

**ANALYSIS OF DOMESTIC SOLID WASTE MANAGEMENT AND WILLINGNESS TO  
PAY FOR SOLID WASTE COLLECTION IN INFORMAL SETTLEMENTS OF  
MZUZU CITY, MALAWI**

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**A THESIS SUBMITTED TO THE FACULTY OF ENVIRONMENTAL  
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## DECLARATION

I hereby declare that this thesis titled, “*Analysis of Domestic Solid Waste Management and Willingness to Pay for Solid Waste Collection in Informal Settlements of Mzuzu City, Malawi*” has been written by me and is a record of my own research work. All citations, references, and ideas borrowed from other sources have been duly acknowledged. This thesis is being submitted in partial fulfilment of the requirements for the award of a Master of Science degree in Sanitation at Mzuzu University. None of the present work has been submitted previously for any degree or examination at any other University.

.....

Student’s name & Signature

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Date

**CERTIFICATE OF APPROVAL**

The undersigned certify that this thesis is a result of the author’s own work, and that to the best of our knowledge, it has not been submitted for any other academic qualification within Mzuzu University or elsewhere. The thesis is acceptable in form and content, and that satisfactory knowledge of the field covered by thesis was demonstrated by the candidate through an oral examination held on: 24<sup>th</sup> September, 2020.

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## ABSTRACT

Previous reports show that there is limited formal solid waste collection in informal settlements of Mzuzu City. Furthermore, there is scanty data about willingness to pay (WTP) for solid waste collection services. The main objective of the study was to evaluate domestic solid waste disposal methods and willingness to pay for solid waste collection in informal settlements of Mzuzu City, Malawi. Data was collected through household surveys, key informant interviews, focus group discussions (FGD's), and observations. Simple random sampling was used to select households. Purposive sampling was used to select the key informants and FDG participants. Descriptive statistics and binary logistic regression analysis were used to analyse the data in Statistical Package for Social Scientist (SPSS). The study found that rubbish pits were the common disposal method (78.2 %). Indiscriminate solid waste disposal was rampant to an extent that baby diapers were seen in open spaces. The study further found that majority of respondents (85.8%, n=600) were willing to pay for solid waste collection at an average amount of K1, 507.38 (\$2.09) per month. Bid amount and income were the only determinants of WTP. The study also found that the best initiatives for solid waste collection include: encouraging public-private partnerships in waste management and enforcing the 3R's of reduce, reuse, and recycle. Other initiatives observed were; conducting awareness campaigns and composting. In conclusion, high WTP indicates that households want the current solid waste management situation to improve. The study recommends collection of wastes in informal settlements and intensifying awareness campaigns on best waste management practices. Furthermore, there is a need to establish an active solid waste collection cooperative which will facilitate collection of huge amounts of wastes for sell or recycling.

**Key words:** Informal Settlements, Domestic Solid Waste, Solid Waste Management, Solid Waste Collection, Willingness to Pay, Mzuzu City.

### **DEDICATION**

This work is dedicated to my dear granny (Ananyati) for her constant encouragement and prayers, to my sister Faith, my parents, siblings, my son Jotham and my lovely wife Chikondi who always see the best in me.

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## **ACRONYMS AND ABBREVIATION**

DCCVM	Dichotomous Choice Contingency Valuation Method
CBO	Community Based Organisation
CSO	Civil Society Organisation
CVM	Contingency Valuation Method
FGD	Focus Group Discussion
FSM	Faecal Sludge Management
GOM	Government of Malawi
GPS	Global Positioning System
HH	Household
KII	Key Informant Interviews
ISWM	Integrated Solid Waste Management
KGS	Kilograms
KSHS	Kenyan Shillings
NSO	National Statistics Office
NEP	National Environmental Policy
NRWB	Northern Region Water Board

NSP	National Sanitation Policy
MCC	Mzuzu City Council
MK	Malawi Kwacha
MSCE	Malawi School Certificate of Education
MSW	Municipal Solid Waste
MSWM	Municipal Solid Waste Management
NGOs	Non-Governmental Organisations
PUSH	Peri-Urban Sanitation and Hygiene
SADC	Southern Africa Development Community
SOLDEV	Synod of Livingstonia Development Department
SPSS	Statistical Package for Social Scientists
SWM	Solid Waste Management
WTE	Waste to Energy
WTP	Willingness to Pay
WRC	Water Research Commission
USD	United States Dollar
UNEP	United Nations Environment Programme
USEPA	United States Environmental Protection Agency



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## CHAPTER 1: INTRODUCTION

### 1.1. Background of the study

Solid waste management (SWM) is problematic in unplanned settlements of developing countries due to indiscriminate solid waste disposal emanating from negative perceptions about wastes, ineffective solid waste collection, lack of coordination among stakeholders and neglect by public authorities (Kasala, 2014; Njoroge *et al.*, 2014). United Nations (1997) define SWM as the supervised handling of waste material from generation at the source through the recovery processes to disposal. The supervision is usually done by government authorities such as city councils and municipalities. The sole purpose of SWM initiatives is to deal with concerns of the environment, health, aesthetic, land-use, resource, economic and social issues associated with indiscriminate disposal of waste (Henry *et al.*, 2006; Wilson, 2007; Nemerow, 2009; Owusu, 2010). Solid wastes should therefore, be managed properly to achieve the desired purposes of the SWM initiatives.

Globally, about 7-10 billion tonnes of wastes are generated every year while 3 billion people lack controlled disposal facilities (UNEP, 2015). Furthermore, solid waste produced by about 2 billion people worldwide, is also not collected leading to indiscriminate disposal of wastes. Uncollected waste is of great concern because it presents serious risks to public health by blocking drains, creating stagnant ponds, and providing a conducive environment for mosquitos and other flies to multiply (Baig, 2013). This leads to the spread of water related and water borne diseases such as Malaria and Cholera. Ineffective SWM escalates cases of morbidities and mortalities in communities (Desa *et al.*, 2011). Indiscriminate disposal of waste results in pollution of agricultural soils, contamination of surface and groundwater, foul odours, spreading of disease vectors and potential fire hazards (Ahsan, 2014; Nnaji 2015).

Furthermore, indiscriminate solid waste disposal causes increase in greenhouse gases leading to climate change and frequent flooding due to blockages of drainages (USEPA, 2002). The magnitude of the effects of indiscriminate solid waste disposal cannot be overemphasized as they are so ubiquitous in our societies. This therefore, should signal collective efforts from individuals, public authorities, the private sector and non-governmental organisations (NGO's) to combat indiscriminate solid waste disposal to improve solid waste management.

In most developing countries such as Malawi, city councils or municipalities are mandated to be the overseer of solid waste management. The solid waste generated in municipalities or cities is referred to as 'municipal solid waste' (MSW). Factors which influence generation of solid wastes in municipalities include; economic conditions, living standards, urbanisation, and population (Liu & Wu, 2011). The quantity and characteristics of MSW are influenced not only by living standards and lifestyle but also the type and availability of natural resources in that particular region or country (UNEP, 2005). Bhada-Tata and Hoornweg (2012) observed that, MSW includes 'all types of solid waste generated by households and commercial establishments, which are usually collected by government authorities'. Globally, the effects of poor municipal solid waste management (MSWM) are felt greatly in most cities and towns of developing countries which are rapidly growing (Seik, 1997). Poor solid waste management not only has health and environmental implications but it also has social and economic implications (Owusu, 2010; Mesjasz-Lech, 2014). It is therefore, crystal clear that poor SWM has adverse effects and these should be an eye opener to everyone to give SWM all the attention it deserves to offset the implications.



SWM also has linkages with faecal sludge management (FSM) since non regular removal of solid waste especially in peri-urban/ informal settlements causes' solid waste to end up in pit-latrines hence accelerating pit-latrines fill up rates and negatively affecting mechanical desludging (Still & Foxon, 2012; WRC 2015). Emphasis should therefore, be put on the fact that the sanitation value chain is affected by indiscriminate solid waste disposal in pit latrines (WRC, 2015). Furthermore, consideration for the future of faecal sludge management proposes a focus on “solid waste removal in informal settlements” with possible privatisation of informal recyclers (WRC, 2015). It is necessary that SWM should be both effective and efficient to prevent undesirable consequences on environment, health and the ecosystem at large (Subhan *et al.*, 2014). Therefore, SWM has to be integrated and sustainable in nature.

In Malawi, there is an increase in unplanned settlements and rapid population growth in urban areas resulting in poor sanitary conditions and inadequate domestic waste disposal (Spong & Walmesly, 2003). This poses a great threat on public health and environmental degradation.

It should be noted that most waste management problems in Malawian cities emanate from inadequate financial muscle, technical expertise and necessary equipment such as waste collection vehicles from mandated institutions (Zezeza-Manda, 2009). This is exacerbated by limited awareness on waste separation interventions. Unlike Malawi, other developing countries such as Tanzania and Kenya are improving solid waste management through appropriate initiatives. These initiatives include solid waste collection by local entrepreneurs and community-based organisations (CBO's), awareness campaigns, alliance among stakeholders, placing bins in communities and composting (Kasala, 2014), among other initiatives.

Malawi can therefore, borrow a leaf from such successful solid waste management initiatives. One study in Lilongwe Malawi's capital city, by Assa (2014) revealed that there is willingness to pay (WTP) for solid waste collection. However, WTP particularly in informal settlements, which often remains underserved from public services such as waste collection is not known. WTP is the maximum amount an individual is willing to sacrifice to procure a good, a service or avoid something undesirable.

Mzuzu City is number three in size among cities in Malawi and has a population of 221,272 (NSO, 2018). An environmental impact assessment for the waste management facility revealed that about 22000 metric tonnes of wastes are generated per year showing an approximate average of 171 Kilograms per inhabitant (Mzuzu City Council, 2013). Mzuzu City had one refuse truck which is constantly affected by breakdowns and cannot suffice to collect waste in all residential areas with informal settlements being affected the most. Mzuzu City by-laws (2016) mandate households to manage their own refuse preferably by use of dug pits. However, more solid waste is seen disposed indiscriminately by households and there are no household solid waste collection services in informal settlements. Mzuzu City has a waste management facility called Msilo but it is not being fully utilised. Recently, there has also been misunderstandings with the communities who are not happy to see solid waste simply dumped in the Msilo facility. With these SWM challenges, it is necessary to evaluate domestic solid waste disposal methods and willingness to pay for solid waste collection especially in the informal/unplanned settlements.

## **1.2. Problem statement**

The National Sanitation Policy (2008) acknowledges that solid wastes management is a problem in Malawian cities. Domestic solid waste is being poorly managed in Mzuzu City. This is evidenced by sights of wastes disposed indiscriminately as one moves around roads, drains, streams, bushy areas and in households. The situation is even worse in the informal settlements. A study by Red Cross (2015) revealed that 41% of the studied households dispose wastes on bare grounds in low- income areas of Mzuzu City. Disposal of solid wastes on bare grounds is detrimental to the environment and public health. Population in Mzuzu City is growing at an annual growth rate of 4.4 % with an expected projection of 522, 000 dwellers in 2030 (Mzuzu City Council, 2013). National Statistical Office (2018) indicated that Mzuzu City experienced the highest inter-censual growth rate between 2008 and 2018 at 5.4 %. There is thus an increase in urbanisation and growth of informal settlements in Mzuzu leading to generation of more solid wastes.

Solid wastes are also deposited in drains as a way of expanding one's land due to lack of land in informal areas (Zezeza-Manda, 2009). Residents in Mzuzu also dispose solid waste in hand dug pits. Although disposing wastes in dug/rubbish pit is seen less adverse as it is encouraged by Mzuzu City by-laws (2016), there is a potential for groundwater contamination from inorganic waste especially in areas of high water tables. From the wastes generated in the city, few wastes (7%) are collected by Mzuzu City Council (MCC) and this is mainly from the commercial and industrial areas. Solid waste collection services do not exist in most residential areas and waste collection is done sporadically in the few areas it exists leading to water pollution, spread of disease causing vectors, odours and boring sites (Mzuzu City Council, 2013). Lack of solid waste collection especially in informal settlements promotes indiscriminate disposal of wastes.

This is exacerbated by lack of knowledge on initiatives which can mitigate indiscriminate solid waste disposal. This study therefore, seeks to evaluate solid waste disposal practices and household's willingness to pay for improved waste services and to examine the initiatives for mitigating indiscriminate solid waste disposal at household level.

### **1.3. Study Objectives**

#### **1.3.1 Main Objective**

To evaluate domestic solid waste disposal methods and willingness to pay for solid waste collection in informal settlements of Mzuzu City, Malawi.

#### **1.3.2. Specific Objectives**

The specific objectives of the research were:

- a) To evaluate methods of domestic waste disposal in informal settlements of Mzuzu City
- b) To examine household's willingness to pay for solid waste collection in informal settlements of Mzuzu City
- c) To assess the determinants of willingness to pay for solid waste collection in informal settlements of Mzuzu City
- d) To examine initiatives in the community which can mitigate indiscriminate solid waste disposal in informal settlements of Mzuzu City

#### **1.3.3. Research questions**

Based on the problem context and the outlined objectives, this research study answered the following questions:

- a) What are the methods of domestic waste disposal practiced by households in informal settlements of Mzuzu City?

- e) By how much in Malawian Kwacha would households be willing to pay for solid waste collection in informal settlements of Mzuzu City?
- f) What are the determinants for willingness to pay for solid waste collection in informal settlements of Mzuzu City?
- g) Which initiatives in the community can mitigate indiscriminate solid waste in informal settlements of Mzuzu City?

#### **1.4. Justification of the study**

Solid wastes are not being managed properly in Mzuzu City. Mzuzu City is expanding exponentially with an influx of urban dwellers and more developmental projects. With the increase in population, urbanisation, economic growth and changes in lifestyle the amount of waste generated is expected to be higher than before hence greater health, social and environmental effects from poor solid waste management.

Solid waste collection as a measure for mitigating indiscriminate solid waste disposal can be done by sanitation/solid wastes entrepreneurs (private sector), CBO's and NGO's. However, there is not much information on willingness to pay for door to door wastes collection. This study intended to bridge the existing gap by examining individual's willingness to pay in Malawian Kwacha for solid waste collection per month. The study is expected to assess the determinants of willingness to pay. The study findings will provide opportunities to the private sector to find potential areas for business in regards to solid waste management. There is also lack of information on implementation of effective initiatives which can be used in the informal settlements to mitigate indiscriminate solid waste disposal in Mzuzu City. This study will therefore, also address that.

### **1.5 Study limitation**

Data collection for the household surveys was mainly collected in the dry season and did not include the rainy season. This may have an effect on the respondent's perceptions on the estimated amount of waste generated since the quantity of waste generated in the dry season may differ with wet season. Furthermore, during the course of the study, fire gutted down offices of the Director of Health and Social Services of MCC. Luckily, the incident happened after the principal investigator had already reviewed most of the documents. It is therefore, assumed that all relevant secondary data was collected before the fire gutted down the office. Finally, the study used contingency valuation method (CVM) whose weakness is biasness which may be introduced by those who may have personal motives. That may have somehow affected this study. To arrest the problem, enumerators were trained prior to data collection on how they could prevent any form of bias. Furthermore, CVM is based on assumptions that people will do what they say but this may not always be true therefore, we can safely conclude that the validity of this study was not significantly compromised.

## **CHAPTER 2: LITERATURE REVIEW**

This chapter presents supporting literature from published books, articles from peer reviewed journals and reports. Solid waste management in Africa and willingness to pay is clearly elaborated to give a clear benchmark of the topic under study. Solid waste disposal methods, challenges, opportunities and attitudes will be articulated to show the current situation in households and municipalities. Of great interest are case studies from developing countries which have dealt with indiscriminate waste disposal and have provided best initiatives on solid waste management particularly in informal settlements. Furthermore, this literature has been reviewed by targeting specific objectives. Lastly, the literature review was summarised to show gaps that will be filled by this study.

### **2.1 Overview of Solid waste management and/ disposal**

The common practice of managing waste in Sub-Saharan Africa and other low-income countries is dumping (although quantitative data is not clear) which is a non-sustainable method (Bhada- Tata & Hoornweg, 2012). Dumping is non-sustainable because it pollutes groundwater and gives room to spreading of disease vectors. Apart from dumping, the other common waste management practices in general are land filling, composting, waste to energy (WTE), and recycling. Pichtel (2005) found that there are basically 5 ways of managing wastes and thus dumping, incineration, composting, recycling and reusing. Coffey & Coad (2010) observed that municipal solid wastes can be disposed in 3 ways namely: open dumping, controlled dumping and sanitary landfill. In open dumping, wastes are unloaded anywhere on the disposal site and everyone has access to them including waste pickers. While in controlled dumping, access to the disposal site is limited

only to authorised personnel and a fence is built to prevent scavenging, wild fires and other poor waste management practices.

The best out of these three disposal method is sanitary landfill whose objective is to ensure that solid wastes are disposed in a way that causes minimum impact on the environment and at minimum cost. Achankeng (2003) observes that most of the waste management methods which have been borrowed from western cultures through globalisation such as incineration and waste-energy recovery, waste reduction and recovery, composting, and landfills have proven to be futile in African cities.

Furthermore, municipal solid waste management is based on trial and error leaving most countries without a viable and sustainable solid waste management method. On the contrary, Awuyor-Vitor *et al.*, (2013) observed that in Africa there is growing use of biogas and compost and there is progress in developing countries although issues like polluter-pays principle and other economic instruments for solid waste management are still lagging behind.

At household (domestic) level, solid wastes are either collected to be disposed at municipality level or households dispose the wastes themselves. In low -income countries solid waste are usually deposited on bare grounds, in dug pits, in drains, along roads, along stream banks, open sites, and unapproved dump sites (Lambi 2001; Zeleza-Manda, 2009; Musa *et al.*, 2016). Coffey and Coad (2010) observed that households focus is on elimination of solid wastes outside the households regardless of the impact. Eliminating solid wastes just outside one's premises leads to indiscriminate waste disposal. Indiscriminate waste disposal refers to the disposal of solid and liquid wastes without taking necessary measures (Abdullahi *et al.*, 2014).



The method of waste disposal appropriate for a certain type of waste is determined by the composition of solid waste produced (Afcon, 2003). For instance, bio-degradable wastes can be disposed in dug pits to make compost.

Solid waste composition varies from region to region depending on climate, availability of natural resources, and also business activities (UNEP, 2005). The household's disposal of their solid waste is also dependent on household's socio-economic features such as income, occupation, educational level, and asset ownership, among others (Rahji and Oloruntoba, 2009). The method of solid waste disposal has implications on health, environment, economic, and social aspect of the households and communities at large. Many studies have been conducted to assess, analyse, and evaluate the effects of the waste disposal method. Of great interest in most studies has been the indiscriminate disposal of waste (Desa *et al.*, 2011; Baig 2013; Ahsan, 2014; Nnaji, 2015). In developing countries, the genesis of indiscriminate disposal can be traced from the common attributes of such countries such as poverty, population growth and poor governance (Adewole, 2009). In a study by Subhan *et al.*, (2014), most households did not prioritise waste management. Their emphasis was on other social economic issues such as education and food security thereby translating into low willingness to pay for environmental management. Poor management of solid wastes at household level mounts enormous pressure on the municipality authorities when dealing with solid waste management (Joel *et al.*, 2012).

Attitudes or perceptions of people also play a great role in solid waste management. Kwailane *et. al* (2014), found that individuals in Lobatse, Botswana, were non-committal about having to pay for the collection of their waste or having to be paid for participating in domestic waste management activities.

This was attributed to negative attitudes or perceptions among individuals. A study by Musa *et al.*, (2016) in Minna, Nigeria also found that the residents had poor attitudes and perceptions towards waste handling such that waste was stored in uncovered sub-standard garbage containers such as old buckets and sacks.

Subhan *et al.*, (2014) also observed that the acute obstacle in SWM is lack of progressive attitudes and involvement especially from the public in successful waste management. For instance, waste management procedures such as recycling and reuse are greatly impinged by variations of how people perceive the importance of wastes (Jha *et al.*, 2011). Low-income households have high propensity of conducting waste separation, reusing and recycling as a source of income unlike high income households who have an affirmative willingness to pay for waste collection services and buying of new materials (Banga, 2011). Attitudes and perceptions on SWM can easily be influenced by the average income of the household (Longe *et al.*, 2009). In a study by Desa *et al.*, (2011), among first year students, it was found that they had negative attitudes towards SWM particularly because of their low educational level. Positive attitude towards environmental management is therefore directly proportional to the educational level of the population. Households who have access to information on SWM have high chances of eliminating negative attitudes towards SWM and are involved in waste separation prior to disposal (Juma and Kendi, 2015).

### **2.1.2 Challenges of Solid waste management in informal settlements of developing countries**

In most cities of developing countries solid wastes are disposed indiscriminately (Medina, 2010). The effects of the indiscriminate disposal are greatly felt in informal settlements. Informal settlements are characterised by lack of proper solid waste management systems, proper infrastructures such as roads, sewerage and drainage systems and lack of improved sanitation and are usually flooded (Kasala, 2016).

Efforts to improve solid waste management in developing countries is hindered by high population growth rate, economic growth, and its associated activities coupled by lack of advanced knowledge in solid waste management (Ejaz and Sadiq 2012; Ahsan *et al.*, 2014). As developing countries are growing economically, there are high rates of urbanisation in cities and consequently more wastes are produced making SWM more complicated than before (Hassan, 2000). Minghua *et al.*, (2009) agrees with Hassan (2000) that in developing countries escalation in population especially in urban areas and the rise in people living in informal settlements in cities significantly contributes to mass production of solid waste.

Njoroge *et al.*, (2014) observed that although SWM is a great challenge in informal settlements. This is so because public authorities usually neglect informal settlements and focus on high income and industrial areas. Furthermore, SWM in informal settlements is challenged by limitations in funding resulting from failure to collect service fees (due to lack of WTP and unreachable areas), lack of coordination among stakeholders, and little involvement of the public (Kasala, 2014). Lack of stable funds limits municipalities in developing countries to sustainably manage solid wastes (Qadis 2006). Much as this is invariably true with most cities in developing countries, a study by Bhada-Tata and

Hoornweg (2012) observed that in some cities of low-income countries SWM is commonly given a large portion of the budget.

### **2.1.3 Opportunities for Solid Waste Management in Developing Countries**

Although most cities in the developing world are still facing challenges to sustainably manage solid wastes, opportunities of improvement do exist. One of the challenges municipalities face is the issue of funding, however, this can be improved by giving opportunity to households to contribute to solid waste management. For example, a study conducted by Assa (2013), found that solid waste collection can raise a total of 14 million Kwacha (USD 19,444) per month from Lilongwe residents in Malawi. This was a way of raising the financial coffers of municipalities for solid waste management. However, the situation has not yet improved. This therefore, calls for a collective effort by every individual, NGO's, private companies, and city councils to improve the system and find additional initiatives for solid waste improvement. Cooperation of households and other stakeholders in waste management sector determines the effectiveness of the solid waste collection system (Afcon, 2003).

The cooperation can be in form of provision of waste containers for storage and allowing the waste to be collected frequently. The estimated willingness to pay by Joel (2013) in Kenya improved solid waste management decision making by city planners and authorities.

Collection of solid wastes is not enough if the wastes will end up in crude dumping. This shows that the waste management facilities to accommodate the collected wastes are not enough. In Mzuzu City, there is Msilo waste management facility which was constructed

to improve the solid waste management situation in Mzuzu. From its design, it can be categorised as a controlled dumping and has compartments to accommodate waste separation, composting and landfilling of toxic and sharp wastes such as those from the electric supply corporation and glasses. The plan was to collect wastes from households, market and industrial areas which will be brought to the facility for the further management. However, recent findings reveal that chiefs want the facility to be closed because of failure of City authorities to prevent crude dumping and scavenging which is posing a hazard on public health (Nation newspaper, 30<sup>th</sup> January, 2020). The chiefs feared that another outbreak of typhoid fever like the one which occurred in 2019 in Mzuzu City. Discussions between the representatives of the community (chiefs) and City Council officials are underway. Failure of the City to manage the waste facility may negatively affect waste collection efforts. Henry *et al.*, (2009) mentioned that poor state infrastructures is one of the common reasons for poor solid waste collection in sub-saharan Africa. Cities like Dar es Salaam (Tanzania), Nairobi (Kenya), Abidjan (Côte d'Ivoire), Dakar (Senegal) and Yaoundé (Cameroon) are doing better compared to others with atleast 40% of the waste being collected (Parrot *et al.*,2009).

#### **2.1.4 Sustainable Solid Waste Management**

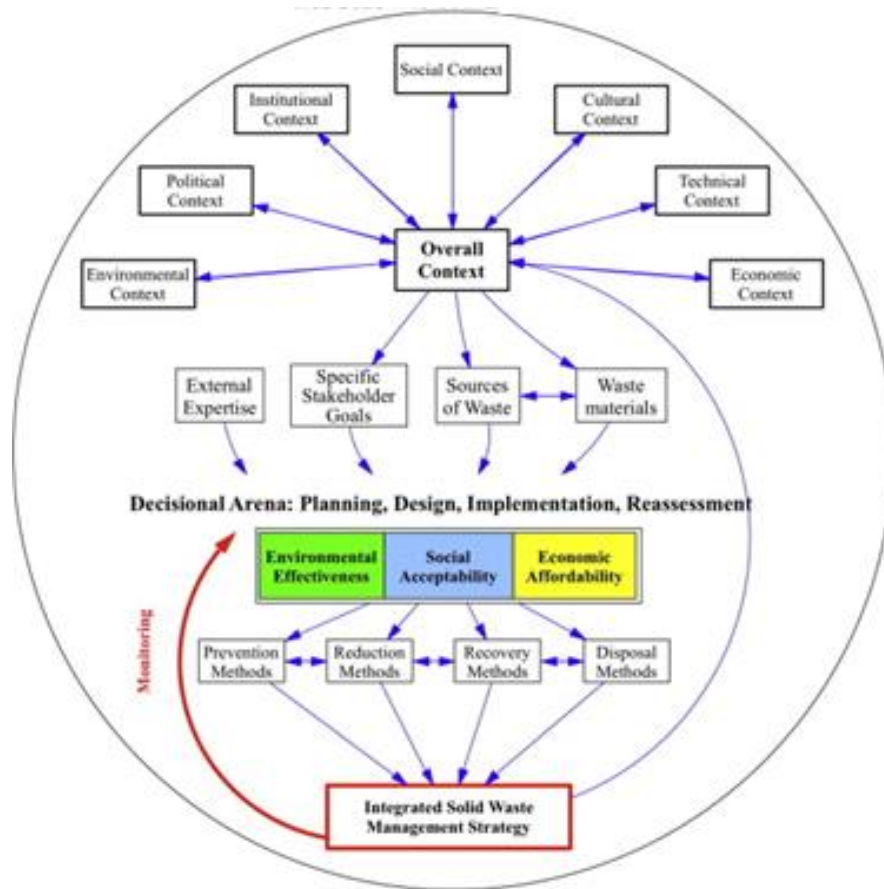
The goal of sustainable waste management is to minimise waste while enhancing the determination to uphold environmentally-correct waste management methods (Meadows, 2008). Sustainable waste management is not being practiced in most Sub-Saharan countries or developing countries (Ezeah & Roberts, 2012, Agbesola, 2013). Sustainable SWM management is very challenging at household level because it requires participation of every household to practice the 3 R's of reducing, reusing and recycling at an increased rate (Akil & Ho, 2014). The least challenge of sustainable SWM management is

characteristics of wastes (Ezeah & Roberts, 2012). Furthermore, venturing into continuous awareness raising country-wide on waste management options such as prevention and reuse can improve sustainable SWM management globally.

Ezeah (2010) explained that the ultimate objective of sustainable SWM should be perpetual upgrade of the surroundings and improved livelihoods through good public health benefits, booming of economies and provision of jobs.

### **2.1.5 Integrated Solid Waste Management (ISWM)**

Integrated waste management entails a holistic approach to scrutinise all facets (both technical and non-technical) of waste management structures because there is an interconnection which exists among them (UNEP, 2005). This prevents one-sided interventions and ensures coordinated progress in waste management. USEPA (2002) observed that the key interventions in integrated solid waste management (ISWM) includes prevention, recycling and composting, and combustion and disposal in appropriate landfills. ISWM is built on 3 balanced pillars of environmental effectiveness, social acceptability and economic affordability (Marshall and Farahbakhsh, 2013) as shown in **Figure 1**.



**Figure 1: ISWM paradigm shift**

**Source:** Marshall and Farahbakhsh (2013)

The backbone of ISWM is the waste hierarchy in which the management procedures includes the four R's of reduce, reuse, recycle and recovery (Bhada-Tata & Hoornweg , 2012). Furthermore, these procedures are succeeded by landfill, incineration, and controlled dumping as depicted in *Figure 2* of Waste hierarchy.

The most desired options are the top 3 R's; Reduce, Reuse & Recycle. Controlled dumping is the least desired option.



**Figure 2 :Waste hierarchy**

**Source:** Bhada- Tata and Hoornweg (2012).

## **2.2 Willingness to Pay for Solid Waste Management**

Municipalities in most developing countries struggle with unwillingness to pay for solid waste collection services (Sujauddin *et al.*, 2008; Onyanta, 2012). Contingency Valuation Method (CVM) is recognised as a backbone for eliciting willingness to pay for non-market goods in environmental economics such as solid waste improvement or collection (Afroz & Masud, 2011).

CVM is a method that uses hypothetical survey questions to elicit people’s preferences for public goods by finding out what they are willing to pay for specified improvements in them. Apart from CVM, the following methods are also used to elicit willingness to pay includes; hedonics, random utility and travel costs and averting behaviour models (Kopp and Smith, 2013). CVM has been widely used in solid waste management and has produced relevant results (Afroz, 2009; Banga 2011; Assa, 2013; Tariq & Rashid 2014; Bhattarai 2016; Song *et al.*, 2016).



CVM has been used to elicit WTP through open ended question approach, iterative bidding approach, payment card approach and dichotomous choice approach (Calia and Strazzera, 2000). Joel *et al.* (2013) used CVM to elicit willingness to pay and found out that residents of Eldorate municipality in Kenya were willing to pay on average Kshs 363 (\$ 3.64) per month for solid waste management improvements. The estimated WTP can be used by urban planners and city authorities to make an informed decision on socially accepted price for solid waste services such as collection. Assa (2013) used a double-bound dichotomous contingency valuation method and found that the residents from Lilongwe City, in Malawi were willing to pay for collection of household wastes. This study found a total willingness to pay estimate of MK14 million (\$19,444) per month which can provide a lasting solution to financial challenges faced by the city council. According to Boyle (1990), the dichotomous approach allows respondents to answer whether they are willing to pay for a fixed amount for the non-market good in question.

Bhattarai (2016) used single-bound dichotomous CVM and found that 83% of the households in Banepa Municipality, Nepal were willing to pay for improved solid waste management. An average of 1.69 USD per day was the garbage fee that the households were willing to pay.

The study found that the current garbage fee was far below the mean WTP of households hence there was a prospect of adjusting garbage fee upwards to collect more funds for improved SWM provision. Double-bound dichotomous CVM was also used by Afroz *et al.*, (2009) to obtain the willingness to pay of respondents to upgrade the waste collection services in Dhaka city, Bangladesh. Households were willing to pay an average of 13 Taka (\$0.15) per month, however, WTP varied between areas receiving door-to-door waste collection and those not receiving door-to-door collection.

Banga (2011) found willingness to pay in Uganda of (79.8 %) households for improved solid waste collection service. Banga (2011) also used a double-bound dichotomous CVM in eliciting WTP for door-to-door waste collection and the positive results were not in line with the common belief that people shun payment of SWM management services and shove the obligation to authorities. Addai and Danso-Abbeam (2014) also used double-bound CVM to elicit WTP and the study revealed that the majority of respondents (94%) were pleased with the current solid waste collection services.

Another study by (Tariq and Rashid, 2014) found willingness to pay of 83% of the respondents for improvement of solid wastes management system and the average value was 84 rupees (\$1.21) in Mingora, Swat, Pakistan. In their study, Song *et al.* (2016) found that most respondents (85.4 %) were willing to pay for solid waste management and also responded positively to the enquiry about WTP. On the contrary, a study by Mohsin *et al.* (2015) in one of the Pakistan's informal settlements revealed that 95% of the respondents were disposing solid wastes by themselves and 75% do not pay for solid waste management showing a low willingness to pay.

### **2.2.1 Single versus Double-Bound Dichotomous Contingency Valuation**

Contingency valuation surveys have the ability to solicit a monetary measure of welfare related with a discrete change in the provision of an environmental good (Hoyos & Mariel, 2010). This can be achieved through the following procedures; discrete choice experiment, bidding game, open-ended question, choice based conjoint analysis, contingent ranking, single- or double-bounded dichotomous choice, paired comparisons, payment card, among others. The single and double-bounded dichotomous choice has been widely used in eliciting willingness to pay for solid waste improvement (Afroz *et al.*, 2009; Banga 2011; Assa 2013; Bhattarai; 2016).

The dichotomous choice contingency valuation method (DCCVM) has been commended because follow up questions increase precision of estimates and simplicity of use in data collection (Calia & Strazzera, 2000; Ahmed and Gotoh, 2006). The DCCVM was earlier recommended by other studies for eliciting willingness to pay for households (Bishop and Heberlein 1979; Hanemann, 1984).

In single-bound-dichotomous choice only one bid is offered and the exact numerical WTP lies above the amount offered in a survey if the respondents agree to pay that amount or below if the respondents decline while in double-bound dichotomous choice respondents are offered a second bid value right after their first responses (Alberini, 1993). In an event that the respondents accept the first bid, a higher second bid is offered and a lower bid is offered when the respondents declines the first bid. This means that the interval is bounded by the second bid and the limit of the WTP distribution. To successfully obtain information of the true WTP distribution, the initial bids are varied among individuals (Calia & Strazzera, 2000).

The single-bound dichotomous choice method has gained popularity and use because of its simplicity in data collection and estimation unlike the double-bound dichotomous choice method (Calia & Strazzera, 2000). However, in terms of efficiency the double-bound dichotomous approach is greater than the single-bound dichotomous approach (Hanemann, Loomis & Kanninen, 1991). To ensure statistical efficiency for both single and double-bound DCCVM, the sample size of single-bound DCCVM should be at least 600 and double-bound DCCVM should have at least 400 samples (Fujita, Furukawa, & Ogawa, 2005).

In their Monte Carlo study, Calia & Strazerra, (2000), concluded that it is superior to use the single-bound rather than the double-bound method as long as the sample size is large enough and a dependable pre-test is done.

### **2.3 Determinants of Willingness to Pay for Improved Solid Waste Management**

Several studies have unveiled determinants of willingness to pay by households for improvement of solid waste management. The determinants are income, education, age (Dehazo 1996; Rahji and Oloruntoba, 2009 Joel *et al.*, 2012; Subhan *et al.*, 2014), amount of waste generated (Dehazo 1996), household size (Dehazo 1996; Tariq and Rashid 2014), amount of money the household is asked to pay, firm services, occupation (Rahji and Oloruntoba, 2009), available disposal methods (Joel *et al.*, 2012), race, type of house, tendency towards environmental protection and practice of recycle (Subhan *et al.*, 2014). The higher the income levels, education, the amount of waste generated and household size, the higher the likelihood of willingness to pay. The higher the education level of respondents, the higher the likelihood for preferring to have solid waste to be well managed. Those who could afford solid waste collection were more likely to be willing to pay for the services.

The higher the household size, the higher the amount of waste generated and therefore, the higher the need to have the large amounts of wastes collected. Good firm services and reduced amount of fees encouraged people to be willing to pay for the services. Type of house is seen as a symbol of wealth (income), therefore, people living in good houses are likely to demand for solid waste collection services than those who are poor and who live in bad houses. Households with more disposal methods may shun collection of wastes, for example, those who practice reuse and recycling at household level.

It is envisaged that those who have a tendency to protect the environment are more likely to be willing to pay for solid waste management. As people grow older, their tendency to protect the environment may diminish as they focus on other things. As for occupation, people with white-collar jobs may not have time to manage their solid wastes, therefore, solid waste management services by companies or municipalities is an advantage to them. Race influences culture and different cultures may have different views on willingness to pay for solid waste management.

A similar study by Niringiye and Omortor (2010) found that only age of household head is associated with willingness to pay for solid waste management improvement while weight of generated wastes, marital status, household expenditure, size of household, and education level were not determinants of willingness to pay for improvement of solid waste management. Younger household heads may care more about the environment than older people. Those who are married are more likely to have willingness to pay for solid waste management improvement than singles as they are concerned with the appearance of their home, among other factors.

An inline study in Kumasi, Ghana found out that housing arrangement, level of education, length of stay in the area, and distance to solid waste dumping sites and gender have a significant influence on the respondents' likelihood of willingness to pay for improved waste management services (Awunyo-Vitor *et al.*, 2013a). However, the amount of money respondents was willing to pay was influenced by factors such as age, income, education, length of stay, house ownership, bags of waste generated, and distance to dumping sites. The determinants of willingness to pay were varying and agreeing depending on the study and analyses used. For instance, Song *et al.*, (2016) found that it was only education level which had a significant influence on WTP.

In their study in Dunkwa-on-Offin, Ghana, Addai and Danso-Abbeam (2014) used logit analysis and found that gender, age, household size and education significantly influence household willingness to pay for improved waste management systems. On gender, females are more likely to have willingness to pay for solid waste management than men since taking care of households is usually seen as their duty culturally. Bhattarai (2016) found that bid amount, age of respondent, sex of the respondent, household size, level of education of respondent, present waste collection service and household income are the factors affecting willingness to pay for improved solid waste management.

According to Assa (2013), willingness to pay for solid waste collection is significantly affected by the level of education, concern for environmental quality, income level and satisfaction for waste collection. On the other hand, Banga (2011) found that willingness to pay and the bid amount was inclined to income, education, age, and home ownership.

#### **2.4 Initiatives for Mitigating Indiscriminate Solid Disposal**

Indiscriminate solid waste disposal is a chief concern in most urban areas and is worse in cities of developing countries (Njoroge *et al.*, 2014). This calls for innovative initiatives to mitigate this practice to prevent threats to public health, environment, social and economic issues. Developing countries should tailor-make their interventions to make them suitable for a particular area to deal with constraints of waste disposal (Rotik *et al.*, 2006). Achankeng (2003) observed that solid waste management problems in Africa can adequately be solved through local initiatives and strategies unlike imported SWM methods. These local initiatives should include decentralised participation management and collaboration among stakeholders and the government should coordinate the entire processes.

In their paper, Butu and Mshelia (2013) observed that indiscriminate disposal of waste could be mitigated through; public enlightenment of dangers of indiscriminate disposal, reassessment of waste legislature, payment of waste collection fees, promoting recycling through waste separation campaigns, coordinated surveillance of solid disposal initiatives. Butu and Mshelia (2013) shifted the responsibility of mitigating roadside dumping of solid wastes to government who should come up with proper orientation, provide necessary wastes facilities, arrange for better methods of collection of solid wastes and that environmental laws should be put in place for the general public. More so, residents should be encouraged to pay waste collection fees.

Juma and Kendi (2015), observed that indiscriminate disposal of wastes could be mitigated by educating residents through various methods such as radio, television, road shows, and circulation of leaflets and pamphlets to inspire people to practice proper SWM. It is also the role of public institutions, clergy, and other local leaders to encourage the youth, the elderly and women to adopt and participate in proper SWM practices. Juma and Kendi (2015) also proposed the introduction of an environmental week to educate everyone one and also training of waste management personnel who would in turn train communities in proper SWM practices such as reduction, composting, reuse, recycling and recovery.

Kasala (2014) in his study on the challenges of solid waste management initiatives in Keko Mchengwa informal settlements found that SWM could be successful with merging and coordination among the existing organs; placing dust-bins in strategic areas; linking solid waste collection fees to other public services provided and education; and awareness creation campaigns followed with community interface. The study found out that some of the challenges in SWM were social, financial, institutional and individual perceptions.

## **2.5 Solid Waste Management in Malawi-Legal Frameworks & Actors in SWM**

In Malawi, issues allied to waste management have been recorded in 3 frameworks namely the National Environmental Action Plan (1994), National Environmental Act (1996), and the National Environmental Policy (NEP), initially approved in 1996 and was amended in 2004 (Barre, 2014). Other frameworks include sanitation bills and public health act. All these documents tackle solid waste management. The National Sanitation Policy (2006) acknowledges that solid wastes management is a problem in cities and that there is no separation of wastes either at the source or disposal site hence making efforts of recycling and/composting difficult. The Constitution of Malawi values proper management of the environment to provide a good healthy living and working environment for all inhabitants of Malawi as echoed by the Government of Malawi (2006) in the National Sanitation Policy.

Section 2 of Environmental protection of the Laws of Malawi (2010) mandates City Councils *“to establish, maintain and manage services for the collection and removal and treatment of solid and liquid waste, and the disposal thereof whether within or without its area and may compel the use of its services by anybody of persons to whom the services are available”* (page 3144). This shows government interest to deal with solid wastes.

The NSP (2006) was later amended in 2008. Its mission is *“to ensure that all people in Malawi own and have access to improved sanitation facilities, practice safe hygiene, and practice safe recycling of liquid and solid waste for sustainable environmental management and socio economic development”*. Theme number 3.3 of the NSP (2008) focuses on sanitation and hygiene promotion and delivery of services in Cities, Municipalities, Towns, Market centres and Peri-Urban areas.



Some of the strategies in relation to solid waste management employed in the theme 3.3 are “to promote recycling and safe disposal of domestic solid waste and also “to extend solid waste refuse collection services to all residential areas and markets with active participation of communities and market committees”. NSP (2008) also calls for Non-Governmental Organisations (NGO) and Civil Society Organisations (CSO) “to promote recycling of organic, liquid and solid wastes for production of organic fertilizers and biogas wherever applicable”. Furthermore, the Government of Malawi (GOM) strategized “to train informal recyclers in solid waste management and employ them at recycling centres and landfill sites” as recorded in the NSP under theme 3.3. This paper focusses more on solid waste management and not liquid waste. The inclusion of solid waste management and involvement of stakeholders in the NSP and the other legislatures and policies above reveals the magnitude of solid waste management challenges in Malawian cities.

Solid waste management remains a challenge with greater challenges being felt in the informal settlements.

## **2.6 Mzuzu City By-Laws**

The vision of Mzuzu City Council according to 2014 to 2019 Strategic Plan, is “*By 2030 Mzuzu shall be a vibrant city for all to live, work, play, and invest*”. Mzuzu City Council is mandated to champion the safeguarding of the environment of Mzuzu from misuse and destruction (UN-HABITAT, 2011). However, the environment of Mzuzu and the health of its residents is in perilous state due pollution of water bodies and the indiscriminate disposal of waste, among others. To mitigate these threats, Mzuzu City Council developed by-laws. Part IV of the Mzuzu City By-Laws (2016), depicts *Provisions for Waste*

*Management Practices for Households, Public Places and Institutions.* Of much interest in this research are household wastes.

Every household is mandated to be kept clean and free from garbage, trash, rubbish, or such other litter or waste which is harmful to human life or deleterious to the environment. For temporal storage awaiting waste collection by the city services households are mandated to use a minimum of 50 litre bucket made of metal or thick plastic, lined with black sheet and covered with a lid. The by-laws also encourage use of waste receptacles at all areas of waste generation in the household and waste to be segregated at source;

- i. separating hazardous waste from non-hazardous waste
- ii. keeping in separate receptacles all biodegradable waste from non-biodegradable waste

Separating waste is important as it a bold step towards waste recycling. The MCC by-laws are also coherent with the 3 R's of the waste management hierarchy. Part **13.3 (f)** stipulates that MCC will be involved in; practicing waste management of 3Rs of reducing, reuse and recycling shall be promoted to reduce the amount of waste that should be collected by the Council services in order to:

- i. highly promote household/institution composting activities; and
- ii. managing waste separation to promote reuse and recycling.

The by-laws also give opportunity to households to participate in wastes management as part **14.3** stipulates that 'Any person responsible for waste generation or in-charge of any premises where waste is generated shall collect and segregate or cause to be collected and segregated any such waste'. The MCC shall also designate special sites or facilities for the purpose of community waste disposal as temporal storage area. The by-laws also

have provision of public health education. It has been observed that MCC totally forbids indiscriminate disposal of wastes in households, streets and other public places.

## **2.7 Summary of Literature review**

The literature review above, has shown that challenges and opportunities exists in solid waste management in developing countries. Simply borrowing of methods from western countries and applying them in SADC may not be the best strategies in solid waste management. Challenges of SWM range from individual level (attitudes or perceptions) to lack of capacity by authorities which lack good infrastructures such as waste management facilities. Although SWM management faces lots of challenges, other cities in Africa like Nairobi and Dar es Salaam are making huge strides in the collection of solid wastes. It has been noted that informal settlements are often neglected, and there may be opportunities of solid waste collection.

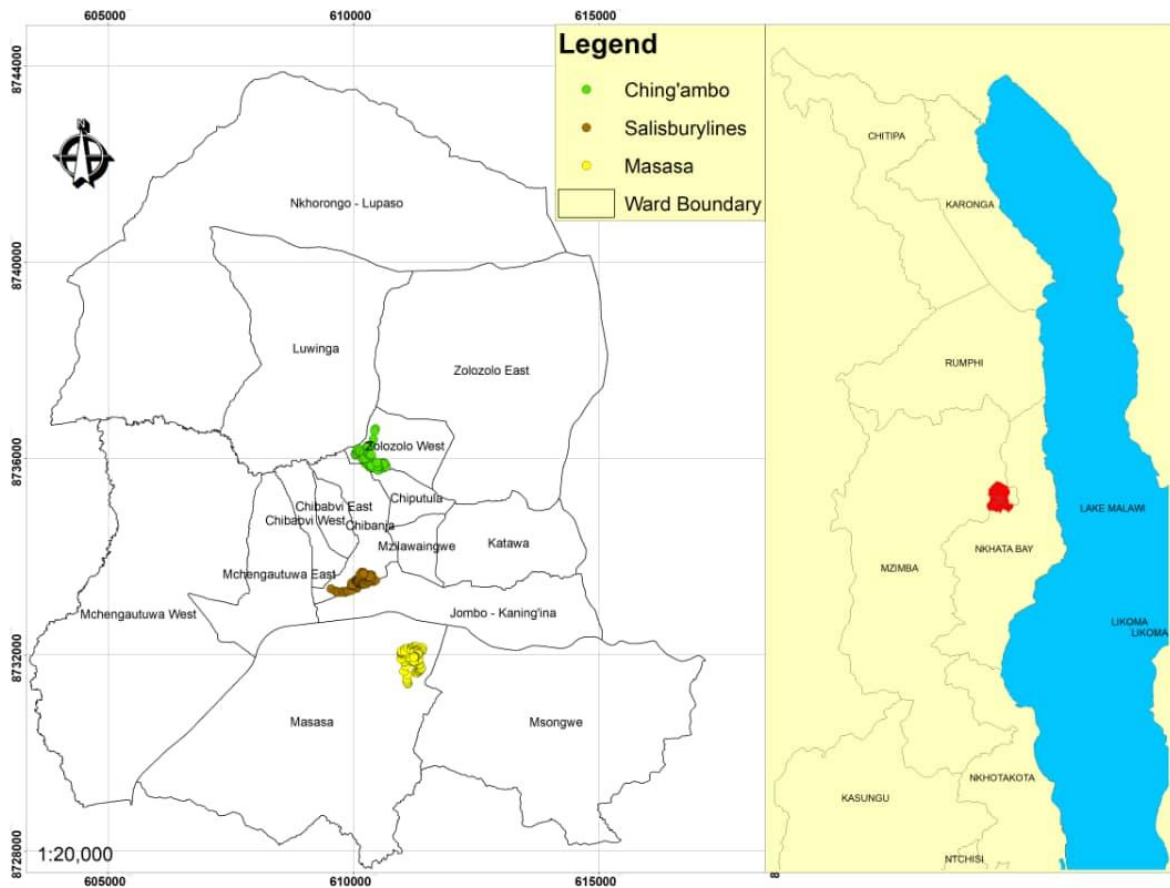
## **CHAPTER 3: MATERIALS AND METHODS**

This chapter outlines the materials and methods used to conduct the study. The chapter begins by giving an overview of the study area. The research design is then explained in detail. This is followed by an outline of sampling methods, sample size determination and a list of study participants used in this study. Data collection methods were also discussed in this chapter. Furthermore, a summary of research questions tallied with type of data and data collection technique is presented in tabular form. Finally, data analysis methods were explained to show how results of this study were are obtained.

### **3.1 The Study Area**

Mzuzu City is found in the Northern Region of Malawi and is located between latitude - 11° 26' 20.274" and S 11° 26.3379' and longitudes 34° 0' 30.384" and E 34° 0.5064'. Mzuzu City is Malawi's third largest city after Lilongwe and Blantyre with a population of 221,272 (NSO, 2018) and there is scarcity of houses which has led to the emerging of informal settlements or peri-urban areas (Zezeza Manda, 2009). The common sanitation facility in Mzuzu is onsite sanitation such as pit latrines. Sewer systems are available but only confined to few institutions like Mzuzu University, Moyale Barracks and Mzuzu Central Hospital. Zezeza Manda (2009) observed that both MCC and Northern Region Water Board (NRWB) are mandated to oversee water and sanitation in the city in accordance with the Local Government Act and Water Works Act or National Sanitation Policy (NSP) respectively. The overlapping of roles may have some negative effects on who does what. However, water supply is mainly done by Northern Region Water Board (NRWB) and the coverage was at 86% as of April 2019 in accordance to the M&E framework for the Water Efficiency Project. MCC mainly oversee sanitation issues

including issuing licences to sanitation entrepreneurs such as solid waste collectors. The map in **Figure 3** shows Mzuzu City.



**Figure 3: Map of Mzuzu City showing location of the study sites**

The informal settlements in Mzuzu include; Ching'ambo, Masasa, and parts of Mchengautuwa, Salisbury Lines, Geisha, Soweto, Nkholongo, and parts of Lubinga. The study was conducted in Masasa, Salisbury Lines, and Ching'ambo informal settlements. These informal settlements have been purposively sampled because they are characterised by unhygienic and unsanitary conditions (Mzuzu City Council, 2013). Furthermore,

Masasa, Ching'ambo and Salisbury informal settlements were selected for the study on the following basis;

- 1) Masasa is one of the densely populated informal settlement according to Mzuzu City Council Urban Profile (2013).
- 2) Salisbury Lines is closer to the central business area of Mzuzu and there were constant water-logging conditions with potential for flash floods during rainy season. This water logging can be attributed to blocked drains by indiscriminate solid waste disposal.
- 3) Ching'ambo was chosen because it also had great number of inhabitants, waste management problems and there were some studies which were conducted pertaining to water and sanitation. Therefore, it was felt that more relevant secondary data could easily be found there.

### **3.2 Research Design**

The study utilised mixed (both qualitative and quantitative) research methods. Using both qualitative and quantitative techniques was necessary in this study because the phenomenon under study was both numerical and non-numerical and data was collected concurrently using the survey questionnaire. For instance, the study intended to explore the respondent's willingness to pay for solid waste collection, assess determinants of willingness to pay and to examine initiatives which the community can employ to eliminate indiscriminate disposal. Both open-ended and closed-ended questions for the household survey and key informant interviews were employed. For example, when collecting data for solid waste disposal methods and initiatives for mitigating indiscriminate solid waste disposal hence both qualitative and quantitative data was

collected. The qualitative method allowed the investigator to probe for more information from the respondents while the quantitative methods was used to obtain values like willingness to pay amounts.

Data was collected through cross-sectional survey, key informant interviews, focus group discussions and observations. Cross-sectional surveys are advantageous for soliciting socio-economic status of the population from a sample (Creswell, 2003). Survey design was also chosen because of its capability to measure social and behavioural sciences (Kothari 2004). The Survey design has also been chosen because of its capability to measure social and behavioural sciences (Kothari, 2004). The objectives of this research are social and behavioural in nature and this is compatible with several studies in solid waste management which have utilised cross-sectional surveys (Agwu, 2012; Kiran *et al.*, 2015; Mamady, 2016; Boateng, 2016).

### **3.3. Sampling framework and methods**

#### ***3.3.1 Sampling Methods***

Firstly, informal settlements were purposively sampled as described in section 3.1 above (The study area). Secondly, households in each informal settlement were randomly sampled. Depending on the nature of the terrain and inaccessibility of some areas, simple random sampling was the best option. Simple random sampling gives each possible sample of size  $n$  an equal probability of being chosen (Beaver *et al.*, 2006). This was advantageous to the research team in an event that they found that the head of a household was not present or is unwilling to participate in the survey; they would simply proceed to the next household. Numerous studies where willingness to pay was solicited for better-

quality solid waste management has used simple random sampling for households (Awunyo-Vitor *et al.*, 2013b). Key informant interviews and focus group participants were purposively sampled. The key informants were chosen from the list of actors in solid waste management from Mzuzu City authorities.

Those chosen were active in solid waste management in Mzuzu city. As for focus group discussions, the participants were chosen from those who were willing to pay from the household survey questionnaire.

### **3.3.2 Sample Size**

The sample size in this study was 600 households, of which 200 households were selected from each informal settlement. According to population census of 2008 by NSO, Masasa, Chingámbo and Salisbury Lines had 660, 409 and 265 households respectively. As of now, the population from these areas has increased. The 600 households were chosen because of the type of data analysis to be used in this study.

Israel (2013) mentioned that the sample size should be in line with the analysis to be conducted. For example, a sample of 200-500 is representative for multiple regression or log-linear regression. This research planned to use logistic regression to analyse determinants of willingness to pay for solid waste collection. Therefore, having a sample of above 500 was an added advantage to find appropriate social and scientific results. According to a study by Fujita *et al.*, (2005), willingness to pay estimations requires a minimum of 600 respondents for a single-bound design and a minimum of 400 respondents for a double-bound dichotomous choice design to effectively produce statistically reliable results. This study used a single-bound dichotomous choice method and therefore, the sample size was large enough to produce statistically reliable results.



### **3.3.3 Study Participants**

The study participants at household level were household's heads (either man or woman) who were capable of making decisions as regards to solid wastes management and were above the age of 18.

Relevant authorities from Mzuzu City Council, NGOs, and other private companies active in solid wastes management in Mzuzu City were involved in the study. Block leaders were also part of the respondents. City Councils in Malawi are mandated to oversee issues to do with sanitation and solid waste management and their personnel were relevant in this study. The authorities chosen from the City Council were those from the department of health and social services. NGOs and other private companies involved in solid waste management were relevant as they have greater understanding of the situation on the ground and interventions currently in place. Block leaders are looked upon as important people and their decision matter in the community. Therefore, getting the opinion of block leaders on solid waste situation and initiatives which can improve the situation was vital.

### **3.4 Data Collection**

In this study, both secondary and primary data were collected. Primary data was collected through household survey (face-face interviews), key informant interviews, observations and focus group discussions. Secondary data was obtained from peer reviewed journals, books, social and scientific articles, administrative documents of the City Council, theses, and reports. Data for the survey was collected using mWater application (App), a software for collecting data.

The questionnaire was entered in mWater App and the mWater App was installed in android smart phones. Using mWater App was advantageous because eased data entry, robust data storage and its capacity to use global positioning system (GPS) locations and

also because of its capacity to attach pictures of observed situation within the questionnaire. Interviewees were asked for permission to record the voice on smart phone during interviews which served as a reminder to the investigator in case some points were omitted during recording on questionnaire. Interviews were still done even when recording of voices was not done.

**Table 1: Summary of data collected**

<b>Data Source</b>	<b>Sample size</b>
Household survey questionnaires (face-face interviews) in mWater app	600
Key informant interviews	5
Focus group discussions with household heads who are willing to pay	3
Observations recorded on camera	259

**3.41 Household survey questionnaire**

The principal goal of the survey was to generate quantitative data about household’s solid waste disposal practices, willingness to pay, determinants of willingness to pay, as well as initiatives which can be employed to mitigate indiscriminate solid waste disposal. The questions were written in simple and concise English and were translated into Chichewa or Chitumbuka by enumerators. The questionnaire was entered in mWater App. The household survey questionnaire was pretested to at least 5% of the households to check how appropriate the questions were, how easily could the questions be understood and

answered as well as the average time it could take to complete the questionnaire (Bhattarai, 2016). The survey questionnaire consisted mostly of close-ended questions and a few open-ended questions to give room for the respondents to articulate fully their views and also to cater for questions which the community might see as sensitive such as household income.

Collecting data of money generated continuous data which was easy to analyse descriptively. Apart from the researcher, five experienced enumerators were recruited and trained on how this study should be conducted.

To obtain data for willingness to pay a single-bound dichotomous choice CVM was used. Bhattarai (2016) also used a single-bound dichotomous choice method which was followed by open-ended questions. The single-bound dichotomous method has been adopted in this study because of proposed type of data analysis, and it requires more respondents (minimum 600) as proposed by (Fujita *et al.*, 2005) giving a large sample size and expected quality data. Using a single-bound method is also faster as respondents are presented with one bid and also prevents bias results from the respondents which can arise from the response of second bids found in double-bound CVM (Calia and Strazzer, 2000). The section of CVM in the questionnaire was designed according to Mitchell and Carson (1989) and also Arrow *et al.*, (1993).

In this research a pilot study was conducted with 5% of random households to obtain the bid amounts to be used on the questionnaire (Bhattarai, 2016). The pilot study also involved discussions with relevant City Council officials, sanitation entrepreneurs and NGOs dealing with solid waste management. The solid waste management entrepreneurs were able to state the present or current price from the middle and high income areas

where they were operating. The proposed bid amounts from the pilot study or pre-test which were later used in the household questionnaire were MK 1000 (\$ 1.39), MK 1500 (\$ 2.08), MK 2000 (\$ 2.78), MK 2500 (\$ 3.47), MK 3000 (\$ 4.17). United States Dollar (\$) was pegged at MK 720 during the pilot study.

The study had a participation question where respondents were asked if they were willing to have their solid waste collected. Respondents who were unwilling to pay by saying ‘no’ to the participation question were probed to articulate the reasons for their responses. For those who would said ‘yes’ to the participation question they were presented with a single-bound CVM. Before asking the participants how much they would be willing to pay, the enumerators and investigator were explaining the proposed business arrangement or the market scenario. The proposed market scenario in this study was that household wastes would be temporarily stored in plastic bags/containers and would be collected using a motorised cart (considering the terrain and inaccessible roads in some informal settlements) and transferred into strategically placed vehicle which had a van and would be transported to the waste management facility where sorting, composting and other waste management options would be done. In areas with accessible roads, wastes would be emptied directly into the van. The waste would be collected in the respective houses of the respondents by waste collection officers. The plastic bags would not be returned to the user but containers would be returned after being emptied. The waste collection services would require people to pay a monthly fee and waste would be collected every fortnight.

#### ***3.42 Key Informant Interviews (KII)***

Key informants comprised of key players dealing with solid wastes namely; Mzuzu City council, Plan International Inc. Malawi, Red Cross Society, Young Voices and Mr. Clean Malawi. The main purpose of the key informant’s interviews (KII) was to obtain

qualitative and descriptive data on the initiatives which the community could employ to mitigate indiscriminate solid waste disposal and the potential public health hazards emanating from the current waste disposal practices and also to have a distinct overview of the current solid waste situation.

The KII was also used to interpret some of the quantitative data collected in the household survey. KII provided information necessary in making informed recommendations in regards to solid waste management in Mzuzu City. In this study 5 key informant interviews were done (*Appendix 3 & 4*).

#### ***3.4.3 Focus Group Discussions***

The focus group discussion (FGD) followed the household survey to triangulate the responses which the household had given by zeroing in to pertinent questions. In this study 3 FDGs were conducted using questions from *Appendix 6*. The primary purpose of the FGD was to collect qualitative data which would be used to assess solid waste disposal practices and measures to mitigating indiscriminate solid wastes disposal. Secondly the FGD was expected to compliment quantitative data obtained from the household survey. FGD's were also recorded on smart phone upon consent of the interviewees.

#### ***3.4.4 Observations***

This study utilised observations to triangulate responses from household survey in regards to solid waste management practices such as how waste is disposed. Furthermore, qualitative data necessary to assess waste disposal practices and subsequent public health threat was collected. The investigator was observing households waste disposal sites, roads, drains, and other areas in the community where wastes is disposed. The investigator used a camera from the smart phone to take pictures which reflected the present condition of solid waste management in informal settlements. The investigator developed a checklist

which was used during those observations (*Appendix 5*). The study recorded 259 observations with pictures of how wastes were disposed. The pictures are stored in mWater app. Although the other observations 341 were not recorded using camera, the investigator recorded the situation in writing.

**Table 2: Summary of research questions tallied with type of data and data collection technique**

<b>Research Question</b>	<b>Type of Data</b>	<b>Data Collection Tool</b>
a) What are the methods of waste disposal in informal settlements of Mzuzu City?	Quantitative & Qualitative	Household questionnaire, KII, FGD, Observations
b) How much in Kwacha are households willing to pay for solid waste collection in informal settlements of Mzuzu City?	Quantitative	Household questionnaire
c) What are the determinants of willingness to pay for solid waste collection in informal settlements of Mzuzu City?	Quantitative	Household questionnaire
d) Which initiatives in the community can mitigate indiscriminate solid waste in informal settlements of	Quantitative & Qualitative	Household questionnaire, KII, FGD, Observations

Mzuzu City?

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KII: Key Informant interviews

FGD: Focus Group Discussions

### **3.5. Data Management and Statistical Analysis**

Data was analysed in Statistical Package for Social Scientists (SPSS) version 20. Prior to data analysis, data was exported from mWater app to Microsoft excel file (csv) and was further exported to SPSS. This tremendously reduced data entry time since data was already entered in mWater App. Data was coded in SPSS and was cleaned to avoid missing values, outliers, un-necessary similarities and other inconsistencies. This was achieved by running descriptive statistics such as mean, mode, median, minimum and maximum.

#### ***3.5.1 Quantitative Data Analysis***

Quantitative data obtained from the survey questionnaire was coded and analysed descriptively to obtain measures of central tendency (mean, median, mode, sum) and dispersion (standard deviation, variances, maximum, minimum), percentiles, frequency tables, crosstabs, and also graphs. Willingness to pay was found by calculating mean or average of the monetary values. Furthermore, Logistic regression model (binary) was used to assess the determinants of willingness to pay.

Unlike the linear probability regression model, the logistic regression model has proven to be valid in analysing the determinants of willingness to pay for improved waste management services particularly because the parameter estimates from the logistic model are asymptotically consistent and efficient (Awunyo-Vitor *et al.*, 2013b).

Furthermore, heteroscedasticity problems are eliminated in logistic model and the conditional probability of making the choice to pay for better-quality waste management services lie between zero and one is limited. This helps in efficient data analysis and WTP estimates.

The following logit model was used to analyse the second objective of this study;

$$\text{Probability (WTP)} = \alpha + \beta_1 \text{ bid amount} + \beta_2 \text{ household income per month} + \beta_3 \text{ gender} + \beta_4 \text{ education} + \beta_5 \text{ type of house} + \beta_6 \text{ house ownership} + \beta_7 \text{ waste separation practices} + \beta_8 \text{ payment of electricity bills} + \beta_9 \text{ payment of water bills} + \beta_{10} \text{ amount of waste generated per day (estimate)} + \beta_{11} \text{ available disposal methods} + \beta_{12} \text{ occupation} \dots\dots\dots (1)$$

The logit model was used because it has been used in similar studies and has been validated in identifying determinants of willingness to pay (Bhattarai, 2016). SPSS was used to analyse the quantitative data and tables (such as Omnibus test model coefficients) were used to present the analysed data. To obtain the mean WTP, simple average calculations were used. The non-numerical socio-economic factors was converted into dummy variables so that they fit in the logistic regression model as depicted in **Table 3**. The model was tested for goodness of using Chi-square test, the Nagelkerke R Square, the Cox and Snell R Square and the Hosmer and Lemeshow goodness of fit tests from SPSS. Cox & Snell’s pseudo R-squared should have a maximum value that is less than 1 while the Nagelkerke R Square has extended values that reach a maximum of 1 (Freeze and Long, 2006).



Both the Cox & Snell's, and Nagelkerke R Square can be expressed as a percentage. As for the Chi-square test, the null hypothesis ( $H_0$ ) is that the model adequately fits the data (or is good). The alternative hypothesis ( $H_1$ ) is that the model in this study does not fit the data (is not good). The study also used Pearson correlation to simply predict the model and remove negative variables which may create suppressive effect and errors when running the model.

**Table 3: Definition of social economic factors (determinants) and assumptions**

<b>Variable/Determinant</b>	<b>Description</b>	<b>Assumption</b>
Bid amount	The amount the household is willing to pay for solid waste collection	High bid amount reduces WTP
Household income per month	Total amount of money the household makes in a month from business or employment	High income increases WTP
Age	Present age	WTP is inversely proportional to age
Gender	1 for male, 0 for otherwise	Females tend to care for households than male hence WTP is likely to be found in women than men
Household size (HH)	Total number of household members including children	Large HH produces more wastes hence WTP for waste collection services

Education	1 for MSCE and above, 0 for otherwise	Those educated could be more willing to pay than the educated
Marital status	1 for yes, 0 for otherwise	Those who are married can have high WTP than those who are not
Type of house	1 for thatched, 0 for otherwise	Those in houses with iron sheets tend to have a high income hence high WTP is expected
Waste separation practices	Whether the household separate solid wastes or not (1=yes, 0 for otherwise)	Those who practice waste separation have low WTP
House ownership	Whether household stays in their own house (1 for owning house, 0 for otherwise)	Those owning a house can be willing to pay than those renting a house
Payment for electricity bills	Whether the household pay for electricity ; 1 for yes, 0 for otherwise	Those who pay for electricity can be willing to pay than those who don't
Payment for water bills	Whether the household pay for water ; 1 for yes, 0 for otherwise	Those who pay for water can be willing to pay than those who don't

Amount of waste generated	Estimated amount of waste generated per week	Those who produce more waste are likely to be willing to have their waste collected
Available disposal methods	1 for other available discriminate disposal methods such as waste skips, 0 for otherwise	More disposal methods can lead to less WTP for door to door collection
Occupation	Whether the respondent is formally employed (1 for yes, 0 for otherwise)	Respondents who are employed can be willing to pay than those not employed
Concern for environmental protection	Whether the respondent is concerned to protect the environment (1 for yes, 0 for otherwise)	Respondents who are concerned with environmental protection can be willing to pay than those who are not concerned

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After regressing the explanatory variables in the table above, the results were compared with similar studies to obtain similarities and differences. This helped in understanding the connection between the explanatory variables and WTP in accordance with the study area.

### ***3.5.2 Qualitative Data Analysis***

The study also collected qualitative data especially for objectives 1 and 4 in which the study evaluated the methods of waste disposal and also finding the initiatives which can

be employed to mitigate solid waste disposal in the community. The quantitative data obtained from objectives 1 and 4 was analysed descriptively as earlier discussed. However, qualitative data requires qualitative data analysis methods. Denzin and Lincoln (2008) a person can use some various methods such as; semiotics, narratives, content, discourse, archival and phonemic analysis. Qualitative data in this research was analysed using content analysis and narratives.

Content analysis facilitated understanding of the community's perception of the disposal methods which the community is practicing and the initiatives which when employed in the community can mitigate the challenge of indiscriminate solid waste disposal. Narratives were used to supplement the content analysis especially for objectives 1 and 4 which evaluated the disposal methods of households & the initiatives which can be implemented to mitigate solid wastes disposal in the community.

### **3.6 Ethical consideration**

Research ethics must be followed to ensure that respondents are well-informed and protected and that the data collected is reliable and valid (Fouka & Mantzorou, 2011). The proposal of this research was submitted to Nation Commission for Science and Technology (NSCT) for ethical clearance. Approval of this study was granted as **Protocol P.05/17/178** (*Appendix 7*). MCC was also engaged prior to conducting the study. Furthermore, respondents were thoroughly briefed on the rationale of the study and were asked for permission to participate in the study. Interviews were only conducted upon written or oral consent of the interviewee.

Respondents were assured of confidentiality and anonymity as their official names would not be publicised or published. Block leaders and chiefs were also asked of permission to

enter into their areas and conduct research and the respondents were free to withdraw from the study any time they so wished without facing any penalties.

## CHAPTER 4: RESULTS AND DISCUSSION

This chapter presents the findings of this study and a discussion of what the findings entail. Characteristics of respondents were expounded to show various social-economic variables found in this study. These social-economic variables were necessary for the study to assess what determines willingness to pay. Results of this study were presented in line with the objectives of this study. Various figures and graphics were used to give a clear picture of the findings. Other similar studies were also referenced to in discussing the findings of this study.

### 4.1 Characteristics of Respondents

The study was conducted in 3 informal settlements; Ching'ambo, Masasa and Salisbury Lines. From each settlement, 200 household surveys were conducted presenting 33.33% of the total 600. The following tables presents the demographic data of the respondents from the survey;

	Frequency	Valid Percent (%)	Cumulative Percent (%)
Female	373	62.2	62.2
Male	227	37.8	100

Total 600 100

**Table 4: Gender of respondents (n = 600)**

The study found that majority of respondents (62.2%) were females than males. This is contrary to the study by NSO (2018) which found that Mzuzu City had more males than females. Having majority of respondents who were females could be attributed to the fact that most males are usually unavailable during working days as they go to work.

**Table 5: Household size, Household income, Age & Education (n = 600)**

	Minimum	Maximum	Mean	Std. Deviation
Household size	1	18	4.83	2.09
Household income	2000	350000	58040	50926.52
Age of respondent	18	86	32.34	9.33
Education	0	20	11.42	3.61

Std. = Standard

The mean household size in the study was 4.83 and the average household size for the northern region was 4.8 according to the Malawi Housing and Population census (NSO, 2018). The minimum household size was 1 and the maximum was 18. The maximum household size of 18 is not common and might be attributed to extended families in the informal settlements. The mean income per household was MK58, 040.00. Most people in the informal settlements do not make huge sums of money compared to middle and high

income families. The minimum age of respondents was 18 and the maximum was 86. The minimum age was based on the acceptable legal age of an adult in Malawi. The study found that some respondents never went to school and highest number of years spent in school was 20. The highest number of 20 maybe attributed to post graduate or doctoral studies or repetition of classes.

**Table 6: Marital Status**

	Frequency	Valid Percent (%)	Cumulative Percent (%)
Not Married	56	9.3	9.3
Married	544	90.7	100.0
Total	600	100.0	

Over 90% of the respondents were married in this study. This may be attributed to minimum age of 18 of respondents since the respondents were adults and people usually marry early in Malawi. Married people were expected to be willing to pay for solid waste collection since they have passion to take care of their surroundings.

**Table 7: Occupation**

	Frequency	Valid Percent (%)	Cumulative Percent (%)
Not formally employed	363	60.5	60.5
Formally employed	237	39.5	100.0
Total	600	100.0	

About 60% of the respondents were not formally employed. Being informal settlements most people usually rely on piece work and small scale businesses. NSO (2018) reported that 81.5% of the labour force were employed and only 18.5% were unemployed. It should be noted that the unemployed were persons who during the reference period of seven days did not work even for an hour but were available for work.

**Table 8: House ownership**

	Frequency	Valid Percent (%)	Cumulative Percent (%)
No	339	56.5	56.5
Yes	261	43.5	100.0
Total	600	100.0	

Majority of the respondents (56.5%) did not own houses. According to NSO (2018), about 83.6% of the people in the northern region stayed in owned or family owned houses. These findings maybe contrary to this study since it was carried in the city (informal settlements) which receives an influx of people from the rural areas in search for jobs who may not own land in the city. People who own houses were more likely to be willing to pay for solid waste collection because it is their house and they would want to keep the environment clean.

**Table 9: Type of house**

	Frequency	Valid Percent (%)	Cumulative Percent (%)
No Iron sheets	63	10.5	10.5
Iron sheets	537	89.5	100.0
Total	600	100.0	



Majority of people in the study (89.5%) were living in houses with iron sheets. Although people may consider iron sheets as a symbol of wealth, having iron sheets does not equal to high incomes. This may not be the same with rural areas.

**Table 10: Payment for water bills**

	Frequency	Valid Percent (%)	Cumulative Percent (%)
No	69	11.5	11.5
Yes	531	88.5	100.0
Total	600	100.0	

More than 88% of the respondents were paying for water bills. Water coverage in the city was at 86% by NRW as of April 2019 accordance to the M&E framework for the Water Efficiency Project. Those not paying for water bills may have relied on other sources of water such as wells or streams. Aside, they might have also been drawing water from a tap of a well-wisher who was not charging them. Water is a basic need and those paying for it may understand that payment for solid waste collection may be important.

**Table 11: Payment of electricity**

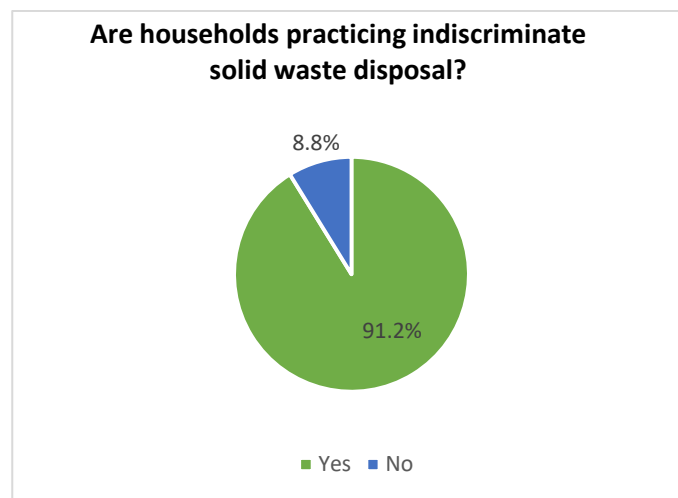
	Frequency	Valid Percent (%)	Cumulative Percent (%)
No	203	33.8	33.8
Yes	397	66.2	100.0
Total	600	100.0	

Majority of the respondents (66.2%) were living in houses with electricity paid for monthly. Those who cannot afford paying for houses with electricity may find payment

for solid waste collection a luxury. In Malawi only 11.4% of the population uses electricity for lighting (NSO, 2018).

#### 4.2 Waste Disposal Practices

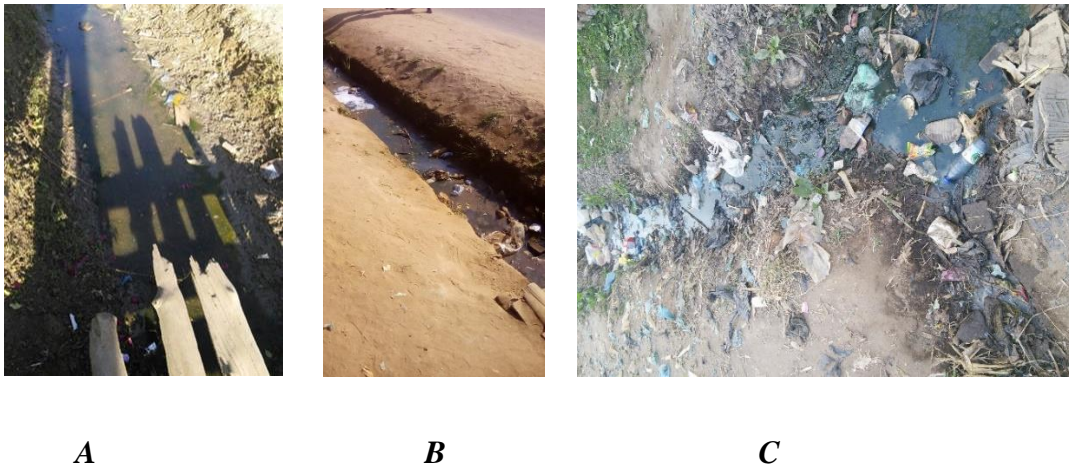
An enquiry of whether households practices indiscriminate solid wastes disposal revealed that 91.2 % ( $n = 600$ ) agreed with the notion and 8.8% ( $n = 600$ ) disagreed with the practice of indiscriminate solid waste disposal in the communities. *Figure 4* illustrates how respondents perceive the existence of indiscriminate waste disposal in the community.



**Figure 4: Opinions on existence of indiscriminate solid waste disposal**

Field observations also revealed that indiscriminate solid waste disposal is being practiced in the study areas including rivers, stream banks and roadside drains (*Figure 5 A, B, C*). Chirwa *et al.*, (2016) also found that surface water disposal of wastes was common in Mzuzu's informal settlements especially in Masasa and seconded by Ching'ambo. The respondents who agreed with the existence of indiscriminate solid waste cited lack of awareness on proper disposal methods and lack of space as the major causes for indiscriminate solid wastes disposal. Other

causes included convenience, lack of door to door waste collection services, lack of secondary disposal sites provided by the council and lack of enforcement of laws by the city council. One of the respondents had this to say ‘*most people are just lazy to dig rubbish pits and they find it easier simply to throw away wastes anyhow*’ (female respondent).



**Figure 5 (A – C) :Polluted water with solid wastes in roadside drain**

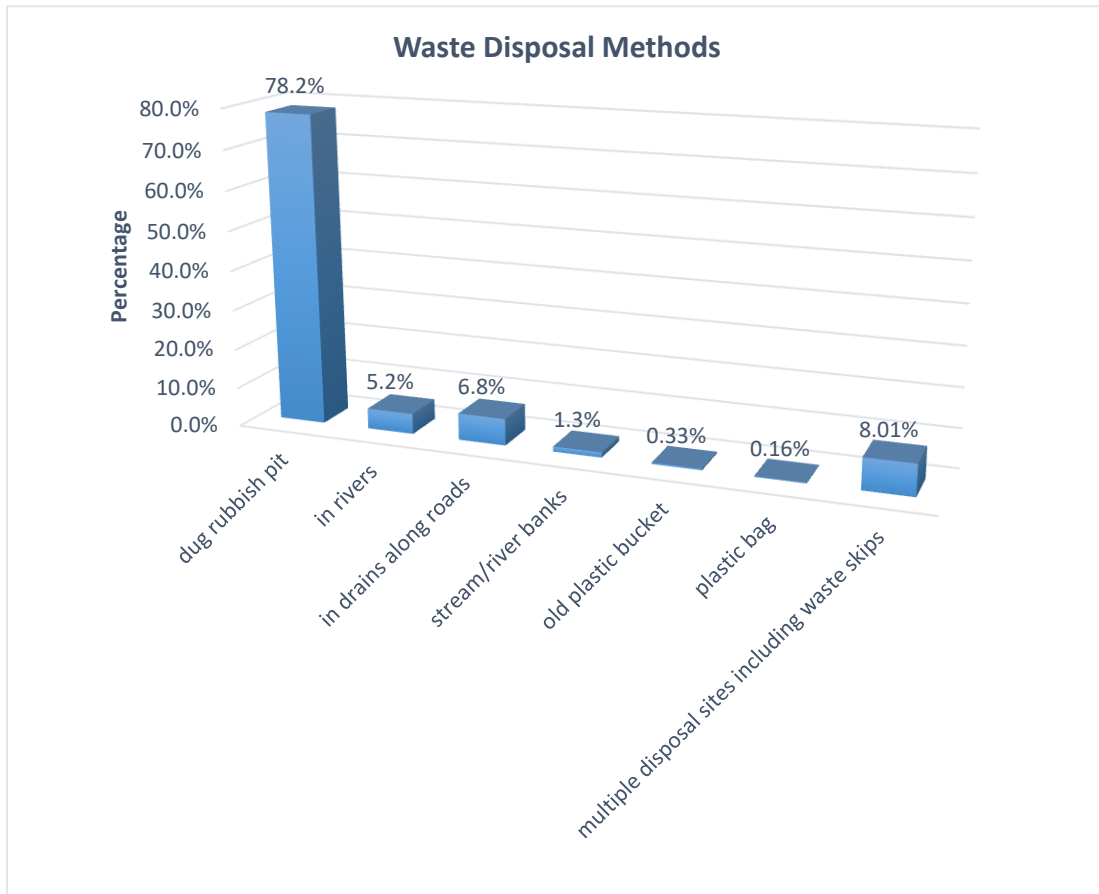
It was observed that Salisbury Lines had more respondents who agreed with the notion of indiscriminate solid waste disposal than Masasa and Ching’ambo; as shown in Table 12.

Practice of indiscriminate solid waste disposal		Informal Settlement
No	Yes	
31	169	<b>Ching’ambo (n = 200)</b>
15	185	<b>Masasa (n =200)</b>
7	193	<b>Salisbury Lines (n = 200)</b>
53	547	<b>Total</b>

**Table 12: Indiscriminate solid waste disposal in informal settlements**

The study also revealed that more than half of the households (54%,  $n = 600$ ) were not aware of MCC by-laws. Those who were not aware indicated that MCC had not disseminated the information to them. A male respondent said that *'I don't know any by-laws and may not be the only one in our community not familiar with the MCC by-laws, no wonder there is indiscriminate solid wastes disposal'*.

The majority of the respondents 78.2 % ( $n = 600$ ) said they disposed their solid wastes in dug pits inside their compound (**Figure 6 and 7**) when asked to mention where they dispose their solid wastes. Few respondents, 5.2 % ( $n = 600$ ) said they disposed their solid wastes in the river



while 6.8 % ( $n = 600$ ) acknowledged that they disposed wastes simply in drains around the neighbourhood. 1.3 % ( $n = 600$ ) respondents were disposing wastes on river or stream banks. Two respondents (0.33%) said they disposed wastes in old plastic bucket and only 1 respondent

(0.16%) claimed to dispose wastes in a plastic bag. The rest of the respondents (8.01%) had more than one place of disposing wastes including open dumping in bushes and using waste skips.

**Figure 6: Waste disposal methods**



**Figure 7: Dug rubbish pit**

An inquiry on waste separation revealed that fewer respondents (1.0%,  $n = 600$ ) mentioned that they reuse wastes. It was noted that other households were also practicing reuse unknowingly. This prompted the researcher to inquire on how different types of wastes were being reused. Paper wastes were mainly used for anal cleaning (or toilet paper) and fire setting. Other uses of paper included covering books and making decorations. Metals however had little or no reuse mainly because fewer wastes metals are produced but also people don't know how to reuse them. As such, most metals were sold to welding shops where products like knives, hoes and axes are made. Plastic bottles were mainly reused as a storage medium for water, cooking oil, salt and beverages like Thobwa. However, a few households used plastics for making hand washing facilities, planting

flowers and starting fire. Plastic paper was mainly used for starting fire and carrying commodities or groceries from the market. Plastic paper was also used for thatching houses and storage of materials in the kitchen. Food wastes were highly utilised in feeding animals like dogs and pigs. Other uses included making manure and re-eating the food.

The study found that households also dispose some solid wastes such as sharp



objects (razors, glasses etc.) and baby diapers in pit latrines. This may accelerate latrine fill up rates (Still & Foxon, 2012). Field observations showed that there is crude dumping of baby diapers in bushes, along roads, or drains in the communities (**Figure 8 A and B**).

**A**

**B**

**Figure 8 (A & B): Diapers fallen from disposed sack (A) and thrown on nearby bush (B)**

Focus group discussions with those who showed willingness to pay in the study areas showed that the issue of baby diapers being thrown anyhow is of great concern. The issue of baby diapers has to be dealt with the utmost urgency as failure to do so is registering consumption of huge amounts of faecal coliforms through contaminated ground water. Respondents also lamented of the unavailability of secondary disposal sites like waste

skips provided by the city council. Only 0.03% ( $n = 600$ ) respondents reported to have waste skips or transfer stations within 200 metres from their households. The 0.03% who had access to secondary disposal sites were from Ching'ambo.

The study also found that waste separation was done by few respondents 37% ( $n = 600$ ) while the majority 67% ( $n = 600$ ) did not practice waste separation. Those who did not practice waste separation in this study said it was mainly because it is disgusting or not interesting. However, others mentioned lack of time and technical knowhow as a hindrance to waste separation. Those who practiced waste separation explained that it was mainly done by putting wastes in different plastic bags soon after generation. While others removed important solid waste from a mixture of waste after drying of disposed waste.

It was observed that both female adults and female children were highly involved in disposing wastes at households. These were followed by male children. It was also observed that more than half of households do not store their solid wastes but simply throw away. Households who do simply throw wastes are likely not to practice waste separation.

The Mzuzu City Council (MCC) Acting Director of Health accepted that indiscriminate disposal of waste is being practiced in Mzuzu especially in informal settlements. The Acting Director of Health had this to say '*SWM is a big problem in informal settlements in Mzuzu, informal settlements are not well planned, accessibility is problem and lack of resources' makes SWM a challenge*'. The then Programme Manager (PLAN Malawi) of the Peri-Urban Sanitation and Hygiene (PUSH) Project also mentioned that waste management is a prevailing problem in informal settlements because in the first place, it is

*an issue of mentality*, and most of the people do not think it is their responsibility to dispose wastes in the right places. Both the City Council official and the Programme manager of PLAN agrees that indiscriminate solid waste disposal is bad both to the environment and public health.

MCC Acting Director of Health explained that since the informal settlements are not or rarely reached with solid waste collection the waste produced remains there, and there are environmental problems like proliferation of preventable diseases such as diarrhoea. Underground aquifers can easily be contaminated by the crude dumping of solid wastes. Further to that, there are also social and economic impacts of indiscriminate solid waste disposal. For example, *‘if you go elsewhere in the world the wastes itself is money, so money is lost our informal settlements because waste is not properly managed’* (Acting Director of Health, MCC). Furthermore, *‘if solid wastes are collected in large amounts they can easily be sold even outside the country as other companies need large quantities’*. An interview with the Programme Manager of PUSH from PLAN Malawi also revealed that the impact of poor solid wastes disposal includes ‘compromising of the beautiful scenery of the city, blockage of drains and the water becoming stagnated, smelly and a breeding ground for mosquitoes which may consequently result in diseases such as Malaria. In addition, if the drains are blocked then the water may flood causing more water and sanitation problems.

#### ***4.21 Solid waste generation***

Results from the survey indicate that the common combination of solid wastes generated by households are organic wastes, plastics, electronic-waste, organic, glasses, paper, ashes and textiles. Out of these solid wastes, organic wastes, ashes, paper and plastics were in high percentage. A comparison between these solid wastes types indicated that organic



and ashes are the most common combination of solid wastes produced. This can be attributed to the notion that households irrespective their poverty levels, they produce organic wastes (e.g. food wastes) and ashes from cooking. The study also found an estimated amount of wastes (through household survey, both wet and dry wastes) generated per household ranging from 2 to 30 Kilograms (Kgs) per week with a mean of 14.2 Kgs.

The highest frequency of waste estimates among households were 10 Kgs (31.2%) and this was followed by 5 Kgs estimate representing 19.3 % as shown in the **Table 13**.

**Table 13: Waste generation estimates**

Solid wastes estimate (Kgs)	Frequency	Percent(%)	Cumulative Percent (%)
2	1	0.2	0.2
3	3	0.5	0.7
5	116	19.3	20.0
10	187	31.2	51.2
15	110	18.3	69.5
20	111	18.5	88.0
30	72	12.0	100.0
<b>Total</b>	<b>600</b>	<b>100.0</b>	

#### 4.22 Best waste management method in the community

The survey revealed that the majority of the respondents (32.2%,  $n = 600$ ) consider land filling as the best waste management method in their communities. 26.7 % ( $n = 600$ ) of the respondents mentioned composting as a solution to the solid waste management problems being faced. Burning of wastes was a third preferred option with a 16.7% ( $n = 600$ ) of respondents supporting it as a best waste management solution. 116 (19.3 %,  $n = 600$ ) respondents said dumping was a best method of managing wastes.

Out of the 116 respondents, 52.5 % (61) were from Ching'ambo. This poses threat to public health as dumping is usually done near streams and rivers. During the survey, 0.33% ( $n = 600$ ) and 2.8% ( $n = 600$ ) respondents chose waste collection and recycling as best solid waste management options. **Table 14** illustrate the solid waste management options. Lower percentages of respondents opting for waste collection and recycling can be attributed to lack of awareness on other proper solid wastes disposal methods. People are usually used to burying waste no wonder land filling was the most preferred option.

**Table 14: Solid waste management options**

<b>SWM method</b>	<b>Frequency</b>	<b>Valid Percent (%)</b>
Burning	100	16.7
Composting	160	26.7
Dumping	116	19.3
Incineration	12	2.0
Land filling	193	32.2

Waste collection	2	0.3
Recycling	17	2.8
Total	600	100.0

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#### 4.23 Concern for the Environment

Results shows that 96.3% ( $n = 600$ ) of respondents claimed that they have a concern for the environment while 3.7% were not concerned for the environment. Those who said they were concerned for the environment mentioned that they do activities such as sweeping around their compound and digging refuse pits. Others mentioned tree planting as a strategy to show their commitment to the environment.

#### 4.3 Willingness to pay for household wastes collection

The study revealed that about 85.8 % of the respondents ( $n = 600$ ) were willing to pay for household solid waste collection. Households were willing to pay an average of K1, 507.38 per month (\$2.09). The minimum garbage fee (bid amount) which households were willing to pay for door-to- door solid wastes collection was K100 (\$0.13) while the maximum was K5000 (\$6.9).

The study found that the total sum of money which can be collected per month is K776,300 (\$1,078.19) out of the 515 households which were willing to pay. **Table 15** depicts the descriptive statistics of the WTP which includes the mean and sum.

Variable	n	Range	Min	Max	Sum	Mean	Std. Dev	Variance
WTP	515	4900	100	5000	776,300	1,507.38	827.91	685,431.83

**Table 15: Willingness to pay for waste collection**

Where n=number of respondents

Min = minimum value

Max= maximum value Sum= summation

Std. Dev = standard deviation

The overall WTP for household solid waste collection in the study was 85.8% depicting that people were much willing to have their waste collected. Although there were value differences in WTP observed across the three surveyed areas, the differences were not statistically significant as depicted in **Table 16**.

Informal Settlement	WTP		Total	WTP %
	No	Yes		
Ching'ambo (n = 200)	33	167	200	83.5
Masasa (n = 200)	22	178	200	89
Salisburyline (n = 200)	30	170	200	85
Total	85	515	600	85.8

**Table 16: Differences in Willingness to pay across informal settlements**

WTP = Willingness to pay

There was willingness to pay for solid waste connection for more than half of the households. This illustrates constant desire for the people to ameliorate the present poor solid waste management situation.

Other studies in developing countries have also found high (above 70%) WTP for solid waste collection services or improvement (Banga, 2011; Joel *et al.*, 2013, Tariq and Rashid 2014, Bhattarai, 2016, Song *et al.*, 2016). This study shows that the community is not pleased with the common solid waste management practices in the study areas hence the high willingness to pay for solid waste collection. The findings of this study however, are different from the findings of Mohsin *et al.*, (2015) in which 75% of respondents disagreed with the notion of paying for solid waste collection improvements and disposal system because of financial problems or simply no willingness to pay at all. Kasala (2016) also found that 76% of households were unwilling to pay for solid waste collection. Differences in the findings of our study to that of both Mohsin (2015) and Kasala (2016) may be attributed to having high percentage of respondents who considered solid waste collection a sore governments responsibility and less important than other services like water (Altaf & Deshazo, 1996).

The study also observed that the average monthly fee which households were willing to pay in Mzuzu was high compared to study findings in other cities such as Lilongwe (Assa, 2013). The differences can be attributed to increased civic education on solid waste management in cities over the years. Furthermore, there are differences in CVM used. Assa (2013) utilized double-bound CVM while this study utilized single-bound CVM. In single-bound dichotomous choice only one bid is offered while in double-bound dichotomous choice respondents are offered a second bid value right after their first responses (Alberin, 1993). The differences in monthly fee solid waste collection can also be attributed to difference bid amounts in these studies.

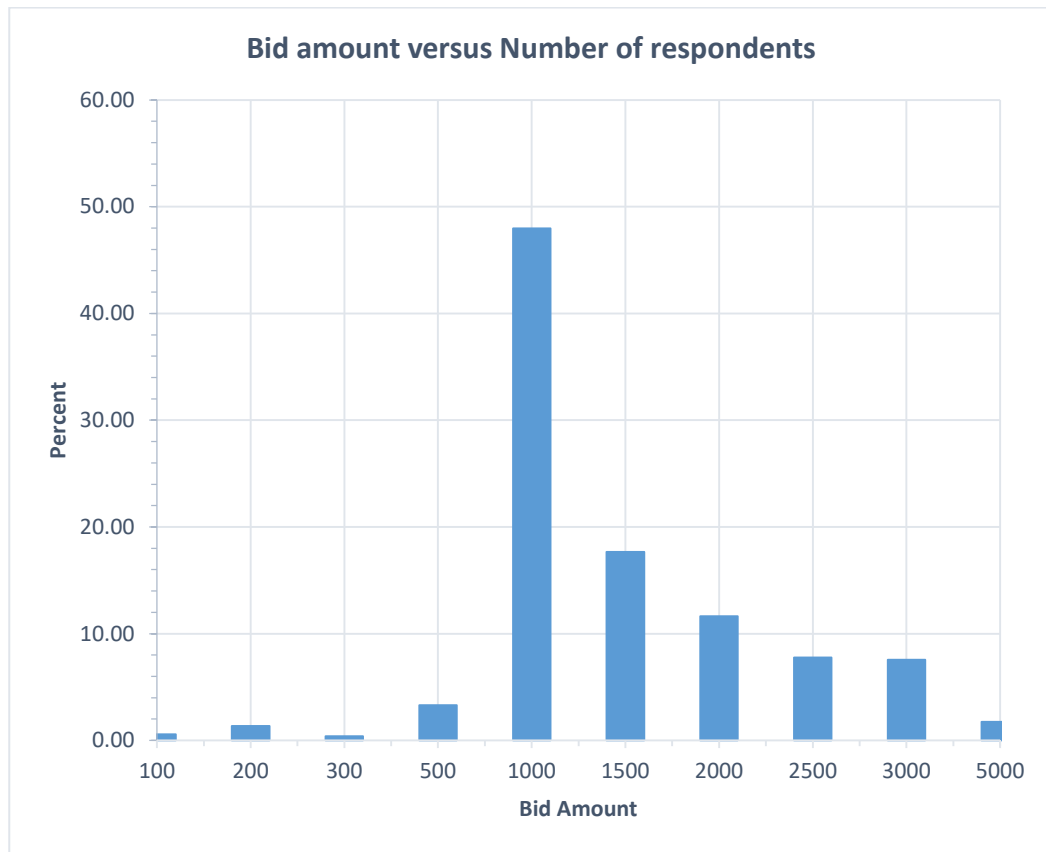
On mode of payment, 86.4 % (n = 515) opted for cash, while 6.5% and 4.3% opted for incorporation of solid waste bills into electricity bills and water bills, respectively. Very

few respondents (2.8 %,  $n = 515$ ) of the respondents chose deduction from public works payment as a mode of payment. This study found that households prefer payment for solid waste collection through cash and not incorporation into electricity or water bills. This reveals that people are afraid that they might get exorbitant bills and do not want one service such as solid waste collection to affect other services like water and electricity.

A study by Kasala (2016) recommended integrating solid waste collection bills into public services like water, electricity and mobile phone. However, this has been contrary to the perception of the respondents in this study.

During the study period, none of the respondents of this study were paying for solid waste collection and solid waste collection was not being done at their households. The most frequent (47.96%) bid amount which respondents were opting for K1000 as depicted in

**Figure 9;**



**Figure 9: Bid amount versus number of respondents**

**Figure 9;** illustrates that the demand for solid waste collection was decreasing after high bid amounts above MK 1000.

The respondents who were not willing to pay for solid waste collection gave various explanations namely; *‘we don’t generate huge waste’*, *‘we are poor and therefore we cannot afford waste collection’*, *‘it is expensive’*, *we use our own bin and make manure for sale and that it is the work of the city council and therefore there is no need for them to pay*. Regardless of other households not willing to pay, this study shows that there is high willingness to pay and solid waste collection might be a success.

#### **4.4 Determinants of willingness to pay**

The study examined the following determinants of WTP; bid amount, household income per month, age, gender, household size, education, marital status, type of house, waste separation practices, house ownership, payment of water bills, payment of electricity, amount of waste generated, available disposal methods, occupation and concern for environmental quality. Basing on statistical results of the surveyed households using the logit model, the determinants of willingness to pay were only income and bid amount out of the 12 dependent variables which were used in the model because 4 variables were left out in the model as later explained in **Tables 21** about the Pearson Correlation. Both income and bid amounts were significant at 5% **Table 17**.



**Table 17: Results of statistical analysis from the logit model**

Variable/determinant	B	S.E.	Wald	df	Sig.	Exp(B)
Bid Amount	0.009	0.001	51.398	1	0.000*	1.009
Household income	0	0	4.41	1	0.036*	1
Gender	-1.143	1.002	1.301	1	0.254	0.319
Education	-0.05	0.079	0.406	1	0.524	0.951
Type of House	0.8	0.938	0.728	1	0.394	2.226
House ownership	-0.016	0.653	0.001	1	0.98	0.984
Payment of electricity	0.084	0.783	0.011	1	0.915	1.087
Payment of water bills	-0.733	0.753	0.947	1	0.33	0.481
Occupation	0.71	0.779	0.829	1	0.363	2.033
Waste separation	-0.881	0.725	1.475	1	0.225	0.414
Available disposal	14.217	25548.6	0	1	1	1493332
Waste generation	0.057	0.054	1.131	1	0.288	1.059

\*p<0.05

B =These are the values for the logistic regression equation for predicting the dependent variable from the independent variable. This is also the unstandardized regression weight.

S.E. =These are the standard errors associated with the coefficients. This shows much the unstandardized regression weight can vary by.

Wald= This is the Wald chi-square test that tests the null hypothesis that the constant equals 0. This is the test statistic for the individual predictor variable.

df =This is the degrees of freedom for the Wald chi-square test.

Sig.= This is used to determine which variables are significant

Exp (B) =This is the exponentiation of the B coefficient, which is an odds ratio.

All the other variables which were used in the logit model: gender, education, type of house, house ownership, payment of water bills, payment of electricity, occupation, waste separation practices, available disposal methods, amount of waste generated were found to be positive but insignificant at 5%. Therefore, these variables were found not to influence willingness to pay in this study.

These findings of this study are similar to the works of Rahji and Oloruntoba (2010) and also Bhattarai (2016) who found that household income and amount of willingness to pay (bid amount) were determinants of willingness to pay. On the contrary, Bhattarai (2016) and Rahji and Oloruntoba (2010) found that the amount of willingness to pay was negative and significant. However, it should be noted that in this study, after the bid amount of MK1000, the demand for solid waste collection decreased. This shows that higher bid amounts will scare customers away. This is in line with the economic theory which stipulates that the higher the price of an economic good, the lower would be quantity of goods and services to be demanded or bought (Gravelle and Rees 2004).

As for household income, the study also found that it was a determinant of willingness to pay just like Bhattarai (2016), and Rahji and Oloruntoba who found the same at  $p < 0.0.1$ .

Other studies which found that income is a determinant of willingness to pay includes (Dehazo 1996; Banga 2011, Joel *et al.*, 2012; Subhan *et al.*, 2014, and Ezebilo 2013). The higher the income of the household, the higher the likelihood to afford payment of solid waste improvement. This is also in harmony to the economic theory of demand which indicates that increase in income is directly proportional to the greater need for better environmental quality (Tietenberg & Lewis, 2010). The findings of this study are contrary to the study by Niringiye and Omortor (2010) who found that only age was a determinant of willingness to pay.

Age of respondent was found to have a negative and significant effect on willingness to pay. The findings of this study are also contrary to Dhungana (2018) who found that household income does not influence WTP for improved solid waste management.

Although other studies found that the following are determinants of willingness to pay; education (Assa, 2013; Rahji and Oloruntoba, 2009), the amount of waste generated (Joel *et al.*, 2012), gender (Awunyo-Vitor *et al.*, 2013), household size (Addai & Danso-Abbeam, 2014), concern for environmental quality (Assa, 2013), Occupation (Rahji and Oloruntoba, 2009), and type of house (Subhan *et al.*, 2014), this study did not find so.

This study agrees with Niringiye and Omortor (2010) that marital status, weight of generated wastes, size of household and education level were not determinants of willingness to pay. The study further found that payment of electricity bills, available disposal methods and waste separation practices were not determinants of willingness to pay.

The logit model used in this study did not pass the Chi-square test in which the *p*-value was less than 0.05 from the omnibus test model coefficients as depicted in **Table 18**. This

means that the null hypothesis which said that the model adequately fits the data was rejected.

The model was found to be good as it passed the Nagelkerke R Square (87.3 %) during analysis in SPSS as shown in **Table 19**. Furthermore, the Cox & Snell R Square was 48.7% which is relatively a good indicator of goodness of fit. However, the model did not meet the Hosmer and Lemeshow goodness of fit test (**Table 20**). The *p*-value of Hosmer and Lemeshow goodness of fit should be above 0.05 if the model is good. However, this study will utilize the goodness of fit of the Pseudo R Squares (Nagelkerke and Cox & Snell) which are more important in logistic regression.

**Table 18: Omnibus test model coefficients**

	Chi-square	Df	Sig.
Step	400.182	11	.000
Step 1 Block	400.182	11	.000
Model	400.182	11	.000

Df – This is the degrees of freedom for the Chi-square test.

Sig.- Significance level which indicates the p-value

**Table 19: Model summary**

Step	-2 Log likelihood	Cox & Snell R Square	Nagelkerke R Square

1	89.391 <sup>a</sup>	.487	.873
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Df = This is the degrees of freedom for the Chi-square test.

Sig.=Significance level which indicates the p-value

**Table 20: Hosmer & Lemeshow test**

Step	Chi-square	Df	Sig.
1	152059.968	8	.000

Df =This is the degrees of freedom for the Chi-square test.

Sig.= Significance level which indicates the p-value

Prior to running the logit model, a 2-tailed Pearson Correlation was run to find out the anticipated relationship among the variables and the predictability of the model as shown in **Table 21**. Although the correlation showed some relationship, it does not fully determine the factors which influence WTP. The negative and insignificant variables shown in **Table 21** were not entered in the model to prevent errors and suppressive effects. The correlation was useful in the study to ensure that the results are valid and to allow for the study to be easily replicated.

Therefore, it was not used to analyse the determinants but rather showed which variables could be used in the model depending on their relationship. It was observed that bid amount, income, gender, education level, type of house, payment of electricity, payment of water bills, occupation and amount of waste generated were positive and significant ( $p < 0.05$ ). House ownership, available disposal methods and waste separation were positive but insignificant. On the other hand, household size, age, marital status and concern for the environment were negative and insignificant. The negative predictor variables (household size, age, marital status and concern for the environment) were not entered or used in binary logistic regression model to prevent creation of suppressive effect in the model. The Pearson correlation partially predicted the regression model as both income and bid amount were found to be positive and significant just as in the logit model as depicted in **Table 21**.

**Table 21: Pearson Correlation results**

		WTP	BA	HI	GE	ED	TH	HO	HH	AG	MS	CE	PW	OC	AW	ADM	WS	PE
WTP	Pearson Correlation	1	0.551**	0.086*	0.140**	0.121**	0.110**	0.108**	-0.034	-0.048	-0.028	-0.037	0.172**	0.185**	0.023	0.024	0.029	0.215**
	Sig. (2-tailed)		0.000	0.035	0.001	0.003	.007	0.362	0.404	0.238	0.487	0.008	0.000	0.000	0.566	0.553	0.483	.000

\*\* . Correlation is significant at the 0.01 level (2-tailed).

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

WTP= Willingness to pay

BA= Bid amount  
HI= Household income

GE= Gender  
ED= Education level  
TH= Type of House  
HO= House ownership  
PE= Payment of electricity  
HH= Household size  
MS= Marital status  
CE= Concern for the environment  
PW= Payment of water bills  
OC= Occupation  
AW=Amount of waste generated  
AD= Available disposal methods  
WS= Waste separation.



#### 4.5 Initiatives for improving solid waste management

An interview with the MCC revealed that the best initiative for solid waste management was simply enforcing the use of 3 R's of reduce, reuse and recycle which is a well-known initiative. It was observed that in Mzuzu City there was a project known as Peri-Urban Sanitation and Hygiene (PUSH) which was spearheaded by PLAN Malawi which has helped MCC to accelerate much in integrated solid waste management (ISWM). The Acting Director of Health had this to say *'now Mzuzu has a modern SWM facility called Msilo (near Dunduzu) which is the first of its kind in Malawi and management of this waste facility goes along with community participation'*. Furthermore, the MCC is embracing 3 R's concept and the community is embracing it little by little. Through the PUSH project, concrete bins were constructed in strategic places to prevent indiscriminate disposal. However, there has been a challenge in using the concrete bins as people are mixing organic and inorganic wastes during disposal. This can be attributed to negligence by users, lack of awareness of the importance of waste separation and delays to collect the



wastes when bins are full which might prompt user to throw the wastes anyhow as shown in **Figure 10**;

**Figure 10 (A-C):Waste disposal facilities with unseparated waste**

**A**

**B**

**C**

Apart from constructing concrete bins, the PUSH project trained entrepreneurs to venture into solid waste collection and also trained teachers and learners on discriminating wastes and disposing them according to categories (waste separation). The PUSH project also encouraged block leaders and landlords to follow the 3 R's waste management concept.

Building capacity of local city dwellers in solid waste management initiatives is a milestone to eliminate in discriminate solid wastes disposal. An interview with the Project Manager of PUSH project revealed that although more entrepreneurs were trained in solid wastes collection, the coverage of solid waste collection is still low and can be estimated to be between 10-20% in Mzuzu with informal settlements being neglected. The City Council was also failing to collect wastes in the City because of mobility challenges since they had one vehicle which has frequent breakdowns. Further study of why there are few active entrepreneurs working in solid waste collection Mzuzu should be conducted.

It was observed that the new SWM facility at Dunduzu started working before all the construction was finished. This was because MCC succumbed to the pressure to close the old dumping site in Mchengautuba. The plan of MCC is to intensify the 3R' s concept within the residents because the design of the new SWM facility is that not all waste should go to the facility. Most of solid wastes is expected to remain in the community. The Acting Director of Health emphasized that '*if waste is not managed, it is an opportunity lost*'. For example, households can compost waste and produce manure.

Production of compost entails that only a few wastes will be taken to the SWM facility hence fostering sustainability. The study sees that practicing reduce and reuse can easily be adopted by communities and city council. However, recycling within Mzuzu City may not be easy due to financial constraints from the city council. Wastes which requires recycling can be collected by entrepreneurs at large scale and be sold outside the country.

Another initiative employed by MCC is fostering public-private partnerships. MCC called for applications from private practitioners for partnerships in SWM. A study by Rahji and Oloruntoba (2009) agrees with the finding of this study that public private partnerships can improve solid waste management. A number of players have emerged and some of them were doing well for example Mr. Clean Malawi and Young voices (YV) who collect household solid wastes at a fee. However, there is a need for proper monitoring of these emergent solid waste entrepreneurs by the city council to ensure that solid wastes are handled appropriately from the point of collection to disposal. An interview with Mzuzu YV revealed that solid waste collection fee was ranging from MK 3,000-MK15, 000 depending on whether households obtain a movable plastic bin from YV.

However, most of the successful waste collection entrepreneurs are focusing on middle and high income areas. Another entrepreneur is Kenya Canteen who deals mainly in reuse wastes such as bottles. **Figure 11** shows reuse and branding of a water bottle by Kenya Canteen in Mzuzu.



**Figure 11: Reuse of plastic bottles**

The study also found that MCC amended its by-laws in 2016 to include issues of sanitation entrepreneurs or waste collection services.

This might ensure that even individual entrepreneurs have licenses and permits to operate freely in Mzuzu. More than half of the respondents lamented that they were not aware of Mzuzu City Council by-laws. This calls for continuous awareness raising not only by the city council but also non-governmental organisations and private companies working in solid waste management. It was observed that other NGOs like Red Cross Malawi were working with institutions of higher learning like Mzuzu University's Centre of Excellence in Water and Sanitation in training sanitation entrepreneurs some of which have showed interest in solid waste management. Results from the household survey showed that the top ranked initiatives for improving solid waste management in order of importance by respondents were *conducting awareness campaigns, composting, placing bins around the community, promoting recycling and introduction of an environmental week* as shown in the **Table 22**;

**Table 22: Top five initiatives for SWM from the survey**

<b>Initiative</b>	<b>Frequency</b>	<b>Percent (%)</b>
Conducting awareness campaigns	263	43
Composting	122	20
Placing bins around the community	94	15
Promoting recycling	78	13
Introduction of an environmental week	43	7

These initiatives have been employed in other countries for example awareness creation campaigns and placing bins around the community (Kasala, 2016), composting, promoting recycling and introduction of an environmental week (Juma & Kendi, 2015). Lack of awareness is clearly a major cause of indiscriminate solid wastes disposal. Zeleza-Manda (2009) also found lack of awareness on solid waste issues especially on waste separation. An interview with one of the block leaders in Ching'ambo revealed that civic educating (awareness campaigns) the people has great potential of turning the solid waste situation from worse to better. Civic education can be done through door-to-door campaigns. Furthermore, raising awareness can be done in form of education campaigns and can be educated through various methods such as radio, television, road shows, and circulation of papers with information to inspire people to practice proper SWM (Juma & Kendi, 2015).

To achieve efficacy and efficiency, NGOs should be involved in the process of civic education because they may have resources to do so.

Other initiatives found by Juma and Kendi (2015) which are in line with this study includes composting and introduction of an environmental week. Composting reduces the amount of wastes which can be disposed and can be a source of income to households through sell of manure and application of manure to their fields.

This study revealed that some respondents are practicing making of manure from solid wastes. For example, some of the households which were not willing to pay for waste collection mentioned that they make manure from solid wastes and therefore no need for solid wastes to be collected. This study therefore sees potential of scaling up composting from solid waste. Further study to assess the percentage of households practicing composting and success stories of composting in Mzuzu need to be conducted.

An Environment Week in Malawi exists and is commemorated at national and district levels depending on availability of funds. However, over the last few years' participation of people in this Week has been limited and this Week has been punctuated with sweeping exercises as the main activity. This is followed by speeches from different authorities and political figures. Respondents who recommended Environmental Week in this study might be elderly people who want to revive the spirit which was there in the 80's and early 90's when the youth were active in keeping cities clean. This study believes that this initiative is not very effective in Malawi due to financial constraints and lack of active participation especially from the youth.

The observed findings reveal that households consider placing bins in the community as a good initiative for mitigating indiscriminate solid wastes disposal. However, this is ironic

since the Mzuzu City Council with support from Plan Malawi and The Church of Central Africa Presbyterian Synod of Livingstonia Development Department (SOLDEV) placed bins in Mzuzu City but the adoption to use the bins is very minimal basing of field observations. This study suggests a further study to investigate reasons for lower adoption rates of use of these bins. The bins in the cities are marked 'organic', inorganic and plastics but people simply dispose the wastes anyhow. This can be attributed to lack of maximum awareness campaigns. Placing bins in the informal settlements may indeed improve the solid waste situation in Mzuzu. However, there is need of establishing waste management committees which can oversee the use of these bins. There is also need of robust response from the city council or solid wastes entrepreneurs in collecting solid wastes from the bins for further management. A study by Kasala (2016) also recommended placing bins in informal as a means of improving solid waste management.

## **CHAPTER 5: CONCLUSION AND RECOMMENDATIONS**

### **6.1. Conclusion**

This chapter focuses on whether the study achieved its set objectives or not. The main objective of the study was to evaluate domestic solid waste disposal methods and willingness to pay for solid waste collection in informal settlements of Mzuzu City, Malawi. The study was designed to find solutions and improve understanding of the challenges of household solid waste management being faced. The most valuable data included whether households were willing to pay, determinants of willingness to pay, waste disposal practices, and initiatives for mitigating solid wastes disposal.

The study found that indiscriminate solid waste disposal is rampant to an extent that even baby diapers are thrown along roads and drains. Solid wastes are also disposed in rivers and rivers/stream banks. This is a potential source of surface water pollution. More than half of the respondents mentioned that they manage wastes through burying in dug pits (rubbish pits) inside household compound. This was followed by disposal in the river/streams and drains. The study found out that solid wastes was not collected among the households sampled. Since solid waste is not collected and is indiscriminately disposed in informal settlements, there is high potential of contamination of both surface and underground water and proliferation of preventable diseases such as diarrhoea. This poses a great threat to public health and may lead to death and loss of finances in taking care of the sick in extreme cases.

The study has established that 85.8% of households are willing to pay for household solid waste collection. This is an indicator that households want to change the present solid waste condition for the better.

Households are willing to pay an average of MK1, 507.38 (\$2.09) per month for solid waste collection. However, this amount may not be cost-effective if only few households are paying for it. The more the households would actually pay for the services the more the profit would be realised. Future research should focus more on assessing the viability of the solid waste collection business in informal settlements. Solid waste collection presents a win-win situation both to entrepreneurs and households.

Entrepreneurs can make profits whereas households can focus on other development activities when solid waste management is subcontracted. Much as this is so, it should be noted that appropriate handling of wastes from collection and the end disposal of the



wastes by entrepreneurs can decide the fate of the solid waste management situation in Mzuzu. The study sees no threat in encouraging solid waste management entrepreneurs to venture into the business and in turn improve the solid waste management conditions in the informal settlement. However, there should be appropriate monitoring and evaluation mechanisms.

The study has established that it is only household income and bid amount which influence willingness to pay for solid waste collection. Households with high income were very willing to pay unlike households with less income. The study concludes that higher bid amounts scares customers away. More households were willing to pay at lower bid amounts not exceeding MK1000 (\$1.38). The study revealed that the following dependent variables did not influence willingness to pay; age, gender, household size, education, type of house, waste separation practices, house ownership, payment of electricity bills, payment of water bills, available disposal methods, occupation, marital status, amount of waste generated (estimate) & concern for environmental quality.

From this study, it can be concluded that the following initiatives can mitigate indiscriminate solid wastes disposal; enforcement of the 3 R's (reduce, reuse and recycling) in waste management, public-private partnerships and collaborations with NGO's to build capacity of sanitation entrepreneur's. These initiatives have been established from the City Council level or stakeholder perspective.

The study also found that household prefer the following initiatives: conducting awareness campaigns, composting, placing bins around the community, promoting recycling and introduction of an environmental week. Some of the major causes of indiscriminate solid

waste disposal were lack of awareness of appropriate waste disposal practices and MCC by-laws. Lack of space to dig refuse pits and lack of secondary waste disposal sites were also reasons for indiscriminate solid waste disposal. Therefore, adopting these initiatives can mitigate indiscriminate solid waste disposal hence improving solid waste management at municipal level. The study concludes that the best way of managing municipal solid wastes is starting from household level, especially informal settlements which are often neglected.

## **6.2 Recommendations**

Based on the above conclusion, the study recommends the following for future actions:

- Massive collaboration between MCC, private companies and NGO's to intensify awareness campaigns on best waste management practices and MCC by-laws
- MCC should enforce the adoption of the 3 R's of reduce, reuse and recycle
- The City Council should provide bins or secondary disposal sites in strategic places in informal settlements
- Waste collection entrepreneurs should also focus more on informal settlements as there is willingness to pay for solid waste collection
- Establishments of an active solid waste collection cooperative which will facilitate collection of huge amounts of wastes for sell or recycling
- There is a need to build capacity of solid waste entrepreneurs and households in the science composting

### **6.3 Areas for further research**

- Assessing the profitability of the solid waste collection business in informal settlements
- Investigating the science of composting in informal settlements as a solution for mitigating poor solid waste disposal
- Can private-public partnerships in solid waste management effectively work under the current environmental management policies?

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## APPENDICES

### Appendix 1: Summary of Research Questions Vs Data Analysis

Research Question	Variable	Data Analysis
a) How much in Kwacha are households willing to pay for solid waste collection?	Price in Kwacha	Finding mean in SPSS
b) What are the waste disposal methods?	Burning, dug pits, recycling, energy recovery, bare grounds, drains, collection bags, secondary city bins (waste skips)	Content Analysis, Narratives Descriptive statistics (frequencies, central tendency and dispersion, graphs, cross-tabs)
c) What are the determinants of willingness to pay for solid waste collection?	bid amount, household income per month, age, gender, household size, education, type of house, waste separation practices, house ownership, payment of electricity bills, available disposal methods, occupation, marital status, amount of waste generated (estimate) & concern for environmental quality	Logit analysis  Probability (WTP) = $\alpha + \beta_1$ bid amount + $\beta_2$ household income per month + $\beta_3$ age + $\beta_4$ gender + $\beta_5$ household size + $\beta_6$ education + $\beta_7$ marital status + $\beta_8$ type of house + $\beta_9$ waste separation practices + $\beta_{10}$ house ownership + $\beta_{11}$ payment of electricity bills + $\beta_{13}$ available disposal methods + $\beta_{14}$ occupation + $\beta_{15}$ concern for environmental quality

<p>d) Which initiatives in the community can mitigate indiscriminate solid waste?</p>	<p>Awareness campaigns, composting, placing bins, reassessment of waste legislature, promoting recycling, proper monitoring of solid disposal activities, partnerships with waste companies, provide necessary wastes facilities, introduction of an environmental week, linking solid waste collection fees to other public services provided,</p>	<p>Content Analysis, Narratives Descriptive statistics (frequencies, graphs , cross-tabs)</p>
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**Appendix 2: Household Survey Questionnaire**

Date of the interview: ----/----/----- (Day/Month/Year) Questionnaire No.:

\_\_\_\_\_

Name of Informal Settlement: \_\_\_\_\_

Name of Block leader \_\_\_\_\_ T/A \_\_\_\_\_



Interviewer Name: \_\_\_\_\_

Total time of interview in minute's \_\_\_\_\_

Respondent Selection: We will interview household's heads (*Expected to be above 18 and responsible for decision making at the household*)

### **Introduction**

Hello, my name is ***Gabriel Kapanda Jr.*** and I am a final year student at Mzuzu University pursuing Master of Science in Sanitation. I am conducting a study aimed at evaluating domestic solid waste disposal methods and willingness to pay for solid waste collection in informal settlements of Mzuzu City, Malawi. Conducting this study is a requirement for the award of the Master's degree. I am therefore, seeking your assistance to provide objective and accurate answers to the questions during this interview. Please note that the answers you provide will not be used against you but will help to generate relevant information for my study. Your name will also not be taken or published. Information collected will be used for academic purposes only and will be treated with utmost confidentiality.

The survey is expected to last within 30 minutes?

Would you spare your time to participate in this survey? Yes  No

If yes, shall we start...

### **Part 1: Basics of Solid Waste Management**

1. How do you understand the term indiscriminate solid waste disposal?

.....  
.....  
.....

2. Are people practicing indiscriminate solid waste disposal?

- A. Yes (1) B. No (2)

2.1 If yes, why do you think people dispose waste indiscriminately from your community?

- A. Lack of awareness of proper SWM methods (1)  
B. Lack of space (2)  
C. Convenient (3)  
D. Lack of door-to-door collection services (4)  
E. Lack of secondary disposal sites provided by the council (waste skips) (5)  
F. Lack of enforcement (6)  
G. Other\_\_\_\_\_

3.0 What do you think are the common environmental effects of indiscriminate solid waste disposal in your community? (*choose all that apply*)

- A. physical nuisance of the waste to the environment (1)  
B. flooding emanating from blockage of drains (2)  
C. hideouts for disease causing animals and insects e.g rodents and tsetse flies (3)  
D. climate change from methane gas emissions (4)  
E. severe health implications from consumption of harmful chemicals (5)  
F. soil, air and water pollution (6)

4.0 What do you think is the best method for waste management in your community?

- A. Dumping (1)
- B. Recycling (2)
- C. Composting (3)
- D. Incineration (4)
- E. Energy recovery through biogas (5)
- F. Landfilling (6)
- G. Other\_\_\_\_\_

**Part 2: Household Solid Waste Management**

No	Question	Response
5.0	<p>What are the different types of wastes usually produced at your household?</p> <ul style="list-style-type: none"> <li>A. Plastic (1)</li> <li>B. E-waste (2)</li> <li>C. Organic (3)</li> <li>D. Glasses (4)</li> <li>E. Paper (5)</li> <li>F. Ashes (6)</li> <li>G. Textiles (7)</li> <li>H. Other (<i>specify</i>).....</li> </ul>	
6.0	<p>How much wastes does your household produce (estimate) per week</p> <ul style="list-style-type: none"> <li>A. 5 Kgs (1)</li> </ul>	

	<p>B. 10 Kgs (2)</p> <p>C. 15 Kgs (3)</p> <p>D. 20 Kgs (4)</p> <p>E. 30 Kgs (5)</p> <p>F. Other (<i>specify</i>).....</p>	
7.0	<p>Where do you dispose your solid wastes?</p> <p>A. In drains</p> <p>B. In dug pits inside compound</p> <p>C. On road side</p> <p>D. On river or stream banks</p> <p>E. In the river</p> <p>F. Waste skips/bins provided by authorities</p> <p>G. Other (<i>specify</i>).....</p>	
8.0	<p>How do you manage wastes?</p> <p>A. burying (1)</p> <p>B. burning (2)</p> <p>C. recycling (3)</p> <p>D. reuse (4)</p> <p>H. It is collected and disposed by the company (5)</p>	

9.0	<p>Are there waste skips within 200 metres of your residents where you dispose wastes</p> <p>B. Yes (1)</p> <p>C. No (2)</p>	
9.1	<p>If yes, what challenges are there in using the waste skip</p> <p>.....</p>	
9.2	<p>If No, would you have used waste skips if they were around and near to dispose wastes?.....</p>	
10.0	<p>Do you practice waste separation?</p> <p>A. Yes (1)</p> <p>B. No (2)</p>	
10.1	<p>If yes, how is the waste separation done?</p> <p>A. Put in different plastic bags soon after generation</p> <p>B. Removed from a mixture of waste after drying of disposed waste</p> <p>C. Other.....</p>	
10.2	<p>If yes, why do you practice waste separation?</p> <p>A. Source of income</p> <p>B. Have expertise to do so</p> <p>C. To make manure</p> <p>D. Facilitate efficient disposal</p> <p>E. Other.....</p>	

10.3	<p>, If No, why?</p> <p>A. Lack of technical know-how</p> <p>B. Disgusting</p> <p>C. Not interesting</p> <p>D. Not enough time</p> <p>E. Too expensive</p> <p>F. I pay for solid wastes collection</p> <p>G. Lack of market for recyclables</p> <p>H. Other.....</p>	
------	----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------	--

10.4	<b>How do you reuse the following wastes?</b>		
	Waste Material	Reuse method	
	Paper	e.g to start firewood	
	Metals		
	Plastic bottles		
	Plastic paper		
	Food wastes		
	Textiles		
	Other wastes.....		
	....		

11.0 Who usually dispose wastes at the household?

- A. Male Children
- B. Female Children
- C. Wife
- D. Husband
- E. Other

(specify).....

12.0 Are you aware of Mzuzu City Council's solid waste management by-laws?

- A. Yes (1)
- B. No (2)

12.1 If no,

why?.....

12.2 If yes, do you use or follow them?

Explain.....

13.0 How does your household store solid wastes prior to disposal

- A. Closed container
- B. Open container
- C. Plastic bag
- D. Doesn't store simply throw away instantly
- E. Other

(specify).....

14.0 Are you concerned with managing the environment?

- A. Yes (1)
- B. No (2)

15. If yes, what does your household do to manage the environment?

.....  
.....

**Part 3: Initiatives for Improving Solid Waste disposal**

16.0 Are you satisfied with how households manage wastes?

A. Yes (1)      B. No (2)

16.1 If, no, explain the reasons

why?.....  
.....

17.0 Has there been an outbreak of diseases in the community which had potential originality from poor solid wastes disposal?

A. Yes (1)      B. No (2)

17.1 If, yes, explain the outbreak and how it affected the

people.....  
.....

18.0 Do you think your household health is endangered by how wastes is disposed in the community

A. Yes (1)      B. No (2)

19.1 If, yes, explain the reasons

why?.....  
.....



20.0 Which of the following initiatives do you think can mitigate indiscriminate solid waste disposal in your community? (check yes or no)

Initiatives	Yes (1)	(No)
<p>A. Awareness campaigns</p> <p>B. Composting</p> <p>C. Placing bins</p> <p>D. Reassessment of waste legislature</p> <p>E. Promoting recycling</p> <p>F. Proper monitoring of solid disposal activities</p> <p>G. City Council's partnerships with waste companies</p> <p>H. Provide necessary wastes facilities like waste skips</p> <p>I. Introduction of an environmental week</p> <p>J. Linking solid waste collection fees to other public services provided like electricity bills</p> <p>K. Other (specify).....</p>		

21.0 Rank the top five initiatives in order of applicability, importance and foreseen success in your community.

1. \_\_\_\_\_
2. \_\_\_\_\_
3. \_\_\_\_\_

4. \_\_\_\_\_

5. \_\_\_\_\_

**Part 4: Willingness to pay for solid waste collection**

22. If solid wastes were collected weekly using a motorised cart and also a vehicle with a van where possible (considering the terrain and inaccessible roads in informal settlements), **would you be willing to have your solid wastes collected?**

- B. Yes (1)
- B. No (2)

22.1 If no, explain why you wouldn't want your wastes to be collected?

.....  
.....

22.2 If yes, would you pay a monthly fee of \_\_\_\_\_ to have your solid wastes collected?

- A) MK 1000
- B) MK 1500
- C) MK 2000
- D) MK 2500
- E) MK 3000
- F) Other \_\_\_\_\_

23.0 What is the best mode of payment for solid waste collection?

- A) Cash
- B) Incorporation into water bills?

C) Incorporation into electricity?

D) Deduction from Public Works payment?

E) Other\_\_\_\_\_

### Part 5: Demographics

25. Kindly provide us with your household's information;

<b>Household Characteristics</b>	<b>Response</b>
<i>household size (HH)- Total number of household members including children</i>	
<i>household income per month- Total amount of money in Kwacha the household makes in a month from business or employment</i>	
<i>Age- Present age of respondent</i>	
<i>Gender-1 for male, 0 for otherwise</i>	
<i>Education- Number of years in School</i>	
<i>type of house-1 for roof with iron</i>	

<i>sheets , 0 for otherwise</i>	
house ownership- <i>Whether household stays in their own house (1 for owning house, 0 for otherwise)</i>	
payment for electricity - <i>Whether the household pay for electricity 1 for yes, 0 for otherwise</i>	
payment for water bills (Water board) <i>.Whether the household pay for water, 1 for yes, 0 for otherwise</i>	
Occupation- <i>Whether the respondent is formally employed (1 for yes, 0 for otherwise</i>	
Marital status- <i>Is the respondent married? 1 for yes, 0 for otherwise</i>	

**End of Questionnaire: Final Remarks**

Thank you for your participation in this study; this is the end of the study. Would you be willing to be part of a focus group discussion in the near future? If yes, kindly provide us with your contact details so that we are able to reach you!!

**Appendix 3: Key Informant Interviews (NGO’s, CBO’s, Solid Waste Management Entrepreneurs)**

Name of Organisation/Company: \_\_\_\_\_

**Topic 1: Solid waste management challenges**

1.1 What does your organisation do in relation to solid wastes management?

.....  
.....

1.2 Do you think solid waste management is a problem in Mzuzu Informal Settlements?

Yes [ ] No [ ]

1.21 If yes, in your experience as an organisation/company explain the challenges in solid waste management.

.....  
.....

1.3 What are the specific social economic effects of the current solid waste management?

.....  
.....

1.4 What are the specific environmental and public health effects of the current solid waste management?

.....  
.....

**Topic 2: Indiscriminate solid waste disposal & management**

2.1 Are solid wastes being disposed indiscriminately by households?

Yes [ ] No [ ]

2.12 If yes, why do you think household dispose wastes indiscriminately?

.....  
.....

2.3 What is the potential public health threat of indiscriminate solid waste disposal?

.....  
.....

2.4 What initiatives can be put in place to mitigate indiscriminate solid waste disposal?

.....  
.....

2.5 What do you think is the best solid waste management option in informal settlements?

.....  
.....

2.61 How do you think this best option (from 2.6 above) can be promoted?

.....  
.....

**Topic 3: Solid waste collection**

3.1 Are solid wastes collected in informal settlements?

Yes [ ] No [ ]

3.12 If yes, who does the waste collection?

- A. City Council
- B. Private company
- C. NGO's

Other (*specify*).....

3.13 If yes, is the waste collection coverage satisfactory?

Yes [ ] No [ ]

3.4 What can be the challenges in solid wastes collection?

.....  
.....

3.5 What do you think can be done to improve solid waste collection?

.....  
.....

**Appendix 4: Key Informant Interviews (Mzuzu City Council Officials)**

**Topic 1: Solid waste management challenges**

1.1 Do you think solid waste management is a problem in Mzuzu Informal Settlements?

Yes [ ] No [ ]

1.11 If yes, in your experience as an organisation explain the challenges in solid waste management.

.....  
.....

1.2 What are the specific social and economic effects of the current solid waste management?

.....  
.....

1.3 What are the specific environmental effects of the current solid waste management?

.....  
.....

1.4 What are the major milestones which the City Council has made towards solid waste management to date?

.....  
.....

1.5 Do most households comply with the waste management by-laws?

Yes [ ] No [ ]



1.51 If No, what do you think is the reason & what can be done to improve the situation?

.....  
.....

**Topic 2: Indiscriminate solid waste disposal & management**

2.0 Are solid wastes being disposed indiscriminately by households?

Yes [ ] No [ ]

2.1 If yes, why do think household dispose wastes indiscriminately?

.....  
.....

2.2 Do households utilise waste skips which you provide in communities?

Yes [ ] No [ ]

2.21 If, No what do you think is the main reason?

.....  
.....

2.3 Why is that not all are informal settlements supplied with waste skips/bins?

.....  
.....

2.4 What is the potential public health threat of indiscriminate solid waste disposal?

.....  
.....

2.5 What initiatives can be put in place to mitigate indiscriminate solid waste disposal?

.....  
.....

2.6 What do you think is the best solid waste management option in informal settlements?

.....  
.....

2.61 How do you think this best option (from 2.6 above) can be promoted?

.....  
.....

**Topic 3: Solid waste collection**

3.0 Are solid wastes collected in informal settlements?

Yes [ ] No [ ]

3.1 If, No why do you think solid waste not collected in informal settlement?

.....  
.....

3.12 If yes, who does the waste collection?

.....  
.....

3.13 If yes (from 3.1), is the waste collection coverage satisfactory?

Yes [ ] No [ ]

3.2 What are the current challenges in solid wastes collection?

.....  
.....

3.3 If households could be willing to pay for SWM, are there any incentives which can provided to such households?

.....  
.....

3.4 Is there a market for the collected wastes?

.....  
.....

3.3 What do you think can be done to improve solid waste collection?

.....  
.....

**Appendix 5: Observation Checklist**

Time	Date	Place	Situation  (Are waste disposed discriminately-yes or no)- <i>tick if there is indiscriminate</i>	Detailed  summary of what is seen	Comments in  regards to solid wastes management

			<i>waste disposal</i>		

**Appendix 6: Focus Group Discussion Guide**

Question 1: Do you think the community will be willing to have their waste collected?

What do you think are the challenges of waste collection? And how can the challenges be alleviated?

Question 2: What are the common ways in which households dispose their wastes? Are these the best options of disposing wastes? How best can wastes be managed at household level?

Question 3: What are the dangers of indiscriminate solid wastes disposal? What are the vivid public health and environmental effects seen in the community?

Question 4: Does the community participate in solid waste management initiatives? Give examples of these initiatives? Are households practicing solid wastes separation at source?

Question 5: What do you think can be done to mitigate solid waste management challenges?

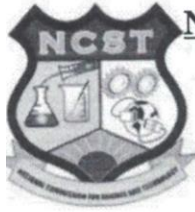
- a) At household level
- b) Community level
- c) At City Council level

Question 6: Are there private companies, sanitation entrepreneurs, CBOs or NGOs who work in solid wastes management in your community? What impacts have the private sector brought? What do you think can be done better to coordinate community participation and private sector interventions?

**End of Discussions**

**Thank you very much for your participation!!!**

**Appendix 7: Ethical Clearance**



## **NATIONAL COMMISSION FOR SCIENCE AND TECHNOLOGY**

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*'A nation with scientifically and technologically led sustainable growth and development'*

Ref No: NCST/RTT/2/6

29<sup>th</sup> May, 2017

Gabriel Kapanda  
Mzuni  
Private Bag 201  
Luwinga  
Mzuzu

Dear Gabriel Kapanda,

### **RESEARCH ETHICS APPROVAL OF PROTOCOL P.05/17/178: DETERMINING WILLINGNESS TO PAY AND INITIATIVES FOR MITIGATING INDISCRIMINATE HOUSEHOLD SOLID WASTE DISPOSAL IN MZUZU INFORMAL SETTLEMENTS**

Having satisfied all the ethical, scientific and regulatory requirements, procedures and guidelines for the conduct of research in the social sciences sector in Malawi, I am pleased to inform you that the above referred research study by IHI has officially been approved. You may now proceed with its implementation. Should there be any amendments to the approved protocol in the course of implementing it, you shall be required to seek approval of such amendments before implementation of the same.

This approval is valid for one year from the date of issuance of this letter. If the study goes beyond one year, an annual approval for continuation shall be required to be sought from the National Committee on Research in the Social Sciences and Humanities in a format that is available at the secretariat. Once the study is finished, you are required to furnish the Committee and the Commission with a final report of the study.

Wishing you a successful implementation of your study.

Yours Sincerely,

Martina Chimzimu  
NCRSH ADMINISTRATOR AND RESEARCH OFFICER  
**HEALTH, SOCIAL SCIENCES AND HUMANITIES**  
For: CHAIRMAN OF NCRSH