SPATIAL ANALYSIS OF THE LINK BETWEEN SOLID WASTE AND FLOODS IN KALIKILIKI and KANYAMA WARD 10 SETTLEMENTS IN THE CITY OF LUSAKA, ZAMBIA

BY

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CERTIFICATION OF APPROVAL

This dissertation by ROSE MUKUMA has been approved as fulfilling the requirements for the award of Master of Science Degree in Spatial Planning by the University of Zambia.

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DEDICATION

This work is dedicated to my husband, Paul M. Manga and children Wisdom Malayo Manga, Paul Mwaba Mapalo Manga and, Gracious Malumbo Manga.

ABSTRACT

Solid waste management is a large and growing problem for countries in the developing world and is often a neglected aspect of urban management. Poor waste management can contribute to the impact of urban flooding by blocking drainages and increasing debris. However, information is lacking on the link between solid waste management and floods in the city of Lusaka, Zambia. It was for this reason that this study sought to establish how the indiscriminate disposal of waste contributes to urban flooding. Specifically, the study sought to identify the types of solid waste produced by the residents in Kalikiliki and Kanyama Ward 10 settlements, investigate how solid waste is disposed of by households and find out challenges faced by residents in disposing of solid waste. A total of 505 questionnaires were administered to any adult present at each particular household. This included 200 from Kalikiliki and 305 from Kanyama Ward 10. Semi-structured interviews were conducted with 20 key informants from relevant institutions and observations were also made. The results of the study indicate that the types of domestic solid wastes generated in the study areas were mainly organic, paper, plastic, old and rusted metals, diapers and textile wastes. The study was able to confirm and map points in the two settlements where waste contributes to flooding. The study also confirmed that waste collection franchise is inadequate in Kalikiliki and Kanyama Ward 10 settlements. This was easily identified by persistent heaps of uncollected waste found on ubiquitous illegal dumps. Therefore, residents in the two settlements resort to unsafe and unsustainable waste disposal practices such as burning, burying and open dumping, which contribute to blockage of drainages. On the challenges faced on solid waste disposal, it was revealed that residents of the two settlements have no designated damping places. The study further revealed that residents' perceptions indicate that means of solid waste management contribute to the flooding in the study areas. The research concluded that open dumping and depositing of waste in uncontrolled and unauthorized locations contribute to increased flood events. Based on the findings, the study therefore recommends that Ministry of local government and rural development through LCC should provide waste receptacles in large quantities and place them at intervals of not more than 200 metres apart in both settlements and even commercial areas.

Keywords: *Municipal Solid waste management, flood management, drainage System, open dumping, developing countries, community response*

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ABBREVIATIONS AND ACRONYMS

ADPC	Area Under Disease Progress Curve
CBD	Central Business District
CBE	Community Based Enterprises
CBO	Community Based Organization
CSO	Central Statistical Office
DANIDA	Danish International Development Assistance
DEM	Digital Elevation Model
DF	Degree of Freedom
DMMU	Zambia Disaster Management and Mitigation Unity
ECZ	Environmental Council of Zambia
EIA	Environmental Impact Assessment
EU	European Union
FGD	Focus Group Discussion
GDP	Gross Domestic Product
GIS	Geographical Information System
GIZ	Germany International Development Cooperation
GPS	Global Positioning System
GRZ	Government of the Republic of Zambia
IPCC	Intergovernmental Panel on Climate Change
LCC	Lusaka City Council
LPPA	Lusaka Province Planning Authority

LSWSMP	Lusaka Solid Waste and Sanitation Management Project
LWSC	Lusaka Water and Sewerage Company
MCAZ	Millennium Challenge Account Zambia
MLGH	Ministry of Local Government and Housing
MSW	Municipal solid waste
MSWM	Municipal solid waste management
NGO	Non-Governmental Organization
NSWMS	National Solid Waste Management Strategy
PPHPZ	People's Process on Housing and Poverty in Zambia
PPP	Public Private Partnership
RCEE	Research Center for Energy and Environment
RDA	Road Development Agency
SAR	Satellite based Synthetic Aperture Radar.
SPSS	Statistical Package for Social Science
SSA	Sub-Saharan Africa
START	**S**ys**T**em for **A**nalysis, **R**esearch and **T**raining
SWM	Solid Waste Management
UN-HABITAT	United Nations Human Settlements Programme
UNZA	University of Zambia
USAID	The United States Agency for International Development
WDC	Ward Development Committee
WMU	Waste Management Unit
ZDC	Zone Development Committees

ZEMA	Zambia Environmental Management Agency
ZMD	Zambia Meteorological Department
ZRCS	Zambia Red Cross Society
ZVAC	Zambia Vulnerability Assessment Committee

CHAPTER ONE: INTRODUCTION

1.1. Background

Municipal Solid Waste Management (MSWM) is a large and growing problem affecting large population worldwide, whether individuals are managing their waste or government are providing waste management services to their citizens. Countries in the developing world, MSWM is often a neglected aspect of urban management (Firdaus and Ahmad, 2010). With rapid population growth and urbanization, and as nations develop economically, waste generation rates are rising (Pai et al., 2014). The problems associated with MSWM are complex because of the quantity and diversity of the nature of waste and financial limitations on public services in towns and cities (Ampofo *et al.,* 2015).

Based on estimates by Hoornweg and Bhada-Tata, (2012), the world cities generated 1.3 billion tonnes of waste annually with Asia accountable for 1 million tonnes per day. In 2016, according to the World Bank estimates, the worlds' cities generated 2.01 billion tonnes of solid waste, amounting to a footprint of 0.74 kilograms per person per day. Annual waste generation is expected to increase by 70% from 2016 levels to 2.2 billion tones by 2025 and 3.40 billion tonnes in 2050. At least 33% of this waste is mismanaged globally today through open dumping or burning (WB, 2016).

In reference to Zambia, the primary concern of this study is that despite MSWM being an alternative to an effective response to flood risk, current model of MSWM seems not to be yielding desired results. The poor disposal of waste frequently leads to blockages in drainages and water courses (Firdaus and Ahmad, 2010), this effectively reduces their capacity of storage and conveyance and leads to flooding. Lack of adequate services in the informal settlements leads to indiscriminate dumping of waste which block drainages, clog rain water which then spills in to people's homes (UN-Habitat, 2010). Edema *et al.,* (2012) refer to MSWM as the process of collecting and treating solid waste. This is a systematic control of generation, source separation, collection, storage, transport, processing, treatment, recovery, and disposal of solid waste. Thus the management of solid waste can be seen as one of the best options for reducing flood risk, contributing to quality of life, health and development generally, while also lowering the impact of disasters (Lamond *et al*., 2012).

However, there is growing evidence that low priority is often accorded to the management of solid waste in Zambia and the reason given is that there is little income generations by the local authorities to enable them undertake such services. This scenario of low priority to solid waste management is supported by Lamond *et al.,* (2012) who observed that, MSWM in developing countries is often accorded low priority for a number of reasons: firstly, poor wages and therefore there may be a lack of relevant training and expertise, secondly is low awareness of the health and sanitation implications of poor MSWM can lead to an absence of pressure from civil society and therefore funds are diverted to other higher profile programs.

Lack of resources perpetuate the low status of MSWM in city management (Kimario, 2014). MSWM units usually do not have adequate funds to purchase equipment, train staff and develop disposal sites. These factors not only result in inadequate collection and disposal of waste in settlements, they also tend to lead to concentration of resources in city centers. Against this background, this study therefore, investigated how solid waste and floods link in the city of Lusaka, Zambia, Kalikiliki and Kanyama ward 10 settlements was selected as a case study.

1.2. Problem Statement

Municipalities in Zambia are responsible for MSWM. Lusaka City Council (LCC) have engaged private entities in form of community based enterprises (CBEs) in the collection of solid waste from households to communal collection points in unplanned settlements. LCC collect waste from communal collection points to the Chunga land fill. Despite the involvement of CBEs in the collection and disposal processes, MSW is generally indiscriminately dumped in drainages and on road sides while a seemingly small portion is transported to the designated dump site within the city. The implication of an appropriate dumping has been clogging of the drainage system and subsequently flooding of the bigger part of the two study areas on yearly basis (Mvula, 2018). Flooding further results into outbreak of water borne diseases which may endanger the lives of the residences.

Given all these problems caused by the aforementioned an appropriate dumping of MSW, limited studies have been conducted to curb this problem. Most studies conducted in Zambia did not consider how MSWM link with floods. Thus, the level of knowledge on the link between MSWM and floods remains unknown. In older to fill this research gap, this study therefore sought to

establish the link between the indiscriminate disposal of municipal solid waste and urban flooding in Kalikiliki and Kanyama Ward 10 settlements.

1.3. Aim of the Study

The aim of the study was to establish how the indiscriminate disposal of municipal solid waste contributes to urban flooding in Kalikiliki and Kanyama Ward 10 settlements.

1.4. Specific Objectives

The objectives of the study were as follows:

i. To identify the types of solid waste produced by the residents in Kalikiliki and Kanyama Ward 10 settlements.

ii. To investigate how solid waste is disposed of by households.

iii. To describe challenges faced by residents in the two study areas in disposing off solid waste.

iv. To establish the link between household disposal of waste and flooding in Kalikiliki and Kanyama Ward 10 settlements.

1.5. Research Questions

i. What types of solid waste are produced by residents in Kalikiliki and Kanyama Ward 10 settlements?
ii. How do households in Kalikiliki and Kanyama Ward 10 dispose of their waste?
iii. What challenges do the residents of Kalikiliki and Kanyama Ward 10 settlements face in disposing of solid waste?
iv. Do the methods used by household to disposal of waste contribute to flooding in Kalikiliki and Kanyama Ward 10 settlements?

1.6. Significance of the Study

The significance of the study is that with the need and recent trends in the demand for the useful information as regards MSWM and floods, this research comes as an information pack in order to understand the contributions of MSWM practices to increased flood events and will be of benefit to the local councils in Zambia, the general public, researchers and policy makers who may wish

to carry out more research and interventions on the same problem. Government at all levels through their various ministries can also use the findings for development programs especially those who deal with environmental management and disasters management as the problems of waste generation and management roots itself to everybody.

1.7 Theoretical framework

A theory is a set of interrelated concepts, definitions, and propositions that explains or predicts events or situations by specifying relations among variables (Casanave and Li (2015)). It provides a way of thinking and analyzing the world in systematic ways as it helps to describe, explain, and predict real world events (O'Neil, 2009). Based on this theoretical definition and its importance, the researcher applied Ajzen's Theory of planned behavior (TPB) (1991). The theory states that attitude toward behavior, subjective norms, and perceived behavioral control, together shape an individual's behavioral intentions and behavior (Ajzen, 1991).

Consequently, the theory was applied on solid waste management to determine why the residents of Kalikiliki and Kanyama Ward 10 behave the way they do towards sustainable solid waste management, what influences their intention and attitude towards solid waste management. The "best predictor of behaviour is intention" (Ajzen, Theory of Planned Behaviour, 1991). This specifically refers to behavioural intention, or the "cognitive indication of the readiness of an individual to perform a specific behaviour" (Ajzen, Theory of Planned Behaviour, 1991), meaning that an individual's response to an act is dependent on the behavioural intention formed or developed. The goal is to ascertain the validity of this theory in the context of poor waste management system in Kalikiliki and Kanyma Ward 10 settlements.

Further, Azjen's Theory of Planned Behaviour (TPB) seeks to cover the individual's attitude, or individual opinion, on a specific behaviour. It largely reflects the individual's personal attitudes, or their perception on the extent on whether an act is good or bad, positive or negative, favourable or not. In reference to current study, indiscriminate disposal of solid waste is a bad act as this has a lot of negative consequences such as blockage of drainage systems which may cause flooding and the outbreak of diseases among others. However, to change people's behavior towards solid waste management, it was important to understand what determines their actions and decisions towards such act (Klockner, 2013) hence suitability of this theory.

1.8 Delimitation of the study

The study was restricted to two settlements of Lusaka District Zambia. The settlements were selected due to frequent flood occurrences.

1.9 Limitations of the study

Time frame to complete the study was not adequate. The other limitation was that majority of the males in the two study settlements whose information would have enriched the study were not available to answer the research questions.

1.10. Organization of the Study

This dissertation is divided into six (6) chapters. Chapter one introduces the research and gives the background as well as the nature and scope of the study, the problem statement, research objectives and questions and Significance of the study. Chapter two presents the review of relevant literature. Chapter three discusses the description of the study site/area. Chapter four presents the research method and approaches employed in data collection, research design and analysis of research findings. Chapter five provides findings and discussion. Literature in support and at variance is quoted. Chapter six highlights the conclusion and gives recommendations based on the research findings.

CHAPTER TWO: LITERATURE REVIEW

2.1. Introduction

This chapter presents review of empirical and theoretical literature available on the management of solid waste and floods around the globe. The review of literature mainly focuses on the concept of municipal solid waste, global waste generation, global problems of waste and global waste compositions. Further, literature on Management of municipal solid waste, municipal solid management challenges, urban waste and flood risk, solid waste management in Zambia and historical perspectives of flooding in kalikiliki and Kanyama is reviewed.

2.2. The Concept of Municipal Solid Waste

Waste is any solid or semi-solid material which have been discarded by its primary owner or original user, and may or may not be found useful by any other person but constitute a nuisance to people when left untreated (Kathravale and Mohd Yunus, 2008). Municipal solid waste (MSW) could be explained to mean left overs, used products having no economic value or demand and which must be disposed or thrown away (Oluwande, 2002, Barttone, 2000, Buckle and Smith, 2000). The standard definition of waste is static, MSW is any unwanted or discarded material that is not liquid or gas (Miller, 1997). Solid waste according to LCC (2004) is the unwanted or useless solid waste materials generated from combined residential, industrial and commercial activities in the given area.

Reed (2002) defines MSW as the waste arising from human and animal activities that are normally solid and that are discarded as useless or un-wanted. DEFRA (2012) defines "waste" as "any substance or object which the holder discards or intends or is required to discard. MSW, commonly known as trash or garbage in the United States and as refuse or rubbish in Britain, is a waste type consisting of everyday items that are discarded by the public (Mazzanti and Zoboli, 2008). MSWM is the collective process of sorting, storage, collection, transportation, processing, resources recovery, recycling and disposal of waste in urban areas (Abila and Kantola, 2013; Ogwueleka, 2009).

In reference to the foregoing discussion about the concept Municipal solid waste, evidence shows that waste management is a large and growing problem especially for countries in the developing

world and is often a neglected aspect of urban management and this has result into impact of urban flooding by blocking drainage, increasing debris and harbouring disease vectors (Mvula, 2018).

A study by Lamond and Bhattacharya-Mis (2012) on the role of solid waste management as a response to urban flood risk in developing countries confirm that solid waste management is an emerging issue in flood risk management practice. Approaches to improve waste management included large municipal programmes and locally based community schemes. It was seen to be important that the management of waste is adopted as part of a wide integrated flood management programme. The researcher demonstrated that waste management can be an effective response to flood risk but, in order to remain successful, it requires that sufficient commitment and engagement can be mobilized in the long term. This study is imperative to the current study due to its alignment to waste management and flood risk as these are the key issues that the present study is considering. However, the existing gap is that the former researcher did not take a holistic approach to include the challenges faced by municipal in solid waste management as a response to prevention of flood occurrences in unplanned urban settlements like kalikiliki and Kanyama ward 10 of Lusaka district.

Further observation in the area of waste management was made by Troschinetz and Mihelcic (2009) who opined that many countries have humans who lack good sanitations as a result poor management of wastes, where wastes are dumped in queries and abandoned sites, risking the health of the people living near or close to these sites. The wetlands and low lying lands near forests form majority of the dumping site locations in many nations as Global solid waste management report, 2012 indicates. In developing states, these sites are not protected from human access because they are left open, unfenced increasing the risk of human exposure to environmental and public health disease (Oyake, 2016).

2.3. Global Waste Generation

Waste generation is the most important aspect to look at in order to have effective MSWM system. The generation of waste varies considerably between countries based on the culture, public awareness and management (Hazra and Goel, 2009; Muñoz-Cadena *et al.*, 2009; Wagner and Arnold, 2008; Magrinho *et al*., 2006). Waste generation rates ranged from 0.66kg/cap/d in urban areas to 0.44kg/cap/d in rural areas of developing countries as opposed to 0.7-1.8kg/cap/day in

developed countries (Miezah, et al., 2015). Developed countries tend to generate greater quantities of waste compared to developing countries and rural areas (Kathiravale and Mohd Yunus, 2008). Countries in Asian and African region produce waste in the range of 0.21-0.37 tons/ capita/ year, while European countries generate higher amount of waste with 0.38-0.64 tons/ capita/ year (Intergovernmental Panel on Climate Change (IPCC), 2006; USAID, 2006; Hoornweg, and Thomas, 1999).

In Asia, countries with higher Gross Domestic Products (GDP), namely Hong Kong and Japan were reported to generate more waste compared to developing countries such as India, Vietnam and Nepal (Shekdar, 2009). In Latin America the range is said to be 0.5-1.0 kilograms/day per person (USAID, 2006). Hoornweg and Bhada-Tata (2012) explains that, ten years ago there were 2.9 billion urban residents who generated about 0.64 kg of MSW per person per day (0.68 billion tons per year). This report estimates that these amounts have increased to about 3 billion residents generating 1.2 kg per person per day (1.3 billion tons per year). By 2025 this will likely increase to 4.3 billion urban residents generating about 1.42 kg/capita/day of municipal solid waste (2.2 billion tons per year).

UN-HABITAT (2010a) stated that urban population now exceeds those residing in rural areas across the globe. Urban residents produce about twice as much waste as their rural counterparts (World Bank, 2012). This contrast in waste volumes could be attributed to differences in socio-economic status and socio-cultural attitude towards MSWM. Increased waste generation in industrialized countries could be connected to higher income level, high rate of urbanization and population (Gu *et al*., 2017). MSW generation is influenced by the level of economic development, population demographics, industrialization, public habits and changing life styles and popularity of fast foods and disposable utensils (Hoornweg, 2000 and Aribisala *et al*., 2004).

Petts and Edulijee (1994) agreed that the state of the economy influences waste generation. World Bank (2012) attributed the highest per capita rates of wastes produced in Latin America and the Caribbean to the tourism industry and a complete accounting of all wastes generated. World Bank (2012) estimated that 1.3 billion tons of waste are produced each year which is expected to increase to approximately 2.2 billion tons per year by 2025. The proportion of Africa's population living in urban areas increased from 24% in 1970 to 40% in 2010, and is expected to reach 50% by 2030

(UN-HABITAT 2010a and 2010b). Sub-Saharan Africa (SSA) generates an estimated 62 million tons of waste per year (World Bank, 2012).

2.4. The Global Problem of Waste

The caring for and management of global waste is a global concern as the population grows, and places where waste is deposited become a problem and a potential hazard. As the human population grows, so does consumption, and this consumption produces large amounts of waste. In view of this, it was estimated in the 2012 report of Global waste management that by 2025, the cities and urban centres in the world will generate over 2.8 billion tons of waste which is more than twice the current amount of 1.3 billion tones especially in low income generating nations. In addition, Oyake, (2016) reported that more than 260,000,000 tons of plastics are produced every year globally, which accounts for almost 8 % of oil production in the world. The same report indicated that almost 1 trillion plastic bags are manufactured and utilized in one year globally. This validates the importance of the use of plastic materials above all others by packaging sector.

Kumar and Mishra (2017) associated the solid waste management to Urbanization and industrialization. They argued that Urbanization and industrialization have led to new lifestyles and behavior which also affects waste composition from mainly organic to synthetic material that last longer such as plastics and other packaging material. MSW of most human households affects how we live and affect the environment. It brings about blockages of drainages which may lead to floods, the pollution of the environment as well as air and the outbreak of diseases such as typhoid and cholera.

Further observation was made by Laurent *et al* (2017) who argued that an increase in population is not matched with an equal increase in revenue for the local municipalities for MSWM. Besides this, rapid urbanization means rapid growth of unplanned settlements that add to the waste, health, and hygiene problems .The global problem of waste is the tons of plastics found everywhere even in oceans which is threatening marine life. It can be deduced from the theoretical and empirical evidence that MSW has diverse effects to human and animal survive. It was for this reason that the researcher conducted a study in Kalikilikiliki and Knayama ward 10 to quickly find solutions to the common problems that are threat to human life.

2.5. Global Waste Composition

Knowledge of waste composition is important in order to implement the most appropriate treatment and disposal process (McDougal *et al*., 2001). Composition of waste affects the collection, storage, and transportation of waste. Waste generated in developing cities are heavier, wetter and more corrosive than those from developed cities (Ogwueleka, 2009). This could inhibit the effectiveness of compaction vehicles used for collection and transfer of waste. Wastes generated in developing countries have high organic content (more than 50%) and a low energy value (3,350–4,200 kJ per kg) (CPHEEO, 2000) and fewer recyclable items (Idris *et al*., 2004). The USA (65%) and Western Europe (48%) generate higher quantities of paper and plastics compared to those from developing countries (IGES, 2001). The largest generator of waste in the United Kingdom in 2004 was from the construction and demolition industry (32%) (Fischer *et al*., 2011).

China is responsible for 70% of 270 million tons of waste generated each year in East Asia and the Pacific Region, and overtook the United States of America in 2004 as the world's largest waste generator (World Bank, 2012). World Bank (2012) estimates that in 2030, China will likely produce twice as much MSW as the USA. These estimates of increased waste generation in China could be connected to higher income level, high rate of urbanization and population. These statistics show that growth in urban areas is in tandem with the increase in population and waste generation. It is evident that there is unsustainable population growth in urban areas in most developing countries which has led to increased levels of waste production. The type and quality of waste generated differs significantly between countries and within urban areas (Monoz-Cadena *et al*., 2009).

2.6. Management of Municipal Solid Waste

MSWM is the collective process involving the purposeful and systematic control of the generation, collection, transportation, storage, sorting, recycling, resources recovery and disposal of waste in urban areas (Abila and Kantola, 2013; Ogwueleka, 2009). The primary aim of MSWM is the delivery of an efficient, cost-effective service, which protects public health and well-being of people and the environment (Mazzanti & Zoboli, 2008). MSWM is the one thing every city government should provide for its residents but is a major problem in most developing countries

(Parrot *et al.,* 2009). Both the public and private enterprises are stretched to capacity if they are to sustainably manage the large quantities of waste produced by residents. As such, while developed countries have systems and strategies to deal with the urban waste dilemma, of course with struggle due to ungraded large quantities of wastes, developing countries like Zambia have not yet formed similar systems and strategies due to an increased urban population, socio-eco-political development status and spatial needs.

Another study conducted by Choi (2016) on environmental effectiveness of solid waste management established that due to the Pollution Control Act, there is no governing agency to control industrial waste which makes up a significant amount of the total waste generated in Oslo, Norway. It was also revealed that the current solid waste management depends greatly on energy recovery and recycling, which are two feasible methods in the given context. Thein the similar instance, the researcher observed that reuse and waste prevention are regarded as more desirable methods in preventing negative impacts to the environment from an environmental perspective.

The differences in managing solid waste not only vary between countries but also among areas in the same country. The conditions, issues and problems of MSWM in the industrialized and developing worlds are different. Though the developed countries generate larger amounts of wastes, they have developed adequate facilities, competent government institutions and bureaucracies to manage their wastes (Abdellah and Balla, 2013). Abdellah and Balla, (2013) have shown that, proper management of solid waste reduces or eliminates adverse impacts on the environment and human health and supports economic development and improved quality of life. MSWM has emerged as a dominant urban environmental issue that has attracted academic, economic and media debates, and has over the years developed into an independent discipline (Manyanhaire *et al*., 2009).

MSWM in Malaysia can be attributed to the description of the main types of collection systems in Table 1, a description of how each type works, the advantages and disadvantages of each work is explained.

Table 1: Descriptions of the Main Types of Collection Systems.

System	Description	Advantages	Disadvantages
Dump at designated location	Residents and other generators are required to dump their Waste at specified location or in a masonry enclosure	Low capital costs	Loading the Waste in to trucks is slow and unhygienic. Waste is scattered around the collection point. Adjacent residents and shopkeepers protest about the smell and appearance.
Shared containers	Residents and other generators put their Waste inside a container which is emptied or removed	Low operating costs	If containers are not maintained, they quickly erode or are damaged. Adjacent residents complain and shopkeepers protest about the smell and appearance.
Block collection	Collectors sound horn and waits at specified locations for residents to bring waste to the collection vehicle.	Economical. Less Waste on streets. No permanent container or storage to cause complaints	If all family members are out when collectors come, Waste must be left outside for collection. It may be scattered by wind, animals and Waste pickers.
Curbside collection	Waste is left outside property in a container and picked up by passing vehicle.	Convenient. No permanent public storage	Waste that is left out may be scattered by wind, animals or Waste pickers. If collection service is delayed, Waste may not be collected or sometime causing considerable nuisance.
Yard collection	Collection laborers enters property to remove waste	Very convenient for residents No Waste in streets	The most expensive system because of walking involved. Cultural beliefs, security considerations or architectural styles may prevent laborers from entering properties

Source: Agamuthu et al., (2004.)

2.7. Municipal Solid Waste Management Challenges

According to the research done by Kimario (2014) shows that some of the challenges faced by the local authorities in implementing effective strategies for solid waste management includes taxpayer unwillingness to pay tax, political interference, outsourced revenue retained by agents, and Loyalty challenge. The researcher recommended that the central government to take a leading role in monitoring the returns to the public by creating public awareness and education the importance of paying taxes for their own benefits. This study is relevant to the current study in that it points out the challenges that the local authorities are facing in managing solid waste.

However, the point of departure with this study is that the former focused much on the challenges faced by the local authorities to implement their strategies on solid waste management as opposed to the latter who focused on the link between solid waste management and flooding in the city of Lusaka.

More empirical evidence shows that solid waste management has become an enormous challenge for Governments and institutions charged with the responsibility of MSWM because of its substantial cost, lack of awareness and participation of people and businesses, limited resources in terms of money, skilled manpower and logistics make it very difficult to handle the bulk volume of solid waste being generated (Addellah & Balla, 2013).In addition, Pokhrel and Virara ghavan (2005) shows that only a fraction of this MSW is collected and disposed of at designated sites. The remaining uncollected MSW is left on the streets, roadsides and drainages resulting in to several outbreaks of cholera and other diseases associated with improperly disposed of MSW. The implementation given here is that these challenges are man caused challenges hence they should be adequately addressed by the man himself through the right channel.

Solid waste management has become a growing area of concern due to the adverse effects it has on human life. Pointing to the challenges of solid waste management, a study by Ampofu *et al*, (2015) revealed that the challenges to waste management is as a result of inadequate number of dustbins, poor attitude to waste management by residents, lack of logistics (contemporary waste collection equipment's and tools), limited number of personnel, lack of education, delay in waste collection and inability to pay for waste collection. Collection, transportation, and disposal of MSW demonstrates a huge expense for developing countries cities, management of waste generally accounts for 30 to 50 percent of municipal operational budgets. Despite these high

expenditures, cities collect just 50 to 80 percent of the refuse produced. For instance, in India as a developing country about 50 percent of refuse produced is collected. Disposal receives less attention, as much as 90 percent of the MSW collected in developing cities ends up in an open dump (Cointreau, 2008; Medina, 1997a). Davi (2007), explains that this is exhibited by the presence of piles of uncollected waste in the Central Business District (CBD) and surrounding commercial areas within the cities.

In view of the challenges to solid waste management, Yunus and Kadir (2003) opined that most of the landfill sites used for MSW open dumping areas pose serious environmental and social threats. In view of these challenges, it is suggested that in order to arrest this problem, solid waste reuse and recycle can be applied before collection, at the point of collection and during disposal.

2.7.1. Solid Waste Disposal

Information on waste generation is important to determine the most suitable waste disposal options for each particular country or city. Improper waste disposal may cause pollution which is a threat to human and other living organisms (Morra *et al*., 2009; Liu and Morton, 1998). It may also damage the ecosystem and disrupt the natural cycle and climate on earth (Raga *et al*., 2001). Solid Waste disposal problems are not confined to the developing world (Asmawati et al., 2012) but they are more acutely felt in emerging economies where rapid growth in urban populations are likely to result in massive increases in the demand for waste disposal and the break down, due to overloading of existing functioning systems (Asmawati et al., 2012). Economics and environmental aspects of waste disposal options are many that can suit the nature of waste and a country's preference and type of technology (Aye and Widjaya, 2006). Developed Asian countries like South Korea are on their way to eliminate land-filling and adopt incineration as their waste disposal option due to scarcity of land (Agamuthu & Fauziah, 2010; Shekdar, 2009; Bai & Sutanto, 2002)

Despite the development of many waste disposal options, landfills remain the most prominent system applied worldwide (Shekdar, 2009; Hamer, 2003). Although a lot of improvement has been possible in the land-filling system and the regulation on the type of waste that can be treated at landfill is stringent, most of landfills operated remain primitive (Hamer, 2003). Ayomoh *et al*., (2008) lists few problems related to improper landfill operation including, health deterioration,

accidents, flood occurrences, pollution of surface and underground waters, unpleasant odor, pest infestation and gas explosion.

Incineration has been the choice for developed countries as they have sufficient financial input and are looking into energy recovery from waste (Papageorgiou *et al*., 2009; Kleiss and Imura, 2006). Even that, incineration is also associated with some other risks including the generation of carcinogenic and toxic compound. It also produces end products which need further treatment where it is highly toxic, collectively known as dioxin (Hamer, 2003). Morselli *et al*., (2008) and Hamer, (2003) reported that the impacts from incineration are over-emphasized and the advancing technology had highly reduced the environmental impacts. However, many of the countries prefer waste minimization compared to waste treatment such as landfill or incineration (Bai and Sutanto, 2002; Boyle, 2000). Technology is advancing every day and chemical recycling of plastic waste has also been made possible in these developed countries (Al-Salem *et al*., 2009). Regardless of the technology chosen, each has its pros and cons.

Solid waste disposal is one of the issues of concern in many developing countries (Idris *et al*., 2004). Currently, land-filling is the only method used for solid waste disposal in most developing countries including Zambia (Agamuthu and Fauziah, 2010; Latifah *et al*., 2009). Problems from landfills include odor, insufficient covering material, flies and other vermin infestations and smoke from open fires (Idris *et al*., 2004). The increasing amount of waste received by these landfill makes it necessary to find other disposal options since constructing new landfills may be difficult due to the scarcity of land, increase of land price and demand for better disposal systems (Latifah *et al*., 2009). Disposal and collection capacity also varies, for instance in cities like La-Paz, and Brasilia the total collection of solid waste is up to 90% on the other hand in Santiago the total collection is less than 57% (USAID, 2006). In Kumasi, Ghana, 40% of waste is said to end up in unauthorized garbage dumps and often the river (Appiah, 2012). From the Zambian perspective, ECZ (2018) observed that waste collection from the residential areas to the official dump site is a challenge due to financial, transport and equipment problems

2.7.2. Collection and Transportation of Waste to the Dump Site

Collection of waste from where it is generated or stored is one of the priority areas in the current MSWM system. Abdellah and Balla (2013) states that in order to maintain the quality of urban

life, MSW should be collected, transported and disposed of efficiently. However, as a complex undertaking, large workforce and fleets of reliable coordination are required. Waste collection should be done according to license conditions, using the right mode of transport and proper methods of collection (Moghadam *et al*., 2009).

In view of waste collection and management, Adogu *et al*. (2015) conducted a study in Owerri municipal Imo state residents in Nigeria and found 90% of the respondents on the questionnaire were aware of the waste management with 97.55% showing a positive attitude toward managing wastes and protection of the environmental health. Further, the results showed a 97.1 % of the household wastes comprising of food residues as well as 95.4% being vegetable wastes. Open dumping 66.3% of the sampled population, and burning 62.4% of the population practiced it forms the two poor waste management approaches illustrated in the study. Wheel barrow transportation stood out as the most famous means of waste transportation to the dumping site. This study is vital to the current study in the sense that it gives a narrative on the practices and attitudes of citizens of Nigeria towards waste management. In spite of this study, it was not yet clear if there was a link between waste management and floods as the previous researcher was very much concerned with the waste management and its impact on heath.

Further evidence on waste management practices was given in a study conducted by Eneji *et al.* (2016) on waste disposal and waste management. The study hypotheses tested at 0.05 level of significance. The implication of the results is that the residents of Calabar South have very negative attitude towards waste management and disposal, while the second hypothesis tested also showed a significant influence of indiscriminate disposal of waste and the health status of the residents of Calabar South Local Government Area. The study concluded that because of the negative attitude the residents of Calabar South have towards the management and disposal of their waste, it has some significant influence on their health status. This study is also important to the current study in the sense that it gives some insights on the attitudes of residences on waste management which is part of this current study. However, the point of departure is that the former focused more on attitudes towards waste management in relations to health while the latter focused on MSWM and flood risks

In reference to waste management, some proposals have been given. Alagoz and Kocasoy, (2008) envisaged that waste collection will improve through encouraging local authorities to involve

private sector-participation, mobilize, and coordinate financial resources for infrastructure development or by-laws that will obligate householders to pay for collection services is critical. This statement suggests that investment in expanding the collection capacity must be accompanied by corresponding investment in the transportation of waste to safe disposal facilities

2.7.3. Waste Reduction, Reuse/Recycle

Methods of waste reduction, waste reuse and recycling are the preferred options when managing domestic waste as they are both methods of waste prevention and protects the environment from flooding (Moh and Lafidah Abd, 2014). Waste prevention help reduce cost of handling, treatment and disposal, ultimately reducing Solid Waste impact on the Environment and landfill space (Kumar and Mishra, 2017; Hashimi, 2007).

Recycling is the process of converting waste products into new products and reduce volume of landfills, reduce air prolusion from incineration and water pollution from landfilling and preserve natural resources for future use (Geissdoerfer *et al*, 2017). In Malaysia, plastics are probably the most common recyclable materials with high potential for recycling (Moh, and Latifah Abd, 2014). Wan *et al*., (2012) state that, recycling could reduce the burden of processing disposed wastes and support the economy as recycling provides wide spread profitable business ventures opportunities (Moh, and Latifah Abd, 2014). In order to enhance and promote recycling, (ECZ, 2004; Scheinberg, 2011) suggested separation at source and introducing incentives for the promotion of waste sorting. In addition, there is need to generate a database of recyclable products.

2.7.4. Waste Management: Global North.

Reuse is a form of waste reduction that extends resource supplies. It keeps high-quality matter resources from being reduced to low matter-quality waste. Two examples for reuse are refillable glass beverage bottles and refillable soft drink bottles made of polyethylene terephthalate (PET) plastics. Denmark led the way by banning all beverage containers that cannot be reused. In Finland, 95% of the soft drink, beer, wine and spirit containers are refillable, and in Germany, 73% are refillable (Miller, 2003). Unlike recyclable cans and bottles, refillable beverage bottles create local jobs related to their collection and refilling.

Recycling is another waste management strategy in developed countries. Recycling is probably the most ideal way of managing waste, but it can be costly and difficult to implement. Recycling aims at environmental sustainability by substituting raw material inputs into and redirecting waste outputs out of the economic system (Geissdoerfer *et al*, 2017). There are numerous products that can be recycled instead of thrown away including aluminum and steel cans, glass bottles, paper, and scrap metal. In 1999, about 28% of United States' MSW was recycled or composted. The US has more than 8,800 municipal curb side recycling programs serving 51% of the population. One advantage of recycling and composting is that they are land serving and pollution reducing strategies (Miller, 2003). One of the best ways to encourage recycling is collection of sorted out materials for free. In Australia, for instance the recycling rate is high and is increasing, with 99% of households reporting that they had recycled or reused some of their waste within the year 2002, up from 85% in 1992 (Miller, 2003). Recycling can save money and resources as well as keep the environment cleaner (Lienig and Bruemmer, 2017).

Another method of MSWM used in developed countries is composting. Composting is an easy and natural bio-degradation process that takes organic wastes which are remains of plants, garden and kitchen waste and turns into a humus-like material, known as compost, which is a good fertilizer for plants and rich food for the plants (Adewale and Taiwo, 2011). Composting could be seen as best sustainable option that would reduce waste volume. On the other hand, it is slow process and takes lot of space. Incineration is a controversial method of waste disposal and is common in countries such as Japan where land is scarcer, as these facilities generally do not require as much land as landfills. Incineration in the United States, about 16% of the mixed trash in MSW is combusted in about 170 mass-burn incinerators (Miller, 2003). On the other hand, this method produces heat that can be used as energy.

Landfill disposing of waste involves burying waste (He *et al*., 1992) and this remains a common practice in most countries. In a sanitary landfill, solid waste is spread out in thin layers, compacted and covered daily with a fresh layer of clay or plastic foam. About 54% by weight of the MSW in the US is buried in sanitary landfills compared to 90% in the UK, 80% in Canada, 15% in Japan, and 12% in Switzerland (Miller, 2003).

2.7.5. Waste Management: Global South.

Managing solid waste is one of the costliest urban services of municipal revenues in developing countries (Coffey and Coad 2010). In this regard, Zambia is not an exception. Lamond *et al*., (2012); Chikuemeka, (2012); Cad, (2011); Al-Khatib, *et al*., (2007) argue that most capital cities in developing world continue to grapple with MSWM services to their constantly growing populations. It is usually regarded that MSWM is the solitary task and responsibility of local authorities in nearly all developing countries, and that the public is not assumed to participate (Coad, 2011; Sam, 2009). A lot of MSW is however, uncollected due to municipalities' financial and administrative capacity constraints and unwillingness of the users to pay for the service have hampered the delivery of proper MSWM services (Sharholy *et al.*, 2007; Sujauddin *et al*., 2008).

The involvement of the private sector has been seen as the one way in the improved delivery of public services (Hampwaye, 2005; sharholy *et al*. 2008). Coad, (2011) also states that more rigid environmental standards and increased costs often make private involvement the only solution available for governments. Ekere *et al*., (2009) suggested that. The operational efficiency of MSWM relies on the active contribution of both the municipal agency and the residents. Hence, socio-cultural aspects include people participating in decision making, community awareness and societal apathy for participating in solutions (Sharholy *et al*., 2008; Moghadam *et al*., 2009). The public private partnership (PPP) enhances community participation in planning and operation, protecting users' rights and even considers community groups as contractors in the delivery of infrastructure and services. Hampwaye (2005) highlights a number of success stories concerning PPPs in the delivery of solid waste, such as the increased amount of solid waste collected in Kuala Lumpur by 2.8 tons more per vehicle per day.

Sujauddin *et al*., (2008) explain that poor MSWM exhibited by the presence of piles of uncollected waste in the Central Business District (CBD), surrounding commercial areas within the cities and along the roadsides leads to flooding as the uncollected waste block the drainages for running water to continue moving. It is for this reason that Coad, (2011) argues that waste collection and disposal in developing countries has been left to individuals or communities. Coad, (2011) further observed that less than 50% of solid waste is collected and the common land disposal method is the open dumping. Hazra and Goel, (2009) proposes that the lack of technical skills amongst personnel within municipalities and government authorities and inadequate infrastructure for

MSWM presents a challenge to flood risk management (Lamond *et al*., 2012; Babayemi and Dauda, 2009; and Onwughara *et al*., 2010). Furthermore, it is concluded that the data existing is so marginal from the public domain (Chung and Lo, 2008). Poor roads and out of date vehicles, inadequate technologies and reliable information and data respectively are the factors influencing MSWM in developing countries (Moghadam *et al*., 2009; Mrayyan and Hamdi, 2006; Matete and Trois 2008; Asase *et al*., 2009). Therefore, it is extremely tough to achieve a vision into the complicated problem of MSWM (Seng *et al*., 2010). In addition, waste workers are connected to low social status (Coad, 2011) a situation which gives as a consequence of low passion amongst the solid waste employees. Politicians give low preference to MSWM compared to other activities that belong to municipalities (Moghadam *et al*., 2009) with the final result of limited trained and skillful personnel in municipalities (Sharholy *et al*., 2008). In this study lessons about waste management practices were drawn from major municipalities in some developing countries how waste is managed. Among them were Mumbai, Bamako and Maputo.

2.7.5.1. Case of Mumbai

India is the second largest nation in the world, with a population of 1.39 billion (census 2021), accounting for nearly 18 percent of world's human population. To this effect, Central Pollution Control Board (CPCB) 2016 Report shows that India produces 52 million tons of waste each year, or roughly 0.144 million tons per day, of which roughly 23 percent is processed- taken to landfills or disposed of using other technologies. This implies that India is facing a sharp contrast between its increasing urban population and available services and resources. Solid waste management is one such service where India has an enormous gap to fill due to magnitudes and density of increasing population.

A recent study by Kachan (2018) revealed that Proper municipal solid waste (MSW) disposal system to address increasing amount of waste is absent. Improper solid waste management deteriorates public health, causes environmental pollution, accelerates natural resources degradation, causes climate change, flooding and greatly impacts the quality of life of citizens.

Further evidence on the causes of flooding in Mumbai in India is subject to many sources of flood risk which includes increased impervious areas and loss of storage within the city. Drainage systems are in general inadequate and often blocked due to poor MSWM practices (Adelekan,

2011; Boadi, and Kuitunene, 2003). Poor storm water drainage is, nevertheless, a major contributory factor to the severity of regular monsoon flooding (Gupta, 2007). Indiscriminate dumping of MSW combined with storm water and municipal wastewater often clogs the drainage system resulting in coastal flooding and inundation during monsoon months (Murthy *et al*., 2001). Response to the 2005 flood the state put in place a ban on the sale and use of plastic bag (UN Habitat, 2010).

In some cities like Mumbai, Chennai, Delhi, Bangalore, Hyderabad, Ahmedabad etc., garbage disposal is done by Public Private Partnerships (PPPs). The private sector has been involved indoor-to-door collection of solid waste, street sweeping in a limited way, secondary storage and transportation and for treatment and disposal of waste. It is accounted that some private firms are carrying out Integrated Municipal Solid Waste Management (IMSWM) which includes collection, segregation & transportation, treatment, compost, refuse derived fuel, and final disposal (CPCB, 2016). Municipal agencies spend about 5-25% of their budget on MSWM. In spite of such a heavy expenditure, the present level of service in many urban areas is so low that there is a threat to public health in particular and to environmental quality in general.

Additionally, despite the above mentioned efforts in solid waste management, there are serious barriers to private sector participation in solid waste management due to the financial status of ULBs except for a minority. Urban sector is seen as a very high-risk sector and also because of institutional complexity due to multiplicity of agencies involved in service delivery. Further, there is lack of a regulatory or policy enabling framework for PPPs, barring few exceptions, and lack of bankable and financially sustainable projects considering the opportunities and risks involved (2016). The report about India on Solid waste management and flood risks reduction is imperative to this study in the sense that it gives hints on area of strength and weakness for the bodies tasked to provide services to the people in the community. However, the gap with the current study is that the population of India may not be equated to Zambia hence the population increase may not be the major factor causing flooding in Zambia, Kalikiliki and Kanyama ward 10 to be specific.

2.7.5.2. Case of Bamako

Congressional research service (2020) shows that Mali has been in crisis since for decades. Once seen as a democratic leader, Mali has become an epicenter of regional conflict and instability over

the past decade. Rebel, terrorist, communal, and criminal networks often overlap. Although relatively secure, Bamako has seen several terrorist attacks, including a 2015 assault at a hotel that killed 19 civilians (one of them American). These complex threats and security dynamics have impeded development and humanitarian relief for Mali, a poor and landlocked country with limited arable land.

It is accounted that in 1999 flash flooding throughout Bamako caused death and destruction and analysis showed that poor waste disposal and clogged drains were significant contributory factors of the flooding (Adelekan, 2011; Setchell, 2008). Consequently, a four-year project was aimed at improving the management of storm water and solid waste in one of the worst affected districts of the city. Among other things the project set up improved waste collection, eight collection routes, each served by a collection using tractor-trailers, with disposal at a nearby landfill. The scheme also created local employment for refuse collectors.

Literature also suggest that Stakeholder participation, combined with a comprehensive planning framework, was used for the first time in the city (Adelekan, 2011). This helped to build consensus and increase capacity within Non-Governmental Organizations and Community based organizations. Channel volume was restored and flood risk reduced and Bamako has not experienced a similar flood disaster since 1999, partly as a result of these measures (Setchell, 2008). However, the City of Bamako in general still faces big challenges in waste disposal as responsibility for funding activities is not clear and the final disposal sites are inadequate. The planned landfill site 30km outside the city has not yet been constructed (UN HABITAT, 2010). It is observed that the populations are not resilient and adaptive to the existing risk (Ahadzie, and Proverbs 2010) and the level of preparedness, recovery and response is very low.

The information about Mali on solid waste management is cardinal to the current study because it shows the challenges that the country is facing in undertaking such services. However, information about Zambia on solid waste disposal and strategies in instances of challenges faced by the Municipality to collect solid waste remains unknown hence this study.

2.7.5.3. Case of Maputo

Maputo, the capital of Mozambique, houses 45% of the total Mozambican urban population, 50% of which is considered to live below the poverty line (UN Habitat, 2007). During the 2000 flood

70 percent of flood deaths were in urban areas near Maputo, mainly in the cities of Xai-Xai and Chokwe (UN Habitat, 2007).

Efforts made to reduce flood risk in Maputo has been construction of improved drainage systems on the border of the Mafala district (Kruks, 2006). The introduction of a "garbage tax" to finance improvements in MSWM was administered. The government negotiated public service contracts that institutionalized the primary collection as a free-of-charge public service for all residents (Kruks, 2006).

In reference to waste management and flood risk in Maputo, Diouf and Fredericks (2014) also holds that the most common strategy for urban development and management has been the attempt to formalize the informal, including the development of formal systems of waste management in public–private partnerships. This initiative in Maputo has been combined with an innovative but ill-functioning system of community-based micro-enterprises for collection at the household level. In Addition, Jha *et al.*, (2011) holds that education that emphasizes on keeping drains free of waste is part of the flood risk mitigation efforts in Mozambique.Within the informal settlements MSWM is not provided by the municipal authority, centralisation has ensured that waste collection is concentrated in the city centre.

The narrative about Maputo is very important to the current study in the sense that it demonstrates what is trending on waste and strategies employed to mitigate it as a way of avoid flood risks and other negativities associated with poor management of waste in the informal settlements. However, information about Zambia, kalikiliki and Kanyama on the link between solid waste and flood was not well documented hence this study.

A typical MSWM system is shown in figure 1 in a low-income country that can be depicted by the elements of generation and storage of domestic waste. SANDEC/EAWAG in Zohoori and Ali (2017, 42) recommends Reuse and recycling on household level including composting, primary waste collection and transport to transfer station or community bin, the transfer station or community bin management. Secondary collection and transport to the waste disposal site and disposal of waste in landfills, recovering and recycling generally occur in all elements of the systems and it is broadly practiced by unofficial segment called waste pickers or by the MSWM staff for the added revenue. Beside, recovered and recycled commodities then enter a chain of dealers, or processing prior to be sold to manufacturing enterprises.

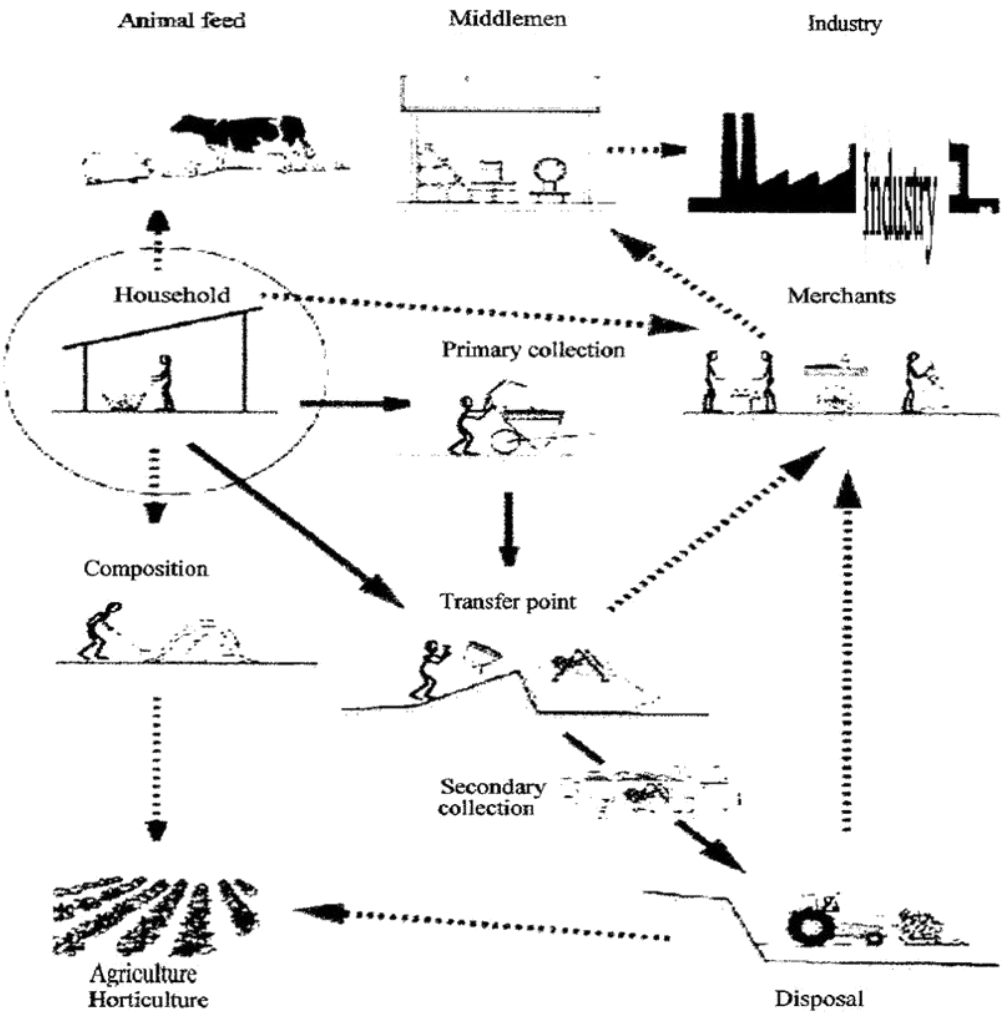

Figure 1: Typical Elements of a Solid Waste Management System in Low Income Countries

Source: SANDEC/EAWAG in Zohoori and Ali (2017, 42)

2.8. Solid Waste Management in Zambia

Management of solid waste is a problem in Zambia despite having the National Solid Waste Management Strategy (NSWMS) in place. The increasing amount of solid waste is almost everywhere in urban centres, in public places and along the roadsides. This implies that there is need for other strategies to be put in place such as environmental awareness and the need for community participation (Edema *et al.,* 2012). Much of the MSW is generated from residential

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A report by Auditor General, Republic of Zambia, (2007) on MSWM in Zambia revealed that over a million tons of MSW is generated each year in the various urban centers in Zambia. The report stated that the management of various types of waste has been a very difficult and challenging issue in Zambia. This difficulty has manifested itself in the perennial outbreak of diseases such as cholera and dysentery and loss of appealing beauty. Disposal sites in almost all the districts are either not there or they are poorly managed (EMA, 2019).

The Waste Management Regulations Statutory Instrument No. 71 of 1993 provides for the control of transportation of waste and management of waste disposal sites. All persons transporting waste or operating waste disposal sites including Local Authorities are required to obtain licenses and have to adhere to conditions and standards set by Environmental management Authority (EMA, 2011). The framework provided by NSWMS will improve significantly the provision of waste management services, through increased investment in equipment, infrastructure and capacity building (Sibanda, 2010). It is envisaged that various instruments, including bans, restrictions, and taxations was employed to deal with specific waste problems. In order to mitigate the non-collection of garbage the government launched a 'Keep Zambia Clean' campaign on 22nd June, 2007 as a short- term action plan, which also included the private sector, comprising collection and disposal of garbage. Longer term solutions were implemented in 2004 which involved cleaning up the city on a permanent basis.

Lessons were drawn from a research conducted by Chilinga (2014) in Livingstone who found out that MSWM in Livingstone was still a problem despite using a make Zambia clean campaign in the area to improve the situation. The study revealed that the campaign was viewed as being ineffective and so largely unsuccessful, as the local community members largely felt that they did not participate in decision making and implementation process of the programme. This is in line with what Roy & Singh, (2007) found.

Another study reviewed was that of Pasi (2012) who in her thesis discussed the impact of reducing central government grants on MSWM in Kabwe. The study revealed that the central government's decision to reduce grants to local authorities disabled them economically. Consequently, they had no means to manage the waste in their townships. Added to this was that in Kabwe waste was found all over public places due to central government's reduction in funding local authorities.

On the other hand, Edema *et al.,* (2012) in their works noted that there was inadequate MSWM facility in Ndola even though people were willing to pay for the service. The study revealed that lack of environmentally friendly, sustainable and affordable MSWM services which had led to wide spread open dumping and open burning of MSW. The waste management situation in the Copper Belt province mining towns is, however, well defined as compared to other towns in the country due to the presence of programmes driven by AHC-MMS (ECZ, 2004). The delivery of these services has been severely influenced by financial and administrative capacity constraints.

In Choma, the management of MSW is not well defined in that the council does not seem to have the adequate capacity to collect MSW from residential areas of Choma (Mwiinga, 2010). This is seen by the presence of piles of uncollected MSW in most parts of the town. A study by Mwiinga (2010) revealed that MSWM in Choma displays an array of problems. The problems revealed by the study can be categorized into financial and general institution constraints (Mwiinga, 2010).

2.8.1. Solid Waste Management in Lusaka City

Lusaka, the capital and largest city in Zambia is growing at a fast rate and the waste problem is also growing. MSW in Lusaka, particularly in unplanned settlements, has reached an alarming level. Heaps of garbage are seen in many places inside and around these settlements (LCC, 2011). In Lusaka city, about 292,000 tons per year of waste are generated; however, only about 8% of all waste generated is collected and even a small share is disposed of at the only official dump site,

the site at Chunga (LCC, 2016b). This meant that Lusaka residents produced 1 litre (0.3kg) of garbage per person per day and average density of 0.225 ton/m^3. The remaining uncollected waste accumulates in the streets and on vacant plots and is often burned in the open, thereby resulting in health hazards (Area under Disease Progress Curve (ADPC), 2010; LCC, 2003; Mensah and Larbi, 2005). Nchito, (2015) observes that municipalities often lack the skills and financial resources required to appropriately manage waste in urban areas. Residents of unplanned settlements lack public awareness and do not understand the dangers of MSW mismanagement (Roy & Singh, 2007; LCC, 2011).

2.9. Urban Waste and Flood Risk in Lusaka

Literature shows that flooding is one of the predicaments that have plagued many countries throughout the world (Tumaple, 2019). Consequently, Improvement of Municipal Solid Waste Management-(MSWM) has recently become one of the ways that is believed to help in reducing the impact of flooding. This shows that solid waste is highly linked to floods especially in the informal settlements.

Understanding the relationship between MSWM practices and flood risk is vital in order to evaluate the contributions of the practices to increased flood events. In view of MSWM and flood risk, Lusaka has the history of flooding because of its terrene but flooding has been exacerbated because of uncollected waste. The flooding areas like Kanyama, Kalikiliki, Johnlaing, Chawama, Misisi, and CBD, lack proper drainage systems and formal MSWM as well as general site service (Kabange, 2010; LCC, 2010; Chisola, 2012).

Further evidence shows that what has been contributing to flooding in Lusaka is to do with human related activities. Accumulation of debris and waste on the streets that is then washed into the drainage system can lead to surface and property flooding. Indiscriminate dumping of uncollected waste in the streets and in drains which mixes human and animal excreta contributes to flooding (LCC, 2015). Jha et al. (2012) opines that Blockages of urban drainage systems by waste increases frequency and severity of flood events. This suggest that some problems that human beings encounter in their lives are self-attracted hence the need to change the mindset in order to avoid such occurrence like flooding.

Contrary to solid waste management by both the local authority and residences, LCC, (2009) observed that ineffective urban planning and inefficiencies with MSWM mechanisms in the city, in the face of climate change events, is exacerbating the flooding problem. In this regards, LCC (2016) concluded that flooding situation in Lusaka city has become every down pour seasonal experience with less or clear institutional-community based preparations as prevention or mitigation measures. In support of the aforementioned narrative, Halley (2001) cited inadequate drainage facilities as the major cause of floods in Africa. Rise in flood risk is connected to the proportional increase of a catchment's impermeable surface area due to urbanization (Swan, 2010).

In reference to solid management and flood risk, Jha *et al*., (2012) established that floods have diverse effects on the lives of the people among them includes widespread devastation, economic damages and loss of human lives. This narrative suggest that urban flooding is a serious and growing development challenge especially in the developing world which needs agent attention. Floods have terrible economic consequences as they lead to the disruption of economic activities. For instance, when people are relocated they lose business opportunities (CPRS, 2011). Similarly, a study in Kenya by Nyakundu, (2009) indicated that some households reduce the quantity of food eaten or skip some meals, or borrow money and food in order to survive through the flood season. Loss of lives and property, loss of livelihood and hinders economic growth. In Kanyama the 2010 floods disrupted the economic activities that 25 percent (%) of the 78,995 Kanyama residents were involved (CSPR, 2011).

The environmental impacts of floods are associated to the contamination of ground water source (CSPR, 2011). The major cause of groundwater contamination is the interaction of ground and surface water; the contamination mostly comes from pits (Toilets). According to APFM, (2007) flooding incidences in poorly planned urban settlements which have poor sanitation cause an increase in coli levels in groundwater sources.

Similarly, the potential problems of floods where observed in Kenya by Nyakundu, (2009) who observed that environmental impacts of floods are undesirable as this causes the roads and bridges are damaged and disrupted, economic activities come to a standstill, resulting in dislocation and the dysfunction of normal life for a period much beyond the duration of the flooding. The cost of rehabilitation to damaged infrastructure, relocation of people and removal of property from

affected areas is too high. The high cost of relief and recovery may adversely impact investment in infrastructure and other development activities in the area.

2.10. History of Flooding for Kalikiliki and Kanyama Ward 10 Settlements

Kalikliki and Kanyama settlements experiences flooding almost every year, even in years with normal to below normal rainfall. The negative health and environmental impact of recurrent flooding continues until this very day (Chisola, 2012). The wettest years in the areas under investigation in the period from 1967 to 2017 were 1978, 1980, 1981, 1986, 1989, 2008, 2010, 2015 and 2017 (Figure2).

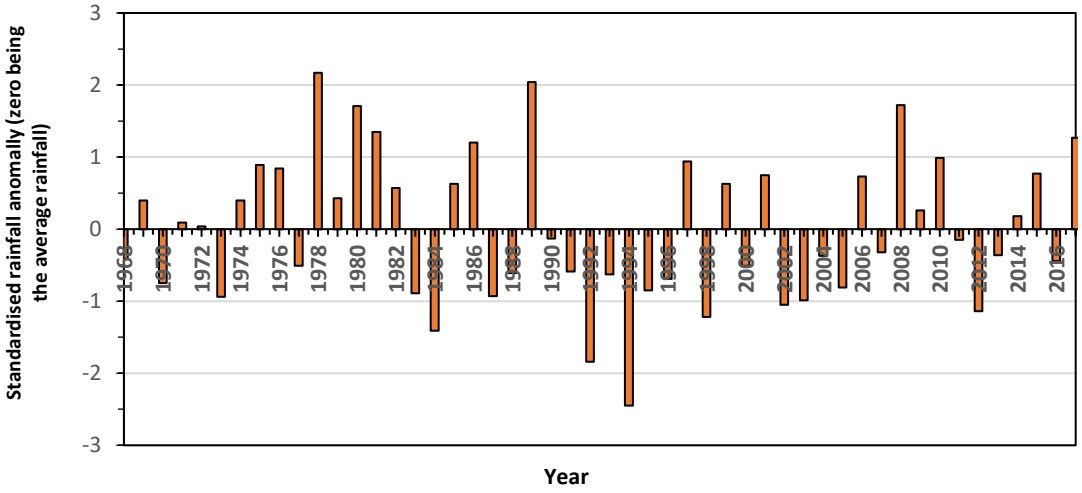

Figure 2: Flooding Timelines for Kalikiliki and Kayama Ward 10 Settlements, 1967-2017

Source: Field data, 2017

Chisola and Kuraz (2016) show that despite the general rainfall pattern giving a decreasing trend, the amount of runoff generated shows an upward trend. Kalikiliki and Kanyama Ward 10 floods of 1977/1978 rainy season left eleven people dead and thousands homeless (Baptist press, 1978; Mulwanda, 1992; Zimba, 2009). Floods hit the two settlements again in the 2008, destroying infrastructure, means of livelihoods and causing deaths resulting from cholera and malaria. There was disruption in the school calendar as some schools were closed for 3 months (UNOCHA, 2009; *Lusaka Times,* 2010). The 2010 floods had 200 families evacuated to the Independence stadium,

some people drowned and some children swept away by the heavy rains. Zambia Vulnerability Assessment Committee (ZVAC) Rapid Assessment Report (2010) in Chisola (2012: 16) shows that; 565 houses were completely damaged, 8,423 partially damaged and 27,219 houses were completely waterlogged. 2 clinics and 5 schools were flooded and most of the roads were partly damaged (Kabange, 2010; Daka, 2011; Chisola, 2012).

In spite of waste disposal highly linked to floods, the narrative was different in Nigeria. The study by Sulaiman and Mohammed (2019) assessed the substantive causes, effects and mitigation strategies of flood scenario in Yola South LGA, Adamawa state. The researcher established that heavy rainfall (18 %) and river over flows (17%) were the major factors that caused flooding in the area. It was also revealed that Sabon Pegi D/L and Modere (20 % and 17 %) were the utmost dominant flood prone areas due to their proximity to River Chochi. In terms of effects caused by the flood scenario in the area loss of properties was found to be more destructive conceived by 23 % of the respondents and 17 % of them revealed that farmlands were also damaged by flood.

With the above problems in mind, the researcher recommended that government should establish resettlement project scheme to relocate the affected people to safer terrain and to integrate effort towards construction and expansion of drainage system in the most flooded areas. Buildings should be ensured legally planned and constructed under intensive supervision of the agencies concern. Environmental problems and consciousness should be enlighten to the inhabitants by both state and federal ministries of environment.

Further suggestion on solid waste management and flood reduction has been given. Tumpale (2019) in his study on Repercussions of Improved Municipal Solid Waste Management on Flood Risk Reduction: The Case of Dar es Salaam, Tanzania recommended that improving solid waste collection could help overcome the problem of flooding particularly if integrated with other initiatives which include 1) Investment in robust flood control structures; 2) Adherence to Urban planning and disaster management policies which prohibit development in hazardous areas, and; 3) Initiate large scale flood risk reduction settlement schemes. Despite this information being relevant on solid waste management and flood prevent, these recommendations may not be applicable to Zambia hence this study to have empirical based strategy on how solid waste can be managed in mitigate flood problems especially in Kilikiliki and Kenyama settlements.

2.11 Knowledge gap

In spite of the reviewed literature being important in giving insights into the dynamics of MSWM in various cities around the globe and how different countries have handled the problem, it appears that studies about the link between MSWM and Floods reported in the literature from other countries Zambia inclusive have not considered how MSWM link with floods. Thus, the level of knowledge on the link between MSWM and floods remains unknown and this present study therefore intended to fill this research gap.

2.12. Chapter Summary

The purpose of this chapter of study was to get an understanding of what has been found by other researchers in Lusaka and other places after examining MSWM practices and investigated their contributions to increased flood events. After a critical review of available literature, it has been observed that there is a link between MSWM and flood risk. It has been indicated that both human activities and natural events contributes to flood risks. Literature has also shown that floods have diverse effects on human survival as this undermines smooth undertaking of economic activities, contaminating of ground water, destruction of public property and loss of both human and animal lives. It is for this view that there is need for more research to properly understand the narratives between MSWM and flood risk so as to help devise informed concerted efforts in preventing this problem.

CHAPTER THREE: DESCRIPTION OF THE STUDY AREAS

3.1. Introduction

This chapter presents the profile of the two settlements under study in terms of their physical and socio-economic characteristics such as location, landscape, population and demography. The two settlements were purposively selected as study sites since they are susceptible to recurrent flooding and they revealed trends which showed that the problem of flooding was persistent over the years. On the basis of the stated criteria Kanyama Ward 10 and Kalikiliki settlement were selected as appropriate cases as study settlements as part of a larger funded project called global SysTem for Analysis, Research & Training (START), through Global Environmental Change (GEC) Research in Africa (START_GEC) and the process of identification was done with stakeholders.

3.2. Location of the Study Areas

Lusaka city is located about 15° 25' S, 28°17' E of Zambia. It spans an approximate total surface area of 380 km^2 (UN-HABITAT, 2009). The city is built on predominantly flat terrain, which geologically comprises schist and quartzite dominated by thick sequences of marbles, in which differential dissolution has created a rugged terrain (Kabange, 2010; LCC, 2010; Chisola, 2012). Currently, the city hosts an estimated population of about 1,747,152 people (CSO, 2013) and more than 60% of the population lives in peri-urban settlements, some of which are considered illegal, the Lusaka City Council is not obliged to provide services to the informal or unplanned settlements (UN-HABITAT, 2009). Lusaka alone accounts for 33.3 percent of the country's urban population (CSO, 2014).

3.2.1. Location of Kalikiliki Settlement

Kalikiliki settlement (Figure 3) is located on the Eastern side of Lusaka approximately 20km from the Central Business District (CBD) of Lusaka City (LCC, 2009; Central Statistical Office, 2010). The settlement is bordered by Mtendere settlement originally a site-and-service housing scheme on the Western and the Natural Resources Development College (NRDC) on the northern side.

Kabulonga a low density area and Hilltop lay on the southern side and Ibex Hill originally a farming area on the Eastern part (UNZA, 2013).

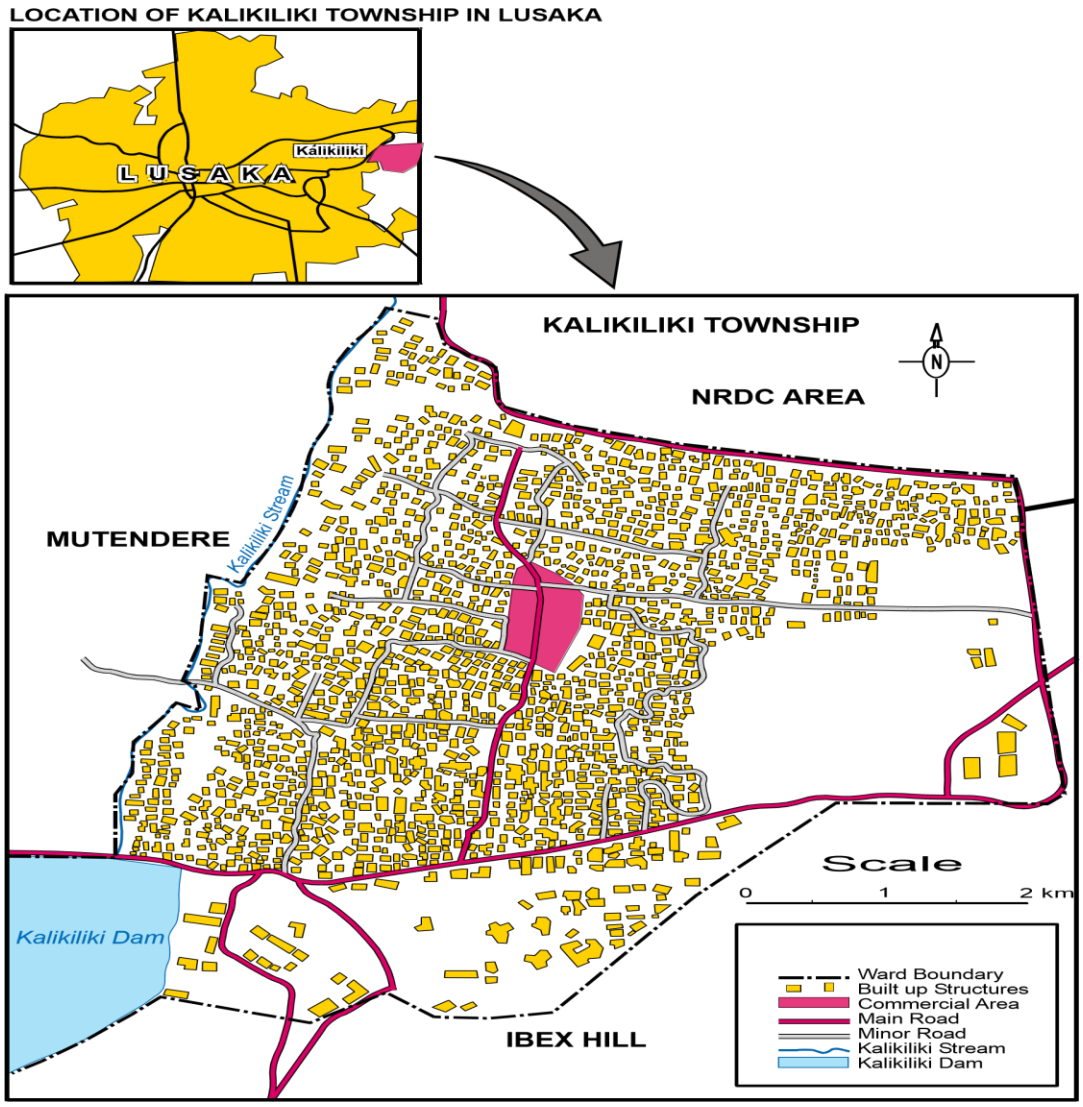

Figure 3: Location Map of Kalikiliki Settlement

Source: Adapted from UNZA spatial Planning Students, (2013).

The above map shows the location of Kalikiliki settlement in Lusaka District as a study area.

3.2.2. Historical Development of Kalikiliki Settlement

Kalikiliki developed as a small squatter settlement in the 1960s. It was started by people who were employed at a farm belonging to a white man to dig laterite, which was used for road construction and brick-making and the excavation left by the digging later became the Kalikiliki dam (Yasini, 2007). Many of these men who worked at the farm started establishing homes in the nearby area so as to cut down on distances from their places of residence to work (Kalikiliki community residents, 2017). The settlement started growing when the pass restrictions were lifted and people became free to move from province to province in the all Zambia. This led to an influx of people from rural areas to the city in search of employment to sustain them and their families (Nchito, 2007).

Kalikiliki is an improvement area which was recognized by Lusaka City Council under the Statutory (Housing and Improvement Areas) Act of 1974 and was granted legal status on 16th February, 1999 when the government through LCC moved into the area to help in ameliorating the social and environmental squalor associated with informality (Nchito, 2007). Kalikiliki was a nick name of a European man (Boer) from South Africa who owned a brick making company in the area. Kalikiliki which means a rush or hustle and bustle in the local language, and the term evolved from the owner's insistence that the workers do their work quickly an expression for working hard (Nchito, 2007; Community Member, 2017). The European's nickname later became the name of the stream, settlement and dam-although the dam is also sometimes referred to as the Kabulonga dam (Nchito, 2007; Community Member, 2017). The earth dam wall remains but it has been decommissioned so it no longer holds water.

3.3. Physical Characteristics of Kalikiliki Settlement

Kalikiliki portrays dualism in terms of character. On the southern side, it is characterized by a residential area that is organized with quality houses in spacious yards and has access to services such as piped water, flush toilets, roads, housing middle and high income earners (UNZA, 2014, also see figure 3 on the location of Kalikiliki settlement). On the other side, the Northern- West part of the settlement is that of small closely built houses and some are made of mud bricks with no defined boundaries, closer to Kalikiliki stream which is prone to floods like many unplanned settlements during the rainy season (Nchito, 2007). Housing infrastructure in Kalikiliki settlement

has developed in a haphazard manner with foot paths in between resulting in limited accessibility and thus the provision of services to the area is difficult in its current state. The main motorable roads within the settlement are mainly one way streets which are in a deplorable condition with no proper drainage system.

Kalikiliki settlement covers a total surface area of 460,277.5 square metres of high land, sloping from the east to the west towards the stream (Yasini, 2007). The general soils of the area are clay soils, with a high water table and poor drainage making the settlement prone to flooding (Nchito, 2007; Yasini, 2007). The settlement has approximately 70 to 80 structures per hectare translating into 420 to 480 persons per hectare making it a high density settlement (UNZA, 2013). People of Kalikiliki have built on natural drain and they have been dumping waste in the stream and it is now constricted enhancing flooding. The settlement lacks basic services such as piped water, sewerage and a MSWM system.

3.3.1. Social- Economic Status

Most Kalikiliki residents have low levels of income as most of them are not in formal employment and are not educated. Generally, they are in the low socio-economic class (LCC, 2016). The majority of the people work as security guards, maids, hair dressers, garden boys and other low earning jobs. Others engage themselves in running small informal enterprises like selling of tomatoes, fruits, charcoal and many other small things run in make-shift stalls in the settlements and these are dotted in all parts of the settlements to sustain their families. Other unemployed people in the area engage in prostitution to earn a living, money lending and saving groups locally known as ‘ichilimba’ (Yasini, 2007).

3.3.2. Demography

According to 2010 census of population, Kalikiliki was estimated to be 39, 139 with estimated household units of about 8,356, total males at 18, 945 and females at 20, 194 (CSO, 2010). Kalikiliki has an average household size of six (6) members based on the national average (CSO, 2013; PPHPZ, 2013). Approximately 41% of the population is aged between 31-45 years of age who can contribute meaningfully to the development of the community if they are properly skilled (CSO, 2010).

3.3.3. Location of Kanyama Ward 10 Settlement

Kanyama Ward 10 Settlement as shown in figure 4 is located on the western side of the city centre and it is about 3 kilometres from the Central Business District (CBD). The settlement borders Chibolya and John Laing to the south of the settlement across Los Angeles Road, Chinika on the North East part, Makeni is on the South West and on the Northern part of the settlement is an industrial area. The settlement covers the total surface area of about 366,737.68 square metres of flat land with rocky outcrops (CSO, 2013, PPHPZ Enumeration Report, 2013 and Yasini, 2007). Kanyama Ward 10 is a ward within Kanyama settlement.

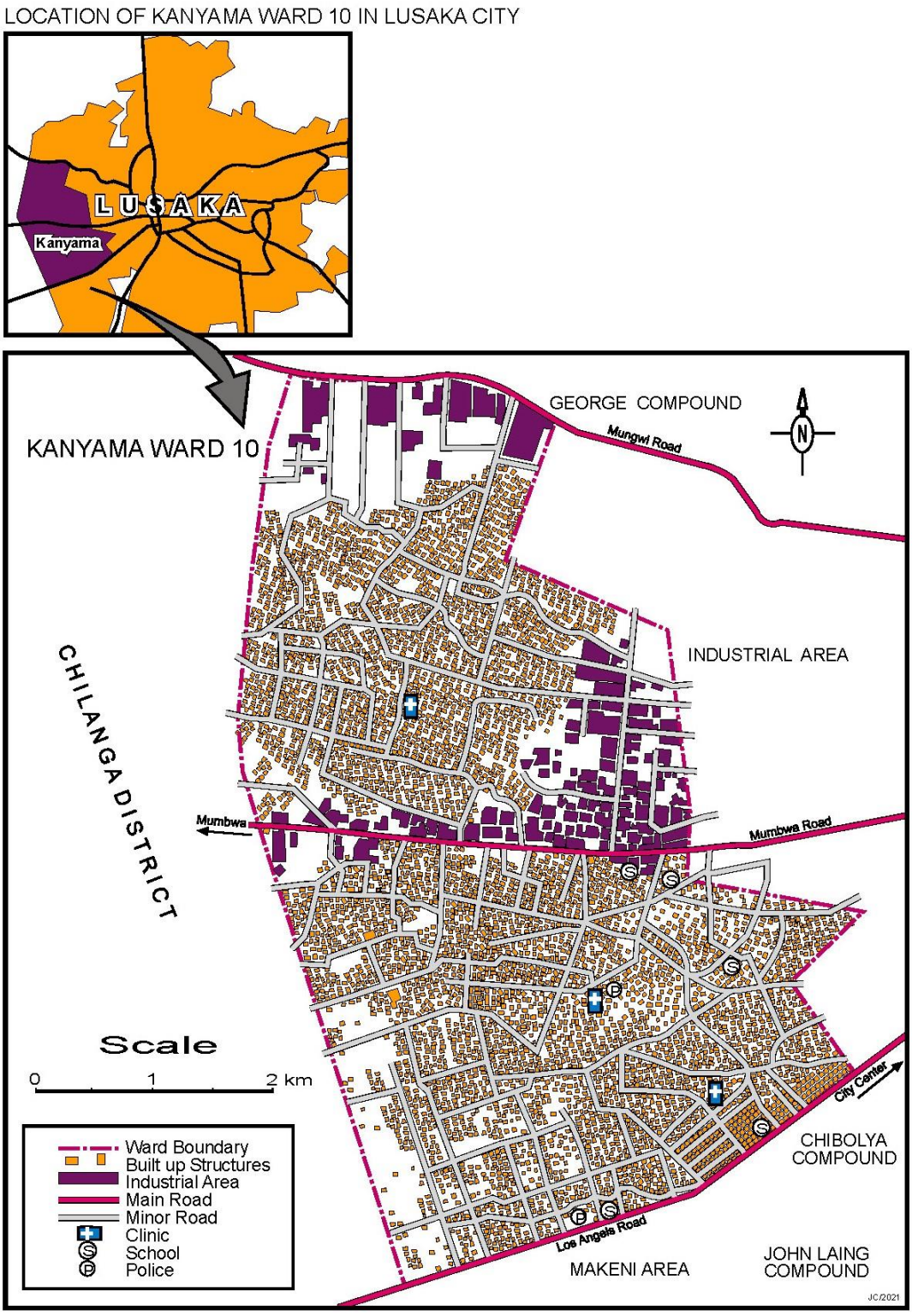

Figure 4: Location Map of Kayama Ward 10 Settlement

Source: Adapted from UNZA spatial Planning Students, (2018)

3.3.4. Historical Development of Kanyama Ward 10 Settlement

Kanyama Ward 10 Settlement is an improvement area and was legalized in 1999 by the Ministry of Local Government and Housing (MLGH) under Statutory and Improvement Areas Act of 1999 (Yasini, 2007). Kanyama Ward 10 is found in Kanyama settlement which had a total population of 169,253 people in the year 2010 (CSO, 2013). Kanyama was a name for a Luvale man called Mr. Fosholo Kanyama who was working as farm supervisor for a European farmer called Mr. Portketer who eventually left the country and Kanyama was left in charge of the farm (Yasini, 2007). Mr Portketer left at a time when the pass restrictions were lifted and people became free to move from one part of the country to the other, rural to urban area. This led to an influx of people from rural areas to the city in search of employment to sustain themselves and their families. The farm eventually became a destination for migrant looking for work in the city soon after independence. Mr. Fosholo Kanyama started allocating plots to friends and relatives from the village and other settlers which later became a settlement. Eventually the population in the area had increased and the housing structures expanded.

The community lived in shacks built of poles and mud and thatched grass roofs. The settlement did not have a school or a clinic and people were sending their children to nearby schools and hospitals or clinics. They were drinking water from shallow wells around the settlement and there was no police presence in the area but, the area was peaceful because the residents had developed a system of policing whereby, people coming to the area for the first time were asked to produce identity papers (Freund, 2007).

Kanyama Ward 10 is an extension of the original Kanyama settlement which has been expanding southwards uncontrollably over the years (Habasonda, 2012). Currently the housing infrastructure in Kanyama Ward 10 is somewhat formal without layout plans and no site sanitation facilities. The plots are small and houses are squeezed together and they are made of concrete blocks with iron or asbestos roofing sheets. The quality of construction works is substandard with some homes posing as possible hazards during the rainy season or heavy winds such that some of the houses collapse or the roofs are brown off, thereby causing extensive damage to properties and in certain cases death. The main road linking Kanyama Settlement to the city Centre is Los Angeles Road. The road is tarred and in good condition. The inner-settlement roads are gravel and most of them are in poor condition. The major community facilities found in Kanyama Settlement include two

government basic schools, two clinics, three police stations and community Centre (used as MPs office), two main markets, one service station, two football grounds and several bars and night clubs. Kanyama Ward 10 settlement experiences serious flooding during the rainy season. During this period pit latrine are filled with water and the contents overflow thereby contaminating the soil and water sources. The floods cause serious damage to roads and housing infrastructure. The floods also leave pools of water which is contaminated with human fecal matter.

3.4. Physical Characteristics of Kanyama Ward 10.

Kanyama Ward 10 is located on a flood-prone area and have no drainage system in place. Residents dump solid waste along roads and backyards of neighbors or any open space which is rarely collected (Community Member, 2017; field Observation, 2017). The area has a high water table and is subject to occasional flooding (Yasini, 2007). The floods form stagnant pools of water which become breeding grounds for mosquitoes and other disease-carrying bacteria. Flooding also causes pits to over-flow and spill their contents into the nearby wells and the surrounding land, thereby causing serious pollution.

3.4.1. Social-Economic Status

The livelihood of the residents of Kanyama Ward 10 settlement is quite diverse, as some people are in the formal and others in the informal sector. The people in the formal sector work in the public and private institutions. Those in the public sector include civil servants, and those in the private sector mostly females are involved in petty trading, brewing and selling illicit beer, tailoring, food making, working as maids, money lending and saving groups locally known as ‘ichilimba’ (Yasini, 2007). Others engage in commercial sex. Men are engaged in carpentry, petty trading, bricklaying, welding, blacksmith, plumbing, mechanic, bus conductors, security guards and stealing in order to earn a living. Others quarry and crash building stones. Others engage in car cleaning, begging on the street, doing piece works in the industries and commercial centers (Mulenga, 2003; UN-HABITAT, 2007). Most residents in the settlement are generally in the low socio-economic class (LCC, 2016).

3.4.2. Demography

Kanyama Ward 10 settlement have been recognized as consisting of high density low cost units (Census, 2010). The total population of Kanyama Ward 10 settlement is estimated at 169,253, with 35,682 households which are said to be inadequate and have insufficient basic services. Kanyama ward 10 had 84,714 males and 84, 539 females in 2010 (CSO, 2011). The population has been increasing through a high birth rate and immigration (CSO, 2010). Youths in Kanyama Ward 10 are the majority and most of them are not doing anything productive but involved themselves in beer drinking activities (Community Member, 2017).

3.5. Summary

In this chapter, the location of the two study areas has been presented. How the settlements began has been discussed and the activities of the people has their way of life. The history of flooding in both settlements have been presented.

Chapter four introduces the research methods used in the study. The research design, target population, data collection and method of analysis are also presented.

CHAPTER FOUR: METHODOLOGY

4.1. Introduction

This chapter outlines the procedure that was followed when conducting this study. It mainly focuses on research approach, research design, sampling producer, sample size and tools for data collection. Further, methods of data analysis, trustworthiness and ethics followed during the study are elaborated in this section.

4.2. Research Approach

A research approach is important as it facilitates the smooth sailing of the various research operations, thereby making research as efficient as possible yielding maximal information with minimal expenditure of effort, time and money (Kothari, 2004). According to Fraenkel *et al*., (2012) a research methodology covers an explanation of how the researcher prefers to conduct the research. Research method according to Creswell (2012), can take three forms which are quantitative, qualitative or a mixture of both. To analyze the link between solid waste and floods in Kalikiliki and Kanyama Ward 10 in the city of Lusaka, the researcher used qualitative approach.

Qualitative research approach, it is an approach which is concerned with developing explanations of social phenomena. It helps to understand the social world and why things are the way they are (Hancock, *et al*., 2009). It is concerned with the social aspects of our world and seeks to answer questions about why people behave the way they do? How opinions and attitudes are formed? How people are affected by the events that go on around them? And how and why cultures and practices have developed in the way they have? (Creswell, 2009; Hancock, *et al*., 2009; Saunders, *et al*., 2009). According to Grbich, (2007) qualitative methodology promotes the argument that when people interact, they share experiences that shape the way they think about a phenomena or how they handle problems related to their research. It actually tends to focus on how people or groups of people have different ways of looking at reality (Grbich, 2007).

Further, the approach allows a researcher to develop a relationship of trust with the respondent possibly enabling a franker conversation (Kasonde-Ng'andu, 2013). Thus the approach allows for in-depth, flexible and broad coverage since it deals with human beings, who are able to express their feelings, and was therefore used in an effort to obtain a deeper understanding of the link

between solid waste and floods in the City of Lusaka, Zambia in particular Kalikiliki and Kanyama Ward 10 settlements.

4.3. The Research Design

A research design according to (Yin, 2009) is the logical sequence that connects the empirical data to a study's initial research questions and, ultimately, to its conclusions, major steps, including the collection and analysis of relevant data (Yin, 2009 and Bryman, 2008). The research design used was a case study because of its flexibility in analyzing a phenomenon under investigations in its natural setting. According to Creswell, (2003) a case study involves the collection of in-depth information through a variety of data collection methods such as interviews, document reviews, archival records, and direct and participant observations to triangulate findings and provide for detailed descriptions of the phenomena under study. A case study method is a popular form of qualitative analysis involving a careful and complete observation of a social unit (Kothari, 2014).

Yin (2018) defines a case study design as an empirical inquiry that investigates a contemporary phenomenon within its real life context with the use of multiple sources of evidence. With the use of case study design, the researcher was able to collect data in a natural setting and context and also able to study and analyze the link between solid waste and flooding in the city of Lusaka, Zambia and behaviors that are created in the study areas. This method suits the questions that were asked and the aim of the study.

4.4. Sampling Methods

In a scientific research, sampling is very important as it helps to select a sample of participants from the total study population. Denscombe, (2010) explains the rule of sampling that it should be representative or exploratory. Field, (2005) define sampling as "a smaller collection of units from a population used to determine truths about that population.

In this study, residents in the two selected Informal settlements in Lusaka (Kalikiliki and Kanyama ward 10), after being identified through stake holder mapping process were sampled. For the purpose of this study, key informants identified included waste disposal service providers, public institutions whose function affect waste management. Based on among other factors, the large number of people affected and informality of settlements. The two areas are both classified as

informal settlements, with Kalikiliki located on the eastern side of Lusaka in Mtendere Ward, while Kanyama Ward 10 on the western side of the city was selected because of the vast nature of the settlement. A total sample size of 525 respondents were selected which included, 20 key informants comprising government officials from the institutions dealing in issues relating to solid waste management and floods in the city of Lusaka Zambia. It also included any adult present at that particular sampled house in Kalikiliki and Kanyama settlements of which 200 were from Kalikiliki and 305 from Kanyama Ward 10.

4.4.1. Purposive Sampling (Key informants)

Purposive sampling is a non-random sampling technic that was used to select key informants who participated in the focus group discussions and interviews. Purposive sampling is selecting a sample "on the basis of the researcher's own knowledge of the population, its elements, and the nature of your research aims" (Babbie, 1997). Latham, (2007) explains that this method is best used when there is a limited number of people that have expertise in the area being researched. In this study, the researcher used purposive sampling to select the key informants. The focus was on experts operating in solid waste or floods in the city of Lusaka, Zambia. This was in order to allow for in-depth interviews with the respondents who ultimately provided detailed information on collected waste and high, moderate and low prone areas to flooding in the two settlements. The 20 key informants were drawn from organisations and institutions as LCC, DMMU, ZRCS, LWSC, ZMD, MLGH, ZDC, MCAZ and Ward Counsellors. According to (Latham, 2007), the advantage of purposive non-probability sampling is that it is a convenient way for researchers to assemble a sample with little or no cost. The justification for the adoption of this sampling technique is that it only allowed for the selection of subjects (respondents) that were relevant to the study. The main language used was English during the interview related process.

4.4.2. Systematic Random Sampling

A systematic random sampling was used to select respondents from the selected settlements. A systematic random sample is obtained by selecting one unit on a random basis and choosing additional elementary units at evenly spaced intervals until the desired number of units is obtained (Finch, 2013). The advantage of using this sampling technique is that it reduced the element of bias in the selection of sample units as it limited any tendency of picking households that were

more convenient in terms of accessibility to the researcher and that every household in the settlement has an equal chance of inclusion. The sampling interval used to select adult residents of particular household to be interviewed was every fifth (5^{th}) household in both Kalikiliki and Kanyama Ward 10 settlements. Were the fifth household being not possible the next house was selected.

4.4.3. Sampling Procedure and Sample Size

In order to determine the sample size, it was important to first establish the population of interest (N). The population of interest (N) consisted of all the households in Kalikiliki and Kanyama ward 10. According to CSO, (2010) census of population, Kalikiliki was estimated to have a total population of 20,268 with estimated household units of about, 8,356 in approximation (CSO, 2010) and Kanyama ward 10 had a total population of 169,253 people with 35,682 households in approximation (CSO, 2011) which formed the population sizes. Thus in order to derive a representative sample size (n), the formula available in Renckly *et al*., (1996), Ebuzoeme (2015) and Ampofo *et al*., (2015) was to be used.

$S= N/1+N (e)^{2}$

Where S = Sample size (?)

N= Household Number

e= Assumed margin of error

1= Theoretical constant

But due to funding limitations, the project team could not get the right percentage and decided to use the rule of thumb to determine the sample size for the project and reached saturation. Rule of thumb is an approximate method or a principle with broad application that is not intended to be strictly accurate or reliable for every situation. It refers to an easily learned and easily applied procedure or standard, based on practical experience rather than theory. Rule of thumb worked out so well in this research. It reached saturation in that the research team reached a point in the analysis of data that sampling more data will not lead to more information related to the research questions. No additional data can be found to develop new properties of categories and the relationships between the categories are disentangled. There were similar instances over and over

again in the data and that made empirical confidence that categories are saturated. At this point researchers stopped sampling data and rounded off the analysis. In this study, 505 respondents were sampled from two informal settlements. 200 from Kalikiliki and 305 from Kanyama Ward 10.

4.5. Tools for data collection

The researcher considered both primary and secondary data to answer the research questions of the topic under considerations. Various tools were used to collect data. Under primary data collection which took place from February to October, 2017, the researcher used semi-structured interviews, questionnaires, focus group discussion, field observations and mapping. Under secondary data, the researcher relied on reviewing documents on solid waste management.

4.5.1 Primary data

4.5.1.1 Semi-structured interviews

Semi-structured interviews are a non- standardized tool for data collection in qualitative research. Interviews are a systematic way of getting information from people through talking and listening from individuals through conversation (KajornBoon, 2006). Thus, interviewing as a tool for data collection was used on key informants as a way of gaining knowledge of individual participants in the research. Kvale, (1996) regards interviews as an interchange of views between people on a topic of mutual interest with the centrality of human interaction for knowledge production and emphasizes the exactness of the research data. In this case study, interviews allowed participants to get involved and talk about their views regarding MSWM and floods in the study areas. Corbetta, (2003) explains semi-structured interviews as “the order in which the various topics in a research is dealt with and the wording of the questions are left to the interviewer’s discretion.

4.5.1.2 Questionnaire

A structured questionnaire consisting of both closed and open-ended questions was also used as tool for data collection. A household questionnaire was used to gather data from the residents of the two selected informal settlements in Lusaka namely Kalikiliki and Kanyama Ward 10. A total of 505 questionnaires were administered in the settlements. Kalikiliki had 200 while Kanyama Ward 10 had 305 questionnaires. The questions were formulated in line with the aim of the study

and presented under particular themes corresponding to the objectives of the study. Stakeholders had a chance to give feedback on the questions that were formulated. These questions were designed to obtain a cross section perspective of what government, the community and individuals can do to solve the problem of indiscriminate dumping of MSW in the two settlements and how best they can prevent flood or cope up with floods in these two study areas. The data was collected on tablets by the project team were the researcher got the data relevant for this study then transferred to the Desk top computer were it was analyzed from and after analysis, data was presented and discussion of findings followed up to conclusion and recommendation.

4.5.1.3 Focus Group Discussion

In order to identify areas which experience high, moderate and low risk of flooding, the project team held a focus group discussion (FGD) with representatives from the, ZMD LCC, RDA, DMMU, MLGH, LWSC, MCAZ, ZRCS and Germany International Development Cooperation (GIZ), dealing in MSW or floods. The major causes of flooding in the identified areas were also highlighted. The discussion helped gather information on how the various institutions collaborate as well as how they view issues of flooding and MSWM in the city. A focus group discussion guide was used to guide the discussions which was composed largely of a series of open-ended questions designed to focus the interview around the link between solid waste management and floods in the city of Lusaka, Zambia whilst providing for an informal conversation level of discussion which enabled the respondents to express their views in their own terms. As the discussions were going on the researcher while working as an observer, explored and took notes on meaning of informative verbal and non-verbal interviews responses, and related them to context and experiences of individual research participants.

4.5.1.4. Field Observations

Field observation is another way through which data was collected from the two settlements to gain a better understanding of the actual situation and to complement the interviews as well as part of the survey, direct field observations were used to record visible piles of solid waste within the settlements. Waste dumping sites, data assessment, and data sheet was used as a data collection tool. Global Positioning System (GPS) was used which provided guidance on specific points which usually flood and those with piled waste. Non-participant observation by taking photographs was

a complementary method used to capture events and scenes related to the physical effects of flooding and coping strategies adopted by the local community and check physically were waste is dumped.

4.5.2. Secondary data collection

Secondary data was collected through document review which included, journal articles, books and internet. Data collected from these documents supplemented on the primary data collected on the study area and on all the three objectives. This is an ideal method as it portrays the values and beliefs of the participants of a particular setting. Literature review is important as it helps in getting an understanding of how a similar situation was dealt with in different settings, other areas or by different researchers.

4.6. Methods of Data Analysis and Presentation

The data that was collected in this study was analyzed qualitatively and is presented through write-ups, tables and figures developed using excel and GIS respectively. Qualitative methods of data analysis involved the use of descriptive statistics to produce frequency tables and figures such as bar charts. Composition analysis of waste which was done at Goma fields within The University of Zambia describes the proportions of different substances that make up domestic waste.

4.6.1. Qualitative Data Analysis

Data that was collected from the field through semi-structured interviews with open ended questions was qualitatively analyzed using thematic approach .The analysis of raw data enabled the researcher transform it into meaningful information. In the first place, there was Familiarization with data collected. This step involves getting to know the data. It was important to get a thorough overview of all the data. This involved transcribing audio for the information collected from participants, reading through the notes taken and generally looking through the data to get familiar with it. Thereafter, the researcher coded the information. In coding, the researcher highlighted sections of the texts with labels or codes to describe their content. After this all data identified by codes was collected into groups to give an overview of main points and common meanings.

After coding was done, the researcher embarked on Generating themes. This involved looking at codes to identify patterns among them and come up with themes. At this point codes, considered irrelevant were discarded. Only those that are conformity with the study objectives were spared. The Reviewing of themes were done to make sure that they are useful and accurate representations of data. After reviewing themes, the researcher defined and named themes. Defining themes involves formulating exactly what is meant by each theme and figuring out how it helps us understand data on the topic under analysis. Finally, the researcher presented the data using graphs and charts based on the emerging themes. For secondary data, insights from already existing data sources which are relevant to the study were extracted and were incorporated in the write ups.

Data from the questionnaire was analyzed using excel as a way of grouping the responses from the respondents of the two settlements under study.

4.6.2. Waste Analysis

MSW collected from study households were analyzed for weight, density and type. As it was not possible to analyze the whole study area, a sample based on availability was used. If households are willing to put their waste in the sacks provided, they were given after the purpose of the study was explained. This sample was representative for the two areas of investigation and described the characteristics of the two settlements. The consistency of household waste was varied. Refuse samples were collected and transported to the sorting site at the University of Zambia Goma fields. Refuse bags were labelled upon collection and where a household used more than one bag, each bag was labelled and the bags taped together. Where bags were not used, researchers got refuse from the containers that the household had utilized during the seven-day period into the bags provided for the study. Each refuse bag collected from a household was weighed and the weight was record and attached to household details. Bags were opened and then sorted separately according to category and then, the sum of the sorted weights was checked against the total bag weight into separate bags and later on, dispose of sorted refuse. A completed record was filed for later analysis. Abu *et al*., (1997) said, an essential component of a waste analysis involves waste characterization or the determination of waste composition. Determination of waste composition was by physical separation and visual observation of collected wastes. The basic weight results were then transferred from the record sheet to the Excel sheet. Excel template automatically

calculated the waste composition and the required statistical data. The sorting and weighing was repeated for all the 30 sampled households.

4.7 Trustworthiness

The state of acceptability in terms of it being true and unique academic product was done using Guba's four trustworthy strategy which are ideal for all qualitative studies. In this study, *credibility* was ensured through the correct plan from the beginning to the end which was a case research design that coincides with the study's title; hence quality of data was assured. *Transferability* was ensured through contextualizing with other studies in which similar information is likely to be found and new information added on to the body of knowledge hence, data quality was assured. *Dependability* was ensured through audit inquiry. This involved examining the processes of data collection, data analysis, and the results of the research study. *Confirmability* was achieved through taking notes regarding personal feelings, biases and insights immediately after an interview and collection of the questionnaires.

4.8 Ethical Considerations

Since this study was purely qualitative it demanded interaction with the participants, thus entering their personal domains of values to collect data. Silverman, (2000) reminds researchers that they should always remember that while they are doing their research, they are in actual fact entering the private spaces of their participants. Understandably, this raises several ethical issues that should be addressed during, and after the research has been conducted. Therefore, ethical issues in this study were addressed by seeking permission from relevant authority. Before going in the field, the researcher ensured that the study undergoes ethical clearance by the Natural Sciences Research Ethics (NASREC) of the University of Zambia. The researcher further sought permission from government departments and non-governmental organizations (NGOs) before collecting data from the participants or respondents working for these institutions.

Participants were also asked to give verbal consent to participate in the study voluntarily or to be recorded where necessary. The researcher also ensured that names of the participants are not disclosed. Participants were also informed about the purpose of the research in which they were requested to participate. The researcher was also impartial and exhibited high levels of honest which was meant to raise the integrity of the research being carried on and confidentiality were

given respect whenever sought by the interviewee so that the research is done according to the etiquettes demanded by the fundamentals of good research (Kajornboon, 2006).The explanation of what the project was all about was given and got informed verbal consent from all participants.

4.9. Chapter Summary

This chapter has given a general overview of the methods used in the study. The relevant methodological issues such as research design, sample size and sampling procedure have been discussed in detail. The chapter has also described the process of data collections and analytical methods used. Chapter five presents the results and discussions of the study according to the stated objectives.

CHAPTER FIVE: RESULTS AND DISCUSSIONS

5.1. Introduction

This chapter presents and discusses the findings of the study in line with the research questions which were to:

i. What types of solid waste are produced by residents in Kalikiliki and Kanyama Ward 10 settlements?
ii. How do households in Kalikiliki and Kanyama Ward 10 dispose of their waste?
iii. What challenges do the residents of Kalikiliki and Kanyama Ward 10 settlements face in disposing of solid waste?
iv. Do the methods used by household to disposal of waste contribute to flooding in Kalikiliki and Kanyama Ward 10 settlements?

The findings are discussed in relation to the reviewed literature which is in support and at variance as well as the theoretical framework employed during the study. It highlights the scope to which the objectives of the study as stated in chapter one were achieved based on spatial analysis of the link between solid waste and floods in Kalikiliki and Kanyama Ward 10 settlements in the city of Lusaka, Zambia. In this chapter, background characteristics of respondents is also presented and discussed.

5.2. Characteristics of Respondents

The sample is described in terms of the sex (gender), marital status, education level, income differentials, sources of income, property ownership and knowledge of the cause for flooding, suggested solutions, actions taken to prevent or mitigate against floods and their impacts, and challenges in flood mitigation.

Characteristics of key informants was simply institutions involved in municipal solid waste management and disaster response in Lusaka. These include Lusaka City Council (LCC) that is responsible for urban governance, Zambia Disaster Management and Mitigation Unit (DMMU) which is mandated to manage disasters in the country, Ministry of Local Government and Housing (MLGH), Zambia Meteorological Department (ZMD) that provide information on the weather,

Lusaka Water and Sewerage Company (LWSC), Zambia Red Cross Society (ZRS) and Zone Development Committees (ZDC).

Table 2: Background Characteristics of Respondents

Background characteristics	Frequency	Percentage (%)
Settlement		
Kalikiliki	200	39.6
Kanyama ward 10	305	60.4
Gender		
Male	106	21
Female	399	79
Marital status		
Single	87	17.2
Married	349	69.2
Widowed	49	9.8
Separated	11	2.1
Divorced	9	1.7
Educational level		
No education	31	6.1
Primary	193	38.3
Secondary	246	48.7
College	25	5
University	10	1.9

Monthly Household income		
Less than 1000 ZMW	86	17.1
1001-2500 ZMW	287	56.8
2501-5000 ZMW	95	18.9
Above 5001 ZMW	37	7.2
Source of income		
Business	147	29
Employed	237	47
Renting out houses	61	12
Piece works	45	9
None	15	3
Ownership of property		
Landlord	227	45
Tenant	278	55
Total	**505 (**for each category)	**100 (**for each category)

Table 2 on gender of respondent's shows that there is a dominance of 79% females who were interviewed and only 21% males out of the 505 households interviewed in the sample. The reasons given for the small fraction of men participating in the study were that the majority had gone to source out income for the household. At household level, women and girls are the majority in MSWM and are the ones who are responsible for the cleanliness of the homes. At economic level women are involved in activities such as street sweeping and men are the ones who work as laborers and drivers on collection vehicles. Since data collection was from households and during

the day, women respondents were many as they are the ones who are usually found at home during the day.

The total number of respondents from Kalikiliki settlement was 200 of which 69.2 per cent were married while, 17.2 percent were single. The widows were 9.8 percent with those separated representing 2.1 percent, only 1.7 percent were divorced. In Kanyama Ward 10, the total number of respondents were 305 of which 69.2 percent were Married while, 17.2 percent were single. The widows were 9.8 percent with those separated representing 2.1 percent, only 1.7 percent were divorced. Most of the respondents in both settlements of study are married. May be it is easy for them to work together and meet basic needs. It was observed that married couples generate more waste resulting from household chores and other activities since there seems to be more members in households of married people than in singles, divorced and widowed households.

The findings of the study on the educational levels of the respondents were high for those who have attained secondary education and were at 48.66 percent, 38.31 percent have attained primary education while, 6.13 percent have never been to any formal school, 4.98 have attained college with Only 1.92 percent who have been to University. Looking at the types of work that majority of the respondents do cannot approve of the highest percentage attaining secondary education. If they have then the results are not very good to go in to colleges and Universities. This has contributed to more residents being in informal employments such as working as maids, garden boy, brewing and selling illicit beer, tailoring, food making, and money lending and saving groups locally known as ‘ichilimba’ in order to make a living.

With regard to monthly income, 56.8 percent of the respondents earned between K1001 and K2500 per month, while 18.9 percent earned between K2501 to K5000, 17.1 percent earned less than K1000. Only 7.2 percent earned an income that was K5001 and above. Low levels of income are a central characteristic of informal settlements where it is easiest to see poor people in the highest concentrations and in poor living conditions (UN-Habitant, 2003). Both kalikiliki and Kanyama Ward 10 income levels are low, material consumption and waste generation is below average. They produce more debris because the areas lack quality infrastructure to support productivity and high consumption patterns, hence high proportions of debris and non- consumption in the waste generated. The income most households stated during data collection in the study areas indicated is far below what the Jesuit Centre for Theological Reflections (2015) which puts Food Basket at

an average of over K4, 000 for a household of six per month is indicating. K5, 000 and above had the lowest number of households. With low income, that is why residents of the two settlements cannot afford to pay for waste collection.

The sources of income according to the findings of the study are that 47 percent of the people interviewed are employed, 29 percent are doing Business 12 percent are renting out houses as land lords while 9 percent are involved in piece works such as washing, cleaning, lifting cargo and selling in shops either at the market or within the settlement and only 3 percent are not doing anything. Although the results of the study show that most of the respondents are employed, very few are in formal employment. Most of them are in informal employment, business and piece work. Some have small shelters turned into shops/stalls were they sell merchandize, which includes washing detergents, domestic household items, vegetables, groundnuts and other food stuffs. From the nature of work that the people do and their income, we can confidently say the majority are in the low economic status. This is the more reason why even MSWM methods are poor and it keeps flooding every year because they cannot afford better ways of combating floods and nothing seem to be done by the relevant institutions (Chisola, 2012). Some among the twelve percent of landlords construct several rooms on their properties in order to raise income through rentals.

With regard to property ownership, the findings of the study revealed that 55 percent of the respondents owned the houses that they live in. However, the results also showed that 45 percent of the respondents were tenants who included those who simply keep houses for others, either friends or relatives. Since the majority of respondents are not in formal employment, it is very difficult for them to find money to buy plots and put up a structure for the family. This is the more reason why even those who own houses they are not in good shape and they fell to maintain them.

5.3. What type of solid waste are produced by residents in Kalikiliki and Kanyama Ward 10 settlements?

The first research question of this study was to find out the types of solid waste produced by residences in two study compounds. The study in both Kalikiliki and Kanyama Ward 10 settlements shows that composition of waste varies as waste is normally found to be co-mingled

and composed of different substances. MSW are mainly made up of household waste (Klundert (van de) and Anschiitz 2000).

5.3.1. Bulk density

Waste was sort and categorized by the START team (Plate 1) as it was co-mingled. The waste being sort was one week's worth of household waste just like CBEs also collect waste after one week. A total of 30 bags were deposited but only 18 were viable out the 20 retrieved. The two bags had started decomposing and was putrid.

Plate 1: Sorting of Waste

Source: Field Laboratory, 2017- START Project

Waste generation rate is defined as average amount of waste generated by one person per day. The unit of measurement is kilograms per capita per day (kg/cap/d). Kayaga and Cotton (2011 citing UN-Habitat, 2010) put the estimated average for Lusaka at 0.6 kg/cap/d. Residential waste normally has the highest per capita weight per day. Waste is also characterized by its bulk density (BD) which is the mass of a unit volume of waste. BD is measured in kilograms per cubic meter

(kg/m³). The average amount of waste generated per person in Kalikiliki is 0.3 kg per day while for Kanyama Ward 10 is 4.4kg/m^3.

5.3.2. Characterization of Waste in Kalikiliki and Kanyama ward 10 Settlement

The physical composition of waste generated from the two study areas is presented in Table5 and 6. Table 5 shows that in Kalikiliki yard waste forms the highest proportion of waste generated which is 49.87 percent while Food waste generated was at 18.05 percent and Plastics constitutes 12.56 percent of the waste generated and diapers represented 11.30 percent, Glass was 2.37 percent whilst Paper was 2.0 percent. Leather and rubber represented 1.63 percent and textiles represented 1.42 percent, ferrous metals were 0.37 percent while Aluminium was 0.33 percent as shown in below.

Table 3: Composition of Solid Waste in Kalikiliki and Kanyama ward 10 Settlement

	Kalikiliki		**Kanyama Ward10**	
1.	**Waste type**	**Percentage**	**Waste type**	**Percentage**
2.	Food waste	18.1	Food waste	22.1
3.	Paper	2.1	Paper	5.2
4.	Cardboard	0.0	Cardboard	0.4
5.	Plastics	12.6	Plastics	10
6.	Textiles	1.4	Textiles	2.4
7.	Leather/Rubber	1.6	Leather/Rubber	1.2
8.	Yard waste	49.9	Yard waste	43
9.	Wood	0.0	Diapers	12.6
10.	Glass	2.4	Wood	0.8
11.	Aluminium	0.3	Glass	0.5
12.	Ferrous Metals	0.4	Aluminum	0.3
13.	Diapers	11.3	Ferrous Metals	1.5
14.	**Total**	**100**	**TOTAL**	**100**

Source: Field data, 2017

Kalikiliki produce more yard waste or debris than any other waste type because the area lacks quality infrastructure, hence high proportions of debris in waste generation. Kalikiliki being a flood prone area household's use debris waste to create embankments, raise the ground to avoid flooding in the yards, and inside the houses. Sacks filled with debris and sand are used to step on to get to and from homes during floods. Thus, debris has been found to be a useful material in informal construction sector (Plate 2). Further, the study found that debris materials were used for mounting makeshift 'bridges' on a stream and on drainage infrastructures. In addition, during rainy season, part of the debris gets washed down the drainage systems. During this study, it was found that debris is one of the key waste attributes that creates a direct link between solid waste and urban flooding in Kalikiliki and Kanyama Ward 10 settlements.

5.3.3. Composition of Solid Waste in Kanyama ward 10 Settlement

Table 4 shows that in Kanyama Ward 10, yard waste was found to be the most abundant comprising of 43 percent. Yard waste or debris includes materials such as stones, leaves, grass and sand among others. Food waste comprising of 22.1 percent, followed by diapers 12.6 percent then plastics 10 percent and textile waste was 2.4 percent. Paper waste generation was at 5.2 percent, ferrous metals were at 1.5 percent while leather and rubber were at 1.2 percent. Wood 0.8 percent, Glass 0.5 percent, Cardboard was at 0.4 percent and Aluminium was at 0.3 percent. These materials have no practical possibility of reuse or recycle.

Further, the study shows that food waste is second highest in proportion in terms of quantity and this is backed by interview data from key stakeholders and community residents. What has contributed to this is the limited access to electricity and the low quality of storage facilities which shows that households have no means to store food. Leftover cooked food and other perishables such as vegetables are easily lost. The study shows a rise in the use of diapers in the study areas which calls for further evaluation given that diapers are insoluble and once they get in to the drainages and block, flooding may happen. The study also found that, bottles, and plastic wastes are in low quantities and do not pose an evident challenge to flooding in the study areas. However, observations revealed a high presence of plastics in the surroundings. This was because plastic bags were the preferred receptacle for the disposal of household waste and bottles are usually retrieved for use by households in the study areas, and scavengers who sometimes sell to those who sell water or local drink commonly known as "Munkoyo". Lack of meat related waste such

as bones points to the fact that meat products are generally out of reach for most households in these areas. Bones may also be removed by dogs and therefore may not have been found with the rest of the waste.

The implication of this finding is that waste may continue to increase with growth in consumption and this may pose a challenge to the authorities bestowed with the responsibility of waste management. Based on this analysis on solid waste, Table 7 summarizes the types of solid waste generated in Kalikiliki and Kanyama ward 10 settlements.

This finding conforms with Laurent *et al* (2017) who established that an increase in population is associated with diverse human activities which some of them are a threat to their own existence in the community. Indiscriminate solid waste which is also associated with population increase may not be well managed by the local authority as these lacks the capacity to match produced waste by the residents (ZEMA, 2019).

Table 4: Dominant Waste Types in Kalikiliki and Kanyama Ward 10 Settlements

Food types	Debris	Others
Maize husks/cobs	Stones	Diapers
Avocado	Ash	Synthetic hair
Pumpkin	Charcoal	Shoes/sandals
Tomatoes	Broken crockery	Rubber
Potato peels		Glass bottle
Sweet potato peels		Metal
Cabbage/vegetables		
Sugar cane		
Egg shells		
Chicken feathers		
Bones		

Source: Field data, 2017

MSWM was not good in the two settlements as piles of uncollected waste were found in both settlements which is evidence that waste is not collected by the institutions or those charged with the responsibility to collect waste in the study areas (Plate 2).

Plate 2: Uncollected Waste in Kanyama Ward 10

Source: Field Photo, 2017

5.4. How do households in Kalikiliki and Kanyama Ward 10 dispose of their waste?

The findings of the study on how solid waste is disposed of according to Figure 5 is that 45 percent of the respondents dispose of their waste within their plots, 41 percent pay for waste collection and 14 percent burn on plots.

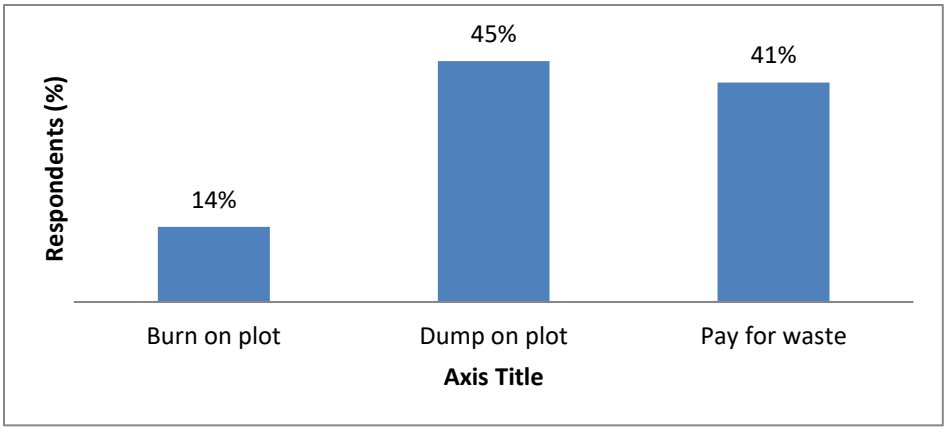

Figure 5: Waste Disposal Systems

Source: Field data, 2017

Results shows that many households dump their waste within the yards, on roadsides, drainage channels and open spaces while others burn within the yard. It was further revealed that a small fraction of residents pays for waste collection. One respondents among those who did not subscribe to official waste collectors had the following views:

> *Since we cannot afford to pay waste collectors we opt to burn or burry the waste within the plot (response from one respondent Kanyama Ward 10, March 12th 2017).*

This finding is in line with Tadesse et al., (2008) who analyzed the factors that influence household waste disposal decision making as alternative (burning, burying and open dumping) ways of disposing of waste was cheaper than paying for waste collection to community based waste collectors. It can be deduced from the findings that residents of the two resettlement do not attach meaning to the implication of indiscriminate disposal of waste as this behavior has negative implications to their own wellbeing.

This finding is also at variance with (Geissdoerfer *et al*, 2017) who suggested that the best method of waste management is recycling which aims at converting waste products into new products and reduce volume of landfills, reduce air prolusion from incineration and water pollution from landfilling and preserve natural resources for future use.

It was also observed that waste is dumped at an open space within the settlement at various places where heaps of solid waste can be seen over the large area. The open dump sites in the vicinity in Kalikiliki and Kanyama Ward 10 are being shown in Plate 3 and Plate 4 respectively.

Plate 3: Indiscriminate Solid Waste Disposal Near Kalikiliki Stream

Source: Field Photo, 2017

Plate 4: Indiscriminate Solid Waste Disposal in Kanyama Ward 10 Settlement

Source: Field Photo, 2017

In spite of indiscriminate disposal of waste, it was established that residents from the two settlements did not have the waste bins and places for dumping waste which encourages flooding. This was validated by the key informant from LCC who narrated that:

The local government through LCC have not provided residents in the two settlements with places and waste bins to dump their waste hence the indiscriminate waste disposal (Focus group discussion with key informant on 12th April, 2017).

It was also observed that some residents are paid for waste collection from different households, however, due to lack of designated dump site in the area they opt to dump them around their own houses as shown in plate 5. This suggest that indiscriminate solid waste cannot being entirely blamed on the residents of two settlements alone but also on the authority with a responsivity to provide social services to the community.

This finding is at variance with Ajzen's Theory of planned behaviour (TPB) (1991) in the sense that other residents may be willing to do what is right but due to the absence of social services in the settlement they opt to act in the manner they act of disposing wastes in anyhow.

Plate 5: Waste in Sacks around the House in Kalikiliki Settlement

Source: Field data, 2017

5.4.1 Model on waste disposal for Lusaka City

It was revealed that Lusaka City waste disposal model has six steps from waste generation to the final disposal place and is ineffective and inefficient in informal settlements. Figure 6 is the 6-step process of MSWM model for LCC which is currently in use in the Lusaka city in informal settlements.

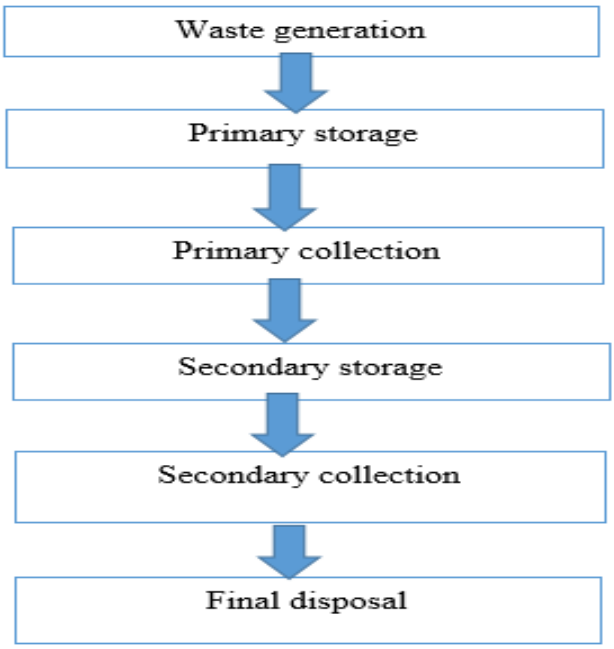

Figure 6: Current Model for Municipal Solid Waste Management in Informal Settlements in Lusaka City.

Source: START-Project, 2017

Looking at this model, it has too many stages in waste management which has contributed to it being costly especially with transport and too many actors who cannot even corroborate with each other well hence the so many stages have contributed to the accumulation of uncollected waste in unplanned settlements. The first stage in the model shows waste generation at household level, second stage shows primary storage of waste after being collected from households, third stage shows primary collection by CBEs to a secondary storage which is a fourth stage, the fifth stage is secondary collection by LCC to the final disposal site which is Chunga dump site.

In line with the many stages in the current model, the START team has proposed a model which will only have three stages once adopted. Waste generation, primary storage and final disposal. The proposed model once adopted will reduce the inefficiencies and improve effectiveness as expenses and the number of actors will be reduced. However, for this model to work properly, LCC should provide skip bins in the study areas, make the collection points known to the residents for them not to be dumping waste indiscriminately. Once the proposed model is adopted, there is

need for LCC to engage CBEs who have the capacity to transport waste from the waste generators to primary storage on the regular basis.

5.5. What challenges do the residents of Kalikiliki and Kanyama Ward 10 settlements face in disposing of solid waste?

Challenges that residents face when disposing of their waste include distance to the dump site, frequency of waste collection, waste collector's and waste collection fees, lack of funds, inadequate refuse receptacles, poor attitude of people towards waste handling, limited number of waste management personnel, lack of contemporary waste management equipment and lack of public education on issues of MSWM.

During FGD on 12th April, 2017 the issue of the absence of communal bins in the two settlements was raised as one which has contributed to wrong alternative ways of disposing of waste which is contributing to floods in the study areas.

One official pointed out that:

> *In Kanyama Ward 10 there is no single bin where waste can be stored after collection from households awaiting collection by LCC which has led to wrong ways of disposing waste leading to flooding in the area (FGD with key informants on 12th April, 2017).*

The implication of this finding is that inadequate infrastructure for MSWM presents a challenge to flood risk management as this reduces the chances of having smart cities (Lamond *et al*., 2012; Babayemi and Dauda, 2009; and Onwughara *et al*., 2010). It is therefore vital that the issue of solid waste disposal is holistic managed by all concerned and affected stakeholders for smart free communities.

This finding resonate well with Manyanhaire et al., (2009) who established that lack of finances to meet the social services are confronting developing countries. This implies that medium and long term interventions are needed to address the solid waste challenges currently faced by the municipalities especially in Zambia.

5.5.1. Views on Distance to the Dump Site.

The resident's views on distance to the dump sites in reference to figure 7 shows that 40 percent of respondents had not seen any collection point in their respective settlements whilst 29 percent stated that the distance to the communal collection point is very far which is more than 2 kilometres in some cases and is approximately a 40 minutes' walk. A total of 25 percent of the respondents indicated that the distance to collection site was near which is less than a kilometres and it is less than 20 minutes' walk. Only 5 percent said the distance is moderately far as they live within a 1 to 2 kilometer radius from the receptacles which is a 20 to 40 minutes' walk.

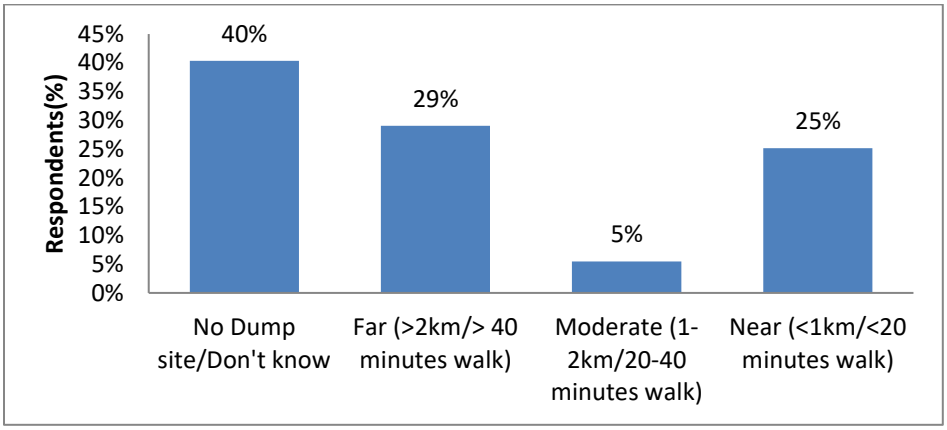

Figure 7: Respondent's Views on Distance to Communal Collection Points.

Source: Field data, 2017

In view of distance, one respondent noted that:

> *The distance between the households and the communal collection points within the community affects the willingness of some community members in carrying waste to the sites and this causes dumping in the open or drainages (Respondent from Kalikiliki, 16 April, 2017).*

The implication of this finding is that the location of communal collection points is far and does not allow for people who carry waste on basic equipment's like wheelbarrows to easily dump their waste for free. There is need to provide more/modern waste management equipment and situated

well within the communities. In general, the distance to the collection site is a factor causing the people to litter the environment.

This finding conforms to Lamond and Bhattacharya-Mis (2012) on role of solid waste management as a response to urban flood risk in developing countries who established that solid waste management is an emerging issue in flood risk management practice.

5.5.2. Regularity of Waste Collection

Of the 505 respondents, the study show that 46.62 percent never had their waste collected, 23.65 percent their waste is collected weekly whilst 12.84 percent had their waste collected fortnightly. Monthly waste collection was 12.16 percent and daily waste collection was 3.38 percent. Waste was collected for more than a month for 1.35 percent only (Figure 8).

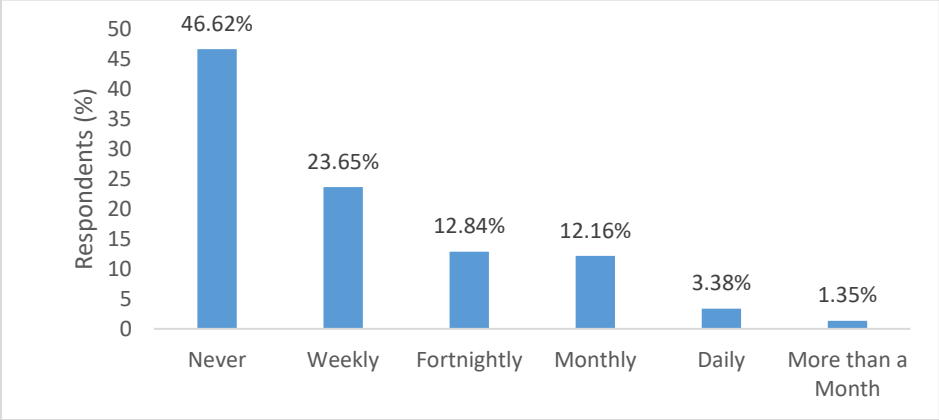

Figure 8: Frequency of Waste Collection

Source: Field data, 2017

In view of frequency on waste collection, one resident from Kanyama Ward 10 made the following remarks:

> *The biggest challenge for those who pay for waste collection is that collection of waste is irregular and inefficient hence resident's resorts to paying private individual waste collectors who dump anywhere and not in designated places (Respondent from Kanyama Ward 10, 19th April 2017).*

Similar to frequency of waste collection, one official indicated that:

There is insufficient capacity and equipment for them to deal with the collection, transportation and disposal of waste (Interview with CBE Kalikiliki settlement on 19th April, 2017).

Another key informant from the FGDS stated that:

Most of the CBEs do not even own vehicles, but have to hire truck which is an added cost and that one truck is expected to operate in more than two areas which raises the problem of frequency of collection (Key Informants, 19th April 2017).

Another informant echoed that:

During the rainy season trucks got trapped in the mud at the main dumpsite at Chunga and this is another added cost of disposal because they have to pay people to push the trucks out of the mud and this can take days (FGDS with key informants, 19th April, 2017).

This is a worrisome situation as the irregular rates of collection poses serious environmental and health hazards. In the Nigerian metropolis of Lagos, Ojolowo and Wahab (2017) also found that the uncollected MSW was a significant indicator of flooding as most drainage channels had been blocked.

5.5.3. Waste Collectors

According to Figure 9, the results show a large portion of waste collectors from 'Private Individuals' which is 78 percent. The second largest in waste collection was 'private company' which had 17percent and Council at 5 percent.

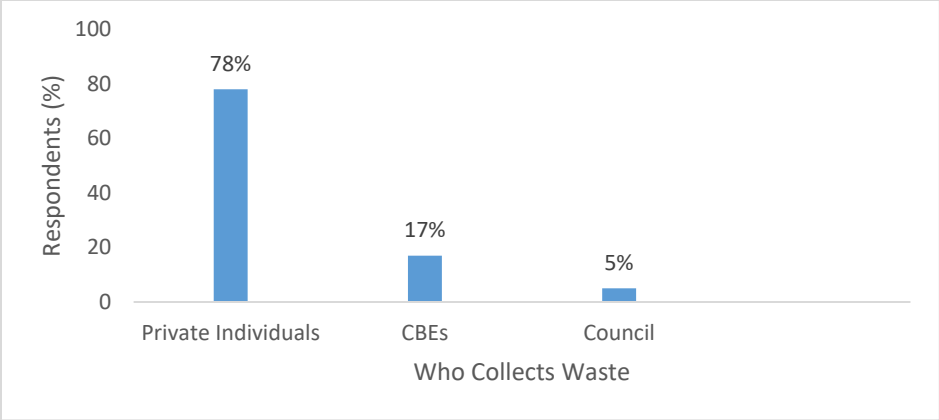

Figure 9: Who Collects Waste?

Source: Field data, 2017

Waste from homes generally is supposed to be collected by CBEs through regular waste collection, or by special collections for recycling. The unregistered individual waste collectors are unregulated and mostly responsible for informal solid waste management in informal settlements. As summarized in Figure 9, 78 percent of the respondents indicated private individuals who are not registered as the ones who collect waste from individual homes. Only 5 percent stated that waste was collected by the council. The 5 percent is also private individuals because LCC has subcontracted CBEs to collect waste for it and so the council represents private individuals. Respondents indicated dissatisfaction with the services they receive from the solid waste collectors especially the CBEs and that is the more reason why they give their waste to private individuals. Residents argued that while subscription to a service provider is fixed, service delivery is unreliable especially in terms of consistency of waste collection.

5.5.4. Waste Collection Fees

Majority of the sampled respondents indicated that they do not subscribe for waste collection and attributed to 41 percent. The views on costs for subscribing to registered waste collectors resonates with the dominant informal ways of disposing waste practices in the two settlements. The dominance of burning, dumping and throwing waste do not attract any costs and these were the preferred methods of waste disposal. The other 21 percent argued that subscription is too expensive. Given that the proportion of those paying for waste is low, it was found that a total of 62 percent use unconventional, unapproved and unsustainable methods to dispose of household

waste in the study areas. These methods contribute to ground water pollution, clogging of urban drainages infrastructure and subsequent urban flooding in the settlements (Figure 10).

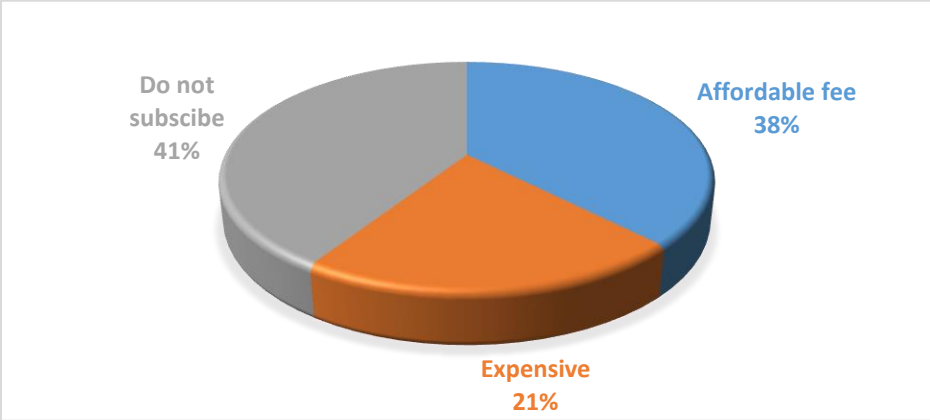

Figure 10: Respondents' Views on Subscription for Waste Collection

Source: Field data, 2017

This finding is in line with the theory of planned behavior underpinning this study. Ajzen's Theory of planned behaviour (TPB) (1991) argues that individual's response to an act is dependent on the behavioural intention formed or developed. The validity of this theory in the context of poor waste management system in Kalikiliki and Kanyma Ward 10 settlements is that some residents do not just want to subscribe to waste collectors hence the planned behavior of indiscriminate solid waste disposal.

5.5.5. Failure to Pay for Waste Collection

It was revealed in the study that 53 percent of the respondents use alternative cheaper methods to dispose of their waste and 33 percent said the services provided after paying were inefficient and ineffective, yet 14 percent lack funds to pay for waste collection.

To validate this challenge, the councilor for Kanyama Ward 10 made the following remarks:

> *Sometimes waste is collected fortnightly or not collected at all because they have no equipment (Interviews Kanyama ward 10 Councilor 19th April, 2017).*

Another respondent mentioned that:

Some generators of waste feel it is the responsibility of the government to offer them free services for solid waste collection and disposal (Response from Kanyama Ward 10 respondent, 15th March 2017).

Plate 6 shows blocked drains due to solid waste accumulation. Residents viewed financial costs associated to solid waste collection as higher than the non-financial benefits. The residents were ready to sacrifice the non-financial benefits of a cleaner environment which would reduce the risk of floods. Household indicated that regardless of the situation, waste is managed, 'anyhow and somehow'.

Plate 6: Blocked Drains Due to Solid Waste Accumulation in Kalikiliki Settlement.

Source: Field Photos, 2017

5.5.6. Waste Separation

Waste separation was another challenge faced in solid waste management. It was revealed that 74.04 percent do not separate waste before disposal and this makes any recovery, reuse and recycling difficult. In view waste separation, respondents made the following submission.

One respondent had the following views:

There is no need to separate because everything is waste and it will all be disposed to the same dump place (Respondent from kalikiliki settlement, March 15th 2017).

Similar to the above response, another respondent stated that:

We do not separate because it reduces on cost of paying for separate bags (Respondent from Kalikiliki settlement, 16th March, 2017).

One official from Lusaka city council when asked why some residents fail to separate waste, made the following remarks:

People sometimes are just ignorant of the benefits of separating waste as compared to dumping everything together (interview with an official from LCC, 19th April, 2017).

The responses on solid waste separation are summarised in the table below.

Table 5: Justification of Failure to Separate Solid Waste

Reasons for not separating waste	Frequency	Percent (%))
All is waste	126	25
All can be buried/disposed in the same way	77	15.3
cannot manage	41	8.1
Reduce costs	25	5
Easy to handle	28	5.6
Capacity	71	14.1
Ignorance	24	4.7
No need for separation	82	16.2
Burning	31	6
Total	**505**	**100**

From the results given, the implication of not separating waste means that all the different types of waste generated will be in one bag and when dumped in drainage will bloke the flow of rain water which will now lead to flooding.

This finding is in line with theory of planned behaviour by Ajzen' (1991) who opined that some actions performed by human beings are intentional. Based on this theory, one would argue that there is need for serious community awareness on the implications of indiscriminate solid waste on flood risks.

5.6. Do the methods used by households to dispose of waste contribute to flooding in Kalikiliki and Kanyama Ward 10?

It was observed in the study that there is linkage between MSWM and flooding incidents. Results shows that wherever was indiscriminate disposal of solid waste the area was flooded due to waste blocking the drainages. The blockage of the drainages also leads to localized water accumulation further contributing to flooding during the rainy season. Refer to Plate 7 that shows blocked drains due to solid waste dumps.

Kanyama ward 10 Kalikiliki settlement

Plate 7: Shows blocked drains due to solid waste dumps.

Source: Field Photo, 2017.

It was further established that wherever waste was piled up rain water cannot sink which also lead to flooding in the two settlement as shown below.

This finding can be likened to the situation in Nigerian metropolis of Lagos, were solid management and flooding is concerned. It was established by Ojolowo and Wahab (2017) that the uncollected municipal solid waste was a significant indicator of flooding as most drainage channels had been blocked. This suggest that, while cities in developing countries work to reduce flood hazard by improving the drainage networks as is the case currently in Zambia through the Millennium Challenge Account and other interventions, such engineering solutions should not be undertaken in isolation of MSWM strategies, more especially dealing with waste from the unplanned settlements.

In spite of poor solid waste management being the major cause of flooding in the two settlements in most cases, there were also other factors that lead to flooding. In the case of Kanyama Ward 10, lack of proper drainages, areas being on a rocky, swampy and population density which demands the use of all available space are among the factors which results in the restriction of free flowing of water.

This finding can be likened to the situation in Nigeria which was reported by Sulaiman and Mohammed (2019) whose findings on the substantive causes, effects and mitigation strategies of flood scenario in Yola South, Adamawa state established that heavy rainfall and river over flows, were the major factors that caused flooding in the area.

On the other hand, it was observed that the large part of Kalikiliki lies on high terrain, hence flooding is confined to the areas near the Kalikiliki stream and the dam wall area as shown in figure 11.

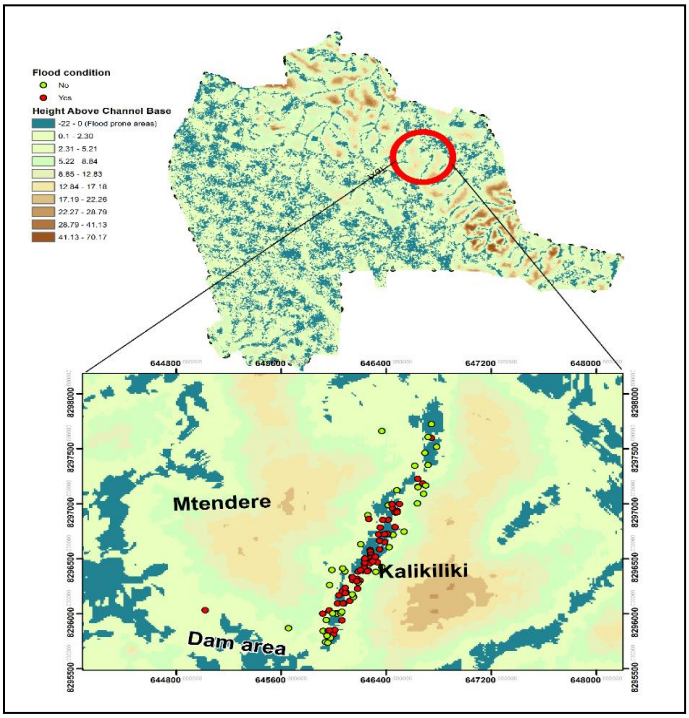

Figure 11: Flood hazard in Kalikiliki settlement based on height above channel base

Source: Field data, 2017

This finding also resonate well with Nchito (2007) who established that the drivers of urban flooding integrated two other contributing environmental factors which are geology and slope (including high groundwater table) are among the major causes of floods in the study areas.

Height above channel base has been used as an indicator of flood hazard in river basins in the Southern African region (Murwira *et al*., 2015). However, more recently, it has been used to map urban floods in Bulawayo city, Zimbabwe (Madzimure, 2017). The implication of this finding is that height above channel base is based on the idea that all areas with elevation below the base of the nearest channel will potentially flood which is the case with Kalikiliki settlement where flooding is confined to the area near the Kalikiliki stream and the dam area.

The two settlements under study are built on areas that are not planned and they lack basic infrastructure such as drainages and, hence there is poor development of the natural drainage, thereby contributing to flooding (United States Army Corps of Engineers 2011). The key determinants of flooding have been established to be lack of appropriate urban planning, poor MSWM and lack of adequate infrastructure.

5.7. Chapter summary

This chapter has presented the results and given detailed discussions of the results on the link between solid waste management and flood risks in Kalikiliki and Kanyama Ward 10 settlements. It has been revealed that Poor MSWM is an increasingly important factor contributing to urban flooding in the study areas while proper MSWM has the potential to reduce risks of flooding. Attitudes of the respondents towards proper MSWM were negative in both residential areas. People did not care about the final disposal of waste resulting in indiscriminate dumping. The majority of the respondents perceived that it was LCCs responsibility to keep public places clean and that residents had no role to play apart from keeping their homes clean. Lack of knowledge by residents on their role in MSWM was an issue that contributed to failure in bringing about changed attitudes towards MSWM. Providing information to make people aware of their roles in MSWM as well as sensitization on proper disposal practices can reduce the environmental impact of flooding. The study revealed that engagement with community leaders and establishment of baseline data was important. From the discussions in the chapter, it can be concluded that attitudes of residents towards MSWM has an influence in the way waste is managed in the study areas and

that changes in people's attitudes and behaviour are essential in MSWM and that will further improve on flood risks in the two settlements under study.The next chapter gives the conclusion and recommendations of the study.

CHAPTER SIX: CONCLUSIONS AND RECOMMENDATIONS

6.1. Introduction

In the previous chapter, the researcher presented and discussed various issues that emerged in the study in line with the objectives of this research. In the current chapter the researcher gives the conclusion of the study and presents recommendations drawn from the findings of the study. The researcher also gives suggestions for further research.

6.2. Conclusions

The purpose of the study was to establish how the indiscriminate disposal of municipal solid waste contributes to urban flooding in Kalikiliki and Kanyama Ward 10 settlements. The general picture of the findings is that there is indiscriminate solid waste disposal in the two settlements and that the existing systems of MSWM by LCC in the city are not working properly which results into solid waste to clog drainage systems and waterways.

Therefore, on the type of solid waste produced by the residents in the study areas, it was revealed that two types of waste are produced which are domestic and commercial waste. Domestic waste comprises mainly of wastes that are generated from household activities. This normally includes such materials as waste paper, plastics, textiles, diapers, leather/rubber and cuts of wood, kitchen waste and yard waste. Currently there is no separation of the various types of waste at household level. Commercial Waste is generated from commercial and business houses and will normally compose of such materials as discarded office paper, cardboard and plastics. The management of this type of waste like for domestic waste is also not well defined. This is exhibited by the presence of piles of uncollected waste in the study areas.

The study further established that distance to the solid waste disposal, lack of vehicle by LCC to collect solid waste on time, financial constraints by the residents to pay for solid waste collection and LCC not taking an active role in educating the public on proper methods for waste disposal in the two settlements have been the challenges associated with solid waste disposal.

On the aspect of methods of disposing the waste, it was revealed that burying in the pits, burning and dumping at illegal dump sites within the nearby areas to the households were the common methods of waste disposal. In spite of these common methods of waste disposal, few residents

managed to pay for waste disposal. However, those who pay for waste disposal mostly pay to private individuals who dump anywhere, anyhow because they are not LCC employees and cannot be allowed to dump at the formal dump site for free. This has led to residents and private collectors dumping their waste where ever they want, along the roads, market places, drains and even in the play grounds which results into disturbing the flow of water during rainy season.

From the results given, it is clear that there is a linkage between solid waste management and flood risks in the two settlements due to the presence of solid waste nearby houses and drainages which disturbs the flow of water. While rampant blockage of both natural and manmade drainage system by solid waste may be largely to blame for flooding, partly the problem can be attributed to poor physical planning, poor environmental management, the topography of the area, land use and land cover alterations.

6.3. Recommendations

Based on the findings, the following recommendations have been made;

- **a)** Ministry of local government and rural development through LCC should provide waste receptacles in large quantities and place them at intervals of not more than 200 metres apart in both settlements and even commercial areas. This can be achieved through public private partnership (PPP) since government alone cannot manage to provide communal containers alone.
- **b)** Mobile courts should be established to try offenders of indiscriminate solid waste dumping and if found guilty, the offender should be fined a relatively substantial amount.
- **c)** Ministry of local government and rural development through LCC should necessarily take steps to educate the citizenry on waste reduction and separation as a matter of national policy.
- **d)** The Ministry of local government and rural development through the LCC should provide transport from the secondary storage to the final disposal site of waste. If government has no capacity of collecting from secondary storage to the main dump site then, they should get CBEs with capacity to transport waste to the final destination regardless of which settlement they reside in. Tendering should be based on capacity to deliver services and not where one is residing.

e) Clear government policies and competent bureaucracies for management of solid waste are needed urgently especially with rapid population growth through urbanization into peri-urban areas to enforce SWM. ECZ and the Local Governments, in this case it is LCC should develop a long term integrated SWM plan.

f) The Ministry of local government and rural development should be holding community activities like collaborative cleaning campaigns to raise awareness of the community on SWM. This is a good practice for good SWM begins at home.

g) The Ministry of local government and rural development should recruit/train more waste management personnel, and intensify regular waste collection.

6.4. Future Research

In line with the findings, further studies are required to interrogate the knowledge gap particularly on the sources, pathways and receptors of urban floods due to MSW.

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APPENDICES

Appendix I: Interview Schedule for Key Informants

The University of Zambia

School of Natural Sciences

Department of Geography and Environmental Studies

Key informants interview guide

1. How is your institution involved in flood risk reduction and preparedness in Lusaka?

2. Does your institution focus on a particular role or many in mitigating against floods?
3. Based on your role in disaster preparedness and response, how does solid waste contribute to urban flooding in Lusaka?
4. How would you describe the current and passed solid waste management systems in relation to urban flooding in Lusaka?
5. Based on your understanding of the entire solid waste management chain, where were the major flaws? Use examples.
6. Out of a ten-point scale, how would you rate or describe the existing solid waste management systems in Lusaka?
7. Based on your institutional roles in mitigating against floods and flood effects in Lusaka, how does the nature of urban planning and land use contribute to urban flooding in informal settlements?
8. How does infrastructure planning and management (roads, drainage, and solid waste management) imped your efforts to mitigate against flood occurrence and flood risk?
9. How does your institution integrate solid waste management and infrastructure planning in mitigating against floods and flood risk in informal settlements in Lusaka?
10. How does your role get integrated in the Lusaka district disaster response framework?
11. What are the decision-making systems and platforms for flood risk reduction and response?
12. What are the key considerations in decision-making to mitigate against floods and flood risk?
13. How have these platforms shaped or influenced flood disaster preparedness and response since 2000? Use specific examples to explain your answer.
14. What mechanisms are used to disseminate information and decisions about flood disaster preparedness and response?
15. Is there any discrepancy between the decisions made and the actions taken to mitigate against floods?
16. Why does this discrepancy exist?
17. How does the current and passed institutional arrangement affect flood mitigation and flood risk reduction?
18. What improvements would you propose to improve institutional performance to mitigate against floods and flood risk?

19. With your experiences, which actor would you recommend to assume the coordination role in mitigating against flood occurrence and flood risk reduction?
20. What are your final reflections on the subject?

Thanks you for your time!

Appendix II: Flood Condition Assessment Data Sheet

Residential area……...

Date……. Enumerator ID……

X	Y	Flood present(yes/no)	Waste effect(yes/no)	Land use/land cover(place flooded)

Appendix III: Waste Dumping Sites Data Assessment Data Sheet

Residential area……...

Date……. Enumerator ID……

X	Y	Formal dump site	Informal dump site-acceptable	Informal dump site-unacceptable	Land use Land use/land cover(place with waste)

Appendix IV: Questionnaire: Flood Occurrence, Impacts and Response at Household Level

The University of Zambia

School of Natural Sciences

Department of Geography and Environmental Studies

Questionnaire code_____ Interviewer ID_____ Residential area_____

Date_____ GPS COORDINATES_____

A. basic household information

1. What is your gender? A. Female B. Male.
2. Household size? Below 15 years_____ Above 15_____Total_____
3. How old are you? _____
4. What is your marital status?

   A. single B. Married C. Separated D. Divorced E. widowed

5. What is your highest level of education?

   A. None B. Primary C. secondary D. college E. university

6. How long have you lived in this area? _____ (specify period unit)
7. Kindly estimate your current monthly household income_____
8. State the sources of your household income?
9. Ownership of house property A. Tenant B. Landlord C. Others specify _____

10. How often do you experience floods?

Frequency	Always	More often	Often	Rarely	Never
2016/17 season					
	Always	More often	Often	Rarely	Never
Past years					

11. Kindly tick which month the floods started and ended; also when you experienced the worst flood incidence this year

	Start	End	Worst incidence
December			
January			
February			
March			
April			

12. How did the floods affect you?

A. House_____

B. Roads_____

C. Waste

D. Water

E. Sanitation(toilet)

F. Others (specify

13. How did you manage to survive through the flood effects?

	What did you do as a result of the flood effects?
House	
Roads	
Waste	
Water	
Sanitation (toilet)	
Health	
Income	
Others (specify	

14. What did you do to protect (ukuchingilila, kukwabililia, kutotonza), against floods and their impacts?

a. As an individual

b. As a community

15. What challenges did you face in your efforts to mitigate against the harmful impacts of floods?

a. As an individual

b. As a community

PART 3: LESSONS LEARNT (PLENARY DISCUSSIONS)

1. Intuitional coordination
2. Policy guide
3. Practice
4. Role of the government
5. Role of the council
6. Role of Politicians
7. Role of private sector
8. Planning in the face of flood related risks and disasters
9. Suggested frame work of action

Thanks you for your time!

Appendix V: Household Questionnaire- Solid Waste Management

The University of Zambia

School of Natural Sciences

Department of Geography and Environmental Studies

Questionnaire code_____ Interviewer ID_____ Residential area_____ Date_____ GPS COORDINATES_____

SECTION A

A. Basic Household Information

10. What is your gender? A. Female B. Male.
11. Household size? Below 15 years_____ Above 15_____Total_____
12. How old are you? _____
13. what is your marital status?

A. Single B. Married C. Separated D. Divorced E. Widowed

14. What is your highest level of education?

A. None B. Primary C. Secondary D. College E. University

15. How long have you lived in this area? _____ (specify period unit)
16. Kindly estimate your current monthly household income_____
17. State the sources of your household income? _____
18. Ownership of house property A. Tenant B. Landlord C. Others specify _____
19. Describe of house you live in

SECTION B

A. Type and Quantification of Waste

1. Which of the following types of waste do you generate in your household?

Type of waste generated	Tick √	Estimated Quantity				
Paper						
Plastic						
Food						
Sanitary waste						
Bottles and cans						
Debris						
Others (specify)						

2. Do you separate your waste? Yes No

Reason_____

3. If the answer is yes, where do you take the separated waste? _____

4. How much do you pay for waste collection per month? _____

If no payment, explain why? _____

_____

5. To whom do you pay?

- Council [ ]
- Private companies [ ]
- Private individual [ ]
- Others (specify) [ ]

6. How often do you pay?

- Daily [ ]
- Weekly [ ]
- Fortnightly [ ]
- Monthly [ ]
- Upon Collection [ ]

7. How often is waste collected from your home by the contracted party?

- Daily [ ]
- Weekly [ ]
- Fortnightly [ ]
- Monthly [ ]
- More than a month [ ]
- Never [ ]

8. If waste is never collected, how do you dispose of your waste? (Tick what is applicable)

- Pit [ ]
- Burn [ ]
- Toilet [ ]
- Council dumpsite [ ]
- Others (specify) [ ]

9. Kindly state your views on the formal dumping sites in terms of the following aspects

1. Distance……
   …….
2. Waste Collection…….....
   …….
3. Waste Collection Fees…….....
   …….

11. What action should be taken to improve on waste collection by:

A. Government/ Council

…….

……

……

…….

B.

Community……

…….

……

……

…….

C.

Individuals…….....

.....

……

…….

Thanks you for your time!

Appendix VI: Focus Group Discussion Guide

PART 1-ASSESMENT OF THE CURRENT STATE

A. FLOOD MANAGEMENT SYSTEMS

	Problem context		**Flood management systems**						**Action points**
Period-2016-17	Prone area	Causes of floods	Response system	Actors/ structures	Roles	Coordination at various scales	Success	Failures	Way forward

B. SOLID WASTE

	Problem context		**Solid waste management systems**						**Action Points**
Period-2016-17	Areas with volumes of solid waste	Causes of waste accumulation	Waste disposal system	Actors/ structures	Roles	Coordination at various scales	Success	Failures	Way forward

C. Necessary factors /conditions for change for the Better-Perquisites for change for the better (reflections on the roles/practices by various actors)

PART 2: **Assessment of Changes**

D. FLOOD MANAGEMENT SYSTEMS

Problem context		Flood management systems						Action points
Prone area	Causes of floods	Response system	Actors/ structures	Roles	Coordination at various scales	Success	Failures	Way forward

E. SOLID WASTE IN HISTORY

Problem context		**Solid waste management systems**						**Action Points**
Prone area	Causes of waste accumulation	Waste disposal system	Actors/ structures	Roles	Coordination at various scales	Success	Failures	Way forward

PART 3: Lessons Learnt (Plenary Discussions)

1. Intuitional coordination
2. Policy guide
3. Practice
4. Role of the government
5. Role of the council
6. Role of Politicians
7. Role of private sector
8. Planning in the face of flood related risks and disasters
9. Suggested frame work of action

Thanks you for your time!