



UGANDA MANAGEMENT INSTITUTE

**SOLID WASTE MANAGEMENT METHODS AND THEIR EFFECTS ON THE ENVIRONMENT IN UGANDA; A CASE STUDY OF HOIMA MUNICIPAL COUNCIL**

**BY**

**MUHUMUZA GEOFFREY**

**B.URP (MUK), PGD DUGM (UMI)  
10/MMS UGM/22/002**

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**FEBRUARY 2012**

**DECLARATION**

**I MUHUMUZA GEOFFREY**, hereby declare to the best of my knowledge that this Master piece is my effort and original work and that this thesis has never been submitted for an award in any other University or for publication as a whole or in part.

However other documents that were consulted have been acknowledged in the references

Sign.....

**MUHUMUZA GEOFFREY**

Date: .....

**APPROVAL**

This dissertation has been submitted for examination with the approval of

**DR. ONGODIA EKOMOLOT**

Sign:.....

**UGANDA MANAGEMENT INSTITUTE SUPERVISOR**

Date: .....

**DR. NAMARA ROSE**

Sign: .....

**UGANDA MANAGEMENT INSTITUTE SUPERVISOR**

Date: .....

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**DEDICATION**

**This thesis is dedicated to my Late Mummy Alice Biretwa Akiiki**

## TABLE OF CONTENTS

Declaration .....	(i)
Approval .....	(ii)
Acknowledgement .....	(iii)
Dedication .....	(iv)
Table of contents .....	(v)
List of tables .....	(ix)
Abstract.....	(x)

### CHAPTER ONE: INTRODUCTION

1.0. Introduction . .....	1
1.1 Background to the Study. ....	5
1.1.1 Historical Background .....	5
1.1.2 Theoretical Background .....	6
1.1.3. Conceptual Background .....	7
1.1.4 Contextual Background .....	8
1.1.5. Background of Hoima Municipality .....	10
1.3 Statement of the Problem. ....	10

1.4	Purpose of the study. -----	12
1.5	Research questions/Hypotheses -----	13
1.6	Conceptual frame work. -----	13
1.7	Significance of the study. -----	15
1.8	Justification of the study. -----	15
1.9	Scope of the study. -----	16
1.9.1	Issues scope -----	16
1.9.2	Geographical scope -----	17
1.9.3	Time scope . -----	17
1.9.4	Limitations of the study, -----	18
1.10	Operational definitions -----	18

## **CHAPTER TWO: LITERATURE REVIEW**

2.1	Introduction -----	20
2.2	Theoretical review -----	20
2.3	Characteristics of Waste -----	21
2.4	Types of Waste -----	21
2.5	causal of increase in Solid Waste -----	21
2.6	Sources of solid waste-----	21
2.7	Solid waste collection and management methods-----	24
2.8	Groups at risks due to Solid waste and source of Human exposures-----	34
2.9	Environmental effects of solid waste management methods (Environmental Degradation and Human Health) -----	35

2.10	Preventive measures for Solid waste Management effects-----	38
2.11	Cultural Taboos and social stigma-----	38
2.12	Inadequate coverage-----	39
2.13	summary of literature review-----	39

### **CHAPTER THREE: METHODOLOGY**

3.1	Introduction -----	40
3.2	Research design -----	40
3.3	Study population -----	41
3.4	Sample size selection -----	41
3.5	sampling Technique and procedure-----	42
3.6	Data collection methods -----	43
3.7	Data collection instruments. -----	45
3.8	Validity and reliability -----	46
3.9	Procedure for data collection -----	46
3.10	Data and analysis-----	47

### **CHAPTER FOUR: DATA PRESENTATION, INTERPRETATION AND ANALYSIS**

4.1	Introduction -----	49
4.2	Socio economic characteristics of respondents -----	49
4.3	Empirical findings and verification of hypotheses-----	51
4.3.1	solid waste management methods in Hoima Municipality -----	52
4.3.2	Effects of existing waste management -----	55
4.4	Hoima Municipal Council Community -----	62



4.5	Resource recovery and reuse -----	63
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**CHAPTER FIVE: SUMMARY, DISCUSSIONS, CONCLUSIONS AND RECOMMENDATIONS**

5.1	Introduction -----	65
5.2	Summary and discussion of findings -----	65
5.3	Conclusion -----	67
5.4	Recommendations -----	68
5.4.2	Effects of the existing waste management methods -----	69
5.4.3	Appropriate methods -----	70
5.4.4	Waste disposal-----	70
5.5	Contributions of the study -----	71
5.6	Areas for further research-----	71

**References**

Appendix i: Table for determining sample size from a given population

Appendix ii: Self administered questionnaire

Appendix iii : Interview Guide /Schedule

Appendix (iv) UMI letter approving Research Proposal

Appendix v: UMI letter of introduction for field research

**LIST OF TABLES**

Table I	Municipal council total area coverage 50 Sq –Km.....	17
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Table II		23
Table III	Targeted and sample population category of respondents.....	42
Table IV	Demographic characteristics of the respondents.....	50
Table V	Solid waste management methods in Hoima Municipality.....	52
Table VI	Opinions on effects of existing waste management methods.....	53
Table VII	Correlation between the method of open burning and the environment.....	<b>54</b>
Table VIII	Relationship between the method of incineration and the effects on the environment correlations.....	<b>55</b>
Table IX	Relationship between composting method and effects on the environment.....	56
Table X	Relationship between prefer land fill and hazardous effects to the environment.....	57
Table XI	Hoima Municipal council community is aware that solid wastes management affects them.....	58
Table XII	Resource recovery and reuse if practiced in Hoima Municipality.....	58

## **ABSTRACT**

The rapid population growth and urbanization in developing countries as Uganda constitute a threat to the Environment. The urbanization, result in more waste and concurrently the development result in New Life Patterns, Standard of living and attitudes change the waste composition to include more and more hazardous waste which calls for various solid waste management methods. Along with the development comes the problems with solid waste management and the situation in Hoima Municipality is at the moment precarious. The environmental problem caused by improper solid waste management in the expanding municipalities like Hoima is one of the urgent issues. The study was about analyzing solid waste management methods and their effects on the environment in Uganda a case study of Hoima Municipality.

The theoretical underpinnings of the study were premised on life cycle analysis theory. The objectives of the study included; evaluating the effects of existing waste management methods and Determining appropriate methods. The study was carried out in Hoima Municipality Hoima District. The study employed both Qualitative and quantitative techniques in data collection. In addition, the data was analyzed using descriptive statistics and relational statistics in form of Pearson's product correlation.

The findings revealed the existing solid waste management methods as open burning, composting, land filling, incineration and indiscriminate dumping. The findings revealed the dangers associated with using such methods as Air Pollution, leachet formation, release of dangerous gases and unsightly sites.

The study therefore concludes that there is a weak but significant relationship between solid waste management methods and their effects on the environment.

The study recommends that Hoima municipal council should emphasis on composting of biodegradable wastes while the in organic wastes be recycled or reused, further the study recommends disposal of wastes to be undertaken in a scientific manner and encourage environmental impact assessments be done for the various waste management methods.

The study suggests areas for further research such as participation of central Government in waste management and possible methods of decomposing solid wastes to make organic manure for urban agriculture.

## **CHAPTER ONE**

### **INTRODUCTION**

#### **1.0. INTRODUCTION.**

One of the greatest challenges facing Uganda's rapidly growing urban centres, is the hazard of urban solid waste or garbage, according to the Globe Clean Services, business manager, Rashid Magezi Solid waste which is a consequence of daily human activity needs to be managed properly. Hoima like other towns in Uganda, faces problems associated with poorly managed solid waste operations. Today waste management is a critical issue in Uganda's urban areas. Almost on daily basis there are press reports highlighting the appalling waste management situation in the urban centres. Among the issues regarding waste management is the inability and inefficient ways to cope with the intensifying amount of waste generation and the increasing urban population. As a consequence this has raised environmental and health concerns.

Dealing with health and environmental issues in a rapidly urbanizing context leads to ever increasing volume of generated waste, posing a major challenge. This is particularly the case in the area of solid waste management. While Hoima is generating an ever-increasing

quantity of solid waste, the effectiveness of its waste collection and disposal systems are not yet to standard.

As a result of changing lifestyles, waste production is expected to be greatly increasing in Municipalities such as Hoima. Currently lifestyles is accelerating waste production in Hoima through consumer products which generate extra packaging. Food wrappers, the extensive use of buvera (non-biodegradable polythene bags), plastics and other types of garbage. It is estimated that the overall average garbage generated per week in Hoima is 480tons (Hoima Municipal Council Health Department, (2011).

Waste handling implies managing the solid waste throughout various processes prior to disposal. It starts with the generation of the waste continuing through storage, collection them and transporting them to the ultimate disposal. Currently all matters concerning waste management is the mandate of Hoima Municipal Council.

Generally most of the waste generated is deposited in skips and dumped at Kibati dumping site where open burning is done on these wastes. Recycling and other integrated methods of waste disposal are not in use in Hoima Municipal Council.

The best approach perhaps is to forestall waste ahead of its generation. A waste should not be considered a waste until it is confirmed to be useless. Most waste can recycled and can be disposed separately within the household. the public should be educated about proper littering and recycling etiquette, health and environmental conservation.

The study sets investigated solid waste management methods in Hoima Municipality and their effects on health and environment.

The term solid waste (SW) may be used to refer to municipal waste and includes: Residential (or household or domestic waste) Commercial, Institutional, street sweeping,

construction and demolition, sanitation and industrial waste. (Rush brook 1999). While municipal solid waste refers from houses hold, streets and public places shops, offices and hospitals, which are very often the responsibility of municipal or other governmental authorities, solid waste from industrial process, are generally not considered municipal. However it should be taken in to account when dealing with solid waste as they often end up in the municipal solid waste stream.

Synonymous to solid waste are terms such as “garbage” trash, refuse and rubbish (Zerbock, 2003) urban dwellers generally consume more resources than rural dwellers, and so generate large quantities of solid waste and sewage. For example, solid waste disposal is a major problem in urban Africa centers, where more half the population now lives in urban areas northern Africa is the most urbanization levels are still lower( about 33-37 percent ) East Africa is the least urbanized sub- region, with 23 percent (United Nations populations division, 1997).

Although human or animal excreta often end up in the solid waste stream, generally the term solid waste does not include such waste materials.

Human activities create waste, and the way these wastes are handled, stored, collected and disposed off can pose risks to the environment and to public health. In urban areas, especially in the rapid urbanizing cities of the world, problems and issues of municipal solid waste management (MSWM) are of immediate importance. This has been acknowledged by most government, however rapid population growth overwhelmed the capacity of most municipal authorities to provide even the most basic services (Zerbock, 2003)

In most developing countries, typically one to two thirds of the solid waste is not collected (Zerbock, 2003) as a result, the un collected waste, which is often also mixed with urban and animal excreta is dumped indiscriminately in the streets and in drains, contributing to flooding, breeding of insect and rodent vectors and the spread of diseases such as cholera.

Solid waste management encompasses generation, collection, transportation and disposal of urban waste. Urban authorities have the responsibility to ensure safe, reliable and cost effective removal and disposal of solid waste, which takes up a large population of available resources which are not adequate to cope with the magnitude of the problem (NEMA 2000)

Municipal Solid Waste is one of the Major challenges for urban regions. According to International experts, waste collection should be extended, Sanitary Landfills should replace existing dumpsites, and recycling of waste should be increased. These measures should furthermore not impair the Municipal budgets. However, a number of initiatives fail, and the final explanation is quite often a “Lack of Knowledge” (Contereau, 2006).

Mankind has indirectly led to severe damages of valuable assets that is natural resources, which is a vital asset for the existence of human being. Various strategies have been laid down for the management of solid waste and several attempts made to improve and manage the pathetic situation of solid waste management using various methods and technologies,(Asomani,1999).



Hoima Municipality like many urban centers has several institutions, households industries that produce a lot of solid wastes all these are sources of solid wastes that have been managed by different methods.

Unfortunately, public agents and urban authorities do not have adequate capacity to handle the increased solid waste mainly due to limited public budgets. Consequences of failure to remove solid waste finally are healthy hazards like tetanus, water and sanitary as well as environmental problems such as contamination and pollution in Uganda especially in urban centers (NEMA, 1999).

Solid wastes can be useful as long as it is well managed for example organic waste which can be used as manure to boost the agricultural fields

Solid waste collection and disposal in Uganda's urban authorities has been their total responsibility due to the decentralized system of governance despite of this, solid waste management (collection and disposal) has increasingly been difficult to handle. The next sections will cover the background, problem statement, objectives, conceptual frame work, significance and justification of the study.

## **1.1 BACKGROUND TO THE STUDY**

This section gives a brief historical, theoretical, conceptual and contextual background to the **proposed** study.

### **1.1.1. HISTORICAL BACKGROUND**

Solid waste management is a consequence of life. In the early beginnings solid waste management posed no challenges because waste was small and there was plenty of land

on which to dispose waste. Once human beings began to congregate in forms of clan, tribe, communities, village, solid waste management began to pose challenges. Epidemics such as the Black Death were a result of lack of solid waste management. It was not until the 19<sup>th</sup> century that public measures to manage solid waste were introduced in 1888 and 1889 England and the USA respectively introduced laws prohibiting dumping of waste into waterways and streets Moeller, (2005). Prior to the twentieth century, many countries produced minimal amounts of solid wastes. The industrial revolution and changes in our lifestyle caused accelerated growth in the volume of solid wastes produced by our society. Since the Industrial Revolution, industrial and mining operations have been accompanied by a problem: industrial waste which may be toxic, ignitable, corrosive or reactive. If improperly managed, this waste can pose dangerous health and environmental consequences. This led to enactment of legislation to manage solid waste in the entire developed industrialized world Moeller,(2005).. Over the time, methods of solid management like recycling and land filling have been developed to cope with the ever increasing solid waste in urban areas with the objectives of protecting human beings and environment and to conserve resource. The earliest methods included: dumping on land, dumping in water, plowing into the soil, feeding animals, reduction of waste incineration. Due to the unsatisfactory nature of these methods, integrated waste management approach was developed. It is based on three principles of solid waste management: waste minimization and reuse, recovery and recycling; and safe final disposal. These principles are expressed as the waste hierarchy Houston,(2009).This is the dominant approach used in the developed world and it has been adopted in most of the developing countries as well but its

application is rather problematic because it is rather complex it is this approach that is being adopted in Uganda.

### **1.1.2. THEORETICAL BACKGROUND.**

In response to the challenges of solid waste management there have evolved theories to explain the phenomena (Burkin,(2006). Out of these theories, the theory of waste and new consumption communities seems to offer a clearer explanation. The theory was developed by Burkin (2006) who argues that through resistance and empowerment, as well as reconnection to production, the communities are able to implement alternatives to the wasteful practices of main stream consumption behavior and achieve partial autonomy from the hegemonic forces of the market. This theory brings to light many issue in view of reducing waste, it purses the fundamental question: Can we control the food market, with all variety towards waste reduction?

The theory of new consumption communities explains how the problem of solid waste management could be addressed through reduction in consumption; hence less solid waste with less solid waste, solid waste management costs collection and disposal are reduced. This theory agrees with the waste management methods of reduce, reuse, recycle, and recover in attempt to consume less and less. It is this theory that seems to have informed policy in Uganda on solid waste management regulation (Ministry of Local Governments,2003),It draws attention to the need for an integrated approach that ensures the full participation of all in waste management.

### **1.1.3. CONCEPTUAL BACKGROUND**

In this study, solid waste management methods is the independent variable and environmental effects the dependent variable. Solid Waste Management methods refer to a particular system being used in collection, transportation and disposal of wastes (Houston, 2009). While the environment is the surrounding around mankind both man and animal life. The concept of solid waste management methods has the dimensions of Garbage reduction, recycling, recovering, combustion land fills and composting. The solid waste management methods are most likely to have both positive and negative impacts/ effects on the environment.

Environment, which is the dependent variable, is conceptualized with health, aesthetics, smell (bad dour), leachets, water / air pollution, land degradation and production of manure for urban farming. Public Environmental awareness and education, culture are the moderating variable. The moderating variable will affect the relationship between Solid Waste Management methods and their environment effects

### **1.1.4. CONTEXTUAL BACKGROUND**

Although Hoima Municipal has been involved in solid waste management prior to colonial rule and through the post-independence period, the current impetus can be located to decentralization policy of the 1990s that culminated in the enactment of the Local Governments Act 1997. The Act mandated local governments to manage waste management in their areas of jurisdiction. While Hoima Municipality has performed this function for more than a decade now, the social waste service is unsatisfactory; and

scenes of heaps of uncollected garbage are a common phenomenon in most parts of the town. As result the population is of the opinion that the municipal waste services are not functioning satisfactorily. Consequently, the willingness of the residents to cooperate in garbage management is low. With respect to the formal organization and management structure, collection and disposal are poorly organized. There is only one disposal site located at Kibati. This dumpsites and collection trucks are insufficient. This disposal site also the determinant for collection and disposal of waste. It means that it is only those nearest to the dump sites that benefit.

As to processing and recycling of waste there is nothing done at all levels of its management. There is no source separation and sorting. However, some scavengers practice an informal way of waste recovery. Alternative options such as energy recovery and composting are not practiced as other ways of waste management. Most of the waste is administered by the Municipal Council with minimal participation of the residents. For a variety of reasons including resource constraints, some residents do not get solid waste management services from the Municipal Council. Therefore, in the absence of waste collection services they use other forms of disposal that pose health hazards and a threat to the environment.

Data on the composition, volume and weight of solid waste generated and collected in Hoima Municipal is estimated to be in the range of 480 tones per week .Irrespective of the volume of solid waste generated the performance of the town's waste collection and disposal is poor. A lot of solid waste is uncollected and dumped in unauthorized areas such as open fields, ditches, roadsides, streets, sewers and other spaces in the town and its neighborhood (Hoima Municipal Council 2011). Uncollected solid waste is a serious

environmental and health hazard. They cause foul smell and attract a host of disease vectors and pests resulting in deterioration of the town's aesthetic quality. Thus the health of the community and town visitors are threatened (Hoima Municipal Council 2011).

There is a government policy contained in the Environment Act (1999) to regulate solid waste management (NEMA regulations, No. 52, 1999). The solid waste management regulations provide for bye laws in order to localize the NEMA Act in the various local authorities. Unfortunately, Hoima municipal has not come up with bye laws on solid waste management. As a result there is illegal dumping, littering of garbage, improper solid disposal and lack of sorting of garbage.

This study focused on the methods used in solid waste management and the effects on health and the environment

#### **1.1.5. BACKGROUND OF HOIMA MUNICIPALITY**

Hoima Municipal Council became into force in June, 2010 by Act of Parliament. It is located in Hoima District in mid – Western Uganda, about 200km North West of Kampala city. It is bordered by other Local Government namely; Buharuka and Kyabigambire sub – county in the East, Kitoba in the North, Buhimba in the South and Bugembe in the West. It houses Hoima District Local Government Administrative Headquarters in Kasingo and the Palace for the Bunyoro Kingdom. It has a population of 102,300 people with a growth of 5%. As a result of the oil discovery in the region this rate is likely to become higher (Hoima Municipal Council 2011).

### **1.3 STATEMENT OF THE PROBLEM**

Solid waste is one of the most serious environmental problems in urban areas especially in developing countries.

As the levels of urban section continue to increase the urban population increases, levels of economic and industrial activity increase and also an increase in change of consumption patterns, these lead to increased generation of solid waste, some of which are costly and difficult to manage. Consequently, poor solid waste management causes serious environmental and health problems which affect the, livelihoods of the urban population and beauty of the urban areas as well as the financial budgets of urban local governments because of the increased need of resources to manage the waste.

Most urban centres in Uganda generate more solid waste than they can adequately collect and dispose off. In most of these towns, only 50% of the generated waste is collected, in Hoima Municipality 30-40% of the waste generated is collected by Hoima municipal council and more than 50% of Hioma municipal council annual budget goes to waste management.

The management of solid waste is becoming a major public health and environmental concern in many urban areas and is likely to turn in to a crisis as uncollected garbage is seen on the roads, streets and drainage channels.

Poor solid waste management can be attributed to; limited involvement of the key actors and failure to treat waste as a resource, institutional gaps (for instance inadequate law enforcement, failure to mainstream waste management in to development plans), technical and management gaps (Inappropriate strategies, inadequate planning, limited

financial resources and inappropriate research), social – economic gaps (ignorance, attitudes, cultural norms and beliefs.

Solid waste in Hoima Municipal remains unabated. The solid wastes that are collected and transported to the disposal site in Kibati dumping site are just dumped there and open burning done, Hence no proper management done resulting in environmental and health hazards (Moeller, 2005). These methods have tended to focus on the household choices of collection methods in a highly formalized way. They have a limitation in that they do not consider the collection processes in general. Collection and disposal of solid waste is associated with complex problems. Thus the need to identify the gaps in the existing methods so that a hybrid approach specific to Hoima context could be grafted. Generally there is relative neglect of the specific variables that affect effective solid waste management in municipalities of developing countries such as Hoima

Unless the problem of solid waste management method is addressed urgently, there is likely to occur an outbreak of epidemics like cholera, environmental parasitic and worms, The study therefore sought to examine the relationship between solid waste management methods and their effects on the environment.

#### **1.4 PURPOSE OF THE STUDY / GENERAL OBJECTIVE**

The study examined the effects of solid waste management methods on the environment in Hoima municipality.

##### **1.4.1 SPECIFIC OBJECTIVES**



The study was guided by the following objectives:

1. To find out solid waste management methods (collection and disposal) in Hoima municipality
2. To evaluate the effects of existing waste management methods on the environment and human health in Hoima municipality
3. To determine appropriate methods that can be used to manage solid waste collection and disposal more effectively and efficiency in Hoima Municipality with less environmental damage.

## **1.5 RESEARCH QUESTIONS**

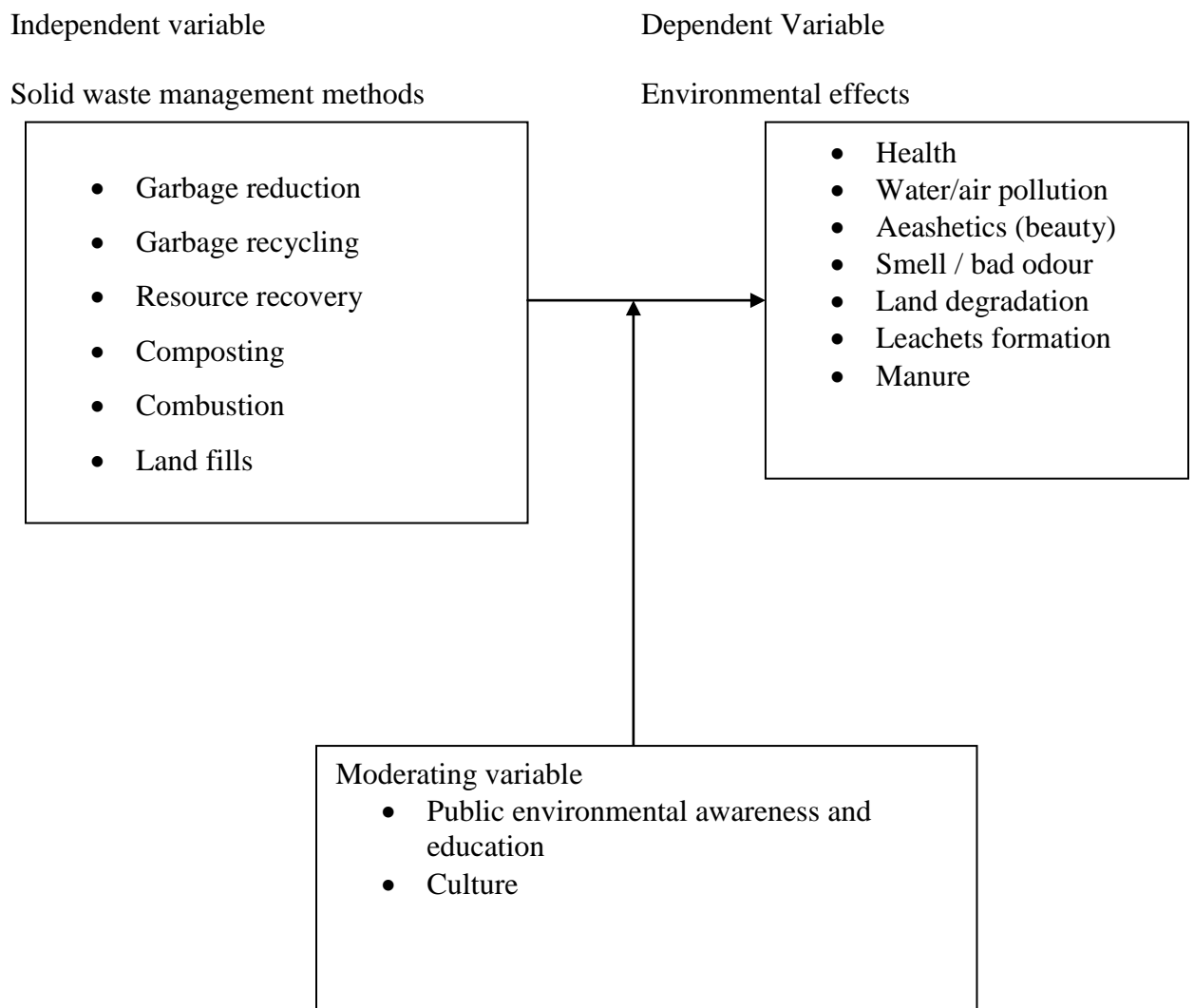
The study attempted to answer the following questions:

1. What are the solid waste management methods in Hoima Municipality?
2. To what extent do solid waste management methods in Hoima Municipality affect the environment and human health?
3. What methods of solid waste management are appropriate to make solid waste management more effective and efficient in Hoima Municipality?

## **1.6 CONCEPTUAL FRAME WORK**

Solid waste management is a complex problem that cannot be looked at as solely technical consideration. It encompasses political, social, financial and economic aspects ( UNDP,2004)

**Figure 1: Conceptual frame work showing Solid waste management methods and their effects on the Environment.**



**Source: Adopted and modified from (contereau, 2006 Moeller, 2005; Houston, 2009) .**

The conceptual framework above shows the relationship between solid waste management methods and Environmental effects. It further shows Garbage reduction, recycling, recovery composting, combustion and land fill as the dimensions of solid waste management methods.

The linkage between the variables indicates that solid waste management methods have an environmental effects.

The two major variables are moderated by public environmental awareness, education and culture on environmental effects will determine the strength of the relationship between solid waste management methods and environmental effects.

## **1.7 SIGNIFICANCE OF THE STUDY**

The study findings will benefit policy makers, technical officers and residents of Hoima Municipal council as follows:

The study will be useful to policy makers to formulate and design effective solid waste management policies and design appropriate methods of solid waste management.

This study will also greatly benefit the academia by enriching the poll of knowledge about solid waste management methods and their effects to the environment.

The study is also a requirement to the researcher for the award of Masters Degree in Management Studies.

## **1.8 JUSTIFICATION OF THE STUDY**

Whereas, there are many previous studies on the problem of Solid waste management world wide (sriel, 1999), no earlier study on the effects of solid waste management methods on the environment in Hoima Municipal council is available. Many authors have pointed out how expensive it is to collect Solid Waste but no study has investigated the how combustion or land filling affects the environment.

Besides, the expansion of Hoima Town in to a Municipality, leading to geographical and population explosion, poses great challenges in the way increased solid wastes could be handled.

It is hoped that the findings of this study will help rise awareness on issues pertaining to garbage management for the community and policy makers especially at local level. This awareness will help build initiatives to reduce the problem.

In his studies in Kenya, Kim( 1998) notes that while there is considerable documentation on innovative community level waste management schemes in Asian and Latin American cities, little research has been done on the importance of, and potential for, waste re-use in African cities. This study is one of those that will make a contribution towards filling that gap.

## **1.9 SCOPE OF THE STUDY**

### **1.9.1 ISSUES SCOPE**

The study focused on solid waste management methods and their effects on the environment in Hoima Municipality

Solid waste management methods are the independent variable while environmental effect is the dependent variable as illustrated diagrammatically in the conceptual frame work.

### 1.9.2 Geographical scope

The study was carried out in Hoima Municipality with a population of 102,300 people (UBOS 2010) projections with a population rate of 3.2% which consists of 4 divisions (Kahooro, Bujumbura, Mparo and Busiisi ) as shown in the table.

Table I The Municipal council has total area coverage of 50 Sq - Km

<b>DIVISION</b>	<b>HOUSE HOLD</b>	<b>MALE</b>	<b>FEMALE</b>	<b>TOTAL</b>
Kahooro	7,309	19,965	20,955	40,920
Mparo	3,309	8,220	10,194	18,414
Busiisi	3,223	8,347	9,044	17,391
Bujumbura	4,426	11,900	13,675	25,575
Total	18,167	29,581	35,015	102,300

**Source: UBOS, 2010 projections**

### 1.9.3 Time scope

The study was carried out in Hoima Municipality this covered a reference period for two years from 2009 – to 2011 as this is a period with marked solid waste management

problems and transitional period from a Town Council to a bigger entity of a Municipality.

#### **1.9.4 Limitations of the study.**

The community was highly suspicious of people carrying out research suspecting that they would be investors who want to grab their land due to the oil prospects in the region.

However the researcher will convince them that it was purely for academic purposes.

The study faced a problem of bias and response errors. This was due to potential respondents who refused to answer questions and those who answered were very careful on what they said leading to some response errors. This was caused by the fact that some respondents were suspicious of the motive of the study. Others thought that the information would be used for taxation purposes especially in the oil region. The researcher used community leaders and residents of the area for data collection as a confidence building mechanism and continuously assuring respondents that the information was for academic purposes only.

#### **1.10 Operational Definitions**

- **Solid waste management :**

This refers to the collection, transportation and disposal of solid from house holds and business house.

- **Community participation:** It refers to involvement of the individual houses, private firms and business operators in partnership with the local government in the management of solid waste.
- **Urbanization:** Is the process through which the proportional of a country's population that lives in urban areas increase
- **Urban areas:** in Uganda these are gazetted cities , municipalities and town councils as per the local government act CAP 243 .(all district headquarters are urban areas by law because they are located in town councils / municipalities
- **Urban centers :** Minimum population size of 25.000 (Town council, 100,000for a municipality, 500,000 for a city)

## **CHAPTER TWO**

### **LITERATURE REVIEW**

#### **2.1 Introduction**

In this chapter a review of previous works has been done with the purpose of clarifying the problem. Sources of literature was be accessed from libraries at in Uganda Management Institute, Makerere university, Ministry of Local Government, National Environmental Management Agency, and the internet. Although there is an extensive scholarship on solid waste management in general, there is little done on urban areas in Uganda and Hoima Municipality in particular. Moreover, much of the literature concentrates on the garbage quantities and less on the effects of methods or processes used to deal with solid waste management. The chapter is structured in accordance with the research objectives and the conceptual frame work. It contains the following sections: solid waste sources, solid waste collection methods and effects on the environment which is the problem under study and focus of the research

#### **2.2 Theoretical review.**



There are many theories that have been advanced by various authors in attempt to find solutions to the problem of solid waste management. These include Life Cycle Cost analysis theory.

#### Life Cycle analysis theory

Life Cycle analysis insists that the nature of the products and their life Cycle is fundamental in an attempt to control, reduce or manage solid waste (Kumaran, et.al 2001). The nature of products points to their life cycle, which should be analyzed in order to determine the level of waste generation and impact with in a given area. This goes with peoples consumption patterns. The product life Cycle analysis explains today the ever growing over generation of solid waste. Improved solid waste management methods can lead to less impacts on the environment; the researcher argues that the best way to control SWM is by employing integrated waste management practices of recycling. Reuse and composting the relationship between solid waste management methods and their effects can be analyzed using the above theory. The role of improved or integrated waste management practices is critical to the environment. The theory above poses challenges of its implementation given the economy of Uganda. The author above puts a good argument to control solid waste management, but the success of the implementation of such theory depends on public environmental awareness, Education and culture. In Uganda, there are many challenges of solid waste management in attempt to control environmental effects. The author does not show how local governments could implement such theory. The limited revenue sources for local governments make it impractical to deliver the various mandated services.

### **2.3 Characteristics of Wastes.**

Corrosive: These are wastes that include acids or bases that are capable of corroding metal containers such as tanks

Ignitability. This is waste that can create fires under certain condition e.g. Waste oils and solvents.

Reactive: These are unstable in Nature they cause explosions, toxic fumes when heated.

Toxicity: Waste which are harmful or fatal when ingested or absorbed (Moeller, 2005).

### **2.4. Types of waste.**

Non Hazardous waste: refuse, garbage sludge, municipal trash.

Hazardous waste: Solvents acid, heavy metals pesticides and chemical sledges

Radioactive: High and low level radioactive waste.

Mixed waste: Radioactive organic liquids, radioactive heavy metals (Moeller, 2005)

#### **2.5.1 Causal of increase in Solid Waste.**

Moeller, (2005) points out the main causes of increased Solid Wastes as high population growth, increase in manufacturing industries, urbanization, and modernization. Modernization, technological advancement and increase in global population created rising in demand for food and other essentials. This has resulted to rise in the amount of waste being generated daily by each household. 158 million tons of Municipal Solid Waste is produced annually in the U.S

## 2.6 Sources of solid waste

Mawanda, (1997) points out that, wastes are generated from commercial domestic, industrial and institutional premises. It goes a head to show that their classified wastes from hospitals heavy industries and mining areas. All this waste is hazardous hence require special handling and disposal. According to (Casey 1999) human excreta is a source of solid waste that is if not properly handled can lead to poor environmental conditions that are harmful to mankind like out break of diarhorrea. Wastes can be classified by the source and the type of solid waste generated as indicated in the table below. Hoorn weg, Daniel and Laura (Thomas, 1999).

**Table ii**

<b>Source</b>	<b>Typical waste generators</b>	<b>Types of solid wastes</b>
Residential	Single and multifamily dwellings	Food wastes, paper cardboard, plastics, textiles, leather, yard wastes, wood, glass, metals, ashes, batteries, oil, tires.
Industrial	Light and heavy manufacturing, fabrication, construction sites, power and chemical plants	Housekeeping wastes, packaging, food wastes, construction and demolition materials, hazardous wastes, ashes, special wastes.
Commercial	Stores, hotels, restaurants, markets offices buildings	Paper, cardboard, plastics, wood food wastes, glass, metals, special wastes hazardous wastes
Institutional	School, hospitals, prisons, government centers	Same as commercial

Construction and demolition	New construction sites, road repair renovation sites, demolition of buildings	Wood, steel, concrete dirt
Municipal services	Street cleaning land scaping parks, beaches, other recreational areas, water and waste water treatment plants	Street sweepings; land scape and tree trimmings; general wastes from parks, beaches and other recreational areas; sludge
Process (manufacturing)	Heavy and light manufacturing, refineries chemical plants, power plants, mineral extraction and processing	Industrial process wastes, scrap materials, off specification products, slay tailings
Agriculture	Crops, orchards, vineyards, dairies, feed lots, farms	Spoiled food wastes, agricultural wastes, hazardous wastes e.g. pesticides

**Source: what a waste; solid waste management in Asia, Hoornweg, Daniel and Laura Thomas 1999 working paper series No.1 urban development sector unit page 5.**

## **2.7 Solid waste collection and management methods**

Solid waste is generated, collected and managed using several methods. Waste is subjected to treatment by incineration, solidification. Heat treatment and chemical treatment. While waste disposal takes a forum of land filling, underground injection wells, waste piles land

treatment and in less developed countries wastes are disposed in following rivers (Moeller, 2005)

Solid wastes from markets in Jakarta were usually collected by the local government workers using hand carts and taken to the near by storage sites on the road sides (Yayasane, 2007)

He further noted that Jarkarata streets in commercial zones were swept by local government employees from 6am – 9am in the morning and from 5pm – 7pm in the evening.

Waste reached temporary storage sites in large bins or designated road side arrears in many ways like the household would place rubbish in containers in front of their property where it would be collected and taken to disposal sites or some times it would be dropped on to the truck. (Beede, 1993)

Managing solid wastes is one of the most costly urban services which is estimated to consume 20 to 40% of the municipal revenue (Sandra, 1994). Solid wastes are managed at different stages, which all require planning. These stages include the generation, storage collection, transportation and final disposal.

### **Garbage storage**

Solid waste storage can be done as primary storage and or secondary storage. This can be by use of temporary containers either card board, plastic or metallic containers. Sandra (1994).

### **Garbage collection**

Solid waste collection can be done by several techniques, container systems, block collection, Kerdside collection, and door – to – door collection and street sweeping as well as drain cleaning UNHCS (1996)

With increasing urban population, by people who pay no tax or very little, urban councils are not in a position to cope with garbage collection nor are they able to change for the collection where residents are poor.

Residents tend to think that urban councils have a duty to collect garbage, without changing them. However in Nairobi, private firms are already collecting garbage, either on behalf of the council or private individuals contract them with consent of the council. Kampala is already planning to do the same. However, individuals already employ private firms to collect garbage in some areas of Kampala New Vision of April 16<sup>th</sup> 2001.

### **Garbage Transportation**

Handling of garbage from the point of disposal in Towns involved several methods that ranged from waste delivery from waste delivery trucks and hand driven carts (NEMA, 2000)

Solid waste transfer and transportation can be short range or long range. This depends on the distance to the disposal site. Wastes can also be transported by use of containers or non – containerized systems ( Wenkere Kisémbó, S, 2001).

### **Combustion**

This takes two forms that is open burning and incineration. Bamukwasha (1998) states that burning of solid waste in Kampala was done at house hold level in small scale as away of reducing the amount of garbage produced.

Incineration is capital intensive which required high maintenance costs and temporary trained operators hence commonly adopted in developed countries. Rand, Harkol and Marxen (2000). Source reduction prevents the generation of wastes and it is the most preferable method of waste management and it goes a long way towards protecting the environment. The environmental protection Agency (EPA) 2001. Rand, Harkohl and Marxen (2000) describe incineration as the process of burning solid waste under controlled conditions.

Incineration of the process of destroying waste material by burning it. Incineration is carried out both on small scale by individuals and on a large scale by industry. It is reorganized as a practical method of disposing of hazards waste materials (such as biological medical waste) Yhdego, (1995)

Incineration should be considered a disposal option, since following incineration there is still some quantity of ash to be disposed off ( probably in a land fill), as well as the dispersal of some ash and constituent chemicals in to the atmosphere. It should instead be considered more items of its waste – reduction potential, which can be 80-90% in terms of waste volume (Rand 2000). This appears to be an extreme attractive option, however, with occasional exceptions.

Incineration is an inappropriate technology for most low- income countries like Uganda. Above all, the high financial start up and operational capital requires to implement incineration facilities is a major barriers to successful adoption in developing countries (Rand 2000).

Reduction by incineration, along with sanitary disposal of the residue, would therefore be a useful alternative to traditional disposal methods, and have proven useful in island nations such as Bermuda and British Virgin Islands (Lettsome, 1998)

### **Resource recovery (recycling and re use)**

This reduces the amount of garbage on the dumping sites since the scavengers scramble to get resource out of garbage.

Paper boxes, old shoes, plastic materials are picked and sold to petty traders for survival  
UNEP (2006)

According to EPA (2001), recycling of solid waste in Denmark has been boosted by the introduction of waste taxes. EPA (2001) highlights that 1987 and 1007 witnessed re –use and recycling of construction materials by over 100 percent recycling paper. Ramesh (1993) shows that recycling of solid wastes reduces the pressure on the collection, disposal and handling systems of waste. At the same time the activity of recycling creates further economic benefits such as employment creation and income generation.



EPA 2001 points out the benefits of recycling to include conservation of resources for children's future prevents emissions of many green house gases and water pollutants, saves energy supplies valuable raw materials to industry thus creates jobs, stimulates the development of greener technologies and reduces the need for new land fills.

Mawanda, 1997 and Mugisha (1995) point out that recycling and reuse of solid waste are very limited in Uganda's urban areas but admitted that the potential exists. Nyakaana J.B (1997) notes that a lot of scrap metal is recycled at Jinja steel rolling mills and Nakawa scrap metal facility in Uganda.

EPA 2001 asserts that solid waste can have lots of different descriptions. Yard waste such as grass clippings and UN used mulch is technically solid waste. So is regular trash that a person may just throw away like spoiled food or paper plates. Recyclables such as cardboard and news are also considered solid waste. The first step in the collection process is to sort the waste by type and define which will and won't be disposed of. Once the waste has been sorted, usually by the residents putting it in the proper bin or container, the next step in collection can take place.

It would seem that the easiest and most effective way to manage solid waste is to reduce the amount of waste to be disposed. This is a strategy that seems simple in concept but has shown promise. However the amount of waste produced, even in developed, countries, is often a function of culture and affluence. For example the developed, a throw a way culture. Since consumers goods are cheap has resulted in an increase in significant increase in MSW

as production becomes cheaper. An emphasis on mass production and development of cheap consumer goods has caused quality and longevity of goods to be sacrificed in the name of lowest market price, causing people to be more likely to simply throw away and replace items instead of repairing or maintaining them( Zerbock, 2003).

Nabuzaale (2009) argues that recycling is the answer to all those plastics littered over the streets. This approach has worked in many developed countries which do not restrict the use plastics on average, a person in the developed country generates more than a hundred fold the plastic waste an average Ugandan does.

Taking Germany as an example, the recycling industry thrives on well nurtured culture of sorting garbage and proper disposal without this system, the scene of polythene and plastic waste could have been worse than what is seen in Uganda. All types of plastics can be used. This will not harm the environment if properly disposed and thereafter recycled.

Recycling in organic materials from municipal solid waste is often well developed by the activities of the informal sector although such activities are seldom recognized, supported, or promoted by the municipal authorities. Some key factors that affect the potential for resource recovery are the cost of the separated material, its purity, its quantity and its location. The costs of storage and transport are major factors that decide the economic potential for resource recovery. In many low – income countries, the fraction of material that is won for resource recovery is very high, because this work is done in very low incomes. Recycling has the advantage of reducing costs of the disposal facilities, prolonging the site

span and also reducing the environmental impact of disposal sites as the organics are largely to blame for polluting leache and methane problems (UNEP, 2006)

## **Composting**

Yhdego (1995) describes compost as a plant matter that has been decomposed and recycled as a fertilizer and soil amendment. Compost is a key ingredient in organic farming. At its most essential, the process of composting requires simply pilling up waste out doors and waiting a year or more modern, methodical composting is a multi – step closely monitored process with measured in puts of matter, adding water and ensuring proper aeration by regularly turning the mixture worms and fungi further break up the material. Aerobic bacteria manage the chemical process by converting the inputs in to heat, carbon dioxide and ammonium. The ammonium is further converted by bacteria into plant, nourishing nitrites and nitrates through the process of nitrification

Compost can be rich in nutrients. It is used in gardens, land scaping, horticulture and agriculture. The compost itself is beneficial for the land in many ways, including as a soil conditioner, a fertilizer, addition of vital humus or humic acid, and as a natural pesticide for soil. In ecosystems, compost is useful for erosion control, land and steam reclamation, wet land construction and as land fill cover.

Compositing organisms require four equally important things to work effectively

- Carbon – for energy; the microbial oxidation of carbon produces the heat
- High carbon materials tend to be brown and dry
- Nitrogen – to grow and reproduce more organisms to oxidize the carbon

- High nitrogen materials tend to be green (or colourful, such as fruits and vegetables)
- Oxygen - for oxidizing the carbon in the decomposition process.
- Water – in the right amounts to maintain activity without causing anaerobic conditions (Yhdego, 1995).

Compositing is a somewhat more low- technology approach to waste management. The waste of many developing nations would theoretically be ideal for reduction through compositing, having a much higher composition of organic material than industrialized countries. For example, generally, in developing countries, the average city's municipal waste stream is over 50% organic material (Hoorweg, 1999). Studies in Bandung, Indonesia and Colombo, Sri Lanka have revealed that residential waste composed of 70% and 81% compostable material, and market waste 89% and 90% composting has not been overwhelmingly successful and wide spread in practice throughout the developing world. Although well documented in China and other areas of Eastern Asia, compositing projects have had a spotty record throughout Africa, Latin America and elsewhere, and have had the largest number of failed facilities worldwide ( UNEP 2006).

There are many advantages to compositing first and foremost, it would reduce, in some cases significantly, the amount of waste requiring ultimate disposal, expanding the life of landfills.

When done correctly, the end result becomes a useful product, capable of being used at the household or farm level to augment soil nutrient levels and increase organic matter in the soil, increasing soil stability. If the product is of high enough quality and markets exist, the produce can be sold.

Environmentally, the process by which composting decomposes organic waste is preferable to land fill processes. In a landfill, bacteria break down organics anaerobically in the absence of oxygen, resulting in the release of methane gas. When properly composted, aerobic process, which produces no methane by-product (Hoornweg, 1999)

## **LAND FILL**

EPA (2001) describes a land fill is also known as dump, rubbish dump is a site for the disposal of waste materials by burial and is the oldest form of waste treatment. Historically landfills have been the disposal and remain so in many places around the world. A land fill may also refer to ground that has been filled in with soil and rocks instead of waste materials, so that it can be used for specific purposes, such as for building houses unless they are stabilized, these areas may experience severe shaking or liquefaction of the ground in a large earthquake.

- Confined to as small an area as possible
- Compacted to reduce their volume
- Covered (usually daily) with layers of soil

Modern landfills are well engineered facilities that are located, designed, operated and monitored to ensure compliance. Solid waste landfills must be designed to protect the environment from contaminants which may be present in the solid waste stream. The land

fill siting plan – which prevents the siting of landfills in environmentally sensitive areas – as well as on site environmental monitoring systems – which monitor for any sign of ground water contamination and for land fill gas – provide additional safe guards. In addition, many new land fills collect potentially harmful land fill gas emissions and convert the gas into energy (EPA, 2001).

The dumping of the solid waste in the landfills is probably the oldest and definitely the most prevalent form of ultimate garbage disposal. Many landfills are nothing more than dumps (Johannessen, 1999). The difference between landfills and dumps is the level of engineering, planning and administration involved. Open dumps are characterized by lack of engineering measures, no leachate management, and few, if any, operational measures such as registration of users, control of the number of tipping fronts or compaction of waste. In an examination of landfills throughout the developing world in 1997-1998, Johannessen, (1999) found varying amounts of planning and engineering. In MSW dumping among the various regions visited, African nations (with the exception of South Africa) had the fewest engineered landfills, with most nations practicing open dumping for waste disposal (Johannessen, 1999).

Characteristics of a modern, well run land fill should include methods to contain leachate, such as clay or plastic liners. Disposed waste should be compacted and covered to prevent Vermin and wind-blown litter. Many landfills also have a landfill gas extraction system installed after they are closed to extract the gas generated by the decomposing waste materials. This gas is often burnt to generate a better environmental outcome than allowing it to escape to the atmosphere, as this consumes the methane (a far more potent green house

gas than carbon dioxide Central Public Health and Environmental Engineering organization (2002)

## **2.8 Groups at risks due to Solid waste and sources of Human exposures.**

The groups at risk from the unscientific waste disposal include; Populations in areas where there is no proper waste treatment method this occurs through ingestion of contaminated water or food. Children these get to t contact with the disease vectors; Wastes workers also get in to contact with disease vectors and Inhalation; Populations living close to waste dump these inhale the poor quantity air and; animals that eat contaminated wastes and get worms. Direct dumping of untreated waste in seas, rivers and lakes results in the plants and animals that feed on it (Moeller, 2005).

## **2.9 Environmental effects of solid waste management methods (Environmental Degradation and Human Health).**

Municipal solid waste management constitutes one of the most crucial health and environmental problems facing governments in African Cities. This is because even though these cities are using 20 – 50 percent of their budget in solid waste management only 20 – 80 percent of the waste is collected. The uncollected or illegally dumped wastes constitute a disaster for human health and the environmental degradation (Cointreau, 2006). Improper handling of solid waste and indiscriminate disposal in open spaces, road margins, tank beds, give rise to numerous potential risks to the environment and to human health. Direct health risks mainly concern those working in the field without using proper gloves

and uniforms; a high percentage of waste workers and individuals who live near or on disposal sites are infected with gastrointestinal parasites, worms and related organisms.

The decomposition of waste into constituent chemicals is a common source of Local environmental pollution. This problem is especially acute in developing nations which very few existing land fills would meet acceptable environmental standards, due to limited budgets. The problem is again compounded by the issue associated with rapid urbanization. As land becomes scarce, human settlements encroach upon land fill space, and Local governments in some cases encourage new development directly on top of operating or recently closed land fills. A major environmental concern is gas release by decomposing garbage. Methane is a by-product of the anaerobic respiration of bacteria, and these bacteria live in land fills with high amounts of moisture. Methane concentrations can reach up to 50% of the composition of landfills gas at Maximum anaerobic decomposition (Cointreau-levine, 1996)

The most obvious environmental damage caused by solid waste is aesthetic. A more serious risk is the transfer of pollution to ground water and land as well as the pollution of air from improper burning of waste (Cointreau, 2006)

Many waste activities generate green house gases; e.g. land fills generate methane and refuse fleets are significant sources of carbon dioxide and nitrous oxide. Open burning dumpsites produce volatilized heavy metals (e.g. Mercury and Lead), dioxins, and furan



leachate from unlined and uncovered dumpsites contaminate surface and ground waters (Cointreau, 2006)

A damaged local environment will first hit the most vulnerable groups of society, those who lack the resources needed to reduce the negative effects of a degraded environment.

In addition, people living under poor circumstances are also directly dependant on their close natural environment for their daily survival Gupta and Sanjay (2004) Older or poorly managed landfills can create number of adverse environmental impacts, including wind-blown litter, attraction of vermin and soluble contaminants (leachate) leaching into and polluting ground water. Another product of landfills containing putrescible wastes is landfill gas mostly composed of methane and carbon dioxide, which is produced as the waste breaks down. (Cointreau, 2006)

There are some human health risks associated with solid Waste handling and disposal in all countries to some degree, but certain problems are more acute and widespread in developing nations. According to Cointreau (2006) Human fecal matter, hazardous industrial waste, decomposition of solids into constituent chemicals, air pollution caused by consistently burning dumps.

Incineration may be a poor use of many waste materials because it destroys not only the raw material but also all of the energy, water and other natural resources sued to produce it. Some energy can be reclaimed as electricity by using the combustion to create steam to drive an electrical generator, but even the best incinerator can only recover a fraction of the

caloric value of fuel materials. Negative environmental consequences of incineration mostly resolve around air bone emissions. Certainly, incinerators should not be located where prevailing wind patterns would carry emissions over densely settled areas. They should be mandatory in any new construction. Incineration volatilize many compounds potentially harmful to human health: metals (especially lead and mercury) organics (dioxins), acid gases (sulfur dioxins) acis gases (sulfur dioxide and hydrogen chloride), nitrogen oxides, as well as carbodioxide and dust (Yhdego 1995).

In summary the effects of Solid Waste on Health, animals, Aquatic life and the Environment in general are diverse. They range from chemical poisoning through chemical inhalation, cancer, neurological disease, uncollected waste can obstruct the storm water run off resulting in flood, nausea and vomiting. Increase in hospitalization of diabetic residents living near hazard waste sites, mercury toxicity from eating fish with high levels of mercury. High algal population in rivers and sea, degradation of water and soil quality, wastes in landfills break down to form methane (potent greenhouse gas), change in climate and destruction of ozone layer due to waste biodegradable, littering of the environment due to illegal dumping, contamination of underground water through leaching (Goorah, 2009).

#### **2.10: Preventive measures for Solid waste Management effects.**

Barlaz, (2003) argues that there are measures to address the effects of Solid Wastes these include, Proper management of Solid Waste, involving public in plans for waste treatment and disposal, Providing the public accurate, useful information about the whole projects,

including the risks and maintain formal communications with the public and educating people on different ways of handling waste.

All these practices have been seen as good preventive measures however, they are not yet implemented in Hoima Municipality.

### **2.11 Cultural Taboos and social stigma**

This is a problem related to waste in many developing countries. For example, in India, as in many societies, that is considered dirty and filthy and those dealing with it are perceived as inferior, second – class citizens Snel, (1999). Traditionally, people working with waste in India-popularly know as rag pickers-usually belong to the “untouchables” (the Dalits), Hence, the prevailing, informal, waste system also affects how people view waste.

The waste workers live and work under extensive health risks, and suffer severe exploitation and deprivation. Possible health hazards include raised levels of infant mortality, hand and leg injuries, intestinal and respiratory infections, eye infections, lower back pain, malnutrition, skill disorders, and exposure to hazardous waste Snel, 1999).

### **2.12 Inadequate coverage**

Solid Waste collection schemes of cities in the developing countries generally serve only a limited part of the urban population. The majority of the people especially in slum areas remaining without waste collection services. These are usually the low income earners living in poor conditions in Peri-urban areas. One of the main causes of inadequate

collection services is lack of financial resources to cope with the increasing amount of generated waste produced (Zurbrugg, 2000).

### **2.13 Summary of literature review**

There is a lot of literature on solid waste management as cited which provides a valuable input to this research problem. It clarifies the variables on the relationship between solid waste management methods and the environment. However, the literature lives out gaps on the effects of methods on the environment. The literature concentrates mostly on one method that is land filling which is predominantly used in developed countries against other methods. As par the literature reviewed no any research has been carried out on the solid waste management methods and their effects in Hoima Municipality.

Therefore the proposed research will contribute to filling the gaps identified.

## **CHAPTER THREE**

### **METHODOLOGY**

#### **3.1 Introduction**

This chapter describes the procedural frame work with in which the research variables are measured. The independent variable being solid waste management methods and the dependent variable Environment effects. The researcher explains how the research was conducted in terms of research design, study population sample size and selection, sampling techniques and procedure, data collection methods, data collection instruments, validity and reliability of research instruments, procedure of data collection and data analysis

#### **3.2 Research design**

A cross sectional case study design using quantitative and qualitative approach was used.

Case studies involve in-depth, contextual analysis of similar situations in organizations, where the nature and definition of the problem happen to be the same as experienced in the current situation (Sakaran, 2003). This was be more desirable because it was helped explain the subjective behavior of the respondents, a detailed examination of one setting was attained and enabled the researcher explore in depth the variables with in the limited means. A cross sectional was used because the information on solid waste management methods and their effects on the environment was collected at that point in time from a simple population. The quantitative approach helped to quantify incidences in order to describe current conditions and to investigate the relationships between the variables using information gained from the questionnaire. The qualitative gives an explanation of events and describes findings using interviews and documentary analysis (Amin, 205).

A combination of these approaches will yielded to a better understanding of the research problem and for achieving a high degree of validity and reliability. This triangulation approach eliminates biases during data collection.

### **3.3 Study Population**

The study population consisted of all the households of Hoima Municipal Council which included;

the Mayor, Councilors, Heads of departments (Technical staff) in Hoima Municipal Council (Government Officials), division chairpersons, garbage collection Headman) business operators, heads of households, nongovernmental organizations among others. The total population for the study was 190 (refer to table 1).

### 3.4 Sample size and selection

Sample size will be determined using a table provided by Krejcie and Morgan as cited in Amin (2005). In this case, each respondent will have an equal chance of being selected and therefore the findings will be acceptable as being representative of the population of study for Hoima Municipal council. The sample size and selection is further presented in table 1 below:

**Table iii targeted and sample population category of respondents**

Target population	Sample population	Sample size	Sampling technique
Major	2	2	Purposive
DIV Chairpersons	4	4	Purposive
Town Clerks	5	5	Purposive
Technical Staff	25	24	Simple random
Counselors	30	28	Simple random
Garbage collectors	15	14	Simple random
Dumper Drivers	3	3	Convenience
House Holds	106	42	Convenience
	190	122	

**Source: adopted from krejcie & Morgan in Amin (2005).**

### **3.5 Sampling Technique And Procedure**

Simple Random sampling method was used for selecting quantitative data. The simple random sampling method helped to allow generalization the findings. The following respondents were purposely selected because they are obvious sources of data. (Mayor, Division Chairpersons, Technical staff of Hoima Municipality, Town Clerk, Division Town Clerks, Health Inspectors, Town Engineers, Environment Officer garbage collectors (dumper driver and garbage collection headman). Such methods, especially the convenience sampling methods, have been known for achieving sufficient responses, and to making the study viable. It is also quick and inexpensive (Sekaran, 2003, Amin, 2005)

Triangulation approach will be used due to the nature of the data that will be selected (both qualitative and quantitative hence these different techniques will make it better to understand the research problem. The approach is known for providing a high degree of validity and reliability since it eliminates biases (Amin, 2005).

### **3.6 Data collection methods**

Data was collected using;-

- The questionnaire method (This involved the use of a set of questions printed in a definite order (Kothari, 2004)

Respondents recorded their answers on the questionnaire. The questionnaire was collected at the respondent's convenience hence increasing chances of getting valid information. The justifications for the questionnaire method are that: sometimes they are useful in Small-scale

studies on sensitive topics. They are usually combined with other tools, most respondents give complete and accurate answers. The method is also used when research requires deep exploration of opinion or in depth information (Amin 2005).

- The interview method. (This comprised of interviews with individuals who are believed to hold important and essential information relevant to the objectives of the study. The justification for the interview method are that it provides in-depth data which is not possible to get using a questionnaire, it makes it possible to obtain data required to meet flexible than questionnaire because the interviewer can adopt to the situation and get as much information can be extracted from the respondent by honest and personal interaction, the interviewer can clarify and elaborate the purpose of the research and effectively convince respondents about the importance of the research, unlike questionnaire, the interviewer can get more information by using probing questions. Many respondents do not like exposing their negative side Interviewers are able to get such information through interaction and genuine conversation. Interviews yield higher response rates mainly because it is difficult for a subject to completely refuse to answer questions or to ignore the interviewer, with interviews the respondents do not need to know how to read and write (Mugenda 1999).

- Observation method. Here the researcher employed a vision to see what is happening in real life situation and then classified and recorded.

The justification for observation method is that; it gives first hand information about the objects; it provides additional, unexpected but useful information which may be encountered during observation sessions. Researchers can formulate their own version of what is occurring, independent of the participants, it also reduces error due to



translation and provides a richer data set, subjects seem to accept an observation intrusion better than they can respond to questioning (Maria, Benon, Joseph 2010).

- Secondary data (documentary materials like text books, journals, Development plan, Budgets council minutes, staff meeting, minutes work plans were reviewed. This was in line with (Sekaran 2003). The Justification are that: More information about the research subject is got; it facilitates conceptualization, assists in formulation of hypotheses and guides the process of operationalization of the variables.
- Photography method. The event was taken the way it was and the photos saved, kept for a long period of time.

### **3.7 Data collection instruments**

#### **a) Self- administered questionnaires**

Self-administered questionnaires contained structured questions with a list of all possible alternatives from which respondents selected the answer that best suit the situation (Mugenda and Mugenda, 1999). In order to capture honest answers, questionnaires were provided for confidentiality of the responses, respondents gave information with out fear of being victimized since it did not reveal their identity (Sekaran, 2003). The questionnaire method is flexible, easy to administer and can be used to collect data with in a short time.

#### **b) Interview guide**

Interview guide with un-structured questions was used. These were be developed for only face to face interviews with key informants; Town Clerks, major, Engineer, Health inspector and counselors. By asking probing questions using an interview

guide, the researcher was able to collect additional and more revealing information, which could not be obtained from self administered questionnaires

c) **Observation check list**

Only those that were relevant to the study were placed on the observation. Checklist for study purposes hence irrelevant items were left out.

d) **Documents:**

Already reliable information was available at the exposure of the researcher to use it.

### 3.8 Validity and reliability.

- a. **Validity** is the ability to produce findings that are in agreement with theoretical or conceptual values, or to produce accurate results and measure what is supposed to be measured (Amin, 2005). A validity test was carried out prior to the administration of the research instruments. This was done under the guidance of my supervisors to find out whether the set questions were capable of capturing the intended data/ intended response (content and relevancy).

b. **Reliability**

This measures the degree to which a research instrument yields consistent results or data after repeated results (Mugenda and Mugenda 1999). The major instrument for data collection was the questionnaire its reliability was assessed using cronbach's coefficient Alpha, Reliability was ensured through test-retest procedure of the questionnaire. The

questionnaire was pretested to 10 respondents and the reliability results were computed using the SPSS package. The results were computed and the scores evaluated. A high coefficient of 0.89 implied a high reliability according to Amin (2005)

### **3.9 Procedure for data collection**

Before conducting the study, the researcher got a clearing letter from the programme coordinator; masters programme Uganda Management Institute to the authorities of Hoima Municipal Council and communities through whom the study was done.

The letter of introduction inspired the respondents to cooperate with the researcher.

The selected respondents were be requested to complete and return the questionnaires within a given period of 8 days without inconveniencing them.

The distributed questionnaires were accompanied by the letter clearly stating the purpose of the study and stressing a statement of confidentiality of the information given.

### **3.10 Data Management and Analysis**

Collected data was converted into numerical codes and SPSS version 12 computer programme was used for analysis.

The data was in nominal scale, and summarized using descriptive statistics. This enabled the researcher to describe meaningfully the distribution of scores, using a few indices (Mugenda and Mugenda 1999)

The data was organized and presented using tables to describe its behaviour

For qualitative data, interviews and questionnaires were reviewed thoroughly, interviews transcribed, sorted and classified in to themes and categories, in order to support the hypotheses set. Detailed information on solid waste management methods was obtained, Patterns and trends established, the information from the interviews scrutinized, analyzed and presented in form of paraphrase or quotations, upon permission of respondents.

In some cases, percentages were used to compare different groups. Pearson product moment correlation technique was used to measure the degree of relationship between solid waste management methods and their effects on the environment (Sekaran, 2003). The captured data was scrutinized for any missing or inadequate information. Qualitative data was sorted, coded, edited and classified in to categories, as indicated by the variables in the questionnaire.

Data was summarized, organized and analyzed, using 3 and 5 Likert Scale.

The Pearson moment correlation was used to determine the relationship among the variables and the direction of the relationship. A Coefficient of determination was computed in order to find out the effect of the independent variable on the dependent variable.

## **CHAPTER FOUR**

### **DATA PRESENTATION, ANALYSIS AND INTERPRETATION**

#### **4.1. Introduction**

This study aimed at establishing the solid waste management methods and their effects on the Environment in Uganda a case of Hoima Municipal Council. The central focus was on establishing the relationship between solid waste management methods as an independent variable and environmental effects as dependent variable. The dimensions of the independent variable are garbage reduction, garbage recycling, Resource recovery, composting combustion and land filling. The dimensions of the dependent variable are health, water/Air pollution, Beauty, smell land degradation leachets and manure. The moderating variable is public environmental awareness, education and culture. In order to accomplish the above task of establishing the relationships. Three hypotheses were posed

and the results are presented in this chapter. In this chapter the following will be discussed the socio economic characteristics of respondents, answers per each of the items relating to a particular objective and the study's findings according to the hypotheses cited in chapter one.

#### 4.2. Socio economic characteristics of respondents.

The following demographic characteristics formed part of the study; gender education, occupation and monthly income.

**Table iv Demographic characteristics of the respondents**

Category		Frequency	Percent	Valid percent	Cumulative percent	
Gender	Male	78	63.9	63.9	63.9	
	Female	44	36.1	36.1	100.0	
	Total	122	100.0	100.0		
Education	O level	31	25.4	25.4	25.4	
	A Level	35	28.7	28.7	54.1	
	Institution	17	13.9	13.9	68.0	
	University	24	19.7	19.7	87.7	
	Others	15	12.3	12.3	100.0	
	Total	122	100.0	100.0		
	Occupation	Civil servant	30	24.6	24.6	24.6

	Self employed	36	29.5	29.5	54.1
	Others	56	45.9	45.9	100.0
	Total	122	100.0	100.0	
Monthly income	50,000-100,000	18	14.8	14.8	14.8
	100,000 – 200,000	29	23.8	23.8	38.5
	200,000 – 500,000	39	32.0	32.0	70.5
	500,000 – above	35	28.7	28.7	99.2
	Others	1	0.8	0.8	100.0
	Total	122	100.0	100.0	

**Source! Primary Data**

The findings in table vi indicates that, most respondents were male 63.9% while females were 36.1% . This scenario is associated with the fact that majority of the business operators in Hoima Municipality are male, and similarly the staff of Hoima municipality, the majority are male. The majority of females are found in saloons and market place. This explains the fact that in Hoima Municipality majority of the women have low education and less access to capital for business financing.

#### 4.3 **Empirical findings and verification of hypotheses.**

In this section, descriptions of respondents' opinions on the various items of the questionnaire relating to the objectives of the study are presented as well as the verification of the hypotheses. Respondents were requested to react to items by choosing (ticking) the option that best described their opinions on the Likert scale ranging from disagree, agree to no comment.

#### **4.3.1. Solid waste management methods in Hoima Municipality.**

Several items in the questionnaire were presented to the respondents and the findings are shown in table.

**Table v. Solid waste Management Methods in Hoima Municipality.**

<b>Method</b>	<b>Frequency</b>	<b>Percent</b>
Open burning	46	37.6
Composting	31	25
Land filling	20	16.7
Incineration	17	13.9
Indiscriminate dumping	8	6.9
Total	122	100.0

**Source: primary data**



From the above table, there is evidence that 37.5% of the respondents preferred open burning, the reasons advanced for this were that its convenient and cheap for them.

Mostly at homes in residential areas. 25% agreed with composting and this basically was in homes periurban parts of the Municipality. Generally, this community who were practices urban Agriculture.

Those who agreed with land-filing were 16.7%. Although land-filling is done it is not yet in advanced stages because of the huge operation costs involved.

This is partly attributed to the fact that funds allocated to garbage are not enough (according to Mr. Mugano Felix, Principal Health Inspector).

To run an effective land-fill in Hoima Municipal Council requires an initial cost of 200M. once established it requires about 300M annually to run it efficiently. Yet given the situation of most developing countries, financial resources are a major constraint (Zerboc, 2003). The case of Hoima Municipal could even be worse. The Municipality depends on Central Government grants which stand at 1B. per year. This funds are too low to met the demands of Solid Waste Management in the Municipality (Principal Health Inspector). Any attempts to generate additional funds for the purposes of SWM from the residents has limited prospects of success because the population is generally poor. In addition solid waste management is not considered a priority compared with employment, health and education.

As regards respondents' opinion on incineration it was 13.9%. Some respondents did not know what it was all about. However it was basically practiced at Hoima Referral Hospital and at Azur clinic in Duhaga for incinerating of medical waste. In an interview with the Town Clerk of Hoima Municipal Council, he underscored the need for raising

community awareness on the solid waste management methods. He said: “ People need more sensitization on the methods of solid waste management both at small and large scale concerning indiscriminate dumping”. Only 6.9% endorsed this method. This is basically because of the dangers it poses to the environment indiscriminate dumping was also common in the central business district mostly at the Hoima main market in any case, waste burn incineration is an expensive method compared to sanitary landfills. The problem is more complicated in most developing countries because, a part from hospitals and some industrial establishments, it is randomly by the communities. This poses dangers and health hazards.

In addition to lack of awareness, “there is no bye-law to enforce town cleanliness by stipulating what to do which could help to force people to refrain from certain behavior. The explained the fact that majority of our people have low education” as observed by the Town Clerk Hoima Municipality in interview with the researcher.

From the data collected it evident that all the five methods of solid waste management were being used in Hoima Municipality, but at different scales and importantly not as a well institutionalized system in accordance with the Life Cycle Cost analysis theory. This is an integrated model that puts emphasis on logical system of flow of management of solid waste. In essence it is premised on well-defined roles of the stakeholders in the chain of solid waste management. Waste flows are either allocated across unit processes a priori among the unit operations or chosen based on cost considerations. It characterizes environmental considerations with respect to an array of pollutants. The unit processes and mass flows in the SWM strategy are specified in a priori by the user and not selected

by the procedure. This aids determination of appropriate combination of collection methods which take cost and ease into account.

This is not the case in Hoima Municipality, where all the methods of integrated solid waste management are present and practiced, but not systematized. Therefore the cost of these methods is not known making it hard to determine the most appropriate collection strategy. At the centre of this are institutional issues. While there are structures for solid waste management in Hoima Municipal Council, their full operationalization remains largely in paper and ad hoc. This is largely a result of limited finances to engage and/or train expertise to implement the Life Cycle model in the management of the municipality's solid waste.

#### **4.3.2 Effects of existing waste management methods on the environment and human health.**

The second of objective sought to find out the effects of the use of the various methods identified in objective on the environment and human health. Data pertaining to this was generated through survey questionnaire and interviews. The results are presented and discussed below.

##### **Opinion on effects of existing waste management methods**

Several items in the questionnaire were presented to the respondents and the findings are show below in table 6.

##### **Table VI Opinions on effects of existing waste management methods.**

Open burning releases bad gases

	<b>Frequency</b>	<b>Percent</b>	<b>Valid percent</b>	<b>Cumulative percent</b>
Valid disagree	7	5.7	5.7	5.7
Agree	86	70.5	70.5	76.2
No comment	29	23.8	23.8	100.0
Total	122	100.0	100.0	

**Source: Primary data:**

From table 6 above, there is evidence that 70.5% of the respondents agreed that open burning releases bad gases. The respondents told the researcher that these are choking gases which make them sneeze and cause irritation on the throat. It also contributes greatly to depletion of the ozone layer hence climate change. The respondents also informed the research that open burning was preferred because it was the easiest and cheapest method to be used

In an interview with the L.C.I official from Kibati he informed the researcher that open burning was done because of the less wastes produced in homes and commercial premises.

**Table VII: Correlation between the method of open burning and the environment (releasing gases in the environment)**

	<b>I prefer open burning</b>	<b>Open burning is done by households in Hoima municipality</b>	<b>Open burning releases bad gases</b>
I prefer open burning Pearson correlation	1	.012	.212

Sign. (2-tailed)	.	.910	.074
N	96	96	72
Open burning is Pearson correlation done by households sig. (2 – tailed ) in Hoima Municipality			

**Source: Primary data:**

Correlation is significant at the 0.05 level (2-tailed).

From the table VII Pearson correlation coefficient,  $r=244$  and the significance is .019 at 0.05 level. This, therefore, indicates a weak but significant relationship between open burning and the environment. This implies that with more emphasis on open burning, the environment and human health will be positively affected. But this is the case? What does this mean? It may mean that the scale or degree at which the method is used is still low. This a point should be discuss.

In the above table, the calculated significance level is.019, which is smaller than the predetermined alpha .05; hence we reject the null hypothesis and accept the research hypothesis; Open burning as a waste management method affects the environment in Hoima Municipality affects the environment is accepted.

Open burning method is one of the oldest ways used to manage solid waste. It is easy to use but also the least expensive way to burn municipal waste, if properly used. The method, however, has its dangers and hazards.

Open burning releases many pollutants into the atmosphere (State of Alaska, 2004), these include, dioxins, polycyclic aromatic compounds, volatile organic compounds, carbon monoxide , hexachlorobenzene, and ash. All of these chemicals pose serious health and environmental hazards. The dioxins are capable of producing a multitude of health

problems; they can have adverse effects on reproduction, development, disrupt the hormonal system or even cause cancer. The polycyclic aromatic compounds and the hexachlorobenzene are considered to be carcinogenic. The particulate matter can be harmful to person with respiratory problems such as asthma or bronchitis and carbon monoxide can cause neurological symptoms.

The harmful effects of open burning are also felt by the environment (state of Alaska, 2002) This process releases acids such as the halo-hydrides; it may also release the oxides of nitrogen and carbon. Nitrogen oxides contribute to acid rain, ozone depletion smog and global warming. In addition to being a green house gas, carbon mono oxide reacts with sunlight to produce ozone which can be harmful. The particulate matter crates smoke and haze which contribute to air pollution.

Due to those potential hazards, have legislated strictly on open burning methods, where they are used, there are stringent guides to ensure safety.

Open burning in Hoima Municipal Council, as in all urban areas of Uganda and much of the developing world is not done in a managed way. This then opens communities to the hazards pointed out above. How much open burning has contributed to some of the health problems in Hoima Municipal Council has not been established, but it is a matter of conjecture.

**Table VIII; Relationship between the method of incineration and the effects on the environment correlations.**

		<b>I prefer incineration</b>	<b>There are effects on the environment as regards use of incineration methods</b>
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I prefer incineration	Pearson	1	.093
	Correlation	.	.360
	Sig. (2-tailed)		
	N	99	99
There are effects on the environment as regards use incineration methods	Pearson	.093	1
	Correlation	.360	.
	Sig. (2-tailed)		122
	N	99	

There is a weak relationship ( $r=0.93$ ) between the method of incineration and effects on the environment and it is insignificant ( $\text{sig. 2 – tailed} = 0.39 > 0.05$ ).

This is because there are few people using this method .It is mostly used in Health facilities and very expensive to install/operate.

Inciration is one of the methods used in Solid waste management strategies. It should be used for waste reduction not as a method for waste disposal because it leaves out ashes which have still to be disposed (UNEP, 1996). It is an attractive disposal method it is potential can be 80-90 percent in terms of volume (UNEP, 1996). Inciration as an option is in appropriate technology for most low-income countries such as Uganda. The high financial start-up and operational capital required to implement inciration facilities is a major barrier to successful adoption in developing countries (UNEP, 1996). A large portion of that cost is the environmental hazard mitigation components, including “emission scrubbers”. Although high costs can be recouped by coupling incirators with energy recovery infrastructure, the additional costs for such infrastructure is well beyond

the ability of developing countries, much as a municipality such as Hoima, Negative consequences of incineration revolve around air born emissions, incineration volatilizes many compounds potentially harmful to human health; metals (particularly lead and mercury), dioxins, acid gas, as well as carbon mono oxide and dust (UNEP, 1996).

Therefore it is not surprising that the findings place incineration as least used method. Since it is the least use, the communities are unaware of its environmental and health hazards.

**Table IX; Relationship between composting method and effects on the environment.**

**Correlations**

		<b>I prefer incineration</b>	<b>Composting has effects on the environment</b>
I prefer composting	Pearson	1	-0.26
	Correlation	.	.800
	Sig. (2-tailed)		
	N	97	97
Composting has effects on the environment	Person	-0.26	1
	Correlation	.800	.
	Sig. (2-tailed)		
	N	97	122

**Source: Primary data:**



There is a weak negative relationship between the method of composting and the effects on the environment (Pearson correlation is -0.026). However the relationship is insignificant because sign, (2-tailed is  $>0.05$ ).

Composting is being promoted as the most ideal method of solid waste management in the developing countries. Here it has much higher organic composition of organic material industrialized countries. In the developing countries the average municipal stream is over 50% organic materials. However, it is a method that is just being introduced. Its negative effects on the environment and health also considered to be lower than the other methods (particularly incineration and land fill). However, epidemiological studies show that people living near composting sites and workers have symptoms of skin diseases and airways (Porta et al, 2009) improperly operated composting facilities release offensive odours because they allow anaerobic conditions to develop. Composting can also have negative effects on natural resources due to application of contaminated compost containing hazardous material, potential leachate, uncontrolled drainage, and improper storage. Uncontrolled dumping of composting residue such as uncompostable and non-recyclable material have negative effects on the environment. Composting, therefore, is not risk-free. It exposes populations and the environment to hazards. Unlike chemical, these hazards may not be obvious (Domingo & Nadal, 2008). This explains the negative findings. In addition composting in Hoima Municipal Council is not yet on a large industrial scale. Even otherwise, there are hardly any scientific studies carried in Uganda on the subject. Nevertheless, studies elsewhere (see above) show evidence of the hazards of composting.

**Table X; Relationship between Landfill and hazardous effects to the environment**

**Correlations**

		<b>I prefer incineration</b>	<b>Composting has effects on the environment</b>
I prefer land fill	Pearson	1	-.002
	Correlation	.	.988
	Sig. (2-tailed)		
	N	101	56
Composting has effects on the environment	Person	-.002	
	Correlation	.988	
	Sig. (2-tailed)		
	N	56	

**Source: Primary data:**

The relationship is very small ( $r = -0.002$  tending to zero) and this very weak relationship is not significant since  $\text{sig. (2-tailed)} = 0.988 > 0.05$ . This is because the method is not commonly used in Hoima Municipality.

4.4 Hoima Municipal Council community is aware that solid waste management affects them.

Table XI;.....

	<b>Frequency</b>	<b>Percent</b>	<b>Valid percent</b>	<b>Cumulative percent</b>

Valid disagree	31	25.4	25.4	25.4
Agree	60	49.2	49.2	74.6
No comment	31	25.4	25.4	100.0
Total	122	100.0	100.0	

**Source: Primary data:**

From Table 10 indicates that 49.2% of the respondents agreed that they were aware of the effects of the solid waste management methods in Hoima Municipality. Some of the issues highlighted included foul smell, release of gases from the dumping site at Kibati, leachet formation and run-off in to Kanende stream which has contaminated the water. This findings is consistent with studies on land fills. Landfills are common methods of waste management in many developing and developed countries. Environmental and health hazards of landfills is well documented (UNEP, 1996; Johannessen & Boyer, 1999; EPA, 2001). Birth defects, asthma, soil acidification, increase in soil metals, vegetation damage, contamination of ground and surface water are some of negative effects associated with landfills.

#### **4.5 Resource recovery and reuse if practiced in Hoima Municipality**

Table XII;

	<b>Frequency</b>	<b>Percent</b>	<b>Valid percent</b>	<b>Cumulative percent</b>
Valid disagree	16	13.1	13.1	13.1
Agree	64	52.5	52.5	65

No comment	42	34.4	34.4	100.0
<b>Total</b>	<b>122</b>	<b>100.0</b>	<b>100.0</b>	

**Source: Primary data:**

From the above table 52% of the respondents agreed that they practiced resource recovery and reuse as a method of waste management in Hoima, Municipality. The researcher observed that those who did it had insufficient skills to handle it. For example untrained children are seen in town looking for scrap.

In contrast according to EPA (2007) material recovery is one of the good methods to manage garbage. According to UNEP report (1999) garbage can be segregated and sorted at households level for better management and benefit. It implies that if recovery and reuse of solid waste in Hoima Municipality is not done then the opportunity of turning it into cash is lost because its recyclability is diminished since its not sorted

Basing on the observation by the researcher items like bottles and paper are picked by scavengers and sold.

The UNEP report of 2006, revealed that the scavengers from waste recovery in Kibera a slum in Nairobi is a regular job and profitable. This implies that resource recovery would also be a viable venture in Hoima Municipal Council and on life threatening environment as with un segregated waste.

## **CHAPTER FIVE**

### **SUMMARY DISCUSSION, CONCLUSIONS AND RECOMMENDATIONS**

#### **5.1 Introduction**

In the preceding chapter the discussion on key findings were made. This chapter provides solid waste management methods, conclusions and recommendations from the study. These conclusions and recommendations are derived from the findings of the study which are presented in this dissertation.

#### **5.2 Summary and discussion of findings**

The purpose of the study was to examine solid waste management methods and their effects on the environment in Hoima Municipality. To achieve the above purpose of the

study a case study design was used as research design. The target population selected included staff of Hoima Municipal council, Councilors, garbage collectors, Division Chairpersons, Town clerks, Drivers and Households. The study population was 190. A sample population size of 122 was selected using the Krejcie and Morgan table, and the following sampling techniques were used: census, purposive and simple random sampling. In order to collect data, three key methods were used namely: questionnaire, interview and documentary analysis. In addition, the following were the data collection instruments used: the self administered questionnaire and the interview guide.

The validity test was carried out to test the research instruments prior to their field administration. In addition, the reliability of the questionnaire instrument was assessed using the cronbach's coefficient Alpha. Thereafter data was collected qualitative data was captured using questionnaires and was analyzed using SPSS. Qualitative data was collected by use of an interview guide, summarized and presented in form of a narrative, paraphrase or directly quoted in some cases. Correlations were obtained in order to measure the degree of the relationship between variables. Accordingly the following were obtained, objective by objective.

The Socio – economic characteristics of the respondents indicated that most of the respondents were male (63.9%), while the females were only (36.1%).

As regards the first study objective: to find out solid waste management methods in Hoima Municipality, the following were the major findings most preferred method and the percentage that is; open burning (37.5%), composting (25.0%), land filling (16.7%)

incineration (13.9%) and indiscriminate dumping (6.9%). The researcher observed that respondents attached great importance to open burning of solid wastes since it was cheap and convenient for them.

The second study objective was to evaluate the effects of existing waste management methods, and the following were the major findings:

- There is a weak negative relationship between the method of composting and the effects on the environment.
- There is a weak but significant relationship between open burning and the environment. There is a weak relationship between the method of incineration and effects on the environment.

The third study objective was to determine appropriate method that can be used to manage solid waste and disposal. The findings of the study indicated that open burning was highly used in the core of the town since it was easy and cheaper but dangerous while composting as a method was used slightly outside the Town with respondents who has big chunks of land and were practicing urban farming.

### **5.3 Conclusions**

From the study findings regarding the hypothesis that were considered, the following conclusions were reached at;

#### **5.3.1 The most preferred solid waste management methods in order of preference in Hoima**

Municipality are open burning, composting, land filling, incineration and indiscriminate dumping.

5.3.2. It was found out by the researcher that the solid water management methods in Hoima Municipality had a weak but significant relationship to the environment and Human Health.

5.3.3. The researcher found out that since the solid waste generated in Hoima Municipality were not too much open burning was being practiced however composting was highly used by those practicing urban farming.

5.3.4. The presence of huge piles of solid waste in Hoima Municipality poses serious problems in that these organic materials are a breeding ground for disease, chemical pollutants once absorbed in to the soil through leachating cannot be removed without considerable cost and their entry into the human food chain is un healthy.

Solid waste management in Hoima Municipality is done haphazardly right from the household level up to the final dumping site in Kibati. Its nature makes its recyclability diminish since it's a mixture of both organic and inorganic materials.

## **5.4 Recommendations**

The recommendations were made in line with the objectives.

### **5.4.1 To find out solid waste management methods**



The researcher found out that open burning and composting were highly used however open burning was exposing the environment to a great danger of pollution compared to composting.

As NEMA has received a grant from world Bank for the composting project in Hoima Municipality the researcher recommends that a great focus be put on composting since it has less effects on the environment. Also there is need to sensitize the public on the solid waste management methods so as they can practice the effectively.

More Radio Programmes should be made by the Health Department of Hoima Municipality as regards sensitizations.

#### **5.4.2 Effects of the existing waste management methods.**

The researcher recommends that the effects of the solid waste management methods can be reduced by use of appropriate methods like promotion of reduction, reuse and recycle. Emphasis should be placed on the three R<sup>i</sup>s, reduction, reuse, and recycle. This will help in creating of less waste and in increased material recovery.

Reduction can be achieved by starting a deposit – refund system, i.e.it should be made compulsory for certain type of waste to be taken care of by the company producing them under extended producers responsibility. In order to ensure that these particular wastes go back to the producers; an extra deposit (20 – 30%) of the price could be charged when someone purchases these items, and this deposit should be recovered on return of the items say cover / foil/plastic bottles). This may reduce the burden of waste to a great extent. Wastes such as polyethen packages, wrappings, drinking water bottles, soft – drink bottles, should be included in this system.

The recycling of waste is another important requirement for sustainable waste management practices to reduce on the effects. In the case of Hoima Municipality of formalized waste recycling or recovery system, should be undertaken by the municipality. NGO's or private firms may be enlisted in organizing and including the non-formal recycling sector as part of the formal system. Rag pickers or itinerant buyers should be allocated in such a manner that the maximum amount of waste is recovered for recycling.

5.4.3 Appropriate methods that can be used to manage solid waste more effectively and efficiency in Hoima Municipality. The researcher recommended composting since already Hoima Municipality was earmarked by NEMA for this project.

Large scale composting can be expensive hence the focus should be on developing it at divisional level, or preferably community level, small scale composting processes. Community –based composting helps in diverting a major portion of the waste generated close to the source of generation, thereby, significantly reducing transportation costs and prolonging the life span of landfills.

Furthermore, community – based composting may enhance recycling activities and facilitate the final disposal of waste in a proper manner. People who are from economically backward categories may be employed for composting schemes. This can be a source of employment and income generation for both the people employed for

composting and the Municipality as well. Community level composting may be efficient and easier to manager community level composting can be undertaken at the local level, thus it will save money and resources for the Municipality.

Manure from the composting plant can also be sold to farmers so as to promote urban farming.

Biogas generated from decomposing waste can be tapped through simple and appropriate technology for use in cooking.

#### **5.4.4 Waste Disposal**

Disposal of the wastes should be undertaken in a prescribed scientific manner. A sanitary landfill designed specificancy for the final disposal of wastes should be build. Sanitary landfills minimize the risks to human health and the environment associated with solid wastes. Formal engineering preparations with an examination of geological and hydrological features and related environmental impact analysis should be carried out before a sanitary land fill is build. Staff working in the sanitary landfill should be properly equipped and trained. Hoima Municipality should find a proper location for a sanitary land fill

Disposal of hazardous waste such as medical or toxic waste should be undertaken with the help of the state government. Special provisions should be made to adequately deal with those wastes, and special transportation facilities and specially trained staff should be employed for dealing with hazardous wastes. The Municipality should immediately seek help from the central government in this regard.

#### **5.5 Contributions of the study.**

The findings of this study are expected to contribute immensely to the area of policy formulation on issues to do with solid waste management methods.

The study has contributed to the world of research in terms of recommendations on the best methods for solid waste management with reduced effect on environment and Human Health in Hoima Municipality.

## **5.6 Areas for further research**

The study should therefore be able to stimulate New academic thinking and further research in area of solid waste management bring in participation of Central Government. Research be done into possible methods of decomposing solid wastes to make organic manure for sale to boost urban Agriculture.

Another important area for further research is with regard to how the integrated solid waste management strategy of reduce; recycle; reuse and recover could be use as solid waste management methods to reduce effects on environment and human health.

Environmental degradation in Urban areas of Uganda could be an area of research.

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## **APPENDICES.**

### **Appendix.1**

#### **MORGAN AND KREJCIE (1970) TABLE FOR DETERMINING SAMPLE SIZE FROM A GIVEN POPULATION.**

**N IS POPULATION SIZE AND S IS SAMPLE SIZE**

<b>N</b>	<b>S</b>	<b>N</b>	<b>S</b>	<b>N</b>	<b>S</b>	<b>N</b>	<b>S</b>	<b>N</b>	<b>S</b>
10	10	100	80	280	162	800	260	2800	338
15	14	110	86	290	165	850	265	3000	341
20	19	120	92	300	169	900	269	3500	346
25	24	130	97	320	175	950	274	4000	351
30	28	140	103	340	181	1000	278	4500	354

35	32	150	108	360	186	1100	285	5000	357
40	36	160	113	380	191	1200	291	6000	361
45	40	180	118	400	196	1300	297	7000	364
50	44	190	123	420	201	1400	302	8000	367
55	48	200	127	440	205	1500	306	9000	368
60	52	210	132	460	210	1600	310	10000	370
65	56	220	136	480	214	1700	313	15000	375
70	59	230	140	500	217	1800	317	20000	377
75	63	240	144	550	226	1900	320	30000	379
80	66	250	148	600	234	2000	322	40000	380
85	70	260	152	650	242	2200	327	50000	381
90	73	270	155	700	248	2400	331	75000	382