6.3	Level of Education and Segregation of Household Hazardous Waste.....	44
4.6.4	Movement from One Place to Another and Storage of household hazardous waste	45
4.6.5	Storage of Household Hazardous Waste before Disposal	46
4.6.6	Size of the land and Storage of household hazardous waste before disposal...	47
4.6.7	Read the Label/ Instructions on the Household Hazardous Goods	47
4.6.8	Level of education and Reading of Labels	48
4.6.9	Reasons for not Reading the Labels on the Household Hazardous Goods	48
4.6.10	Management of used cosmetic products and laundry products	49

4.6.11 Management of Unused Drugs (Human and Animal).....	49
4.6.12 Management of Pesticides, Insecticides, Fungicides and Other Farm Chemicals	50
4.6.13 Management of Old Batteries and Used Electronic Items	50
4.6.14 Management of containers of used oils, paraffin, petrol and empty aerosol cans	51
4.6.15 Managing Unused Adhesives and Glues	51
4.6.16 Managing Used Needles and Syringes for Animal Treatment	51
4.6.17 Challenges Facing the Management of Household Hazardous Waste	52
CHAPTER FIVE: SUMMARY, CONCLUSIONS AND RECOMMENDATIONS	53
5.1 Introduction.....	53
5.2 Summary	53
5.2.1 Type of Hazardous Waste Generated by Pastoral Households	53
5.2.2 Occurrence of Accidents Related to Household Hazardous Waste.....	54
5.2.3 Level of Knowledge on Household Hazardous Waste	55
5.2.4 Household Hazardous Waste Management Practices at Household Level	58
5.3 Conclusions.....	61
5.4 Recommendations For Practice	62
5.5 Areas for Further Studies	64
REFERENCES.....	66
APPENDICES	70
Appendix I: Consent on the Participation.....	70
Appendix II: Household Heads Questionnaire	72
Appendix III: Key Informant Interview Guide	80
Appendix IV: Map of Kenya Showing Mandera County	81
Appendix V: Approval of Research Proposal.....	82
Appendix VI: Research Authorization Letter	83
Appendix VII: Kenyatta University Ethic Review Committee Approval	84
Appendix VIII: NACOSTI Approval	85
Appendix IX: Mandera County MOH Research Authorization	86

LIST OF TABLES

Table 3. 1: Target Population.....	21
Table 3. 2: Sampling frame.....	23
Table 4. 1: Socio Demographic Data of the Research participants	28
Table 4. 2: Number of Household members	29
Table 4. 3: Movement from One location to another.....	29
Table 4. 4: Size of the land	30
Table 4. 5: Types of HHW Generated	32
Table 4. 6: Different seasons and types of HHW Generated.....	33
Table 4.7: Seasons households generate different type household hazardous waste	34
Table 4. 8: Most common household Hazardous waste according to Season	34
Table 4. 9: Buying of Household Hazardous Goods	35
Table 4. 10: Age of the Household Members who were Involved in accidental mishap .	36
Table 4. 11: Type of Household Hazardous Waste/S that Caused the Reported Accident	37
Table 4. 12: Health Problems that Occurred Due to the Accident, Place of Treatment and Outcome of the Accidents.....	38
Table 4. 13: Knowledge Scores	39
Table 4. 14: Source of Information on Household Hazardous Waste	40
Table 4. 15: Level of Knowledge on Household Hazardous Waste	41
Table 4. 16: Knowledge on Management of Household Hazardous Waste practices	43
Table 4. 17: Categories of Household Hazardous Waste segregated	44
Table 4. 18: Level of Education and Segregation of Household Hazardous Waste	45
Table 4. 19: Movement from One Place to Another and Storage of household hazardous waste	46
Table 4. 20: Size of the land and Storage of household hazardous waste before disposal	47
Table 4. 21: Level of education and Reading of Labels	48

LIST OF FIGURES

Figure 1. 1: Conceptual Framework 9

ABBREVIATIONS AND ACRONYMS

AIDS:	Acquired Immune Deficiency Syndrome
ASAL:	Arid and Semi Arid Lands
AVMA:	American Veterinary Medical Association
DEA:	Drug Enforcement Administration
DEP:	Department of Environmental Protection
EPA:	Environmental Protection Authority
EPR:	Extended Product/Producer Responsibility
FSD:	Foundation for Sustainable Development
HHC:	Household Hazardous Chemicals
HHP:	Household Hazardous Products
HHW:	Household Hazardous Waste
HHWM:	Household Hazardous Waste Management
HSW:	Household Solid Waste
ISSWM:	Integrated Sustainable Solid Waste Management.
JICA:	Japan International Cooperation
NCCK:	National Council of Churches of Kenya
NEMA:	National Environment Management Authority
NGO:	Non Governmental Organisation
OTC:	Over The Counter
POM:	Prescription Only Medicine
RAs:	Residential Associations
TSD:	Treatment, Storage and Disposal.

US:	United States
WASH:	Water, Sanitation and Hygiene
WEEE:	Waste Electric and Electronic Equipment
WHO:	World Health Organization

DEFINITION OF OPERATIONAL TERMS

Attitude: This is a predisposition or a tendency to respond positively or negatively towards certain ideas, persons or situations like household hazardous waste

Household Hazardous waste: household waste which can be characterized as; being ignitable, reactive, corrosive or toxic and requires special handling and disposal procedures to avoid risk to health and/or environmental effects such as pesticides.

Household heads: This is one of the members of the household recognized as the head of the unit by the other members of the household unit or by himself (or herself) if living alone.

Household: A group of related persons, who live together in the same dwelling unit and regularly take their food from the same pot and live in the same house.

Knowledge: These are facts, information, and skills acquired through experience or education; the theoretical or practical understanding of household hazardous waste management.

Nomad: This is a community member who has no fixed habitation and hence regularly moves from one place to another in search of pasture and water for their animals

Pastoral households: This is a group of related individuals whose way of life is based on rearing goats, camels, sheep and cattle, and is typically nomadic.

Pastoralists: Are people who derive more than 50 per cent of their income from livestock and livestock Products.

ABSTRACT

Household hazardous waste possess physical, chemical or biological characteristics, which requires special handling and disposal procedures to avoid risk to health and/or environmental effects. The pastoral population of Mandera county has been treated in health facilities with complains of poisoning or reaction resulting from hazardous substances. Health effects of exposure to household hazardous waste could also take time to manifest in people who are exposed to it, such as development of cancers and effects on unborn babies. The pastoral population is unaware of the potential hazards caused by the many household hazardous waste in their homes therefore the options of safe disposal and storage are unexplored. The main objective of this study was to establish household hazardous waste management practices among pastoral community of Mandera County, Kenya. The specific objectives were; to identify the type of household hazardous waste generated and their disposal methods; to determine the occurrence of accidents related to household hazardous waste and to determine the level of knowledge on household hazardous waste management among household heads in the pastoral community. The study employed a descriptive cross sectional design. The sample size for this study was 415 household heads and 17 key informants from Mandera East Sub-County. The study used a multistage sampling technique that comprised of three steps: simple random sampling, systematic simple random sampling and purposive sampling. Data was collected by use of both qualitative and quantitative methods. Questionnaires, focus group discussions and key informant interviews tools were used to collect data. A pre test was conducted to assess the validity and reliability of the research instruments. Clean coded data was entered into SPSS version 20, frequencies and percentages were used for descriptive statistics while Chi square was used for inferential analysis. Quantitative data was presented in frequencies and percentages. The study found that almost half (48%) of the household heads in Mandera County had moderate knowledge on household hazardous waste while (32%) had good knowledge which had been obtained from radio and health workers. The study also found that almost all of the households at (99.5%) in Mandera County were generating used batteries and electronic items; unused drugs and pharmaceuticals for either human or animal use; remains of pesticides, herbicides, fungicides and accaracides; and used needles and syringes from animal treatment. The study found out that open dumping and incineration were the most common methods of waste disposal by all the study research participants. Further, to this, 8.3 per cent of the households in Mandera County had members who were victims of household hazardous waste related accidents. Most of these household members affected were aged between 0 and 5 years. The study established that there was a significant association between the level of education of research participants and segregation of household hazardous waste ($p < 0.05$), the study also found that movement of households influences storage of HHW. Finally the size of land occupied by households had a significant association with the storage of HHW. This study recommends that the county government, national government and NGOs should initiate training and awareness creation programmes aimed at increasing knowledge on household hazardous waste in the pastoral population.

CHAPTER ONE: INTRODUCTION

1.1. Background to the Study

Household hazardous waste (HHW) refers to household waste which poses chemical characteristics such as ignitability, reactivity, corrosivity and toxicity. HHW can cause physical injury to the waste handlers and household members if improperly managed. HHW can also cause chemical poisoning to human and animals. In addition, household hazardous waste can cause serious environmental and health problems when improperly stored or disposed of (Lohri *et al.*, 2012).

Numerous domestic products once used, or at the end of their useful life are converted to dangerous waste due to their composition and require special management, treatment and disposal to prevent environmental disturbances, water pollution and harmful human effect (Driedger, 2001). Household hazardous waste (HHW) presents a serious health threat to the many homes who store it, waste handlers and scavengers who roam the landfills because they release contaminants such as mercury and volatile organic compounds to the environment causing long term effects to human beings and the environment (Elston, 2010).

Lack of obligation by households to segregate HHW from the general household waste makes it very difficult to plan for its management (Desa *et al.*, 2012). Poor understanding of the general public on what constitutes household hazardous waste products is one of the main causes linked to the lack of treatment, poor storage and disposal (TSD) practices in homesteads (Mbeng *et al.*, 2012). Many developing countries do not have a national household hazardous waste system, or even a national strategic

plan for the development of one, while household hazardous waste has become increasingly important problem and needs an attention from governments, NGOs, CBOs and the academic circles (Taboada-Gonzalez *et al.*, 2010).

In Europe, the European Commission (2013) reported that household products play a major role in the generation of household hazardous waste, which are problematic in their management and disposal routes. These wastes include florescent lamps, arsenic treated wood, paints and pesticides. However, Inglezakis and Moustakas (2015) indicate that household hazardous waste generated in households was not clearly defined in legislation. Therefore, there lack an obligation to segregate household hazardous waste from the general household waste. In Indonesia, Fikria *et al.* (2015) indicate that various household activities produce household hazardous waste, which cause danger to human health and the environment.

In Nigeria, Abimbola *et al.* (2012) indicates that key components in ensuring proper HHW management include identification of type of wastes generated, encouraging waste reuse and recycling and intensification of public education. Adu-Boahen *et al.* (2014) argue most of the households in Ghana generate solid household hazardous waste like plastics, batteries and electronic waste, which were mainly disposed off by burning. They also found that awareness and education on household hazardous waste was a key factor in the appropriate management of household hazardous waste.

In Kenya, Omambia and Ogonya (2017) indicate that the most common household waste in Eldoret included wood, glass, scrap metal, textiles, kitchen waste, disposable nappies and scrap metal. However, the community members had low knowledge on different

disposal methods and segregation. In rural Mandera every household has some hazardous waste comprising of pharmaceutical waste, animal drugs, batteries, torches containing lead, pesticides (accaricides), electronics and non-biodegradable waste such as polythene papers which have the potential for posing risk to life, health, property or the environment if improperly consumed, stored, or disposed of (District Public Health Office, 2013).

1.2. Problem Statement

African countries are facing health effects caused by HHW. As these countries are increasingly integrated into the global economy, local markets and homes are often flooded with dangerous imported goods as well as industrial wastes (Malandrakis, 2008). The health effects of exposure to hazardous waste may progress slowly and end up in chronic conditions. The common health problems include; Skin conditions, respiratory infections, central nervous disorders, blood infections, congenital disorders and many forms of cancers (Fleisted & Christensen, 2007).

Data is difficult to obtain on the rates of people exposure to toxins in any country; it is especially difficult to obtain in Africa, where meager health resources are focused on prevention and treatment of infectious diseases (Driedger, 2001). The pastoral populations in Mandera indicate that their health complains directly relate to household hazardous waste consumption, such as ingestion of accaricides applied on animals to kill or repel ectoparasites either through milk or accidental ingestion through contaminated hands and containers (District Public Health Office, 2013). According to MOH (2013), four rural health facilities (Neboi, Khalalio, Shafshafey and BurAbor) reported 33 cases of poisoning among the children less than five years of age and 21 adult poisoning. The

same facilities in Mandera east reported 10 cases of poisoning in children under five years and 2 cases of poisoning in adults from the months of January to December in 2014 (MOH, 2014). Even though programs to increase household hazardous waste knowledge among pastoral communities have been implemented, monitoring evaluation was not conducted to assess the effectiveness of the programmes. To address the issue of household hazardous waste poisoning, empirical evidence is needed to develop policies and strategies.

Veterinary drugs and human drugs and other pharmaceuticals could be in small amounts but they are an important component of every household's stream in the pastoral population where self-medication is highly practiced (Driedger, 2001). Unused pharmaceuticals pose significant health problems when improperly stored or disposed. Reports have indicated that both children and adults have been poisoned after ingesting improperly disposed pharmaceuticals and other poisons after use in Mandera county rural population (MOH, 2014).

Studies have been conducted on household hazardous waste management both globally and locally (Chandrappa & Das, 2012; Driedger, 2001; Flisted & Christensen, 2007; Malandrakis, 2008). Most of these studies were conducted in developed countries to improve on methods of HHW management and related policies. In Africa pilot studies on HHW were conducted in Cameroon and Zambia but mainly focused in urban areas. In Kenya, studies done on household waste have only focused mainly on general household solid waste and so far no study was done on HHW among the pastoral population. This study sought to address knowledge gap in household hazardous waste in Kenya and specifically the pastoral population of northern Kenya.

1.3. Justification of Study

This study provides information on the level of knowledge on HHWM practices among the pastoral communities that can be used to formulate policies and to develop training programs on household hazardous waste management. This study determined the type of hazardous wastes that are generated by the pastoral households in Mandera East as little literature is available about it. This was an opportunity to come up with practical HHW management strategies of managing the various HHW generated by the pastoralist population. The study also documented the occurrence of hazardous substance related accidents and injuries in the pastoral population of Mandera East Sub County. Even though there are policies focusing on waste in Kenya, the enforcement of these policies in relation to HHW has been poor, this document can contribute to the enforcement legislation on HHW in Mandera County government.

1.4. Research questions

- i. What are the types of household hazardous wastes generated by pastoral households in Mandera County?
- ii. What are the patterns of accidents that occur at pastoral homes that are related to hazardous substance?
- iii. What is the level of knowledge on HHW among the pastoral community in Mandera County?
- iv. What are the HHW management strategies amongst the pastoralist in Mandera County?

1.5 Objectives of Study

1.5.1 General Objective

To determine household hazardous waste management practices among pastoral community of Mandera County, Kenya.

1.5.2 Specific objectives

- i. To identify the types of household hazardous waste generated by households in the pastoral community of Mandera County;
- ii. To determine the occurrence of accidents related to household hazardous waste among the members of households of the pastoral community in Mandera County;
- iii. To determine the level of knowledge on household hazardous waste (HHW) management among the pastoral community of Mandera County;
- iv. To identify household hazardous waste management practices at household level in the pastoral community of Mandera County;

1.6 Significance of study

This study aimed to identify HHW management practices by the pastoral population in Mandera County. There is little data available on the types of HHW that are generated by pastoral community and related accidents and injuries resulting from it, therefore the study provides useful data that would help in the planning and management of HHW in pastoral areas. As part of recommendation, strategies of managing household hazardous waste have also been documented for adoption by pastoral communities and other stakeholders such as the County Government, NEMA, WHO and development partners. The findings of this study have also identified the channels that can be used to educate the

Mandera county pastoral community distinguish between household waste that are hazardous and the ones that are nonhazardous and adopt the principles of sound waste management hierarchy of reducing, reusing, recycling and safe disposal of these household wastes.

1.7 Limitation and Delimitations

Limitation

The study faced various constraints in the process of data collection. Since most of the community members in Mandera County are nomadic pastoralists, it was hard to reach out to them. However, the researcher visited the community members in their nomadic settlements, which are set up in form of villages holding up to 10 households. There was also a challenge of moving from one village to another during the data collection process. However, the research hired a vehicle to use during the period of data collection.

Delimitation

This study was delimited to the five wards of Mandera East Sub County, which included Arabia, Libehiya, Khalalio, Neboi and Township wards. The target population of this study was 25,923 pastoral household heads in the five wards in Mandera East Sub County.

1.8 Conceptual Framework

Household hazardous waste occurs as a result of numerous products that have been used or have reached the end of their useful life at the households and are converted to dangerous waste. This waste due to its composition requires special management, which

is based on the principle of prevention, reduction, recycling, recovery and finally disposal (Gu et al., 2014).

Any discussion on waste management will involve the use of various specialized frameworks. The frameworks are the cornerstones of general waste management implementation and guide policy development on waste management. The objectives of such a framework would focus on the four major waste related program areas: minimizing wastes; maximizing environmentally sound waste reuse and recycling, promoting environmentally sound waste disposal and treatment (Yasuda & Tanaka, 2006).

Waste management hierarchy is nationally and internationally accepted guide for prioritizing waste management practices with the objective of achieving an optimal environmental and health outcome. The hierarchy sets out the preferred order of waste management practices from the most preferred to the least preferred methods. Waste generation at the household level can be minimized, reused and or recycled, which are the most preferred methods. Incineration, open burning, open dumping and land filling are the least preferred methods in the hierarchy (Yasuda & Tanaka, 2006).

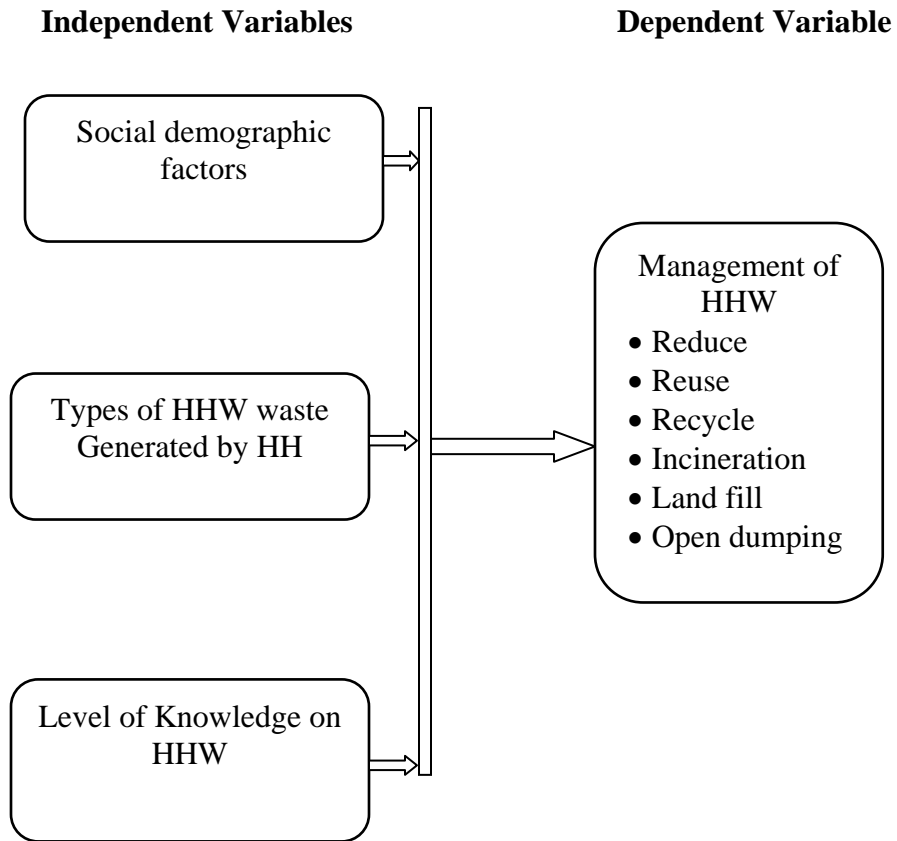


Figure 1. 1: Conceptual Framework

Source: Zero Wastes South Africa (2008)

CHAPTER TWO: LITERATURE REVIEW

2.1. Introduction

This chapter presents a review of literature on Household Hazardous Waste management practices among pastoral community. The chapter comprises of an overview of household hazardous waste, types of Household Hazardous Waste generated by households, risk factors of Household Hazardous Waste, knowledge levels on HHW, and different management practices of Household Hazardous waste and summary of the literature reviewed.

2.2 Overview of Household Hazardous waste

Household Hazardous Waste (HHW) consists of highly heterogeneous waste from households and the waste composition depends on factors such as living standards, geographical location, cultural, individual habits, type of housing and season (Vidanaarachchi *et al.*, 2006). These household items that have been used, or have reached the end of their useful life are converted into dangerous wastes, which due to their composition need proper management, treatment and disposal (Bandunee *et al.*, 2015). Used household materials that contain corrosive, toxic, ignitable or reactive ingredients are considered to be household hazardous waste (Ojeda-Benítez *et al.*, 2013). These materials are contained in such products as household cleaners, detergents, furniture polish, pesticides, pharmaceuticals, paints, thinners, solvents, and items used in the care and service of motor vehicles. When inappropriately managed, products of this kind become “Household Hazardous Waste” (HHW). This type of waste can cause all

sorts of environmental disturbances, with ensuing detriment to human health (Lohri *et al.*, 2012).

Some of the wastes produced by households are of a similar type to those produced by large industries. Household hazardous wastes make up only a small percentage of household waste, but they are a serious problem (Fleisted & Christensen, 2007). According to Driedger (2001), the four major properties of hazardous waste include corrosive, explosive/reactive, flammable and toxic. Corrosive waste has a chemical action that can burn and destroy living tissues or other materials that come in contact with the hazardous waste. Explosive/reactive waste can detonate or explode through exposure to heat, sudden shock, pressure, or incompatible chemicals. Flammable waste can be easily set on fire and Toxic waste is capable of causing injury or death through ingestion, inhalation, or absorption through the skin.

2.3 Types of hazardous waste generated by households

According to Slack *et al.* (2005), household hazardous waste fall into one of the following eight categories: automotive products, household cleaners, paints and solvents, poisons, medications and pharmaceutical products, sharps, e-waste and miscellaneous items. Household hazardous waste can further be subdivided into two broad categories (Slack *et al.*, 2005). These are low toxicity materials and high toxicity materials. The low toxicity materials have relatively less toxicity or other hazardous characteristics such as water-based paint, automotive batteries, LPG cylinders and fluorescent tubes and lamps. The high toxicity category consists of a wide variety of materials that may have significant toxicity or other hazardous characteristics mainly pesticides, garden chemicals, acids, alkali, aerosols, fuels and many other products(Slack et al., 2005).

However, these findings were conducted in the United Kingdom which is a developed economy hence the results of the study cannot be generalized to Mandera County in Kenya as it is a developing economy. The most common household hazardous waste in Kenya includes batteries, accuracies, pesticides and other animal health products.

2.4 Risk Factors of Household Hazardous Waste

All household hazardous wastes such as oils, batteries, pesticides and medicines contain hazardous products. The best way to determine if household waste contains hazardous components is to read the labels on the products. Labels that read “danger”, “warning”, “caution”, “toxic”, “corrosive”, “flammable”, or “poison”. These words tell us that the products we are purchasing are capable of causing severe burns, illness, blindness, fatal harm, or even death if not used, stored, or disposed of properly. When precaution is not observed by households, the leftovers of these products can be dangerous to the health of individuals or the community members (Malandrakis, 2008).

Improper handling or disposal of products containing hazardous ingredients can result in serious accidents to people and animals by either drinking, eating, touching, or breathing household hazardous wastes. Some household hazardous waste and products emit toxic fumes that may produce acute reactions such as headaches, fatigue, burning eyes, runny noses, and skin rashes (Driedger, 2001).

The health risks associated with HHW in children are typically greater than that of adults. With their smaller bodies and endless curiosity, children are much more likely to come into contact with HHW at the home that have been stored or disposed of improperly, and to suffer ill effects from that contact (Wagner *et al.*, 2013). Refuse workers and landfill

workers can be injured by chemical splashes or poisonous fumes caused by mixed or concentrated household hazardous wastes. Firefighters can also be injured by these household hazardous wastes when responding to a fire. However, all these studies were conducted in different countries with different types of hazards and the challenges posed by the hazards. The results cannot be generalized to Kenya as it is a developing country with different household hazards.

2.5 Knowledge on Household Hazardous Waste

Residents are often unaware of the potential hazards caused by many HHW in their homes. Recognition of hazardous products and wastes is paramount to encouraging the safe and proper disposal of moderate risks waste. In addition to this, the public is often unaware of their options for reducing, recycling and disposal of their HHW. To improve the reduction, storage and disposal of HHW, an education program targeting residents, community groups and school children is necessary, also information centers such as libraries and community gathering places can be established. There is not sufficient knowledge among the service providers and other relevant institutions to provide protection for human and the environment against chemical and other hazardous waste which are abundant and one of the major environmental challenges today (Ojeda-Benítez *et al.*, 2013). Due to differences in legal frameworks and macroeconomic factors, the findings of studies conducted in other countries cannot be generalized to Kenya.

2.6 Household Hazardous Waste Management Practices

2.6.1 Importance of managing Household Hazardous Waste

There are cogent reasons why attention needs to be given to HHW in any national public health program that advocates for disease prevention due to the following reasons

(Wagner *et al.*, 2013). Exposure to Household Hazardous Waste (HHW)/household hazardous products (HHPs) is a readily controllable health risk; it is by far easier to control the poisoning of young women with mercury in soap or dry cell batteries in young children than to find a local cure for AIDS. Moreover, any toxic substances in HHW /HHPs tend to exacerbate the severity of the endemic communicable diseases and vice versa. For instance, both lead poisoning and malaria affect the immune system, which can lead to synergism when two diseases co-occur (Senzige, 2014). Lastly reduction and recycling of HHW conserves resources and energy that would be expended in the production of more products (Taboada-Gonzalez *et al.*, 2010). The management of HHW incorporates a chain of process from temporary storage, segregation, collection, transportation, reuse/recycle, resource recovery, treatment and final disposal (Senzige, 2014).

2.6.2 Types of Household Hazardous Wastes collections

One-day collections per month, is a type of waste collection where householders bring their household hazardous waste to a designated location on a specified date. The wastes received in this type of program are either recycled or sent to a hazardous waste treatment or disposal facility. According to Gu *et al.* (2014), one-day collection events can be organized for remote communities by regional facilities in their areas of service. Permanent collection facilities is another type of HHW collection, it is designed to store hazardous household wastes for short periods of time (Anyamani, 2014).

Door –To-Door Collections is also a type of HHW collection where trained staffs pick up materials in a retrofitted truck and sorted, packaged, and stored at a main facility until

enough waste is collected to warrant disposing it. Door-to-door type of collection is a very expensive service and typically is provided in conjunction with other collection events (Mbeng *et al.*, 2012). In some communities curbside collection program is practiced where yellow boxes are set out at the curb for pickup of hazardous household wastes (Taboada-Gonzalez *et al.*, 2010). Mobile collections which are also referred to as satellite or roving is practiced in some areas as a type of HHW collection. Mobile sites stay in one location for a specific period and then move the whole operation to the next site in within the service area. At the end of the collection period at the site, the waste is placed on a truck and transported back to the main facility; or if the truck is not full, it moves on to the next site (Massawe *et al.*, 2014).

2.6.3 Household Hazardous Waste storage and Segregation

HHW handling and separation involves the activities associated with management of wastes until they are placed in storage containers. Handling also encompasses the movement of loaded containers to the point of collection. Separation of HHW from household waste is an important step in the handling and storage of HHW. According to Slack *et al.* (2005), the rules for storing hazardous products include following the directions for storage on the label; protecting the original label; storing household hazardous chemicals in the original container; keeping containers dry to prevent corrosion; storing products in a well-ventilated area; storing products away from any flammable materials or sources; and storing products away from children and pets. Generally high, locked shelves work best (Massawe *et al.*, 2014).

2.6.4 Household Hazardous Waste disposal methods

Quantities of HHW remain unaccounted for in the domestic waste stream. Legislative pressure to deal with certain HHW appropriately like, (Waste Electrical and Electronic Equipment, Batteries and accumulators) has brought into view the issue of HHW management (Anyamani, 2014). Correct disposal methods of HHW vary from one product to another, sewer disposal of one product may dilute it sufficiently to render it harmless, while another product thrown down the drain may adversely affect wastewater treatment facilities. Ideally, labeling each product with appropriate disposal methods would assist in solving this dilemma. Unfortunately, laws which require detailed methods of chemical products may not apply to all consumer products. However the approved methods of HHW disposal are; reuse, triple-rinse container, recycle, Save for collection, flush down drain, put in trash, Fuel blending, chemical treatment , incineration and hazardous waste landfill (Malandrakis, 2008).

2.7 Summary of Literature Review

This chapter has reviewed relevant literature on the type of household hazardous waste generated by households. The literature review indicated that household hazardous waste fall into one of the following eight categories: automotive products, household cleaners, paints and solvents, poisons, medications and pharmaceutical products, sharps, e-waste and miscellaneous items. The risk factors of household hazardous waste include causing severe burns, illness, blindness, fetal harm, or even death if not used, stored, or disposed of properly. In addition, the literature above shows that knowledge levels of household hazardous waste was varying from one region to another and from one community to

another. Further, the literature shows that household hazardous waste management practices include reduction, reuse, recycle, incineration, landfill and open dumping.

CHAPTER THREE: MATERIALS AND METHODS

3.1 Introduction

This chapter outlines the procedures and methodology that was used to achieve the objectives of this study. The chapter comprises of study design, variables, location of the study, sampling technique and sample size, pre-testing of data collection tools, data collection techniques, logical and ethical consideration and data analysis.

3.2 Study design

This study employed a descriptive cross sectional design that involved the use of both qualitative and quantitative research. This study design was adopted because it analyzes data collected from a representative subset, at a specific point in time. In addition, it allows the combination of both qualitative and quantitative data. This study design aimed at describing the various hazardous household waste management practices by pastoralist households in Mandera County. Additionally, the type of HHW generated and their disposal methods, the occurrence of accidents related to household hazardous waste and the effect of the level of knowledge on household hazardous waste (HHW) management among household heads in the pastoral community were determined. This research design was used by Udofia *et al.* (2017) in a cross sectional study of household disposal practices and reported harm in Southern Ghana. The research design was also used by Amouei *et al.* (2014) in an investigation of household hazardous wastes production in the Amirkola Township in Iran.

3.3 Variables

3.3.1 Independent Variables

Independent variables included the types of household hazardous waste generated; socio demographic factors and level of knowledge on household hazardous waste (HHW) management.

3.3.2 Dependent variables

The dependent variable in this study was household hazardous waste management practices.

3.4 Location of Study

This study covered Mandera East Sub County, which covers 2,793.10 square kilo meters. Mandera East Sub County is one of the six sub Counties of Mandera County located in the North Eastern region of Kenya. The general population of the study area is 184,639 people (KNBS, 2010). The sub county consists of five wards namely; Arabia, Libehia, Khalalio, Neboi, and Township. The main socio economic activities in study area include; informal employment, seasonal farming, small scale trading and pastoralism. The pastoral community lives mainly in the five wards of Mandera east. Their main socioeconomic activity is pastoralism. Mandera is dominated by ethnic Somalis, whose clans comprise of Gurreh, Degodia, Murule and Corner tribes (KNBS, 2010). The climate in Mandera East is characterized as Arid; temperatures tend to be hot throughout the year. The day to day temperatures fall above 35 degrees during the day and above 20 degrees at night.

3.5 Inclusion Criteria

The study included all household heads (both male and female), or a household member above 18 years of age in their absence, which had lived a pastoral lifestyle for more than 6 months in Mandera East Sub County and consented to be involved in the study. The household members had to be above 18 years in age because for below 18 years the researcher would be required to obtain parental consent. In addition, the duration of living a pastoral life among the respondents is important to fully recognize the waste generation in the pastoral communities and hence 6 months is adequate time gain this information. The household heads were selected in this study as the researcher believes they are responsible of managing their households, which includes managing household waste.

3.6 Exclusion Criteria

The study excluded households whose heads or an adult member was not available during data collection, and any respondent who refused to give consent during data collection. The study also excluded household heads and adult members who were found insane or sick.

3.7 Study Population

The study population was pastoral households in Mandera East Sub-County. The key research participants were heads of households. The household heads were male or female who were responsible for the household during the data collection. According to KNBS (2010), there are 25,923 households and 184,639 persons in Mandera East Sub-County, which means there are about 25,923 household heads in the five wards of Mandera East sub-county. The five wards include Arabia, Libehiya, Khalalio, Neboi and

Township. The target population of this study was therefore 25,923 pastoral household heads. The study also included stake holders in waste management, working in the study area as key informants. The key informants have adequate information on HHW because of their role in government departments dealing with sanitation. These were 7 officers in the Public Health Department, 1 staff of National Environmental Management Authority (NEMA), 5 heads of wards, 1 staff of Water, Sanitation and Hygiene program (WASH) and 2 staff from Mandera East Sub-county health facilities. The key informants were therefore 17.

Table 3. 1: Target Population

Wards	Households
Arabia ward	2,921
Libehiya ward	7,568
Khalalio ward	2,854
Neboi ward	8,477
Township ward	4,103
Total	25,923

Source: KNBS (2010)

3.8 Sampling Technique

This study made use of multistage sampling method. The first stage involved using simple random sampling, the second stage involved using systematic simple random sampling and the third stage involved using purposive sampling. This study used simple random sampling to select two wards from the five wards; these were Libehiya and Khalalio wards from the five wards of Mandera East Sub-County. This was done by the use of table of random numbers. Simple random sampling was further used to select two villages from each of the two wards earlier obtained; Harar and Farey villages were randomly picked for Libehiya ward while Matasafara and Bur Abor villages were

randomly picked for Khalalio ward. To identify the households whose heads were to be interviewed, the research assistants located the center of the village and tossed a pen to obtain the direction of movement. From where the pen pointed the closest household was visited to interview the household head and then systematic simple random sampling was used to interview every second household head until the desired sample size was achieved. Purposive sampling was used to select key informants from relevant government ministries and other stakeholders who directly deal with sanitation activities.

3.9 Sample Size Determination

The sample size was determined using Fisher et al. (2003) formula. This formula was used to obtain a representative sample of the target population. The target population is estimated at 25,923 pastoral households.

$$n = Z^2 pq/d^2$$

Where,

- n = the desired sample size (if the target population is $> 10,000$).
- Z = is the standard normal deviation = 1.96 which corresponds to 95 per cent confidence interval.
- p = is the proportion in the target population estimated to have the characteristics being studied. The pastoral population is estimated at 57 per cent of the total population in Mandera County (Kratli & Swift, 2014).
- $q = 1 - 0.57 = 0.43$.
- d = the level of statistical significance set = 0.05

$$n = 1.96^2 (0.57) (0.43)/0.05^2 = 377 \text{ household heads}$$

10 per cent of the sample size was added to cater for possible attrition or non-response. This therefore increased the sample size to 415 household heads.

The sampling frame of this study comprised of all the households of the 4 villages in the 2 wards of Khalalio and Libehiya in Mandera East Sub-County.

Table 3. 2: Sampling frame

Sub locations	Population	Households	Sample Size
Harar	1534	213	75
Farey	2885	465	164
Matasafara	829	118	42
Burabor	3078	382	134
Total	3907	500	415

Source: KNBS (2010)

3.10 Construction of Research Instruments

Primary data was collected by use of researcher-administered questionnaires; the questionnaires included structured and unstructured questions. Primary data was also collected by use of key informant interview guide. Semi-structured and structured questionnaires (see Appendix II) were administered to obtain information from the household heads. Key informant interview guide (see Appendix III) was also used to generate information from 17 key informants.

3.11 Pre-Testing

Pre-testing was carried out before the questionnaires were administered to the participants, to certify that the questions were relevant, make sense and clearly understandable. In this study, pretesting involved 38 household heads (10% of the sample size) and was carried out in Hareri Hosle Location (about 50 km from Mandera town) which has similar characteristics to the study area.

3.11.1 Validity

To enhance validity in this study, the instruments to be used were developed carefully to ensure the data generated addressed the objectives of the study. In addition, the validity of the research instruments was improved by seeking the opinions of experts in the field of study, particularly the supervisors to promote accuracy and meaningfulness of inferences. Obtaining an adequate sample size was also used to obtain the validity of the study. Pre-testing of the instruments before they were adapted for use was conducted to determine their suitability and changing any unclear and ambiguous question.

3.11.2 Reliability

Reliability is important to ensure the instruments yield the same results and reduce random errors in the study. Reliability was achieved by developing good quality questionnaire and constructed according to the specific objectives, correct coding of questioner, training of enumerators before data collection and constructing questionnaire that doesn't waste the time of the interviewees. The questionnaire's reliability was statistically measured by measuring the internal consistency. In turn, internal consistency was measured by use of Cronbach's Alpha. The alpha value ranges between 0 and 1 with reliability increasing consistently with increase in value (Cooper & Schindler, 2006). This study used coefficient values > 0.7 is normally accepted rule of thumb that designates acceptable reliability.

3.12 Data Management and Analysis

3.12.1 Data Management

Data Management began with instruments checking, which involved eliminating questionnaires that were not fully filled and which had inconsistent responses. This was then followed by data editing, which sought to correct illegible, incomplete, inconsistent and ambiguous answers. The quantitative data was coded, where a codebook for different variables was prepared on the basis of the numbering structure of the questionnaires. The data entry was done carefully. Data was also cleaned and reviewed for consistencies.

3.12.2 Data Analysis

The research instruments in this study generated both qualitative and quantitative data. Qualitative data was obtained from the open ended questions in the questionnaire and from key informant interviews. Thematic content analysis was used to analyze qualitative data gathered and related literature and presented into the thematic areas of study. On the other hand, quantitative raw data was coded and entered into Statistical Package for Social Scientists (SPSS version 21) for analysis. Descriptive statistics mainly frequencies and percentages were used to summarize the quantitative data. The analyzed data was presented in frequency distribution tables. In addition to this, inferential statistics (chi-square) was used to identify the association between the dependent and independent variables.

3.13 Logistical and Ethical consideration

Research approval and authorization to conduct the study was sought from Kenyatta University graduate school and Kenyatta University Ethics Review Committee (see

Appendix VI & VII) respectively. A research permit to carry out the study was also obtained from the National Council for Science, Technology and Innovation (see Appendix VIII). In addition, authorization to carry out this study was sought from the Ministry of Health (see Appendix XI) of Mandera County government. Informed consent was sought from the study participants before data collection (see Appendix I). Anonymity was highly maintained throughout the study by not recording names of participants. Research participants did not receive any incentives to participate in the study and no participant was forced to answer questions they did not wish to answer.

CHAPTER FOUR: RESULTS

4.1 Introduction

This chapter presents results of the study with respect to the objectives. The general objective of the study was to explore household hazardous waste management practices among pastoral community of Mandera County. The results were presented in table and figures.

The sample size of the study was 377 household heads. In addition, 10 per cent of the sample size was added to cater for possible attrition or non-response. This was therefore increased to 415 household heads. Out of this, 412 responses were obtained, which gives a response rate of more than 99.27 per cent. Three of the questionnaires were not fully filled and had inconsistent responses and hence could not be used in the study. Key informants in the study included public health officers, health facility in charge, National Environmental Management Authority (NEMA) staff, chiefs/ ward administrators and NGO staff dealing with WASH.

4.2 Socio Demographic Data of the Research participants

Table 4.1 presents data on the socio-demographic characteristic of the research participants. The results indicate that 52.4 per cent of the participants were male while 47.6 per cent were female. Most of the research participants 37.9 per cent were aged between 26 and 40 years, 34 per cent were aged between 41 and 54 years, 15.5 per cent indicated that they were over 64 years in age and 15.5 per cent indicated that they were aged between 18 and 25 years. Additionally, most (83%) of the research participants had

no formal education at all, 13.1 per cent had primary education, while 3.4 per cent had had secondary education and 0.5 per cent had tertiary level of education.

Different species of animals have a bearing on the generation of different types of household hazardous wastes related to animal care. Different species of animals determines the form of treatment and also relates to seasons. Table 4.1 presents data on species of animals kept by Household Heads. From the table, it is observed that 20.4 per cent of the households had camels, 42.2 per cent indicated that they had cattle, 68 per cent had goats and 18 per cent were rearing camel, cattle and goats (all species).

Table 4. 1: Socio Demographic Data of the Research participants

Socio Demographic characteristics	Frequency	Percent
Sex		
Male	216	52.4
Female	196	47.6
Total	412	100.0
Age Group		
18 to 25 years	64	15.5
26 to 40 years	156	37.9
41 to 65 years	140	34.0
Over 65 years	52	12.6
Total	412	100.0
Level of education completed		
No formal education	342	83.0
Primary Level	54	13.1
Secondary level	14	3.4
Tertiary level	2	.5
Total	412	100.0
Camel	84	20.4
Cattle	174	42.2
Goats	280	68.0
All species	74	18.0

4.2.1 Number of Household members

The study sought to know the number of people who live in households because it has a direct impact on the quantity of HHW generated. According to the findings, 34.5 per cent

of the research participants had between 6 and 8 people living in their households, 31.6 per cent had more than 8 people, 23.8 per cent had between 3 and 5 people and 10.2 per cent had less than 3 people. This implies that most of the pastoral households in Mandera County had between 6 and 8 members.

Table 4. 2: Number of Household members

Number of Household members	Frequency	Percent
Less than 3 members	42	10.2
3 to 5 members	98	23.8
6 to 8 members	142	34.5
More than 8 members	130	31.5
Total	412	100

4.2.2 Movement from One location to another

Table 4.3 presents data on movement of households from one location to another. Results indicate that 34.5 per cent of the households moved from one location to another in search of pasture more than three times a year, 29.1 per cent moved twice a year, 19.4 per cent did not move, 8.7 per cent moved three times a year and 8.3 per cent moved once a year.

Table 4. 3: Movement from One location to another

	Percent	Frequency
More than 3 times a year	34.5	142
Three times a year	8.7	36
Twice a year	29.1	120
Once a year	8.3	34
We don't move	19.4	80
Total	100.0	412

4.2.3 Size of the Land for the Pastoral Households

Table 4.4 presents data on the size of land for the pastoral households. According to the findings, 65.2 per cent of the households were using community land and did not have

land of their own, 10.6 per cent had one acre, 8.6 per cent had 2 acres and 7.1 per cent had 3 acres. This shows that most of the pastoral households in Mandera County do not own land of their own and hence they use community land. This explains the reasons why most of the research participants indicated that they did not own land and pastoralists can move around the year from one location to another in search of pasture.

Table 4. 4: Size of the land

	Frequency	Percent
Less than half an acre	14	3.5
One acre	44	10.6
2 acres	35	8.6
3 acres	29	7.1
4 acres	16	4.0
5 acres	2	.5
More than 5 acres	2	.5
Have no land	269	65.2
Total	412	100.0

4.3 Types of Hazardous Waste Generated by Pastoral Households

In this study, the first objective was to identify the type of household hazardous waste generated by households in the pastoral community of Mandera County. This research objective was achieved by putting forward to the participants' eight questions asking them if they generated the categories of HHW in the options provided by the interviewer.

The categorized Household Hazardous waste into eight broad categories which comprised of drugs and pharmaceuticals, sharps, pesticides, used electronics, automotive products such as oils, adhesives, paints and solvents and disinfectants. A household could produce all or some of these HHW depending on their economic activity, season and type of domestic animal they rare.

4.3.1 Sources of Household Hazardous Waste

The community in Mandera County is mainly pastoralists and hence keep livestock including camels, goats, sheep and cattle. The rearing of livestock involves use of drugs for treating the animals when they get sick. This leads to generation of drugs, plastic containers, syringes and needles. Drugs, syringes and needles used in the treatment of animals have toxic properties when incinerated. In addition, the daily activities of the nomadic community involves the use of electronics such as torches containing lead, batteries and flammables such as paraffin because they are not connected to electricity. The pastoral communities generate poisons such as acaricides and pesticides as they are used to treat and prevent parasitic infections in their livestock. These types of waste are corrosive and toxic and hence can lead to the death. Detergents, glues and adhesives are equally produced in households are also common HHW. Generally these wastes are, reactive, ignitable or toxic and require special handling form storage, segregation and disposal.

4.3.2 Generation of Household Hazardous Waste

The household hazardous wastes were categorized into 8 broad categories: unused drugs and pharmaceuticals; used needles and syringes; remains of pesticides, herbicides, fungicides and acaricides; used batteries and electronic items; automotive products; remains of glues and adhesives; paints and solvents; and disinfectants, laundry products and used cosmetics.

According to the findings, 99.5 per cent of the research participants indicated that their households were generating used batteries and electronic items (mobile phones and

radio), 96.1 per cent indicated that they were generating left over of used drugs and pharmaceuticals, 86.4 per cent indicated that they were generating remains of pesticides, herbicides, fungicides and accaricides and 83 per cent indicated that they were generating used needles and syringes for animal treatment.

In addition, 7.3 per cent of the research participants indicated that their households were generating automotive products such as oils, paraffin and petrol. Also, 1.5 per cent indicated that their households were generating remains of glues and adhesives and 1.0 per cent indicated that their households were generating disinfectants, laundry products and used cosmetics. However, none of the research participants indicated that their households were generating paints and solvents wastes. Other hazardous household wastes generated include polythene papers.

Table 4. 5: Types of HHW Generated

	Percent		
	Yes	No	Total
Unused drugs and pharmaceuticals for either human or animal use	96.1	3.9	100
Used needles and syringes for animal and human treatment?	83	17	100
Remains of pesticides, herbicides, fungicides and accaricides	86.4	13.6	100
Used batteries (all size and type) and electronic items (mobile phones, radio, and television)	99.5	0.5	100
Automotive products such as oils, paraffin and petrol	7.3	92.7	100
Remains of glues and adhesives	1.5	98.5	100
Paints and solvents	0	100	100
Disinfectants, laundry products and used cosmetics	1	99	100

4.3.3 Generating same type of HHW in Different Seasons

In different seasons animals get different types of diseases that require the use of different types of drugs for treatment. There could also be variations in the use of pesticides and other hazardous waste depending on the season. According to the findings, 75.7 per cent

of the pastoral households generate different types of household hazardous waste in different seasons of the year while 24.3 per cent generated the same types of household hazardous waste in different seasons of the year. This implies that most pastoral households in Mandera County generate different types of household hazardous waste in different seasons of the year.

Table 4. 6: Different seasons and types of HHW Generated

	Frequency	Percent
Generating different types of household hazardous waste in different seasons	312	75.7
Generated the same types of household hazardous waste in different seasons	100	24.3
Total	412	100

4.3.4 Seasons that households generate more household hazardous waste

Since most of the households were generating different types of household hazardous waste in different seasons of the year, it was important to determine which household hazardous wastes were generated in each season in the seasonal calendar of the pastoral community. From the findings, 38.8 per cent of the research participants indicated that they have seasonal variations in their waste stream during the windy season (June and July), 28.2 per cent indicated during the dry season (January, February, march, August, September and October), 24.3 per cent indicated they had no seasonal variations in their waste stream and 8.7 per cent indicated during the wet season (April, May, November and December). This shows that most of the households were generating different types of hazardous waste in their waste stream during the windy and dry season (January, February, march, June, July, August, September and October). This is because livestock gets sick mostly during the windy and the dry seasons.

Table 4.7: Seasons households generate different type household hazardous waste

	Frequency	Percent
Dry season	116	28.2
Windy season	160	38.8
Wet seasons	36	8.7
No seasonal wastes	100	24.3
Total	412	100.0

4.3.5 Most common household Hazardous waste in the Seasons

Different household hazardous wastes are generated in different seasons of the year and hence it was important to understand the most common household Hazardous waste in each season to plan for its management. From the findings, 38.1 per cent of the research participants indicated that animal drugs were the most common household hazardous waste followed by accaricides and pesticides (35.3%) and needles and syringes (26.6%). This implies that animal drugs were the most common household hazardous waste followed by accaricides and pesticides and needles and syringes mostly during the windy season.

Table 4. 8: Most common household Hazardous waste according to Season

Types of waste	Season	Frequency (n=312)	Percent
Animal drugs	Rainy season	119	38.1
Accaricides and pesticides	rainy season	110	35.3
Needles and syringes	Dry, windy and wet seasons	83	26.6

4.3.6 Buying of household hazardous goods

The research participants were also requested to indicate where they buy the household hazardous goods from. To identify the places where household hazardous goods are bought which later covert to hazardous waste is important in their management. Many

outlets may not be able to advise the customers who purchase the goods on its storage and disposal.

The results were as presented in Table 4.9. From the findings, 43.7 per cent of the research participants indicated that they bought household hazardous goods from retail shops, 25.2 per cent indicated from hawkers, 16.5 per cent indicated from open air market, 14.1 per cent indicated from chemists and 0.5 per cent indicated supermarkets.

Table 4. 9: Buying of Household Hazardous Goods

	Frequency	Percent
Retail Shop	180	43.7
Supermarket	2	.5
Open air market	68	16.5
Chemists	58	14.1
Hawkers	104	25.2
Total	412	100.0

4.4 Occurrence of Accidents Related to Household Hazardous Waste

The second objective was to determine the occurrence of accidents related to household hazardous waste among the members of households of the pastoral community in Mandera County.

4.4.1 Victims of Household Hazardous Waste Related Accidents

Accidents and injuries resulting from poorly managed HHW is common among human and pets in households both in developing and the developed world. Some accidents could be fatal to children and even adults if not treated properly and timely (Senzige, 2014).

The research participants were asked to indicate whether any of their household members had been a victim of household hazardous waste related accidents. From the findings,

91.7 per cent of the study research participants indicated that none of their household members has been a victim of household hazardous waste related accidents. However, 8.3 per cent indicated that their household members had been a victim of household hazardous waste related accidents. This implies that most of the household members in Mandera County had not been victims of household hazardous waste related accidents.

4.4.2 Age of the Household Member Who were Involved in Accidental Mishap

Accidents and injuries from HHW are common in children who get exposed to them because they are curious about things but severally adults have also been exposed due to their occupation or their unplanned handling. From the research participants who indicated that their household members had been a victim of household hazardous waste related accidents, the study also sought to determine their age. From the findings, 64.7 per cent of the research participants indicated that the household members who got the accident were aged between 0 and 5 years, 29.4 per cent indicated that they were 18 years and above in age and 5.9 per cent indicated that they were aged between 6 and 11 years.

Table 4. 10: Age of the Household Members who were Involved in accidental mishap

	Frequency	Percent
0-5 years	22	64.7
6-11 years	2	5.9
18 years and above	10	29.4
Total	34	100.0

4.4.3 Type of Household Hazardous Waste/s that Caused the Reported Accident

The research participants, who indicated that their household members had been a victim of household hazardous waste related accidents, were asked to indicate the type of household hazardous waste/s that caused the reported accident. As indicated in Table 4.11, 58.8 per cent of the research participants indicated that the household hazards

accidents were caused by accaricides/pesticides, 29.4 per cent indicated that they were caused by paraffin while 11.8 per cent indicated that they were caused by animal/human drugs.

Table 4. 11: Type of Household Hazardous Waste/S that Caused the Reported Accident

Type of HHW	Frequency	Percent
Accaricides/pesticides	20	58.8
Animal/human drugs	4	11.8
Paraffin	10	29.4
Total	34	100.0

4.4.4 Health Problems that Occurred Due to the Accidental Occurrences , Place of Treatment and Outcome of the Incidents

The research participants were also asked to indicate the health problems that occurred due to the accidental incidents as informed by the healthcare worker According to the findings, 35.3 per cent of the research participants indicated that unconsciousness was one of the health problems that occurred due to the accidents. This was followed by diarrhea and vomiting (29.4%), eye irritation (17.6%), respiratory infection (11.8%) and skin infection (5.9%). The key informants, who included health care workers such as clinical officers and nurses, indicated that the most commonly reported accidental occurrences due to household hazardous waste at the pastoral households included injury related to sharp objects such as needles, food poisoning, drug poisoning, cuts, fire outbreak as well as skin diseases and respiratory illness from pesticides.

The research participants were asked to indicate where the family members were treated after the accident due to household hazardous waste. From the findings, 41.2 per cent of the household heads indicated that the family members were treated by other family

members after the accident due to household hazardous waste, 35.3 per cent indicate that they were treated in a hospital and 23.5 per cent indicated that they were treated by traditional healers.

The research participants were further asked to indicate what the outcome of the accident was. The results were as presented in Table 4.12. From the findings, 94.1 per cent of the household heads indicated that the victims of the household hazardous waste accident survived while 5.9 per cent indicated that they died.

Table 4. 12: Health Problems that Occurred Due to the Accident, Place of Treatment and Outcome of the Accidents

Health problems resulting from HHW accidents	Frequency	Percent
Diarrhea and vomiting	10	29.4
Skin infection	2	5.9
Eye irritation	6	17.6
Respiratory infection	4	11.8
Unconsciousness	12	35.3
Total	34	100.0
Place of treatment		
Hospital	12	35.3
Traditional healer	8	23.5
Treated by family members	14	41.2
Total	34	100.0
Outcome		
Survived	32	94.1
Died	2	5.9
Total	34	100.0

4.5 Level of knowledge on Household Hazardous Waste

The knowledge of the pastoralists on household hazardous waste influences their ability to manage different types of household hazardous wastes. Therefore, the third objective of the study was to determine the level of knowledge on household hazardous waste (HHW) management among pastoral community of Mandera County.

4.5.1 Knowledge Scores

The knowledge scores of the research participants on household hazardous waste management practices were measured by the number of questions they got correct responses where 0 to 3 scores were considered to be little knowledge, 4 to 7 scores was considered moderate knowledge, 8 to 11 was considered to be good knowledge and 12 to 13 scores was considered to be excellent knowledge. The knowledge scores were obtained from Hebbal et al. (2011). From the findings, 48.1 per cent of the research participants obtained between 4 and 7 scores, 32.7 per cent obtained 8 to 11 scores and 18.4 per cent obtained below 3 scores and 0.7 per cent obtained between 12 and 13 scores. This shows that most of the research participants had moderate awareness on household hazardous waste management.

Table 4. 13: Knowledge Scores

	Frequency	Percent
0 to 3	76	18.4
4 to 7	198	48.1
8 to 11	135	32.7
12 to 13	3	0.7
Total	412	100.0

4.5.2 Identification of Household Hazardous Wastes

The recognition of the existence of HHW in pastoral households is important as the sound management starts from knowing that this type of waste requires special handling. According to the findings, 92.8 per cent of the research participants indicated that they can identify household hazardous waste while 7.2 per cent stated that they cannot correctly identify household hazardous waste. This implies that most of the pastoral household heads in Mandera County can correctly identify household hazardous waste.

However, most of the household heads understood what household hazardous waste is, after the research assistants explained to them. This is because there is no specific term for household hazard waste in vernacular languages in Mandera County and considering that most of the household heads had no formal education.

4.5.3 Source of Information on Household Hazardous Waste

From the research participants who had heard about household hazardous waste, the study also sought to establish the source of information to identify household hazardous waste from general household waste. From the findings, 42.7 per cent of the research participants who had heard about household hazardous waste reported that the source of information was radio, 38.8 per cent indicated health workers, 6.3 per cent indicated neighbor and 4.8 per cent indicated veterinary officers. This implies that most of the household heads that had heard about household hazardous waste had obtained from radio and health workers.

Table 4. 14: Source of Information on Household Hazardous Waste

	Frequency	Percent
Health workers	160	38.8
Radio	176	42.7
Neighbor	26	6.3
Veterinary officers	20	4.8
No information	30	7.2
Total	412	100.0

4.5.4 Level of Knowledge on Household Hazardous Waste

Knowledge on the various types of household hazardous waste management methods influences their utilization in disposing various types of household hazardous waste. Actually the management of household hazardous waste starts from its recognition in order to segregate them from the other waste stream. The research participants were

given the options for the various methods of HHW management methods and a dichotomous scale was used to measure the awareness on management methods.

From the findings, 85 per cent of the research participants indicated that they had awareness on open dumping, 58.3 per cent had awareness on incineration/burning, 15.3 per cent had awareness on reuse, 2.7 per cent had awareness on land fill/burying, 1.3 per cent had awareness on reducing usage and the same percent had awareness on recycling. This implies that most of the household heads had knowledge on open dumping and incineration. Knowledge on other methods of household hazardous waste management practices like reuse, land fill/burying, reducing usage and recycling was found to be uncommon among most of the household heads.

The key informants also indicated that household hazardous waste disposal methods that are practiced by the pastoral community of Mandera East Sub County include burning in an open area, compost pit, crude damping and opening damping.

Table 4. 15: Level of Knowledge on Household Hazardous Waste

	Frequency		Percent	
	Yes	No	Yes	No
Reduce usage	4	298	1.3	98.7
Reuse	48	266	15.3	84.7
Recycle	4	296	1.3	98.7
Incineration	176	126	58.3	41.7
Land fill/Burying	8	290	2.7	97.3
Open dumping	350	62	85.0	15.0

4.5.5 Knowledge on Management of Household Hazardous Waste Practices

Most of the research participants (81%) stated that unused adhesives and glues should be disposed by burying. This is the correct way of managing unused adhesives and glues. In addition, according to 91.3 per cent of the research participants, remains of pesticides,

insecticides, fungicides and other farm chemicals should be disposed by burying/landfill. This is was the correct way of managing remains of pesticides, insecticides, fungicides and other farm chemicals.

According to the findings, 97.6 per cent of the research participants reported that empty oil and flammable containers should be reused, which was wrong. Further, 86.8 per cent of the research participants indicated that needles and syringes to treat animals should be reused, which is a wrong method of managing used needles and syringes. Also, 86.4 per cent of the research participants indicated that unused drugs (human and animal) should be disposed by burning. However, drugs are made of chemicals and hence burning them may lead to environmental pollution and hence this is wrong method of management.

In addition, 40.8 per cent indicated that aerosol/ compressed cans should not be incinerated. Burning of aerosol/ compressed cans may lead to explosions and hence it is a wrong way of managing aerosol/ compressed cans. Further, 29.6 per cent of the research participants reported that old batteries (all types) and used electronic items (phones, radio, and torches) should not be disposed by burning. However, this is a wrong way of managing used electronic items (phones, radio, and torches).

Table 4. 16: Knowledge on Management of Household Hazardous Waste practices

knowledge	Freque ncy (n=412)	Percent
	Yes	%
Remains of Pesticides, insecticides, fungicides and other farm chemicals should be disposed by burying/landfill	376	91.3
Unused drugs (human and animal) should be disposed by burning	356	86.4
Old Batteries (all types) and used electronic items (phones, radio, television) should be disposed by burning	122	29.6
Unused adhesives and glues should be disposed by landfill/burying	332	81.0
Needles and syringes to treat animals should be reused	356	86.8
Empty oil and flammable containers should be reused	400	97.6
Aerosol/ compressed cans should be incinerated	168	40.8

4.6 Household Hazardous Waste Management Practices at Household Level

The fourth objective of the study was to identify household hazardous waste management practices at household level in the pastoral community of Mandera County. This objective was achieved by identifying the storage, segregation and disposal methods used in managing the various types of household hazardous waste generated in pastoral community of Mandera County. It is important to identify the HHW management practices at household level in the pastoral community in this study in order to measure whether they have a good practice or bad practice and to give recommendations on improvement on HHW management at the HH level.

4.6.1 Segregation of Household Hazardous Waste

The research participants were asked to indicate whether they segregate their household hazardous waste from the general household waste before disposal. According to the findings, 87.8 per cent of the pastoral research participants indicated that they do not segregate their household hazardous waste from the general household waste before storage and disposal while 12.2 per cent indicated that they did.

4.6.2 Categories of Household Hazardous Waste Segregated

From the research participants who indicated that they segregate their household hazardous waste from the general household waste before disposal, the study also sought to establish the categories of household hazardous waste they segregate from the general hazardous waste. According to the findings, 88 per cent indicated that they segregate used needles and syringes, 84 per cent indicated that they segregate unused/ expired animal and human drugs and the same percent indicated that they segregate poisons, insecticides, fungicides and pesticides. In addition, 16 per cent of the research participants indicated that they segregate adhesives and glues, 12 per cent indicated that they segregate containers of used oils, paraffin, petrol and empty aerosol cans while 8 per cent indicated that they segregate batteries (all types) and used electronic items (phones and radio, torches).

Table 4. 17: Categories of Household Hazardous Waste segregated

	Frequency		Percent	
	Segregate	Do not segregate	Segregate	Do not segregate
Unused/ expired animal and human drugs	42	8	84.0	16.0
Poisons, insecticides, fungicides and pesticides	42	8	84.0	16.0
Batteries (all types) and used electronic items (phones, radio, torches)	4	46	8.0	92.0
Containers of used oils, paraffin, petrol and empty aerosol cans	6	44	12.0	88.0
Adhesives and glues	8	42	16.0	84.0
Used needles and syringes	44	6	88.0	12.0

4.6.3 Level of Education and Segregation of Household Hazardous Waste

The level of education and knowledge may affect segregation of Household Hazardous Waste among pastoral communities. Primary education and no formal education were

classified as “low or no education” while secondary education, college education and university education were classified as “educated”. Many household hazardous goods have labels that direct the users on how to store and dispose them. This can only be read by literate persons and may disadvantage many pastoral household heads as most of them have no formal education. In addition, household heads who have never heard of segregation, may not advocate for its use in the households. From the findings, there is a significant association between level of education and segregation of household hazardous waste from the general household waste before disposal ($\chi^2= 98.515$, $df =1$, $p <0.05$).

Table 4. 18: Level of Education and Segregation of Household Hazardous Waste

Level of education completed		Segregate your household hazardous waste		Total	Chi square
		Yes	No		
Low or no education	Count	36	360	396	$X^2=98.515$ $df=1$
	Percent	9.09	90.91	100	
Educated	Count	14	2	16	P-value=.000
	Percent	87.5	12.5	100	
Total	Count	50	362	412	
	Percent	12.2	87.8	100	

4.6.4 Movement from One Place to Another and Storage of household hazardous waste

Pastoralists who move from one location to another and the frequency of movement may affect the storage of household hazardous waste as they may not move with it. Movement of households will also affect on the choice of the disposal methods such as incineration and open dumping. From the findings, there is a significant association between movement from one place to another and storage of household hazardous waste ($\chi^2= 44.233$, $df =1$, $p <0.05$). The households that were not moving were more likely to store household hazardous waste before disposal than households that were moving. The

likelihood of storage of household hazardous waste decreased with increase in the number of movements.

Table 4. 19: Movement from One Place to Another and Storage of household hazardous waste

Movement from One Place to Another		Storage of household hazardous waste before disposal		Total	Chi square
		Yes	No		
No movement	Count	20	60	80	$X^2=44.233$ df=1
	Percent	25	75	100	
Movement	Count	20	312	332	p-value=.000
	Percent	6.13	93.87	100	
Total	Count	40	372	412	
	Percent	9.71	90.29	100	

4.6.5 Storage of Household Hazardous Waste before Disposal

Storage of household hazardous waste is very important in its management. Hazardous waste must be stored in an appropriate manner to avoid contamination or poisoning effect on animals and human. The duration of storage depends on the form of the waste generated

The research participants were requested to indicate whether they store their household hazardous waste before disposal. From the findings, 87.9 per cent of the research participants indicated that they do not store their household hazardous waste before disposal while 12.1 per cent indicated that they store their household hazardous waste before disposal. This implies that most of the household heads do not store their household hazardous waste before disposal.

4.6.6 Size of the land and Storage of household hazardous waste before disposal

The size of the land owned by a household may affect the storage and management of household hazardous waste before disposal as this requires space. From the findings, there is a significant association between size of the land owned by households and storage of household hazardous waste ($\chi^2= 78.888$, $df =1$, $p <0.05$). The households that had smaller pieces of land were more likely to store household hazardous waste before disposal than households that larger pieces of land. The likelihood of storage of household hazardous waste decreased with increase the size of the land.

Table 4. 20: Size of the land and Storage of household hazardous waste before disposal

Owning a piece of land		Storage of household hazardous waste before disposal		Total	Chi-square
		Yes	No		
Own a piece of land	Count	34	102	136	$X^2=78.888$ $df=1$
	Percent	25	75	100	
Community land	Count	21	255	276	P- value=.000
	Percent	8	92	100	
Total	Count	55	357	412	
	Percent	13	87	100	

4.6.7 Read the Label/ Instructions on the Household Hazardous Goods

The ability of the household heads and members to read labels and instructions may influence how they manage household hazardous waste. Many of the household hazardous goods either show images or have instruction on how best to handle and dispose them. The ability and willingness to observe or read them will aid the user on how to dispose them safely. From the findings, 83.4 per cent indicated that they do not read the label/ instructions on the household hazardous goods they buy while 11.6 per

cent indicated that they read the label/ instructions on the household hazardous goods they buy. This implies that most of the households do not read the label/ instructions on the household hazardous goods they buy.

4.6.8 Level of education and Reading of Labels

The level of education of the household heads may affect their ability to read through labels. According to the findings, there is a significant association between level of education and reading of labels/ instructions on the household hazardous goods ($\chi^2=184.276$, $df=1$, $p < 0.05$). The results also indicated that the pastoral household heads with tertiary education read labels/instructions on the household hazardous goods, followed by those who had secondary education, primary education and only a few (2.4%) of those who had no formal education were reading the labels/instructions.

Table 4. 21: Level of education and Reading of Labels

Level of education		Reading label/ instructions on the household hazardous goods		Total	Chi square
		Yes	No		
Low or no education	Count	34	362	396	$X^2=184.276$ $df=1$
	Percent	8.6	91.4	100	
Educated	Count	14	2	16	P-value=.000
	Percent	87.5	12.5	100	
Total	Count	48	364	412	
	Percent	11.7	88.3	100	

4.6.9 Reasons for not Reading the Labels on the Household Hazardous Goods

It was also important to understand the main reasons for not reading instructions and labels in Household Hazardous Goods. This is because the labels/instructions contain information on the disposal methods and storage of Household Hazardous Goods.

Therefore, from the household heads who indicated that they do not read the label/ instructions on the household hazardous goods they buy, the study also sought to establish reasons for not reading the labels on the household hazardous goods they buy. According to the findings, 81.1 per cent of the research participants indicated that they do not know how to read, 12.8 per cent indicated that they have never seen any label, 5.6 per cent indicated that many goods do not have labels while 0.6 per cent indicated that they don't care to look at the labels.

4.6.10 Management of used cosmetic products and laundry products

The research participants were requested to indicate how they manage used cosmetic products and laundry products in their household. From the findings, 75 per cent of the research participants reported that they managed used cosmetic products and laundry products in their households through open dumping, and 25 per cent indicated through reduction of usage. This implies that most of the households were managing used cosmetic products and laundry products in their household through open dumping.

4.6.11 Management of Unused Drugs (Human and Animal)

Most of the households in Mandera County are pastoralists and hence it was important to understand how they dispose unused drugs for human and animals. According to the findings, 51.7 per cent of the research participants indicated that they manage unused drugs (human and animal) in their households through open dumping, 39.8 per cent indicated through incineration/ burning and 8.5 per cent indicated through burying. This findings show that the method used mostly to manage unused drugs (human and animal) in their households was open dumping.

4.6.12 Management of Pesticides, Insecticides, Fungicides and Other Farm Chemicals

Being pastoralists, most households in Mandera County use pesticides, insecticides, fungicides and other farm chemicals and hence it was important to understand how they dispose them. Therefore, the research participants were asked to indicate how they manage remains of pesticides, insecticides, fungicides and other farm chemicals in their households. According to the findings, 47.9 per cent of the research participants indicated that they used land fill/burying to manage remains of pesticides, insecticides, fungicides and other farm chemicals in their household, 37.9 per cent indicated that they used open dumping, 13.6 per cent indicated that they used incineration/ burning and 0.7 per cent indicated that they used reduction of usage. Anyamani (2014) indicates that remains of pesticides, insecticides, fungicides and other farm chemicals should be kept in double polythene bags awaiting collection in the household hazardous waste collection program.

4.6.13 Management of Old Batteries and Used Electronic Items

Pastoralists often use torches to look after their livestock at night and during the day they use electronic gadgets like radio for music and news. Therefore, it is important to understand how they manage old batteries (all types) in their households. According to the findings, 67.8 per cent of the research participants indicated that the management old Batteries (all types) in their households through reuse by crashing them to prepare local ink, 20 per cent indicated through open dumping, 7.8 per cent indicated through incineration/burning and 3.9 per cent indicated through burying.

4.6.14 Management of containers of used oils, paraffin, petrol and empty aerosol cans

Since most pastoralists move from one location to another, they use paraffin to light their lamps at night because of the inaccessibility to a power source. In addition, they use other aerosols, petrol and oil containers. These containers are either used to transport different products from their original content or carry their content which is highly hazardous. Therefore, the research participants were also requested to indicate how they manage containers of used oils, paraffin, petrol and empty aerosol cans in their household. According to the findings, 83.3 per cent of the research participants indicated that they were managing containers of used oils, paraffin, petrol and empty aerosol cans in their household through reuse, 9.1 per cent indicated through incineration/burning, 4 per cent indicated through land fill/burying and 3.5 per cent indicated through open dumping.

4.6.15 Managing Unused Adhesives and Glues

Adhesives and Glues are common in most pastoral households in Mandera County and hence it is important to understand how they are managed. Therefore, the research participants were asked to indicate how they manage unused adhesives and glues in their households. From the findings, all the research participants (100%) indicated that they manage unused adhesives and glues in their households through open dumping.

4.6.16 Managing Used Needles and Syringes for Animal Treatment

During animal treatment pastoralists often use Needles and Syringes and hence it is important to understand how they manage them after use. Thus, the research participants were asked to indicate which method they use to manage used needles and syringes for

animal treatment in their households. According to the findings, 67 per cent of the research participants indicated that they manage used needles and syringes for animal treatment in their household through reuse, 31 per cent indicated burying, 1.5 per cent indicated open dumping and 0.5 per cent indicated reduction of usage.

4.6.17 Challenges Facing the Management of Household Hazardous Waste

The key informants were asked to indicate the main challenges facing the management of household hazardous waste among pastoral community of Mandera East Sub County. They indicated that these challenges include lack of knowledge about the danger of household hazardous waste, lack of knowledge on ways of disposal, absence of storage facilities to prompt collection of the wastes, lack of general awareness on HHW, inappropriate disposing methods and poor infrastructure for transport of hazardous waste.

CHAPTER FIVE: SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

5.1 Introduction

This chapter presents the summary of the data findings, conclusion drawn from the findings highlighted and recommendation made there-to. The conclusions and recommendations drawn were focused on addressing the objective of the study which was to explore household hazardous waste management practices among pastoral community of Mandera County, Kenya.

5.2 Summary

5.2.1 Type of Hazardous Waste Generated by Pastoral Households

The study found that most of the households in Mandera County were generating used batteries (all size and type) and electronic items (phones, radio and torches); unused drugs and pharmaceuticals for either human or animal use; remains of pesticides, herbicides, fungicides and acaricides; and used needles and syringes for animal treatment. These findings support the findings of District Public Health Office (2013) which reported that in rural Mandera every household has some hazardous waste comprising of pharmaceutical, animal drugs, batteries, torches containing lead, pesticides (acaricides), electronics and non-biodegradable waste such as polythene papers which have the potential for posing risk to life, health, property or the environment if improperly consumed, stored, or disposed.

The study also found that animal drugs were the most common household hazardous waste followed by acaricides, pesticides, needles and syringes mostly during the windy season. According to MOH (2014), acaricides and pesticides such as fungicides,

herbicides, insecticides, and rodenticides are the common poisons used in homes. The study found that most of the household heads bought household hazardous goods from retail shops and hawkers.

5.2.2 Occurrence of Accidents Related to Household Hazardous Waste

Improper handling or disposal of products containing hazardous ingredients can result in serious accidents to people and animals by either drinking, eating, touching, or breathing in of household hazardous wastes. The study found that 8.3 per cent of the households in Mandera County had members who were victims of household hazardous waste related accidents. These findings support MOH (2013) report that the pastoral populations in Mandera East have severally reported health complains directly related to household hazardous waste consumption, such as ingestion of acaricides applied on animals to kill or repel ectoparasites either through milk or accidental ingestion through hands and containers.

In addition to this, most of the household members who got the accident were aged between 0 and 5 years. These findings support MOH (2013) report that health facilities in Mandera East reported 10 poisoning in children under five years and 2 cases of poisoning in adults from the months of January to December in 2014. This is also supported by Ojeda-Benítez *et al.* (2013) argument that health risks associated with HHW in children are typically greater than that of adults. With their smaller bodies and endless curiosity, children are much more likely to come into contact with HHW in the home that have been stored or disposed of improperly, and to suffer the ill effects from that contact.

The study revealed that most of the household hazards accidents were caused by accaricides/pesticides followed by paraffin and animal/human drugs. These findings agree with District Public Health (2013) report that accaricides/pesticides are the most common household hazard wastes in Mandera East Sub County.

The study revealed that unconsciousness was one of the health problems that occurred due to the accident, followed by diarrhea and vomiting, eye irritation, respiratory infection, skin infection, injury related to sharp objects such as needles, food poisoning, drug poisoning, cuts, fire outbreak as well as skin diseases and respiratory illness from pesticides. These findings agree with Senzige (2014) argument that the most common household hazardous waste related health problems among pastoralists include poisoning injuries and skin infection.

5.2.3 Level of Knowledge on Household Hazardous Waste

The study established that most of the household heads in Mandera County had some knowledge on household hazardous waste. However, most of the household heads could identify household hazardous waste they generated but polythene paper was regarded as a hazardous waste due to the deaths it caused when ingested by animals, while used dry cell batteries which are very hazardous were not identified as hazardous waste among the pastoral household heads. These findings agree with Ojeda-Benítez *et al.* (2013) findings that pastoralists are often unaware of the potential hazards caused by many HHW in their homes.

According to Yasuda and Tanaka (2006), poor understanding from the general public on what constitutes household hazardous waste is one of the main causes linked to the lack

of treatment, poor storage and disposal (TSD) practices in homesteads. The study found that the household heads had mainly obtained information on household hazard wastes from radio and health workers. The study also found that most of the household heads had knowledge on open dumping and incineration. Knowledge on other methods of household hazardous waste management practices like reuse, land fill/burying, reducing usage and recycling was found to be lacking among most of the household heads. The study also identified that dry cell batteries were being reused in inappropriate way by crushing them and making ink for *Quran* teaching but the pastoral population do not know the dangers associated with it. These findings agree with Slack *et al.* (2005) argument that the public is often unaware of their options for reducing, recycling and disposal of their HHW.

The study established that most of the household heads in Mandera County had moderate knowledge on households' hazardous waste management. These findings agree with Wagner *et al.* (2013) argument that residents are often unaware of the potential hazards caused by many HHW in their homes. Recognition of hazardous products and wastes is paramount to encouraging the safe and proper disposal of moderate risks waste. The study found that the households' heads had knowledge on the management of unused adhesives and glues and remains of pesticides, insecticides, fungicides and other farm chemicals. The household heads also indicated that remains of pesticides, insecticides, fungicides and other farm chemicals should be disposed by burying.

The household heads indicated that unused adhesives and glues should be disposed by burying. This is contrary to Slack *et al.* (2005) recommendation that incineration at high temperatures is the best disposal management method for adhesives, sealers, and

flammable materials. The study established that the household heads had no knowledge on the management of empty oil and flammable containers. They indicated that empty oil and flammable containers should be reused, which was incorrect. Oil and flammable containers can be easily set on fire and hence should be triple rinsed before disposal as recommended by Massawe *et al.* (2014). Further, household heads indicated that needles and syringes to treat animals should be reused, which is an incorrect method of managing used needles and syringes. According to Ojeda-Benítez *et al.* (2013), reusing needles and syringes may lead to re infections and hence should be fully encapsulated and placed in puncture proof containers at the home awaiting collection.

The household heads indicated that unused drugs (human and animal) should be disposed by burning. However, drugs are made of chemicals and hence burning them may lead to environmental pollution by the release of dioxins and furans which have adverse health effects and is therefore an incorrect method of managing drugs and pharmaceuticals. In addition, the household heads indicated that aerosol/ compressed cans should not be incinerated. Burning of aerosol/ compressed cans may lead to explosions and hence it is a wrong way of managing aerosol/ compressed cans. Further, the household heads reported that old batteries (all types) and used electronic items (phones, radio and torches) should be disposed by reusing or incineration. The pastoral population is reusing used batteries for making local ink called *qhat* in *quran* schools where children leak the ink made of the batteries exposing them to heavy metals and also apply the crushed powder on open wounds for the acids to wash the bacteria, which means that heavy metals have direct access to the blood of animals and human. However, this is a wrong way of managing used dry cell batteries and other electronic waste. E-waste should be collected for

segregation, removal of hazardous material and recycling is the recommended method of managing electronic waste.

5.2.4 Household Hazardous Waste Management Practices at Household Level

The study found that households in Mandera County do not segregate their household hazardous waste from the general household waste stream before disposal. For the households who were segregating their household hazardous waste were mostly segregating unused/ expired animal and human drugs and the same percent indicated that they segregate poisons, insecticides and fungicides. A few (one fifth) were segregating containers of used oils, paraffin, petrol and empty aerosol cans; and batteries (all types) and used electronic items (phones and radio). According to Ojeda-Benítez *et al.* (2013), lack of obligation by households to segregate HHW from the general household waste makes it very difficult to plan for its management.

The study also revealed that most of the households do not read the label/ instructions on the household hazardous goods they buy. Those who were not reading the label/ instructions indicated that the main reasons were that they do not know how to read, have never seen any label and many goods do not have labels. These findings are contrary to Hammet *et al.* (2002) argument that some of the rules for managing household hazardous Products are following the directions for storage on the label and protecting the original label to guide the treatment in the event of poisoning.

The study revealed that the method used mostly to manage unused drugs (human and animal) in their households was open dumping. According to Anyamani (2014), most often unused or expired medications are either flushed down the toilet or thrown in the

garbage where they pose a threat to the environment. If flushed, pharmaceuticals may pass through treatment facilities and end up in surface and groundwater. If land filled, they have the potential to leach from the landfill into groundwater. Alternately, without a safe and effective method for disposal, prescription drugs may be left indefinitely in medicine cabinets where they pose a threat of potential prescription drug misuse or abuse. When disposed of in the trash, children or illicit drug users might get access to them. According to Mbeng *et al.* (2012), livestock farmers should be advised to consult a local veterinary clinic, waste collection company if there are expired and unwanted medications are on the farm for opportunities to safely dispose of these products.

The study revealed that most of the households in Mandera County were managing old batteries (all types) in their households through reuse. These findings agree with Massawe *et al.* (2014), that e-waste provides a source of valuable income through recycling and reuse. In some African countries such as Ghana and Nigeria it provides economic opportunities through the development of community based collection, recovery and recycling. However, low-price non-rechargeable standard batteries often have short lifetimes and contain heavy metals such as lead and/or cadmium. Dead dry cell batteries are often given to children for the so-called *kila* game, which involves trying to smash the cells on another stationary battery (Mbeng *et al.*, 2012). The black power in the cell (cadmium and nickel salts) are scattered in the play area where the children can become exposed. There are cases reported of children dying, going into a coma, or being made sick by swallowing the black powder in dry cell batteries in Zambia. Some adults have reported where they had crushed the batteries and used the black powder as shoe polish, hair dye, or on black boards. In Mandera the black powder

in the dry cell batteries are smashed by children to prepare ink for learning *Quran*, where they leak the wet ink in case they want to make a correction exposing them to heavy metal poisoning (Massawe *et al.*, 2014). Actually children go round the households collecting the used batteries to reuse them for the preparation of this ink. In addition to this, the powder in some cases is applied on chronic wounds to wash away bacteria and other germs causing direct skin absorption of these heavy metals.

The study found that most households in Mandera County were managing containers of used oils, paraffin, petrol and empty aerosol cans in their household through reuse. Many of the automotive products are flammable and should not be disposed in to the drains, sewer, nor in the garbage containers. Used automotive oils are used as form of pesticides and applied on the traditional houses to repel termites in Mandera County. Oil poured onto the ground or down the storm sewers may eventually find its way into surface water such as rivers, streams or even ground water and contaminate drinking water and harm living organisms. According to Massawe *et al.* (2014), triple-rinse container is the prescribed treatment method for empty oils, paraffin, petrol and empty aerosol containers. To triple-rinse, the container is filled 1/4 full with water (or the solvent recommended on the product label), close it tightly, and shake or invert so the rinse reaches all inside surfaces. This is repeated two or more times.

The study found that households manage used needles and syringes for animal treatment in their household through incineration/burning. These findings are contrary to Ojeda-Benítez *et al.* (2013) argument that needles and syringes should be disposed using save for collection method. Save for collection indicates those products that should be saved for a household hazardous waste collection. This is supported by Malandrakis (2008),

who recommended that all used sharps are fully encapsulated placed in puncture proof containers at the home. Household Health care waste should be taken to drop off collection sites or mailed back through postal services which have worked well in rural communities in the United States.

The study revealed that in most households in Mandera County it was the duty of the mothers to manage household hazardous waste. However, in some households fathers and other members of the family were playing the role. These findings agree with Tiwari (2001) findings that women rather than men handle household hazardous waste. Female participation was mostly involved in recycling, composting and burying.

5.3 Conclusions

The study concludes that most of the households in Mandera County were generating used batteries (all size and type) and electronic items; unused drugs and pharmaceuticals for either human or animal use; remains of pesticides, herbicides, fungicides and acaricides; and used needles and syringes for animal treatment. Different types of household hazardous waste were generated in different seasons of the year. As compared to the dry and wet seasons, the composition of the waste stream had more used animal drugs, acaricides, pesticides, needles and syringes during the windy season.

The study also concludes that most of the household heads in Mandera County had moderate knowledge on household hazardous waste, which had been obtained from radio and health workers. The study revealed that most of the household heads had knowledge on open dumping and incineration as hazardous waste disposal method, but knowledge on other methods of household hazardous waste management practices like reuse, land

fill/burying, reducing usage and recycling was found to be lacking among most of the household heads.

The study concludes that 10 per cent of the households in Mandera County had members who were victims of household hazardous waste related accidents. In addition, most of the household members who got the accident were aged between 0 and 5 years. Most of the household hazards accidents were caused by accaricides/pesticides followed by paraffin and animal/human drugs. The study established that most of the household hazardous wastes related accidents occurred in their households after more than two years.

The study concludes that most households in Mandera County do not segregate their household hazardous waste from the general household waste before storage and disposal. The study revealed that most of the households do not read the label/instructions on the household hazardous goods they buy. The study found that open dumping and incineration were the most common methods of dealing with household hazardous waste among households in Mandera County.

5.4 Recommendations For Practice

1. The study found that generation of HHW was dependent on seasons as Households were generating different types of hazardous waste during different seasons of the year based on the type of animals they keep. This study therefore recommends that the remains of pesticides, herbicides, fungicides and accaricides should be stored well and their remains disposed in the same season of the year, mobile collections and one

- day collection should be conducted before the end of the season to remove this hazardous waste from the households.
2. The study found that in most cases the victims of household hazardous waste did not go to the hospital for treatment. This study recommends that the Ministry of Health of Mandera County Government should increase awareness on the importance of reporting to healthcare facilities for treatment in the event household hazardous waste accidents occur and possibly carrying the hazardous waste that caused the poisoning to the health facility for correct case management.
 3. Lack of knowledge on household hazardous waste affects the management of household hazardous waste. The study found that most of household heads had no formal education and hence they had little knowledge on the identification and the correct household hazardous waste management methods. This study recommends that the county and national government should come up with trainings and awareness creation programmes aimed to increase knowledge on household hazardous waste management. The training programmes can be offered in public barazas and through mass media such as radio. In addition, the study recommends that training programmes should be accompanied by monitoring and evaluation to assess the knowledge of the pastoral communities before training, during training and after training. This will play a major role in ensuring that programmes are adjusted after mid-term evaluation to fit the knowledge needs of the community.
 4. The study found that most of the household heads knew of burning and open dumping only. Different hazardous waste should be disposed in different ways (reduce, reuse,

- recycle, incineration, land fill and open dumping) and hence community members should be trained on these management methods.
5. The study also found that there were no collection centers for hazardous wastes such as needles and syringes as well as e-waste. The study recommends that the county government in collaboration with national government should establish mobile collections methods which are appropriate for household hazardous waste that needs special handling for destruction or recycling in the pastoral zones. This will help to reduce the accumulation and the risk of hazardous wastes such as needles, syringes and e-waste which can be harmful to human health. In addition, the study recommends that monitoring and evaluation of the mobile collections should be conducted to assess their effectiveness.
 6. The study established that children of pastoral community of Mandera do reuse old batteries by crashing and using the black powder as ink which is often leaked in the cause of learning, public education on the importance of using the harmless traditional materials (wild gum and charcoal) as ink should be revived. The dangers of using old batteries as ink should be emphasized.

5.5 Areas for Further Studies

1. This study was limited to Mandera East Sub-county and hence its findings cannot be generalized to other Counties in Kenya. This is because different communities generate different types of household hazardous waste. This study therefore suggests comparative studies on hazardous household waste management practices among different communities in Kenya.

2. The study also suggests further studies on the effect of knowledge, attitude and practices on Household hazardous waste in Kenya.
3. In addition, the study suggests further studies on household hazardous waste management practices in urban areas in Kenya.
4. Also, further studies should be conducted on the role of monitoring and evaluation in the implementation of household hazardous waste management training programmes.

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APPENDICES

Appendix I: Consent on the Participation

HOUSEHOLD HAZARDOUS WASTE MANAGEMENT PRACTICES AMONG PASTORAL COMMUNITY OF MANDERA COUNTY, KENYA

The Purpose

I am Abukar Abdi Sheikh, a postgraduate student in the School of Public Health of Kenyatta University pursuing a degree of master of public health-monitoring and evaluation in the school of public health of Kenyatta University. The main objective is to explore hazardous household waste management practices among pastoral community of Mandera County, Kenya. The study also seeks to determine the level of knowledge on household hazardous waste (HHW) management among pastoral community; identify the type of household hazardous waste generated by households in the pastoral community; identify household hazardous waste management practices at household level in the pastoral community and determine the pattern of occurrence of accidents related to household hazardous waste among the members of households of the pastoral community in Mandera County.

Procedures

Participation in this study will require I ask you some questions on household hazardous waste management practices. Information will be written down in a same sheet of paper. You may ask questions related to the study at any time. You may refuse to respond to any questions and you may stop participating at any time without consequences to you.

Discomforts and risks

There will be minimum risk to you for participating in this study. However, some questions you will be asked will be of a sensitive nature and may make you uncomfortable. If this happens you may refuse to answer if you so choose. You may also stop the interview at any time. The interview shall take approximately 30 minutes of your time.

Benefits

There may be no direct benefits or compensation to you as an individual but the information generated will be used by the administrators and other stakeholders to come

up with strategies to improve household hazardous waste management practices in the pastoral community.

Voluntary Participation and Withdrawal

Your participation is entirely voluntary and should you change your mind you are free to opt out at any time. You may skip questions or stop participating at any time without any penalty.

Confidentiality

I will not identify you and no information that will make it possible for anyone to identify you will be required in this study. The information provided will only be used for academic purposes and will not be given to any organization or individual for any other use. All information will be kept under key and lock and the electronic information will be under a password.

Contact information

Any queries regarding this study may be directed to me, Abukar Abdi Sheikh cell phone number 0722101360.

Having been informed about the study and having read the above and understood all that it entails, do willingly give consent to participate in the study.

Participant signature..... Date.....

Researcher's signature..... Date.....

Appendix II: Household Heads Questionnaire

This is an academic study assessing household hazardous waste management practices among pastoral community of Mandera County, Kenya. The information herein requested is for use to meet academic requirements and as such shall be treated with utmost confidentiality. No full or part of the information shall be disclosed to the government, any authority or potential competitors, and hence any form of victimization shall not be leveled to the informant for whichever kind of information.

Demographic Information

1. Gender

Male Female

2. Age Bracket

18 to 25 years 26 to 40 years

41 to 65 years Over 65 years

3. Level of education completed

No formal education

Primary Level

Secondary level

College level

University level

4. How many people live in your household?

Less than 3 3 to 5

6 to 8 More than 8

5. How often do you move from one location to another in search of pasture?

We don't move

Once in a year

Twice in a year

Three times a year

More than three times a year

6. What is the size of your land?

- Less than half an acre One acre
 2 acres 3 acres
 4 acres 5 acres
 More than 5 acres others (Specify).....

7. What species of animals do you keep?

- Camel Cattle
 Goats All species

Level of Awareness on household hazardous waste Management practices

Operational Definition of household hazardous waste; refers to house hold waste which requires special handling and disposal procedures to avoid risk to health and/or environmental effects.

1. Have you ever heard of household hazardous waste? Yes No

2. If Yes, What was your source of information to identify household hazardous waste from general household waste?

- Health workers Radio Television
 Neighbor others (specify).....

3. Which of the following household hazardous waste management practices do you know?

	Yes	No
Reduce usage	[]	[]
Reuse	[]	[]
Recycle	[]	[]
Incineration	[]	[]
Land fill	[]	[]
Open Dumping	[]	[]

4. Do you agree with the following statements on the management of household hazardous waste?

	Yes	No
Remains of Pesticides, insecticides, fungicides and other farm chemicals should be disposed by burying/landfill		
Unused drugs (human and animal) should be disposed by burning?		
Old Batteries (all types) and used electronic items (phones, radio, television) should be disposed by burning		
Unused adhesives and glues should be disposed by landfill/burying.		
Needles and syringes to treat animals should be reused		
Empty oil and flammables containers should be reused		
Aerosol/ compressed cans should be incinerated		

Type of Household Hazardous waste Generated by pastoral Households

1. Does your household generate unused drugs and pharmaceuticals for either human or animal use?
Yes [] No []
2. Does your household generate used needles and syringes for animal and human treatment?
Yes [] No []
3. Does your household generate remains of poisons, pesticides, herbicides, fungicides and accaricides?
Yes [] No []
4. Does your household generate used batteries (all size and type) and electronic items (phones, radio, and television)?
Yes [] No []
5. Does your household generate remains of glues and adhesives?
Yes [] No []
6. Does your household generate automotive products such as oils, antifreeze, gasoline and brake fluids?
Yes [] No []
7. Does your household generate paints and solvents?
Yes [] No []
8. Does your household generate disinfectants, laundry products and used cosmetics?
Yes [] No []
9. Does your household generate the same type of household hazardous waste in different Seasons of the year?
Yes [] No []
10. If No, which seasons does your household generate different types of household hazardous waste?
Dry season [] Windy season []
Wet seasons []
11. Which household Hazardous waste is common in the season?

12. Where do you buy the household hazardous goods from?

- Retail Shop Supermarket
 Open air market Chemists
 Others

Household Hazardous Waste Management Practices at Household Level

1. Do you segregate your household hazardous waste from the general household waste before storage and disposal?

Yes No

2. If yes, which categories of household hazardous waste do you segregate from the general household waste?

	Segregate	Do not Segregate
Unused/ expired animal and human drugs	<input type="checkbox"/>	<input type="checkbox"/>
Poisons, insecticides, fungicides and pest control chemicals	<input type="checkbox"/>	<input type="checkbox"/>
Batteries (all types) and used electronic items (phones, radio, television)	<input type="checkbox"/>	<input type="checkbox"/>
Containers of used oils, paraffin, petrol , empty aerosol cans and other automotive products	<input type="checkbox"/>	<input type="checkbox"/>
Adhesives and glues	<input type="checkbox"/>	<input type="checkbox"/>
Used needles and syringes	<input type="checkbox"/>	<input type="checkbox"/>

3. Do you store your household hazardous waste before disposal?

Yes No

4. Have you ever read the label/ instructions on the household hazardous goods you buy?

Yes No

5. If no, why haven't you read the labels on the household hazardous goods you buy?

Don't know how to read Never seen any label
 May goods don't have label Don't care to look at it

6. What do you do with the household hazardous goods in your home after they are used?

Reuse as much as possible	<input type="checkbox"/>	Reduce its use	<input type="checkbox"/>
Recycle	<input type="checkbox"/>	Incineration	<input type="checkbox"/>
Land filling/ burrying	<input type="checkbox"/>	Open dumping	<input type="checkbox"/>

7. How do you manage used cosmetic, laundry and cosmetic products in your household?

Reduce usage	<input type="checkbox"/>	Pour down the drain	<input type="checkbox"/>
Land fill/Burying	<input type="checkbox"/>	Open dumping	<input type="checkbox"/>
Reuse	<input type="checkbox"/>	Recycle	<input type="checkbox"/>

8. How do you manage unused drugs (human and animal) in your household?

Reduce usage	<input type="checkbox"/>	Incineration/ Burning	<input type="checkbox"/>
Land fill/Burying	<input type="checkbox"/>	Open dumping	<input type="checkbox"/>
Reuse	<input type="checkbox"/>	Recycle	<input type="checkbox"/>

9. How do you manage remains of poisons, pesticides, insecticides, fungicides and other farm chemicals in your household?

Reduce usage	<input type="checkbox"/>	Reuse	<input type="checkbox"/>	Open Dumping	<input type="checkbox"/>
Incineration/ Burning	<input type="checkbox"/>	Land fill/Burying	<input type="checkbox"/>	Recycle	<input type="checkbox"/>

10. How do you manage old Batteries (all types) and used electronic items (phones, radio, television) in your household?

Reduce usage	<input type="checkbox"/>	Recycle	<input type="checkbox"/>	Open Dumping	<input type="checkbox"/>
Incineration/ Burning	<input type="checkbox"/>	Land fill/Burying	<input type="checkbox"/>	Reuse	<input type="checkbox"/>

11. How do you manage containers of used oils, paraffin, petrol and empty aerosol cans in your household?

Reduce usage	<input type="checkbox"/>	Reuse	<input type="checkbox"/>	Open Dumping	<input type="checkbox"/>
Incineration/ Burning	<input type="checkbox"/>	Land fill/Burying	<input type="checkbox"/>		

12. How do you manage unused adhesives and glues in your household?

Reduce usage	<input type="checkbox"/>	Reuse	<input type="checkbox"/>	Open Dumping	<input type="checkbox"/>
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Incineration/ Burning Land fill/Burying

13. Which method do you use to manage used needles and syringes in your household?

Reduce usage Reuse Open Dumping

Incineration/ Burning Land fill/Burying

14. Whose duty is it to manage household hazardous waste in your home?

Father mother children others (specify).....

Occurrence of accidents related to household hazardous waste

1. Have any of your household members been a victim of household hazardous waste related accidents?

Yes No

2. If yes, what was the age of the household member who got the accident?

0-5 years 6-11 years 12-17 years 18 years and above

3. If yes, how often do household hazardous wastes related accidents occur in your household?

Every month Every 3 months

Every six months Every nine months

Once an year Every two years

After more than two years

4. Which type of household hazardous waste/s caused the reported accident?

.....

5. What are the health problems that occurred due to the accident?

Diarrhea and vomiting Skin infection

Burns Eye irritation

Respiratory infection Unconsciousness

6. Where was the family member treated after the accident due to Household hazardous waste?

Hospital Traditional healer

Treated by family members [] others (specify).....

7. What was the outcome of the accident?

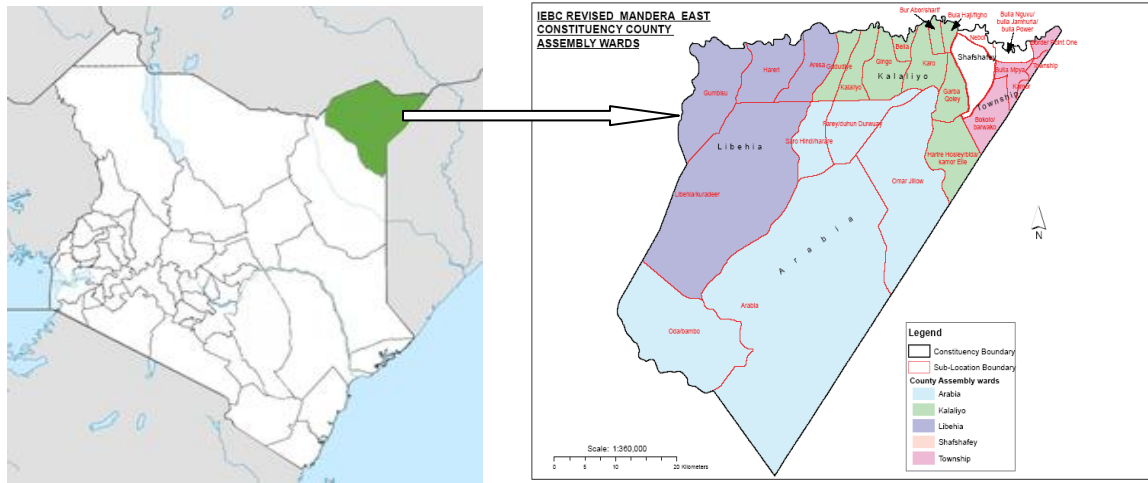
Survived [] Disabled [] Died []

Appendix III: Key Informant Interview Guide

For public health officers, health facility in charges, national environmental management authority staff, chiefs/ ward administrators and NGO staff dealing with WASH

1. What is household hazardous waste?
2. Which the most common hazardous waste among the pastoral community of Mandera East Sub County
3. Which household hazardous waste disposal methods that are practiced by the pastoral community of Mandera East Sub County use?
4. Who in your opinion who should manage household hazardous waste?
5. What facilities or services are provided in the pastoral areas for the management of household hazardous waste?
6. Which is the most appropriate method you recommend for the pastoral households to manage their household hazardous waste?
7. Which are the most commonly reported accidents related to household hazardous waste that occurs at the pastoral households?
8. What are the main challenges facing the management of household hazardous waste among pastoral community of Mandera East Sub County?
9. Is there a policy that has been developed to guide the implementation of household hazardous waste management in Mandera County?
10. Is the county government in your opinion doing enough to manage household hazardous waste?

Appendix IV: Map of Kenya Showing Mandera County



Map of Mandera East Sub County showing the wards

Appendix V: Approval of Research Proposal



KENYATTA UNIVERSITY
GRADUATE SCHOOL

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Website: www.ku.ac.ke

P.O. Box 43844, 00100
NAIROBI, KENYA
Tel. 810901 Ext. 57530

Internal Memo

FROM: Dean, Graduate School

DATE: 6th January, 2016

TO: Abukar Abdi Sheikh
C/o Community Health
Dept

REF: Q141/CE/23179/2012

SUBJECT: APPROVAL OF RESEARCH PROPOSAL

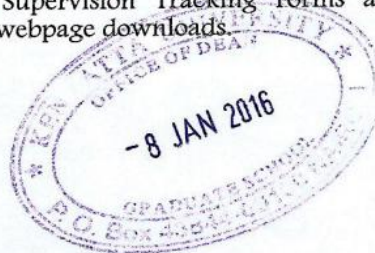
This is to inform you that Graduate School Board, at its meeting of 9th December, 2015 approved your Research Proposal for the M.P.H Degree entitled, "Household Hazardous Waste Management Practices among Pastoral Community of Mandera County, Kenya".

You may now proceed with your Data Collection, subject to clearance with Director General, National Commission for Science, Technology and Innovation.

As you embark on your data collection, please note that you will be required to submit to Graduate School completed Supervision Tracking Forms per semester. The form has been developed to replace the Progress Report Forms. The Supervision Tracking Forms are available at the University's Website under Graduate School webpage downloads.

Thank you.

DAVID NJOROGE
FOR: DEAN, GRADUATE SCHOOL



c.c. Chairman, Department of Community Health

Supervisors:

1. Dr. Jackim Nyamari
Environmental Health Department
Kenyatta University
2. Dr. Joan N. Njagi
Environmental Health
Kenyatta University

Appendix VI: Research Authorization Letter



**KENYATTA UNIVERSITY
GRADUATE SCHOOL**

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P.O. Box 43844, 00100
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Internal Memo

Our Ref: Q141/CE/23179/2012

DATE: 6th January, 2016

The Director, General
National Commission for Science and Technology,
P.O. Box 30040,
NAIROBI

Dear Sir/Madam,

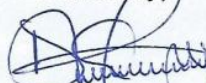
RE: RESEARCH AUTHORIZATION ABUKAR ABDI SHEIKH – REG. NO. Q141/CE/23179/2012

I write to introduce **Mr. Abukar Abdi Sheikh** who is a Postgraduate Student of this University. He is registered for M.P.H degree programme in the **Department of Community Health**.

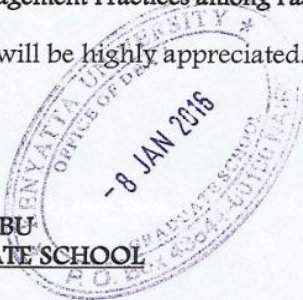
Mr. Abukar intends to conduct research for a M.P.H proposal entitled, **“Household Hazardous Waste Management Practices among Pastoral Community of Mandera County, Kenya.”**

Any assistance given will be highly appreciated.

Yours faithfully,


f **MRS. LUCY N. MBAABU**

FOR: DEAN, GRADUATE SCHOOL



LNM/rwm

Appendix VII: Kenyatta University Ethic Review Committee Approval



KENYATTA UNIVERSITY ETHICS REVIEW COMMITTEE

Email: chairman.kuerc@ku.ac.ke
secretary.kuerc@ku.ac.ke
ercku2008@gmail.com
 Website: www.ku.ac.ke

P. O. Box 43844 - 00100 Nairobi
 Tel: 8710901/12
 Fax: 8711242/8711575

Our Ref: KU/R/COMM/51/731

Date: 23rd May, 2016

Abukar Abdi Sheikh,
 Kenyatta University,
 P.O Box 43844,
 Nairobi

Dear Abdi,

APPLICATION NUMBER PKU/499/1595 – “HOUSEHOLD HAZARDOUS WASTE MANAGEMENT PRACTICES AMONG PASTORAL COMMUNITY OF MANDERA COUNTY, KENYA.”

1. IDENTIFICATION OF PROTOCOL

The application before the committee is with a research topic, “Household hazardous waste management practices among pastoral community of Mandera County, Kenya” received on 29th April, 2016 and discussed on 17th May, 2016.

2. APPLICANT

Abukar Abdi Sheikh, Department of Community Health

3. SITE

Mandera County, Kenya

4. DECISION

The committee has considered the research protocol in accordance with the Kenyatta University Research Policy (section 7.2.1.3) and the Kenyatta University Ethics Review Committee Guidelines, and is of the view that against the following elements of review,

- (i) Scientific design and conduct of study,
- (ii) Recruitment of research participant,
- (iii) Care and protection of research participants,
- (iv) Protection of research participant’s confidentiality,
- (v) Informed consent process,
- (vi) Community considerations.

AND APPROVED and that the research may proceed ON CONDITION that you incorporate its advise below.

Appendix VIII: NACOSTI Approval

THIS IS TO CERTIFY THAT: **Permit No : NACOSTI/P/16/10299/13248**
MR. ABUKAR ABDI SHEIKH **Date Of Issue : 18th August,2016**
of KENYATTA UNIVERSITY, 43844-100 **Fee Received :Ksh 1000**
nairobi,has been permitted to conduct
research in Mandera County

on the topic: HOUSEHOLD HAZARDOUS
WASTE MANAGEMENT PRACTICES
AMONG PASTORAL COMMUNITY OF
MANDERA COUNTY, KENYA

for the period ending:
18th August,2017


Applicant's
Signature



Director General
National Commission for Science,
Technology & Innovation

Appendix IX: Mandera County MOH Research Authorization

MANDERA COUNTY GOVERNMENT



MINISTRY OF HEALTH SERVICES

Box 13 – 70300, Mandera.

REF; MCG/PH/VOL11/297

23rd August 2016



TO WHOM IT MAY CONCERN

RESEARCH AUTHORIZATION ABUKAR ABDI SHEIKH REG. NO. Q141/CE/23179/2012

I would like to introduce the bearer of this letter who is a postgraduate student at Kenyatta University. He is registered for MPH Program (Monitoring and Evaluation) in the Department of Community Health and intends to collect data for his Thesis topic: Household Hazardous Waste Management Practices Among Pastoral Community of Mandera County, Kenya.

The ministry of health has reviewed his documents and granted him the permission to conduct his study in Mandera East Sub County.

Please accord him the necessary support.

A handwritten signature in blue ink, appearing to read 'Ibrahim Sheikh Hussein', with a long horizontal line extending to the right.

Ibrahim Sheikh Hussein

For; Director of Health Services

Mandera