AN INVESTIGATION INTO THE EFFECTIVENESS OF HOUSEHOLD SOLID WASTE MANAGEMENT STRATEGIES IN HARARE, ZIMBABWE

by

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DEDICATION

Written and dedicated to my family: Tinashe Prince, Tinevimbo Blessing and Chipo. I also would like to make a special dedication to all the people making a living out of recycling waste in Harare for you are a special kind.

ABSTRACT

The main objective of the study was to investigate the effectiveness of the strategies employed by the City of Harare in household solid waste management. To achieve these, structured questionnaires, interviews, observations and focus group discussions were employed in data gathering together with secondary data. The study was conducted in Harare's low, medium and high density income suburbs. Findings revealed that organic solid waste constituted the largest proportion of waste generated in Harare and other forms are also generated yet their collection is very minimal. Residents resort to illegal night dumping, resulting in the proliferation of associated diseases. In light of these findings, it was recommended that waste collection entities be capacitated, people be educated on waste recycling, reduction and reusing. A commission was to be put in place to ensure proper enforcement of waste legislation, effective and sustainable day in running of household solid waste management in the city.

KEY TERMS

Solid Waste, Household, Management, Strategies, Effectiveness, Harare, Zimbabwe

STATEMENT OF SUBMISSION

I declare that **AN INVESTIGATION INTO THE EFFECTIVENESS OF HOUSEHOLD SOLID WASTE MANAGEMENT STRATEGIES IN HARARE, ZIMBABWE** is my own work and that all the sources that I have used or quoted have been indicated and acknowledged by means of complete references.

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SIGNATURE	DATE
Mr. Benjamin Mandevere	22/03/16

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ABBREVIATIONS AND ACRONYMS

BEO	Best Environmental Option
CBOs	Community Based Organisations
CGHRA	Combined Greater Harare Residents Association
EA	Environment Africa
EIAP	Environmental Impact Assessment Policy
EMA	Environmental Management Act
EMA	Environmental Management Agency
EPA	Environmental Programme Action
EPGs	Environmental Pressure Groups
ESAP	Economic Structural Adjustment Programme
et al.	And others
HCC	Harare City Council
ILO	International Labour Organisation
IPP	Integrated Product Policy
ISWM	Integrated Solid Waste Management
IWMS	Integrated Waste Management Systems
LGCDP	Local Government Capital Development Programme
MET	Ministry of Environment and Tourism
MSW	Municipal Solid Waste
NEP	National Environmental Policy
NGOs	Non-Governmental Organisations
NIMBY	Not In My Back Yard
NSSA	National Social Security Authority

PSP	Private Sector Participation
RDCCBP	Rural District Council Capacity Building Programme
S I	Statutory Instrument
SEPA	Swedish Environmental Protection Agency
SEPA	Swedish Environmental Programme Assessment
SPSS	Statistical Package for Social Sciences
SSA	Sub-Saharan Africa
SWM	Solid Waste Management
UN	United Nations
UNCED	United Nations Conference on Environment and Development
UNEP	United Nations Environmental Programme
UNICEF	United Nations Children Emergency Fund
UNSD	United Nation Statistics Division
WEEE	Waste Electrical and Electronic Equipment
WHO	World Health Organisation
ZIMSTAT	Zimbabwe National Statistics Agency
ZINWA	Zimbabwe National Water Authority

CHAPTER ONE

Introduction and Background

1.1 Introduction

Human settlements are facing increasingly complex and formidable environmental problems, particularly in Less Economically Developed Countries (LEDCs).These include water, ground and air pollution. Notable problem is household solid waste whose production has not been matched by an increase in the capacity of municipalities to manage the waste, giving rise to disposal problems (Srinivas, 2003). Waste management and disposal seem to be the major challenges in the face of financial, technical and administrative incapacity of developing countries (Jerie, 2006).This waste emanates from both residential and industrial sources, and should be managed in ways that are environmentally friendly, ecologically sound, economically viable, and socially acceptable and without causing health hazards (Macizoma, 2001; Katyal and Satake, 2001; and Jerie, 2006). Thus the strategies employed in the management of household solid waste are of concern especially given the fact that quantities of household solid waste are on the rise and may increase fourfold by 2025 (World Resources, 1996).

It is of great concern that over 100 people die every year due to diseases caused by improper household solid waste management (Tevera, *et al.* 2003). It is estimated that up to 5.5 million people are at risk of death from diseases that are a result of poor household solid waste management (Hardoy, *et al*. 2001).These diseases can be avoided if proper waste management strategies are put in place (Zerbock 2003).

Harare, capital city of Zimbabwe, is subject to these ever-increasing household solid waste management problems. This is partly because of a number of factors which include among others lack of financial capacity, technical expertise, limited environmental education and increased population numbers. The Harare City Council is therefore facing household solid waste management challenges as it tries to effectively manage household solid waste at low cost, and reduce environmental degradation and

deterioration due to improper disposal of household solid waste. Both organic and inorganic waste are produced and dumped haphazardly in Harare (Jerie, 2006). Recent studies by Tsiko and Togarepi 2012, Masocha (2005) and Makuku and Masiye (2002), have been undertaken to try and establish the causes of this poor household solid waste management. However, their focus was not on the assessment of the effectiveness of the strategies employed in household solid waste management. Thus, there is need for new information to improve the effectiveness of the strategies used in household solid waste management.

Strategies have been traditionally recommended for waste minimisation and these are part of the waste management hierarchy and involves, reusing, recycling, reducing, avoiding and land filling. This research examines the effectiveness of these conventional waste management strategies. This is against the background that major challenges are faced in household solid waste management and of note is the identification of suitable sites for and selection of methods of household solid waste disposal, lack of proper and adequate compactors and skilled personal, environmental education and financial resources. (EPA, 2004; WHO, 1993; Tevera, 1993; Tevera, 1991)

1.2 Background to the study

The problem of household solid waste management in Less Economically Developed countries (LEDCs) is a product of a multiplicity of factors; and these include among others deteriorating infrastructure (Zerbock, 2003; Machivenyika, 2012), little environmental education among the general populace, increased urbanization and industrialization, too many persons per dwelling, cultural and personal attitudes (Chirisa, 2012). In countries that are enjoying an economic boom, the management and disposal of solid waste is so formidable that it exceeds existing financial, technical and administrative potential and capabilities (Zerbock, 2003). In Harare (Zimbabwe), lack of technical knowledge among municipal workers, the dollarization of the Zimbabwean economy, failing economy and lack of environmental knowledge by residence of Harare is affecting household solid waste management (Chirisa, 2012).

Table 1.1 shows an increase in the population of Harare from 1969 to 2012. The population trend suggests that the levels of waste generation are increasing as signified by new open dumping on roadsides and open spaces, even those previously cleaned by the local authority. The growth in population has a bearing on the generation of waste because, in general, the bigger the population the larger the amount of waste generated (Medina, 2010).

Table 1.1: The Growth of Harare's Population (1969-2012)

Year	1969	1982	1989	1994	2000	2012
Population	364.390	656.011	973.444	1.290.44	1.831.140	4.485.615

Source: Zimbabwe National Statistics Agency (ZIMSTAT 2012)

This possibly explains why Saungweme (2012) argued that the accumulation of waste on open spaces and road sides is a failure by local authorities to employ proper and efficient waste management strategies which can cope with the rate of waste generation when population increases. This is also supported by Zerbock (2003) who indicated that, in many LEDCs such as Zimbabwe, Zambia and other countries, an increase in population is not matched with an equal increase in revenue for local municipalities to do proper household solid waste management. The mushrooming of informal settlements in Harare has also resulted in the failure by the local authorities to manage household solid waste and to adequately plan and put in place appropriate methods of household solid waste management which suite the various situations that are arising in the city (Chinobva and Makarati, 2011). This has resulted in waste management problems.

The amount of household solid waste generated by a country is proportional to its population and the mean living standard of its people (Kinnaman, 1999). This means that the bigger the population the more the household solid waste generated, for example 4.485.615 was Harare's population in 2012 and this means more waste generation compared to 1969 when the population was 364.390. Household solid waste management strategies in developed countries are advanced, adequate and supported financially (Medina, 2010). According to the Swedish Environmental Protection Agency

(SEPA, 2005), strategies such as landfill bans and taxes were introduced to ensure that less household solid waste goes to the landfills and more is recycled. They have also introduced the Integrated Product Policy (IPP) to ensure that producers produce their products in an environmentally friendly manner (SEPA, 2005). However, the situation is different in the developing world where the process of household solid waste management is negatively affected by several challenges as indicated by Katyal and Satake (2001) who observed that, due to financial problems, poor household solid waste disposal results in serious environmental problems.

In Zimbabwe the strategies that have been employed to manage household solid waste include collection, reusing, recycling, reducing, composting, incineration and dumping at designated sites such as the Pomona dumpsite in Borrowdale a low density residential area on the north-eastern side of Harare. Legislation such as the Environmental Management Act of 2002, city by-laws, environmental campaigns such as the “Bin It” campaign, environmental education and other strategies have been used to manage household solid waste in Harare. Household, solid waste still remains a problem as evidenced by its continuous accumulation on street sides and outbreaks of waste related diseases such as typhoid, cholera and dysentery (Saungweme 2012; Chirisa, 2012).

Zimbabwe has over five pieces of legislation that deal with environmental management issues and these include among others the Environmental Management Act Chapter 20:27 and the Public Health Act 15:09. However, these legal instruments are administered by different government departments and ministries (Magadzire and Maseva, 2006). This brings duplication of duties in policy implementation, Ministries and Government Departments tend to hold different legal positions but performing the same functions. For example, it is difficult to tell who should monitor household solid waste handling issues among the Ministry of Local Government, Ministry of Environment, Climate and Water, Ministry of Tourism and The Ministry of Health and Child Welfare. This is evidenced by section 70 (3) of the EMA Act which encourages sustainable waste management and section 68 (1) of the Public Health Act which also talks of sustainable

waste management. Table1.2. shows the Environmental Legislation and Governing Institutions in Zimbabwe.

Table 1.2: Environmental Legislation and Governing Institutions

Environmental legal Instrument	**Governing Ministry/ Department**
Environmental Management Act Chapter 20:27	Environmental Management Agency/Ministry of Environment, Climate and Water
Public Health Act Chapter 15:09	Ministry of Health and Child Welfare
Urban Council Act Chapter 29:15	Ministry of Local Government and National Housing
Water Act Chapter 20:22	Ministry of Water Resources
Rural District Councils Act Chapter 29:13	Ministry of Local Government and National Housing
Regional Town and Country Planning Act Chapter 29: 12	Ministry Local Government and National Housing

Source: Primary Data (2014)

These Acts are governed by six different Government Ministries yet they deal with one and the same aspect in household solid waste management, of ensuring that the residence and members of the public are accorded a clean environment free of waste-related diseases. There are five other statutory instruments and policies in waste management which seek to prevent nuisances associated with casting of flyers, pamphlets, advertisements or waste paper upon undesignated places. These include among others Harare waste management by-law (Statutory Instrument [SI] 477 of 1979), Harare Waste Management Amendment By-law (SI 127 of 1981) and Harare (Anti-litter) By-law (SI 185 of 1981). In addition to these Harare by-laws, Zimbabwe has other policies that also attempt to deal with waste management. These include among others the Draft National Environmental Policy (DNEP), Environmental Impact Assessment Policy (EIAP) and the Zimbabwe National Sustainable Strategy (ZNSS) (Ministry of Environment and Tourism, 2002). Despite the legal instruments listed above, the Ministry of Environment and Tourism (2004) indicated that Zimbabwe does not have an overall waste management policy and this is a contributory factor to the

crisis in the waste management sector in most of its urban centres (Makuku and Masiye 2010). Magadzire and Maseva (2006) also indicated that the poor waste management situation has been exacerbated by inadequate enforcement rather than absence or ineffectiveness of national legislation governing waste management. Tevera *et al.* (2002) also share the same sentiments that poor legislative implementation causes illegal dumping. Senkoro (2003) and Kidd (2009) also agreed with the point that ineffective enforcement of these instruments leads to environmental and health problems.

Despite the availability of these legislative tools, waste management still remains a major concern in Zimbabwe's urban areas such as Harare. While human behaviour and perceptions about solid waste management play a major role, the available strategies can be evaluated. Residents do not want household solid waste in their backyards; they want it removed. Unfortunately this is not happening in the City of Harare as the collection of household solid waste seems to be ineffective. This is evidenced by illegal dumps on open spaces along roads in the majority of high and medium density areas.

1.3 Problem Statement

The current state of Harare is not pleasing as waste alongside roads, open spaces and other undesignated sites reflects a view of an environmental disaster which is not only catastrophic but also a drawback to the concept of sustainable development and health for all by 2020 (Chirisa, 2012). This is against the fact that institutions such as the Environmental Management Agency, Harare City Waste Management Department and Non-Governmental Organisation are mandated by the Zimbabwean Government to ensure proper household solid waste management.

The growth of the population coupled with urbanization, industrialization and the use of the multi-currency (US dollar, South African Rand and the Botswana Pula) system in Zimbabwe's economy has resulted in increased household solid waste generation since the buying power of the population is strengthened by the use of various currencies. The increased household solid waste generation together with the mismanagement of the generated household solid waste is contributing to the contamination of ground and surface water which affects human health (Mangizvo, 2010; Tsiko *et al*. 2012).

In Harare, the management of household solid waste is a major challenge because its generation exceeds the capacity of local authorities to effectively handle it (Srinivas, 2003). This has resulted in the dumping of household solid waste on road sides and open spaces in the city leading to the proliferation of diseases such as cholera, typhoid, malaria and dysentery. Solid waste is either burnt on open spaces or dumped at undesignated places. Saungweme, (2012) and Chinobva and Makarati, (2011) cited that the cholera outbreak of 2008 and typhoid outbreak in that same year and subsequent years in Harare have been attributed to poor solid waste management. These problems have arisen despite attempts by waste management authorities to manage the household solid waste using longstanding collection strategies and waste minimization (Chirisa, 2012). There is therefore need to examine the effectiveness of the methods employed in order to come up with more effective strategies to safeguard the wellbeing of the city and its inhabitants.

The current practice in waste management in most residential suburbs of Harare is collection of the waste from sources of generation which are households (the high, medium and low density areas) and dumping it at designated points (such as the Pomona dumpsite) without proper segregation and treatment of the waste (Mubaiwa, 2013; Chikobvu *et al*. 2011; Masocha, 2005; Madebwe and Madebwe, 2006). It is important to note that Harare City Council does not have enough data on household solid waste management because the available record is out-dated and new research has not been done because of financial problems. In Zimbabwe, there is scarcity of data on the effectiveness of household solid waste management strategies yet sporadic and erratic household solid waste management systems are common in Harare. This has contributed to the local authorities taking everything to be waste, yet recycling and reusing can ensure that not all is waste as some so called waste can be changed to useable items (Masocha, 2005). This can be made possible by providing residence with proper receptacles in the right quantities to allow for separation of household solid waste.

While household solid waste management practices have been investigated in studies, up until now data on the effectiveness of available household solid waste management

strategies has not been investigated and people's perceptions on household solid waste management strategies has been lacking. Effective household solid waste management is more than just collecting waste and dumping of the collected waste as practised by most municipalities to include Harare Municipality. It is an efficient combination of various components of household solid waste management. This project therefore seeks to establish, if the Harare City waste management system function efficiently and effectively. This is done by establishing if the strategies used in Harare are clear, comprehensive, cost effective, and environmentally sound and with household participation as well as Private Sector Participation (PSP). The project aims therefore to establish the effectiveness of available household solid waste management strategies and give recommendations for a better integrated household solid waste management for the city of Harare.

1.4 Rationale of the Study

Population is not static, it changes due to various factors and because of this, there is need for authorities to be on the guard and to facilitate change in household solid waste management with time and ensure that available household solid waste management strategies are up to date and meet the sustainable development mark (Chiwandamira, 2000).

Urbanization, industrialization and economic growth in developing countries and transition in several other social and political issues due to globalization call for a sustainable environmental management system in which waste management strategies tally with the situation at hand for the benefit of the present and future generations (Environment Africa, 2013).

Zimbabwe has more than seven pieces of legislation that pertain to waste management (Table 1.2).These acts according to Tevera *et al.* (2003) and Nhete (2006) are acknowledged but still waste management standards are deteriorating in most urban centres in Zimbabwe. The various government departments and ministries need to revisit environmental management legislation to see if they still stand the test of time or need to be improved (Magadzire and Maseva, 2006). Thus institutions such as the Environmental Management Agency (EMA), National Social Security Authority (NSSA),

Ministry of Environment Climate and Water, Harare City Council and other organizations in Zimbabwe need to be guided on household solid waste management strategies (Magadzire and Maseva, 2006).

Harare has seen the proliferation of informal settlements and industries that are generating waste and are illegally dumping (Chirisa, 2012). This means that Harare is confronted with an increasingly complex problem of managing huge amounts of solid waste generated each day by its inhabitants. This research therefore may go a long way in advising all Government and non-governmental institutions that have a role in the waste management issues of the city of Harare.

Harare is failing to handle its household solid waste as evidenced by waste on the streets and frequent outbreaks of related diseases. Thus the Ministry of Health and Child Welfare and the Harare City Council (HCC) need guidance on how to cope with the new dispensation of household solid waste generation and associated health problems such as the cholera outbreak of 2008 - 2009 which claimed over 3500 human lives in Harare (Federation of Red Cross and Red Crescent, 2010).

Despite having by-laws, the city of Harare does not have the mandate to arrest offenders on waste matters (Magadzire and Masevo, 2006).This is because the council is not mandated by the available laws to arrest and prosecute waste offenders. This task has been given to the Environmental Management Agency (EMA). Despite this set up, EMA is only dealing with companies and seem not to pay attention to households and how they dispose of their household solid waste. Several changes have occurred in waste management issues, but in Zimbabwe some of the legislation that deals with household solid waste management was not amended for over two decades. (Magadzire and Masevo, 2006) and this calls for an all-stakeholder intervention to ensure that new ideas are brought in, on issues of household solid waste management (Magadzire and Masevo, 2006). This is seen in countries like South Africa where some waste management legislation has been changed for the better (Zerbock, 2003).

1.5 Broad Objective of the Study

The broad objective of this study is to investigate the effectiveness of the strategies used in the management of household solid waste in Harare. This will enable the researcher to come up with an overall workable household solid waste management strategy so as to reduce environmental pollution and associated human health problems. In order to achieve this, the broad objective is broken down into the following specific objectives.

1.5.1 Specific objectives

The study seeks to achieve the following objectives:

- To determine the types and amounts of household solid waste generated in Harare.
- To analyse the impacts of waste generated on the environment and human health.
- To assess the effectiveness of current solid waste collection and disposal strategies in reducing environmental pollution.
- To come up with recommendations for effective household solid waste management strategies for the city of Harare.

1.6 Study Area

Harare is the capital city of Zimbabwe and thus a leading financial, commercial, industrial and communication centre. It is situated at an elevation of 1483 metres and its climate falls into the warm temperate category. The climatic year is divided into three main seasons and these are the warm-wet season (November-April), the cool-dry season (May- August) and the hot-dry season (September-October).Temperatures range from 2-22 degrees Celsius in July (the coldest month) and 15-30 degrees Celsius in October (the hottest month).

Harare has over 250 residential areas which are categorized as low, medium and high density suburbs. This categorization is based on the economic and social status of the population in the various residential areas. Basically the low density areas has stands that are more than 1000 square meters is home to the city elite, the roads are well

maintained and free of potholes making the areas accessible. The medium density areas stands ranges from 600 to 1000 square meters in area, these areas have more than 5 people per household and the roads are damaged with potholes all over. The high density areas, houses the biggest population with more than seven people per household. This area is dominated by roadside dumps and the roads are bad with potholes all over. The household solid waste from the three densities is dumped at Pomona dumpsite because Zimbabwe and Harare in particular does not have a landfill. Harare had two dumpsite originally, which where Pomona in Pomona Borrowdale and The Golden Quarry in Eastlea, however currently the Golden Quarry dumpsite is not functional. Focus in this project is on the low density suburbs of Gunhill to the north, and Mandara and Borrowdale to the north-east; high density suburbs of Highfield and Budiriro to the south-west and Mbare to the south; and medium density suburbs of Waterfalls to the south-east, and Milton Park and Westlea to the north-west.

The area is generally composed of both indigenous and exotic trees. The trees include *msasa*, mango, avocado, orange, jacaranda, banana, *mupfuti* and several others. There is also the Mukuvisi River which passes through various residential areas such as Mbare and Waterfalls among others. The Mukuvisi River is dominated by water-loving plants such as reeds and water hyacinth, the latter has proliferated mainly because of sewage disposal into the river.

The soils are generally red clay and good for agriculture, and urban agriculture is widely practised during the rainy season especially by those in the high and medium density areas who will be trying to augment their food security. It is also important to note the presence of hills in various areas such as the Kopje to the west of the city centre and the Warren Hills around the Warren Park and Westlea areas where the National Heroes Acre is situated. The study area is shown on the map in (Appendix 5).There are several roads that link the central business district and the various residential areas as well as other towns and cities of Zimbabwe.

CHAPTER TWO

Literature Review

2.1 Introduction

This chapter reviews literature available on household solid waste management strategies. It evaluates the conventional ways of solid waste management which are universally deemed effective and compares with the current waste management strategies in Zimbabwe's capital city, Harare. An analysis of what was found by other researchers on effective household solid waste management strategies shall also be done to ascertain the applicability of such findings in the Zimbabwean context. This allows identification of research gaps in existing literature.

2.2 Overview of Waste Management in Developing Countries

The United Nations Statistics Division (UNSD, 2011) defined solid waste as all material that is not prime products for which the person generating the material has no further use in terms of their own purpose of production, transformation or consumption and which he/she wants to dispose and that is not intended to be disposed using pipeline. Miller (2004), however, argues that not all waste should be discarded as some can be transformed into useful products through recycling. Waste from various economic and non-economic activities needs to be managed properly to ensure that waste-related environmental problems are minimized (Tevera *et al.* 2000; Senkoro, 2003; Srinivas, 2003). In fact, Jerie (2005) indicated that the shortcomings of Harare's waste management system were initially exposed when the Golden Quarry dump near Warren Park caught fire on Monday 28 August 2000 and the Fire Brigade battled for a week to extinguish the blaze. Such environmental problems pose serious threats to human health and the environment (ZINWA, 2000; Mandimutsa, 2000; Tevera *et al.* 2002, Jerie, 2006).

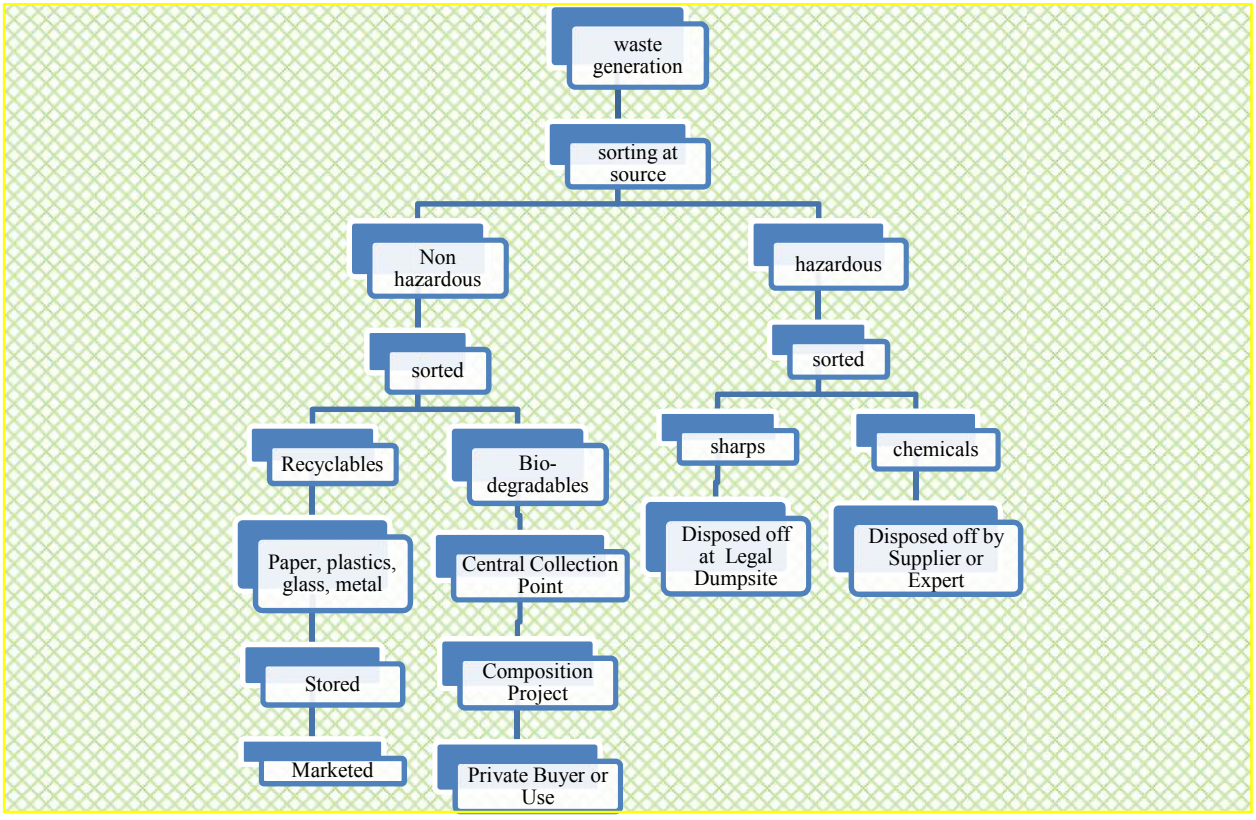
Waste generation in low income countries averages between 300 – 600 grams of waste per person per day (Cotton *et al.*1999). Also Practical Action Southern Africa (PASA, 2006) indicated that more than 2.5 million tonnes of household and industrial waste are

produced per annum in urban areas across Zimbabwe. Further to this, urban waste collection was reported in 2006 to have dropped from at least 80% (in the mid 1990's) of total waste generated to as low as 30% in some large and small towns (Tevera, 1991). According to the United Nations Environmental Programme (UNEP, 2008, Senkoro, 2003; Srinivas, 2003) half the urban population in developing countries do not have adequate solid waste disposal. Achankeng (2003) revealed that municipal household solid waste management constitutes one of the most serious service provision challenges facing African towns and cities. Due to the complexity of household solid waste management, Zurbrugg (2003) indicated that collaboration by a large number of stakeholders is essential for the success of an effective household solid waste management system.

Srinivas (2003) and Medina (2010) assert that many cities in Africa and Asia collect less than half of the waste generated and dump it in open spaces. This explains why Jerie (2006) indicated that the general picture is that significant quantities of waste are generated in the institutional sector where no sound practices for managing the waste are available. In Zimbabwe, the hardest hit by erratic waste collection are low-income residential areas such as Mbare, Highfield, and Budiriro (Hardoy *et al.* 2001; Gumbo, 2005), and also the rapidly expanding informal settlements such as Epworth, Hopely and Mahalape among others. This means that most of the waste being generated in such locations is mismanaged and consequently it is dumped in open spaces (Tibaijuka, 2005). Sharing the same sentiments was Senkoro (2003) who asserted that there is overwhelming evidence in the form of growing piles of uncollected solid waste that municipalities in Sub-Saharan Africa are failing to keep pace with the scale of urbanization, and the environmental and health problems associated with it. Tevera (1991) attributed this inefficient solid waste management system to a poor revenue base which precludes meaningful investments in solid waste disposal infrastructure and hampers regular maintenance. This notion was also raised by Macozoma (2001) who indicated that shortage of adequate financial resources hampers sanitary disposal of solid waste in developing countries including those in Sub-Saharan-Africa.

Most developing countries follow proper ways of handling and managing their household solid waste International Labour Organisation (ILO, 2007).Household solid waste should be sorted into hazardous and non-hazardous waste; the latter is further sorted as degradable and non-biodegradable. This requires a number of receptacles in order to enable for this separation of waste. The ideal waste management system according to ILO (2007) should resemble the model on Figure 2.1. It is however disturbing to note that due to financial, logistical, and legal shortfalls developing countries fail to follow this model (Tevera, 1991; Macozoma, 2001). Evidence in Harare, for example, shows that waste is rarely sorted and is dumped indiscriminately at Pomona dumpsite (Jerie, 2005; Tevera *et al.* 2002). This indiscriminate dumping is done by the City Council after collecting the un-separated household solid waste.

Figure 2.1: Model of a Developed Solid Waste Management System



Source: ILO (2007)

The management of household solid waste should follow the above set channels but this is not the case in Zimbabwe and other developing countries because the problem of

solid waste management is becoming more complex than before (ILO, 2007), because of various reasons that includes poor funding, the ever increasing population which has resulted in rural–urban migration leading to increased waste generators, the political problems in Zimbabwe have also seen the country's economy melting to the point that waste management is being neglected. The economic situation has seen residents fail to pay to the city council and thus crippling the council from doing their work. These predicaments have made waste management complex in Zimbabwe. Waste management in Zimbabwe needs urgent attention because there is mismanagement of household solid waste at all level from generation, storage, collection, transportation, right through to the disposal of waste (ILO 2007). From the model in Figure 2.1, Harare does not sort waste; waste is just dumped at Pomona without separation. In fact Harare city council licensed only 300 individuals who are into metal recycling on 25 June, 2014 (News Day, 2014). These licenses allow the holders to do waste recycling by collecting waste from the dumpsite as well as households for recycling. These are but too few to do complete recycling in a big city like Harare and also considering that some of these license holders do not have equipment and vehicles to use during the collection of recyclable waste.

Waste is not separated at the point of generation thus making it difficult to recycle and reuse. According to (ILO, 2007, Tevera, 2002; Senkoro, 2003), the majority of local authorities are unable to supply adequate storage bins at household's level resulting in littering. They also fail to collect waste due to inadequacy of vehicles and fuel (Makwara, 2001). This non-collection of waste has resulted in the rampant mushrooming of illegal dumps (ILO, 2007).These illegal dumps are breeding areas for vermin, flies and mosquitoes, which exposes people to diseases such as cholera, malaria, dysentery and diarrhoea (ZINWA, 2000; Mandimutsa, 2000; SKAT, 2002; Tevera, *et al.* 2002).

Zimbabwe is using the crude dumping method of waste disposal where waste is just dumped and left uncovered the case of Pomona dumpsite. Harare does not have a sanitary landfill which is lined to handle leaching and the waste is not compacted; and hazardous waste is dumped together with non-hazardous waste without separation or

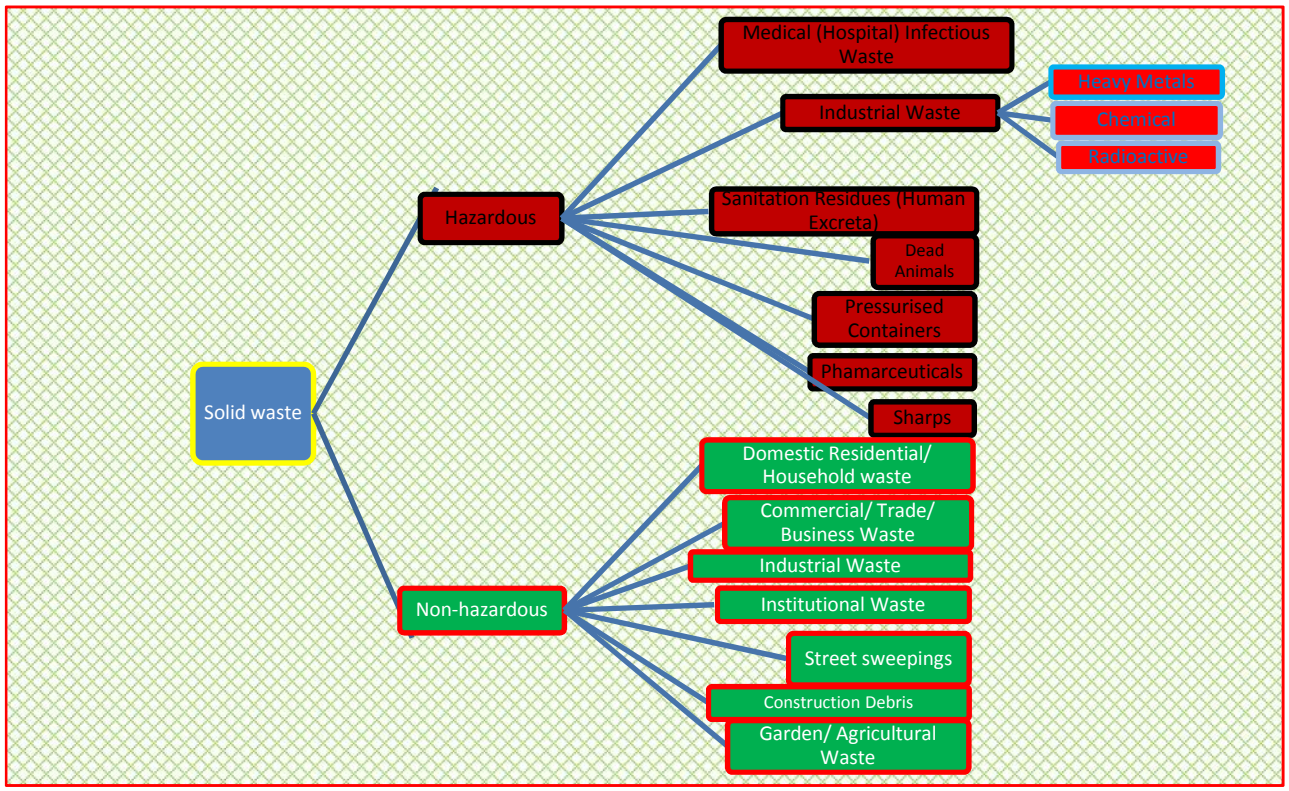
treatment (ILO, 2007).In Harare the Golden Quarry dumpsite produces leachate which flows along roads (ILO, 2007); this exposes people to diseases and contamination of underground water (Tevera, *et al.* 2002; ZINWA, 2002).

2.3 Waste Classification

Waste is either organic or inorganic. This categorization is based on whether a waste rots or not. These are also divided into two categories: hazardous and non-hazardous waste. This classification is based on the potential of waste to cause damage or harm to living organisms and the environment in general. This division is illustrated in Figure 2.2. These types of waste emanate from different areas such as industrial, domestic and commercial sites and these provide different benefits and pose various problems to the environment if the strategies used to handle them are not effective (ILO, 2007).

According to Jerie, (2006) the final resting place for all waste is the dumpsite and in this case it is Pomona dumpsite. In Harare all waste is dumped irrespective of its origin, nature and potential negative or positive impact to the environment. This is because there is no separation of waste at all level of waste management.

Figure 2.2: Waste Classification



Source: ILO (2007)

These types of waste require a different strategy of waste management. This is the only way to ensure that their negative effects on the environment are minimized and the positive effects are maximized (ILO, 2007). Although it looks non-hazardous, some domestic waste is hazardous for example pesticides, paint, thinners, polish and others. This is a risk to users and exposes people to hazard (ILO, 2007).

2.4 Problems of Poor Household Solid Waste Management

Solid waste management is defined as a range of activities in the handling of waste, including generation, storage, collection, transportation, processing, treatment and disposal (Booth and Lankester, 2001).This is supported by Chiwandamira, (2000) who indicated that the goal of waste management is to ensure that the disposal of waste does not result in environmental pollution and degradation. The problem of indiscriminate dumping of waste has become ubiquitous in most towns and cities in

Zimbabwe (Chirisa, 2012). Harare by virtue of being the capital city of Zimbabwe, economic activities are rife and attracts huge population from the rural areas and other small towns. This big population contribute to the generation of household solid waste, since it is accommodated at various households (Nhete, 2006).

The United Nations (UN, 2012) population projections show that there will be a rapid population growth in the world with an increase of 41% to 8.9 billion by 2050 from 2010, with nearly all the growth taking place in developing countries. These will lead to increased household solid waste. Thousands of tonnes of solid waste are generated daily in Africa (Nhete, 2006). Most of this waste ends up in open dumps and wetlands, contaminating surface and groundwater (ZINWA, 2002) and posing major health hazards (Conyers, 2001; Jerie, 2006). In West African cities, as many as 70% of refuse collection trucks are always out of service (Achankeng, 2003). In 1999 the City of Harare failed to collect refuse from nearly all its residential areas because only seven of its trucks were operational out of the 47 trucks (USAID, 2009). This combination of high population increase, shortages of bins, poor collection and shortages of trucks for collection definitely results in open space dumping and a catastrophic situation as diseases will proliferate (Chirisa, 2012).

Tevera, *et al.* (2003) argue that increasing population, changing consumption patterns; economic development, increasing income; urbanization and industrialization result in increased generation of waste. Sharing the same sentiments is Redelinjihiys (2010) who used the formula: **I = PAT** to explain the crucial role played by the population size, affluence and technology in environmental degradation and pollution, where **I** = Environmental Impact = Population size, **A** = Affluence = Technology.

According to Mukuka and Masiye (2002) there is a quasi- linear relationship between population growth and waste produced in Lusaka, Zambia. Waste management has become woefully inadequate as is evidenced by the rise in illegal dumping and the proliferation of the now seemingly permanent piles of rubbish in some commercial, industrial and residential areas in urban centres (Nhete, 2006). In this case the problems of household solid waste in developing countries is a product of very large urban populations who behave as if the physical environment is elastic and can receive

and transform waste and in general can be used as human beings see fit without being affected (Hardoy, *et al*. 2001). This notion is supported by Ezeah (2010) who said that waste management is affected by poor technology and lack of skills among municipalities.

The Harare city council is still dumping waste at Pomona dumpsite because they do not have proper technical abilities to construct landfills. They also have poor budgets that they cannot even import or invite technical skills from other countries and insufficient funds from municipal budgets cannot finance adequate levels of services especially for low-income people living in the middle and high density suburbs (Chidavaenzi, 2006; Chinobvu and Makarate, 2011).This is against the background that according to Chidavaenzi (2006) urban growth in Zimbabwe continues at a much faster rate than the provisions and expansion of infrastructure and services thus complicating household solid waste management. Mudzengerere and Chigwenya (2012) pointed out that despite the large population, municipals charge very nominal fees that in some cases fail to even cater for the operational costs.

The problem of household solid waste management is not only a result of the growth of population but also various other factors (Chirisa, 2012). Makwara (2011) indicated that lack of capacity to manage household solid waste by the authorities is one of the most visible and pressing urban environmental problems. Demographic changes and economic growth is also a factor that contributes to the generation of household solid waste and this has become a serious issue in Zimbabwe where the household solid waste collection has virtually collapsed, triggering its chaotic and rampant illegal dumping, resulting in blocked drains and the spread of diseases (Nhete, 2006).

The environmental laws in Zimbabwe criminalize littering by individuals and companies and anyone caught is liable to a fine or imprisonment (Environmental Management Act, 2002). There is however reluctance on the part of government departments and agencies to prosecute offenders (Makwara and Magudu, 2013). Chinobvu and Makarate (2011) indicated that the regulations are also out-dated and the fees charged offenders are tantamount to encouraging littering. The reluctance might be due to the fact that the authorities concerned are failing to deliver what is expected of them and,

resultantly, it becomes difficult for them to educate and discourage the public from dumping household solid waste all over the open spaces. It is also difficult to enforce the available legislation to stop illegal dumping because there is no basis as people cite as their defence the erratic household solid waste collection (Nyanzou 2003). They argue that they cannot sleep with waste in their beds this is further worsened by limited number of policing personal in the residential areas as the city authorities have tended to deploy more people in the city centre to deal with illegal vending than the residential areas where illegal household solid waste dumping is common.

2.5 Proper Household Solid Waste Management

Establishing proper household solid waste management and improving facilities for collection, recycling, treatment and disposal of household solid waste can be very costly. For example, building and operating sanitary landfills and incineration plants require huge investments and incur substantial operation and maintenance costs (Gallagher,*et al.* 2005). Urban managers are therefore encouraged to pursue the paths of Integrated Solid Waste Management (ISWM) and the 3Rs of waste management (Reduce, Reuse and Recycle) that place highest priority on waste prevention, waste reduction, and waste recycling instead of just trying to cope with the ever-increasing amounts of waste through treatment and disposal. Such efforts will help city authorities to reduce the financial burden on cities for waste management, as well as reduce the pressure on landfill requirements. Internationally known principles of waste management are the only noble way to go. Figure 2.3 illustrates the best waste management options.

Figure 2.3 illustrates that if the environment is to be protected there is need to completely avoid waste generation; this can be done by avoiding the use of non-biodegradable products and encouraging the use of biodegradables. In cases where the population cannot avoid the non-biodegradables, it is wise to reduce whatever waste being generated. This reduced waste should be reused and be recycled in order to reduce the sprouting of waste dumps. This includes the re-using of waste that can be used again before throwing it away as waste. In cases where recycling and recovering of waste fails, it is environmentally proper to treat all waste to avoid releasing poisonous

substances into the environment. After treatment then the waste can safely be disposed into a landfill and not a dumpsite where it is not properly managed.

Figure 2.3: Waste Management Hierarchy

Source: Edith Cowan University (2008)

There is therefore need to recover high value recyclable materials at residential places and small industries (Nhete, 2006) to ensure proper household solid waste management, using colour-coded bin bags to encourage waste separation at source. These receptacles should be properly labelled plastics, glass, paper, cans and so on' (Environment Africa, 2013). This makes it easy to collect the recyclables and items that can be reused; the material will be cleaner to use than a 'mix it all then separate at the end of the chain' approach. Rajagopalin (2005) however indicated that recycling is not a solution to managing every kind of waste material; in fact recycling technologies are unavailable especially in developing countries like Zimbabwe. It is also important to note that according to Environment Africa (2013) there are only twenty eight (28) recycling plants recorded in their database in Zimbabwe and most of these companies are unknown to many people, especially those from the high and medium density areas of

Harare. This makes the management of waste somewhat difficult as there is need for separation facilities as well as environmental education.

2.6 Household Solid Waste Disposal

Methods used for household solid waste disposal in most residential suburbs in developing countries include illegal burning, burying, crude dumping in open spaces, rivers and drainage basins as well as composting (Taru and Kuvarega, 2005; Manyanhaire *et al.* 2009;Saungweme, 2012). This can be attributed to poor household solid waste collection systems and the residents' attitude towards household solid waste such as the "Not in My Backyard" (NIMBY) system (Boehm, 1995) which makes it difficult to establish locations for landfills. Other waste disposal methods include landfills, composting, incineration and other forms of waste disposal. Landfills are common sights in high income countries like America, Japan and England (Curran *et al.* 2007; UNEP, 2005)

Residents' perception of household solid waste plays a very important role in the selection of waste disposal facilities and their sites. However, most sites for these facilities are identified by experts without consulting the public; hence the proposed facility is likely to face either adoption or rejection depending on the attitude of the residents. For instance, incinerators or landfills require substantial amounts of money for operation and maintenance, some of which is expected to come from residents as refuse tax or facility maintenance costs. If there is rejection, therefore, residents continue to use open space dumping and littering.

2.6.1 Landfills

Landfills can be classified for the reception of various waste types as:

- Inert sites – the landfills only accommodate inert waste which has very little impact on the environment and they do not react with other waste
- Non-hazardous sites – these also include inert waste
- Hazardous sites – these take hazardous waste

Various factors are considered in selecting a site for a landfill and these include distance from the residential sites, water bodies, recreation sites and other areas. The

geological and hydrological conditions of the area, the cultural patrimony of the area, flooding risk and landslides risk in the area are also some of the factors to be considered. These factors, according to Jerie (2005), can be divided into environmental, socio-cultural and administrative factors. Environmental Impact Assessment (EIA) is also a prerequisite of the landfill development concept. This looks at issues around the environment, management of the site, cost, distance from waste generators and several other issues. In Zimbabwe a landfill development is exposed to the EIA process. It also provides migratory measures on nuisances such as blown litter, how to cover and control odours, landfill restoration and other issues.

2.6.2 Dumpsites

A dumpsite is an area set aside by a local government for solid waste disposal without measures to minimize environmental pollution or limit slope stability (Dariusz, 2003). It lacks compaction and soil cover on any routine basis. According to Dariusz (2003) there is periodic spreading and grading on a dumpsite to pave way for trucks to unload waste. There are no mechanisms and measures to control leachate and landfill gas that are generated in the dumpsites. This explains why Jerie (2005) indicated that the Golden Quarry dump in Harare caught fire on 28 August 2000 and the fire brigade battled with the fire for a week. According to Jerie (2005) a dumpsite is the final resting place for all municipal and industrial solid waste in Zimbabwe. These dumpsites have open burning and according to Jerie (2005) the pollution from smoke is an environmental and health hazard to the residents of Borrowdale, Warren Park and Westlea suburbs of Harare because they are located around the dump sites.

According to Taylor and Allen (2004) a dumpsite is the simplest, cheapest and most cost-effective method of disposing of waste (Barrett and Lawler, 1995). In most developing countries almost 100 percent of generated waste goes to dumpsite. This is unlike in developed countries where solid waste is landfilled. Allan (2001) indicated that dumpsites will remain a source of ground water pollution. These are associated with a plethora of health and social effects such as odours, nuisance, ozone gas formation and other problems. It is however important to note that dumping is the most economical way of managing municipal household solid waste (MSW) in developing countries such

as Zimbabwe despite the fact that the dumpsites produce gasses and leachates which can harm human beings and the natural ecosystems. The gases are primarily methane and carbon dioxide which are produced when methanogens decompose complex molecules.

2.7 Illegal Dumping an Environmental Problem

Manyanhaire, *et al.* (2009) defines illegal dumping as the improper or unlawful disposal of waste on land, water or at any location other than a permitted landfill or facility. It is also referred to as “open and midnight dumping” because waste is often dumped in open areas from vehicles, along roadsides and late at midnight. Primarily illegally dumped waste is non-hazardous materials that are just dumped to avoid disposal fees or time and effort required for proper disposal (Mubaiwa, 2013). These materials typically include construction and demolition waste such as drywall, roofing shingles, lumber, bricks, abandoned automobiles, auto parts, scrap tires, furniture, yard waste, household trash among others. Residential waste may be illegally dumped in areas that lack or have costly pick-up services (Saungweme, 2012). Spinardi, *et al.* (1998) adds that sites used for illegal dumping vary but may include abandoned vacant lots on public or private property and infrequently used alleys or road ways. Illegal dumping can occur at any time of the day but is more common at night and in the early morning hours Masocha, (2005).

Illegal dumping is a problem not only because it spoils the aesthetic value of the environment, but also because it creates serious health risks (Musademba, *et al*. 2011; Jerie, 2011). Chemicals may also leach out of these dumps into drinking water supplies and pollute surface water such as streams and ponds (UN-Habitat, 2006). These sites can also be harmful to wildlife that lives around them. Animals may consume chemicals found in dumps, or become trapped amongst the mangled mess of tires, plastic containers, wires and metal scrap (EMA, 2013). Illegal dumps sometimes catch fire, for example the illegal dumps in Mbare Township, Harare (Saungweme, 2012). Burning of materials found in undesignated places can lead to the release of toxic smoke and harmful substances into the atmosphere (SO_2, CO_2, CO) only to comedown as rain wash in surrounding areas and even areas far off the original place of household solid

waste generation (Chifamba, 2007). This is called acid rain which is very destructive to buildings, crops, livestock as well as indeed human health.

Inadequate waste management services, population effects, physical characteristics of the environment, lack of waste disposal alternatives and municipal workers' attitude to work are identified as the major causes of illegal dumping (Taru and Kuvarega, 2005; Longe, *et al.* 2009; Musademba, *et al.* 2011; Saungweme, 2012). In most urban environments, areas with poor light access, highways, alleys and areas with unoccupied properties are prime common targets of illegal dumping.

2.8 Household Solid Waste Management in Developing Countries

According to Jibril, *et al.* (2012) and Ezeah (2010) very few urban areas in the developing world have adequate and sustainable waste disposal systems. Household solid waste is a growing urban problem which has not received much attention in Sub-Saharan Africa (Ezeah, 2010).The complexity of household solid waste management unfolds due to increasing urbanization, changing waste composition and other issues (Tevera, *et al.* 2003). This makes most developing countries a home of waste. In India, for example, 70 – 90% of landfilling is open dumping (Kurian, 2002). The generation of waste, according to Williams (2002), will continue to rise. This is supported by UNHABITAT (2003) which indicated that if present trends continue, two billion people could be living in slums by 2030 and this will result in increased waste generation and worsening the already bad household solid waste management. This is because there is no household solid waste collection in such settlements yet they generate such. These dump their waste anywhere illegally just as they are regarded illegal also, complicating the waste management systems in general.

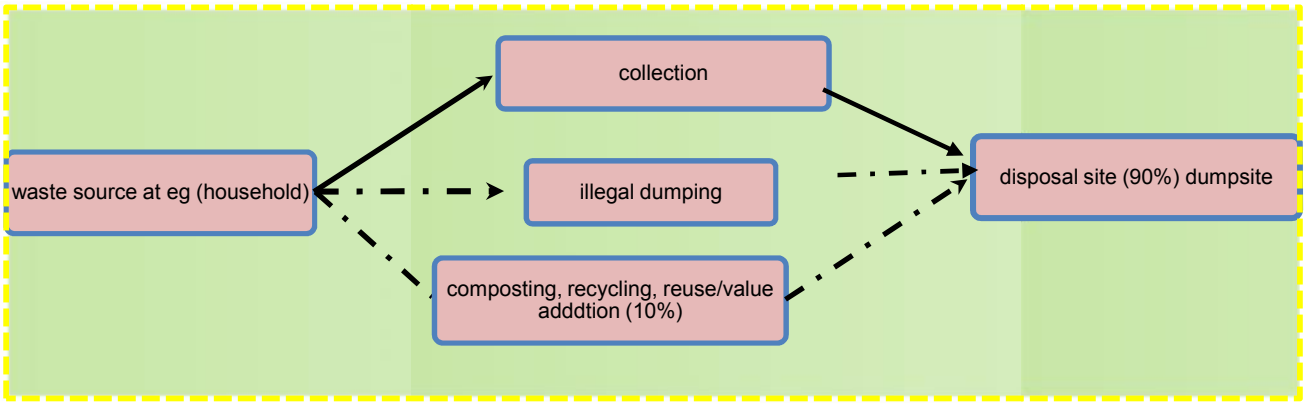
2.9 Household solid Wastes management issues in Harare

According to Conyers (2001) the city of Harare employed the contract system of waste collection in 1997, in which waste collection was a responsibility of contracted parties, but hardly a year later in 1998 they terminated the contracts and resumed waste collection themselves because the city council felt they had the capacity and also that paying contractors strained their budget. Chidavaenzi (2006) also indicated that almost half of the wastes generated do not reach the designated disposal sites. This was

supported by Kaseke (2005) who pointed out that solid waste management has become a major problem in Zimbabwe's towns and cities and the problem is proliferating due to population growth, industrialization and increased use of non-biodegradable plastics, bottles and electronics. Kaseke (2005), Chidavaenzi (2006),and Tsiko and Togarepi (2012) indicated that the majority of these high density suburbs in Zimbabwe such as Mbare, Budiriro, Mabvuku, Glen View and Kuwadzana are characterized by illegal dumping due to erratic waste collection systems. Practical Action Southern Africa (2006) also alludes that more than 2.5 million tons of household solid waste and industrial waste are produced per annum in urban areas across Zimbabwe and disposal service provision is nothing but skeletal. This is more significant in Harare because it is the capital city and has the largest population.

The household solid waste in Harare is basically thrown away and there is very little recycling. This is shown in Figure 2.4 which illustrates that there is the generation of waste at source which is collected and deposited at a dumpsite. There is no separation of waste and 90% of the collected waste is dumped without separation at the official dumpsite. Some of the waste is illegally dumped and then the authorities move it to the official dumpsite. It should be noted that only 10% of this generated waste goes to recycling, composting, reusing and other value addition processes. The situation shows that in Harare like many other developing cities household solid waste management is not properly done (ILO, 2007).

Figure 2.4: Waste Management in Harare



Source: ILO (2007)

2.10 Electronic waste

This is a form of household solid waste generated from electrical appliances. It is called Waste Electrical and Electronic Equipment (WEEE). This is simply any unwanted device that has an electrical plug or runs on batteries (Shah and Shaikh 2008). This form of waste contains non-hazardous materials such as glass, wood, non-ferrous and ferrous metals and hazardous components such as lead, mercury, arsenic, cadmium and flame retardants (Namias 2013) Electronic waste is fast becoming a problem in most developed countries because of poor E-waste handling. The electronic waste poses a multiplicity of potential hazards and causes various health affects to people after long–term exposure. These are tabulated in table 2.1.

Table 2.1: Potential Hazards and Health Impacts of E-waste Components

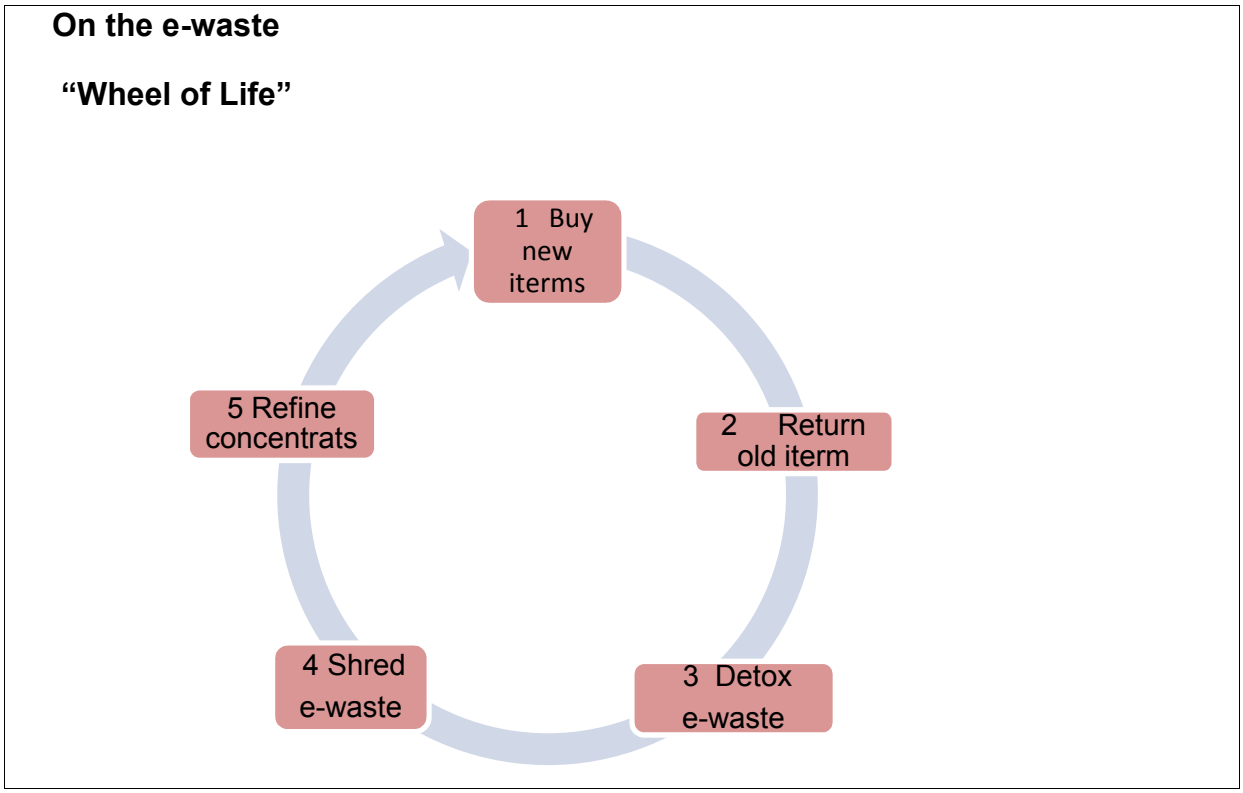
E- waste component	Potential hazard	Potential health effect from long-term exposure
Cathode ray tube (CRT) glass, batteries, solder, older printed circuit boards	Lead dust	Anaemia, Kidney damage, high blood pressure, nerve and brain damage, miscarriage, birth defects
Batteries, switches, thermostats fluorescent tubes	Mercury vapour	Nerve and brain damage, birth defects
Nickel-cadmium batteries, printed circuit boards, phosphor coating on CRT glass	Cadmium dust	Kidney disease, bone problems, lung cancer
Older printed circuit boards	Beryllium dust	Lung disease, probably lung cancer
Plastic cases and parts	Flame retardant dust	Possible thyroid hormone problems

Source: California Department of Public Health (2012)

There are several other hazardous components of e-waste such as antimony trioxide, selenium, chromium, manganese, polyvinyl chloride (PVC plastics) and cobalt and polybrominated flame retardants (STEP, 2009). These cause health hazards to human beings and the environment. According to Shah and Shaikh (2008), between 1994 and 2003 disposal of PCs resulted in 718,000 tonnes of lead, 287 tonnes of mercury, and 1,363 tonnes of cadmium being placed in landfills in the United States. The mercury, chromium, lead and brominated flame retardants are likely to cause the most adverse health effects in humans (Shah and Shaikh 2008). According to Namias (2013), 50

million tonnes of e-waste was disposed of in 2009 and 72 million tonnes are expected to be disposed of in 2014.The best management of e-west is demonstrated in Figure 2.5.

Figure 2.5: E-waste "Wheel of Life"



Source: Shah and Shaikh (2008)

Figure 2.5 shows the Swiss ways of managing and handling e-waste, this was dubbed the "wheel of Life" and in this wheel there are five stages which are:

Stage 1 Is the purchasing of electronic devices.

Stage 2 Is returning the end-of-life appliances.

Stage 3 Is the "detoxification" thus removing the critical components to avoid dilution and contamination.

Stage 4 Is the shredding and collecting of like material for refinement.

Stage 5 Is the refinement stage.

Despite this e-waste management system in Switzerland it is important to note that most developing countries, including Zimbabwe, do not have proper e-waste management strategies and according to Makwara (2013) household solid waste in Zimbabwe is not even separated, thus domestic waste, including e-waste and industrial waste, is just dumped at the same dumpsite without treatment.

2.11 Zimbabwean Waste Policies and Laws

In Zimbabwe, according to Tevera, *et al.* (2003), legislation pertinent to solid waste management was previously spread over seven statutes administered by more than four government ministries hence there was lack of coordination and uniformity. Achankeng, (2003) say that out-dated and poorly enforced environmental legislation which lacks set standards has been complicating solid waste management in Sub Saharan Africa (SSA).Tevera, *et al.* (2000) however indicated that in Zimbabwe these shortcomings have been addressed by EMA Act Chapter 20:27 which have replaced most environmental legislation such as the Natural Resources Act 20:13 and Hazardous Substances and Articles Act 15:05, thus trying to bring harmonization in environmental legislation although acts such as the Public Health act are still functional and being implemented independent of the EMA Act.

According to Makuku and Masiye (2002) a policy is a plan of action outlining the aim and ideas of an organization. The Government of Zimbabwe has a number of policies aimed at ensuring proper household solid waste management. However, Maseva (2005) aptly states that Zimbabwe does not have an overall national waste management policy and this has been attributed to the current waste management crisis in most if not all urban centres in Zimbabwe (Ministry of Environment and Tourism, 2004). This is the case despite, Masocha (2005) pointing out, that there are several policy documents that recognize the importance of developing efficient waste management systems in order to safeguard people's health as well as the environment.

The policies include the Environmental Impact Assessment (EIA) of 1994 which requires that major projects be exposed to EIA before they take off. These projects include residential, waste dumps, roads and several others. This according to Masocha (2005) is a response to the United Nations Conference on Environment and

Development (UNCED) of 1992 in Rio de Janeiro. There is also the draft strategic document on waste management of 2004 which gave birth to the programme dubbed 'A Clean Environment Everyone's Duty" which, according to Masocha (2005), aims to ensure the transformation of Zimbabwean cities, towns and growth points to their past clean status. Of note is also the draft environmental policy whose objective is to prevent irreversible environmental damage. This draft policy states that a clean environment is the right of every Zimbabwean. This is supported by Section 73 of the Zimbabwean Constitution which gives people the right to a clean environment. There is also The National Sustainable Development Strategy of (NSDS, 2004) which is a follow up to the Johannesburg plan of implementation. This, like the constitution of Zimbabwe, sought to protect people from inhabiting a harmful environment due to poor environmental management.

These and other policies have not been communicated properly to the local authorities (Masocha, 2005) and this makes them crippled to the extent that they cannot communicate them to the public in order to come up with public awareness programmes. In addition, Chikuruwo (2006) indicated that the absence of municipal courts and absence of arresting powers on municipal police has serious impact on household solid waste management and waste in general. Following in the same vein is Ireen (2008) who said that poor government policy and response, lack of political priority and transparency in budgetary allocations, and bureaucratic and top-down approaches in decision making have made household solid waste management a complex activity. Infect substantial portions of budgets are devoted to collecting, transporting and disposing solid waste. Focus is on end-of-pipeline solutions that are capital and technology intensive and therefore costly.

According to Makwara and Magudu (2013), in spite of the numerous clean-up and anti-litter campaigns that have been initiated by different individuals and organizations coupled with the tremendous efforts that have been made by the Ministry of Health and Child Welfare, Ministry of Environment, Climate and Water, Environmental Management Agency and other Government Ministries and Departments in making the public aware of the disadvantages associated with littering, endemic and insistent filth engulfs

Zimbabwe as people continue to litter. This is why Bartone (2000) argued that to improve solid waste management there is need to enforce laws against illegal dumping and municipalities should be given arresting powers to enforce this; this could alleviate problems of illegal dumping.

2.12 Problems Leading to Poor Household Solid Waste Management in Zimbabwe.

According to Makwara and Magudu (2013), the problem started way back in the early 1990s when the Economic Structural Adjustment Programme (ESAP) was introduced, followed by the infamous land invasion in the early 2000s which triggered the unprecedented economic meltdown in Zimbabwe. This negatively impacted on the revenue base of municipalities which now depend heavily on government and donor funding. This situation saw the standard of waste management continue to fall way below accepted standards with town councils failing to collect waste around their areas of jurisdiction regularly as scheduled (Makwara and Magudu, 2013).

According to Katyal and Satake (2001) the financial and material resources are scarce in developing countries, thus waste collection is less effective resulting in serious environmental problems. Studies by Masocha and Tevera (2003), Mapira (2001), Mapira and Mugwini (2005) and Makwara (2011) show that because of lack of capacity, household solid waste has become one of the most visible and pressing urban environmental problems. This is supported by Nhete (2006) who argues that in Zimbabwe waste collection has virtually collapsed and has given birth to chaotic and rampant illegal dumping. Chidavaenzi (2006) also indicated that until the mid-1990s Zimbabwe's urban centres were regarded as models of cleanliness in Africa and beyond but the economic meltdown which resulted in no fuel and frequent breakdown of waste collection vehicles without repair led to poor waste management.

In Zimbabwe, the local government system was also seriously affected by the withdrawal of donor support as from 1998 owing to the political difference between donor countries and central government (Machivenyika, 2012). This is supported by Makwara and Magudu (2013) who indicated that prior to the withdrawal of external aid, local authorities tended to over-rely on external technical, material and financial

assistance through such programmes as Urban 1 and 2, the Local Government Capital Development Programme (LGCDP), the Deregulation Programme and the Rural District Council Capacity Building Programme (RDCCBP). Due to the economic meltdown between 2000 and 2010 many challenges militated against sound urban solid waste management (Musademba, *et al.* 2011). Machivenyika (2012) also said that the country's household solid waste management is poor because of its deteriorating infrastructure which hinders proper movement of trucks that collect waste and this together with poor financial backup makes the whole waste management issue a vicious cycle. Chinobva and Makarati, 2011) failure by the local authorities to collect refuse results in urban dwellers dumping it at open sites as well as peri-urban areas which are health hazards and cause pollution. This explains why, UNHABITAT (2006) indicated that less than 20% of urban solid waste is collected and disposed of properly.

2.13 Sustainable Waste Management

There are steps that Zimbabwe has taken towards "A clean Zimbabwe" and this sustainable waste management is based on the following principles, according to ILO (2007) the management of household solid waste is critical and some principles have been formulated in a bid to ensure proper waste management. These principles if well implemented lead to proper waste management. These principles are tabulated in table 2.2.

Table 2.2 Principles of Sustainable Waste Management

Cradle - to – grave	This is a policy of controlling waste from its creation (cradle) to its final resting place (grave)
Life cycle principle	According to this principle, products should be designed, produced and managed so that all environmental concerns are taken into consideration, accounted for and minimized during generation, use, recovery and disposal.
Duty of care principle extended producer responsibility	The individual or organization that produces waste (the generator) is under all circumstances, responsible for that waste from cradle to grave
Integrated waste management	This is an internationally accepted approach used to manage waste, which requires that waste generation should be avoided or minimized as much as possible. Any waste that is generated should be recycled or reused wherever practical. Any waste that cannot be recycled or reused should be treated or compacted to reduce toxicity and volume. Any waste that cannot be subjected to the above should be disposed of in properly designed and managed landfills.
Polluter pays principle	The person who causes pollution must pay for its clean up and for any damages caused.
Precautionary principle	According to the precautionary principle, unknown waste must be treated as extremely hazardous until it is identified and classified.

Source: ILO (2007)

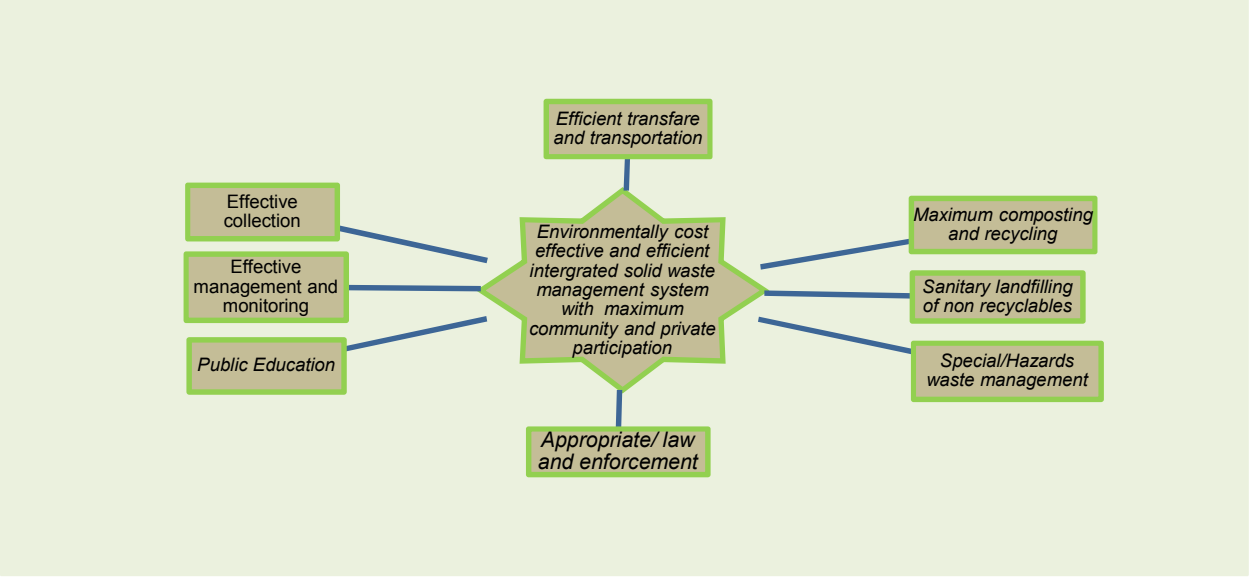
The 'cradle to grave' principle demands that waste should be handled properly from the place of generation (the cradle – in this case the household) to the final resting place (the grave). This means that all necessary aspects should be provided at the cradle such as receptacles at household and collection of waste should be done and the waste be dumped properly. This principle also calls for close cooperation between the waste generator and the authority responsible for collection and disposal.

The lifecycle principle demands proper management of products from date of manufacturing up the ladder until the end of a product's life. This means that to reduce waste the products should have minimal toxic substances and customers should be educated on how to dispose these at the end of life of the product. This applies more in electronic waste. The duty of care principle also applies in the management of products from date of production to the final resting place because the customers of given products should be able to assist in the management of its waste. This goes hand in glove with environmental education to members of the public because this teaches

people to be responsible about waste issues and encourage them to practise the precautionary principle, and advocate for the treatment of waste whose toxicity is not known before they are disposed to ensure that no mistakes are made.

There is also the polluter pay principle which is responsible for ensuring that individuals and institutions that pollute the environment pay for their pollution and also compensate affected parties. These principles all back up the integrated waste management principle which demands that all available waste management strategies be effectively applied shown in Figure 2:6.

Figure 2:6 Strategies for Integrated Solid Waste Management



Source: Environment and Public Health Organisation (2008)

These principles, if well implemented, will ensure that waste generation is minimised, and recycling and reusing are upheld. This will also see to it that waste is treated and properly disposed of in proper landfills. The integrated waste management approach to waste management is therefore the ideal situation in the management of household solid waste because it is an all stakeholder participation approach; this approach has been employed in several developed countries and has been a success. It is therefore wise for developing countries to follow the same waste management development path.

CHAPTER THREE

Research Methodology

3.1 Introduction

This chapter provides the research methodology used for the study. In order to effectively plan for household solid waste storage and collection strategies, it is vital that the city authorities and other stakeholders have data on the types and characteristics of the waste generated. The knowledge of the sources and types of household solid waste together with data on composition is vital in designing and in the operation of the elements of household solid waste management. The validity and reliability of the results obtained from this research project depend on the soundness of the data collected.

3.2 Research Design

The study adopted a mixed method approach involving triangulation of qualitative and quantitative designs. In this study the qualitative design depended on the following methods of data collection: open ended questionnaires, interviews, focus group discussions and observations. The quantitative design focused on hypothesis testing through statistical testing and data analysis to establish relationships between variables such as household size and amounts of waste generated. It therefore depended on closed ended questionnaires, field measurements and statistical tests of relationships between variables. Secondary data was obtained from the City of Harare Department of Waste Management, Ministry of Health and Child Welfare, Environmental Management Agency (EMA), Ministry of Local Government and National Housing, Ministry of Environment and Natural Resources, National Social Security Authority (NSSA) and other environmental institutions in Harare.

3.3 Epistemological and Ontological Basis of the Study

There are two dimensions of the ontological perspective of social science research and these are positivism and interpretivism (Grix, 2004). According to the positivist perspective, reality exists independently of our knowledge and the social world is revealed to us and not constructed by us. Therefore objective knowledge is possible

because there is fixed and unchanging reality that can be tapped. Positivism therefore uses methods derived from the natural sciences and applied to the social sciences. From the positivist perspective arise the epistemological assumption that knowledge come from experience and therefore a theory can be confirmed or refuted from data gathered through observation and experience using our senses (objective data). This is hard data and therefore quantitative. The interpretive perspective of social reality is that reality is a complex social construction of meaning, value and experience; therefore interpretive data is referred to as soft data (qualitative) obtained through observations, interviews, documents and open ended questions (Grix, 2004). Hofer (2004) defined epistemology as the study of beliefs about the origin and acquisition of knowledge. Therefore this study is based on previous studies, field evidence as well as field surveys so as to validate what theory say and to derive specific knowledge from the field.

3.4 Study Population and Sample

Population is the aggregate or totality of objects or individuals regarding which inferences are made in a study (Sidhu, 2003). In this research the total size of the entire group was drawn using socio-economic status. The population was drawn from residential areas of Mbare, Budiriro and Highfield (high density), Milton Park, Waterfalls and Westlea (medium density) and Borrowdale, Mandara and Gunhill (low density). The residential areas, population size and samples drawn are shown in the table 3.1

Table 3.1: Residential Areas, Population Sizes and Samples Drawn

Residential area	Number of Households	Sample drawn
Mbare	10674	44
Highfield	10969	43
Budiriro	14551	43
Milton Park	656	30
Waterfalls	1098	30
Westlea	1448	30
Mandara	1015	15
Borrowdale	1107	15
Gun Hill	371	15

Source: Harare City Council (2013)

In high density residential areas there are an average of 10 people per household with an average size of 200 square meters to 400 square meters per given stand. Thus these areas have more residents than the medium density residential areas where there are 7 people per household. Medium density residential areas have people with middle income, and their purchasing power is greater than that of those in high density areas. Therefore these are less populated than high density residential areas. However, it is not clear whether the differences in household sizes affect waste generation and collection. It is tempting to hypothesize that the low density suburbs where people have high incomes can manage waste better than people in medium and high density suburbs as found by Tevera (1999).

Given the differences in population sizes and number of households, a proportional sample from each residential area (low, medium and high) was drawn to ensure equal representation in the sample. Thus fewer people were drawn from low density residential areas because there are fewer people and houses. On the other hand, a proportionally larger number of respondents were drawn from high density suburbs where there are more households as shown in Table 3.1. The respondents from each residential area were randomly selected since they have similar characteristics depending on the area.

Creswell (2003) justifies the need for a sample instead of studying the whole population for the research to be manageable given a large study population as well as reducing the financial costs of the research. A total sample size of 270 respondents was used since it is within acceptable sample size of the rule of thumb for primary research. This sample is justified by Haralambos and Holborn (2000) who postulates that a sample for social research should be at least 33.3% of the study population. One respondent from each household was picked to complete the questionnaire. Each respondent also provided oral information during completion of questionnaires.

Convenient sampling was used to pick 30 key informants such as the Director of Waste Management in the Harare City Council, Officials from Ministry of Local Government and National Housing, Ministry of Health and Child Welfare, Ministry of Environment, Climate and Water, Chairman of the Combined Greater Harare Residence Association

(CGHRA), National Social Security Authority (NSSA) Director, officials from the Environmental Management Authority (EMA) and other environment organization. These key informants were selected based on their knowledge of the city's household solid waste management situation. All key participants were interviewed.

3.5 Methods and Materials

The research employed elements of both qualitative and quantitative data. This was obtained using the questionnaire, interview, focus group discussions and the observation methods. The materials and methods are discussed below.

3.5.1 Questionnaire Survey

The questionnaire designed for this survey was meant to collect information on the household solid waste management practices in the residential areas of Harare. The main focus of the questionnaire was the specific strategies used in managing solid waste generated in the households (Appendix 1).The other questions upon which the survey was anchored related to the types of waste generated, as well as collection and disposal methods.

This questionnaire was divided into three sections: Section 'A' (background information) Section 'B' (waste generation, collection and disposal) and Section 'C' (waste policy and management strategies). Respondents ticked in the provided boxes mostly in section (A) and filled in given spaces on the questionnaire in other sections of the questionnaire. All respondents were asked the same questions. This ensured reliability of the instrument.

Background information was important because it helped in linking educational levels and individual perceptions on household solid waste management. It also gave an insight on how individual households take responsibility of waste management. Similarly it is important to determine the type of solid waste generated by the different households and establish how the waste is disposed of. This allows for a comparison between strategies used to dispose of waste and the desired strategies that can be considered effective depending on the type of waste. The questionnaires were administered in March and April 2014 by the researcher and four undergraduate

assistants from the Midlands State University in Gweru and The Women's University in Africa (Harare campus). This was done to minimise time taken to administer the questionnaires since three hundred questionnaires were to be administered over residential areas that are geographically wide apart.

3.5.2 Interviews

The interviews helped to derive information that could not have been captured by other methods. This helped to cross check information provided by other relevant stakeholders. Table 3.2 shows the information gathered.

Table 3.2: Key Informants, Organization and Reasons for Interview

ORGANIZATION	INTERVIEWEE	REASON FOR INTERVIEW
Harare City Council.	Director Waste Management Chief Health Officer	• Planning strategies and organizational logistics • Health issues and waste, • legislation governing city authorities on waste management • Problems they face • Future plans on waste management
Environmental Management Agency.	Operations Officer Information and Publicity officer	• legislation governing waste management • Problems they face in household solid waste management • Strategies used in household solid waste management • Future plans on household solid waste management.
National Social Security Authority.	Director	• Safety issues in household solid waste handling.-Legislation on safety. • Future Plans on household solid waste.
Ministry of Health and Child Welfare.	Health Director	• Effects of waste on health. • Legislation and policy. • Educational information on household's solid waste management.
Ministry of Local Government and National Housing	Director of Housing	• Legislation on residential allocation and informal settlement. • Strategies in household solid waste management in both the planned and illegal settlements.
Ministry of Environment , Climate and Water	Environmental Officer	• Legislation and policy. • Effects of household solid waste on the environment and available solution. • Strategies used in household solid waste management
Ministry of Primary and Secondary Education	Education Officer	• Educational issues on waste and strategies used in household solid waste management.
Zimbabwe Environmental Lawyers Association	Legal Officer	• Legislation on waste management.
Greater Harare Residence Association	Chairman	• Waste collection issues • Problems of waste-programs so far put in place to control waste management in Harare

Source: Primary Data (2014)

3.5.3 Observations

Specific open spaces with dumps were selected to observe the appropriateness for dumping. In the field some sites could be appropriate for dumping of specific waste while others like open spaces and road side are not; this allows inferences to be made about the appropriateness of the strategies used in household solid waste management. More so the nature of the household solid waste observed at the dumpsite can determine the effectiveness of household solid waste management strategies.

In this study, on-spot observations validated information obtained from interviews and this gives a true picture of household solid waste in Harare. The exercise gives practical evidence as opposed to depending on verbal reports. An observation checklist helped triangulate information collected using other data collection instruments (Appendix 3). This gives a correct record of what is happening on the ground and leads to conclusions on the effectiveness of the strategies used in household solid waste management.

3.5.4 Focus group discussions

Wilkinson (2004) defined focus group discussion as an informal discussion among selected individuals about a particular topic. It is composed of between five and twelve people (Morgan 2002). In this research the groups were composed of six people and the researcher chose the facilitator and notified him prior to the date of the discussion. Individual group members were notified of the date and venue two days before the discussions. Each participant was formally called on his or her cell phone.

The group would gather and discuss household solid wastes issues such as types of the household solid wastes, amounts and management of the household solid wastes. Introductions were done first in which individuals would tell the group their names and the organisation they represented. The questions were discussed randomly as the facilitator wished. The researcher was part of the group and also contributed to motivate the group to participate. The discussions were recorded on a voice recorder to ensure that all the important information is captured.

The people who were in the group were given assurance that the information they provided was for academic use only. The guidelines to the focus group discussions are listed in appendix 10.

3.6 Validations of the Research Findings

To ensure that the study findings are relevant, more than one method of data collection was used. Thus the use of questionnaires, observation, focus group discussions and interviews ensured validity. These methods were triangulated to crosscheck the findings. The findings were compared with empirical studies by previous researchers to check for consistency. The researcher also continuously crosschecked and verified the collected data to ensure that it satisfied the stated research objectives. The issue of confidentiality also ensured validity in the sense that the participants were given assurance that the information was for academic purposes, thereby motivating them to provide full information without reservations.

A pilot testing of the instruments was done first in one chosen area in each of the low, medium and high density residential suburbs to check for anomalies on the instruments and methods. Fifteen (15) questionnaires were administered for the pilot study, five in each. The main objective was to find out how long it took a participant to complete the questionnaire, to find out if the instructions on the questionnaires were clear, which questions remained unanswered and why and whether the layout of the questionnaire was flowing clearly. This resulted in the correction of the questionnaire before the final data gathering. The results from the pilot study were similar and consistent; therefore, the questionnaires and the interview guide were proved to be reliable and valid.

It is however important to note that the researcher cannot totally claim that this is credible without any flaws because in some interview sessions the researcher did not have access to the intended participants since some senior government officials had to delegate their juniors due to other commitments.

3.7 Ethical Issues of the Research

Ethical issues in research are the cornerstone for conducting effective and meaningful research and according to Best and Kahn (2000) ethical behaviour of individual

researchers is under unprecedented scrutiny. In this research the researcher took a number of ethical steps to ensure that this research was ethically acceptable.

The researcher wrote a letter to the Harare City Council to seek permission to carry out the research and this was granted. All the participants in this project were asked to complete an ethics consent form. This form gave them the assurance that the information they provided was to be used for academic purposes only. The researcher also showed the participants his identity documents such as the University ID card and also the National ID card to ensure trustworthiness. The researcher also advised the Harare City Council of the days on which photographs were to be taken and when the collection crew was followed to see how they collected waste. This ensured no conflict between the researcher and the crew. Permission was also sought from the authorities to access statistics and important documents from different sub-offices across the residential areas in Harare.

A timetable was made with the respondents to ensure that there was no conflict with regards to time. The researcher ensured that participants were not involved without their knowledge and consent. No participant was coerced to participate and there was no invasion of privacy. Infect the researcher explained the academic purpose of his research to the participants to give them confidence.

The researcher did not hold any information from the participants about the true nature of the research. Participants were given the freedom to decide for themselves when and where, in what circumstances and to what extent their personal attitudes, opinion, habits, eccentrics, doubts and fears were to be communicated to or withheld from others. The researcher upheld Nachimias and Nachimias's (1999) assertion that confidentiality of participants and identities should be upheld. And for the sole reason of sharing information with participants the researcher gave them his cell phone number and postal address.

According to Kottler (2006) participants must also understand that they have the right to withdraw from the study at any time. In this research all participants were asked to complete an ethics consent form in which they were advised to withdraw anytime they

wished to do so. Participants were informed and reminded throughout the study that their participation was voluntary. Direct consent was the only form of consent that was sort in this research and no substitute consent (third party consent) was employed. No respondent was advised on what to write, in accordance with Gray's (2004) view that the purpose of any research is to collect data and not to change the respondent or their opinion. For this reason the researcher ensured that there is no influence on what the respondent would give as an answer.

Basically the ethical principle of beneficence and justice was the foundation of this project and this demanded that it is the duty of the researcher to do well and to be fair to participants. No names of institutions were linked to any respondents and the research report would not mention any person or any institution, thus maintaining anonymity in the report. Subsequent to data analysis, submission and approval of the final document all the documents in the form of completed questionnaires will be destroyed by the researcher for anonymity reasons.

3.8 Data Analysis

The data was analysed and presented using descriptive statistics as well as use of cross tabulation, pie charts and bar graphs. An in-depth qualitative analysis of the findings from questionnaires, interviews, focus group discussions and observation allowed inferences and conclusions to be made about the effectiveness of strategies used in household solid waste management. Since effectiveness is a string variable which cannot be quantified, the qualitative responses and personal observations were adequate to at least make a conclusion.

CHAPTER FOUR

Data Presentation and Analysis

4.1 Introduction

This chapter provides the analysis, presentation and discussion of the research findings. Effective planning strategies by the Harare city authorities depends on reliable data on household solid waste characteristics, collection and disposal as well as perceptions by stakeholders on effective solid waste management options. The data is discussed in line with the research objectives and literature citations in chapters one and two respectively.

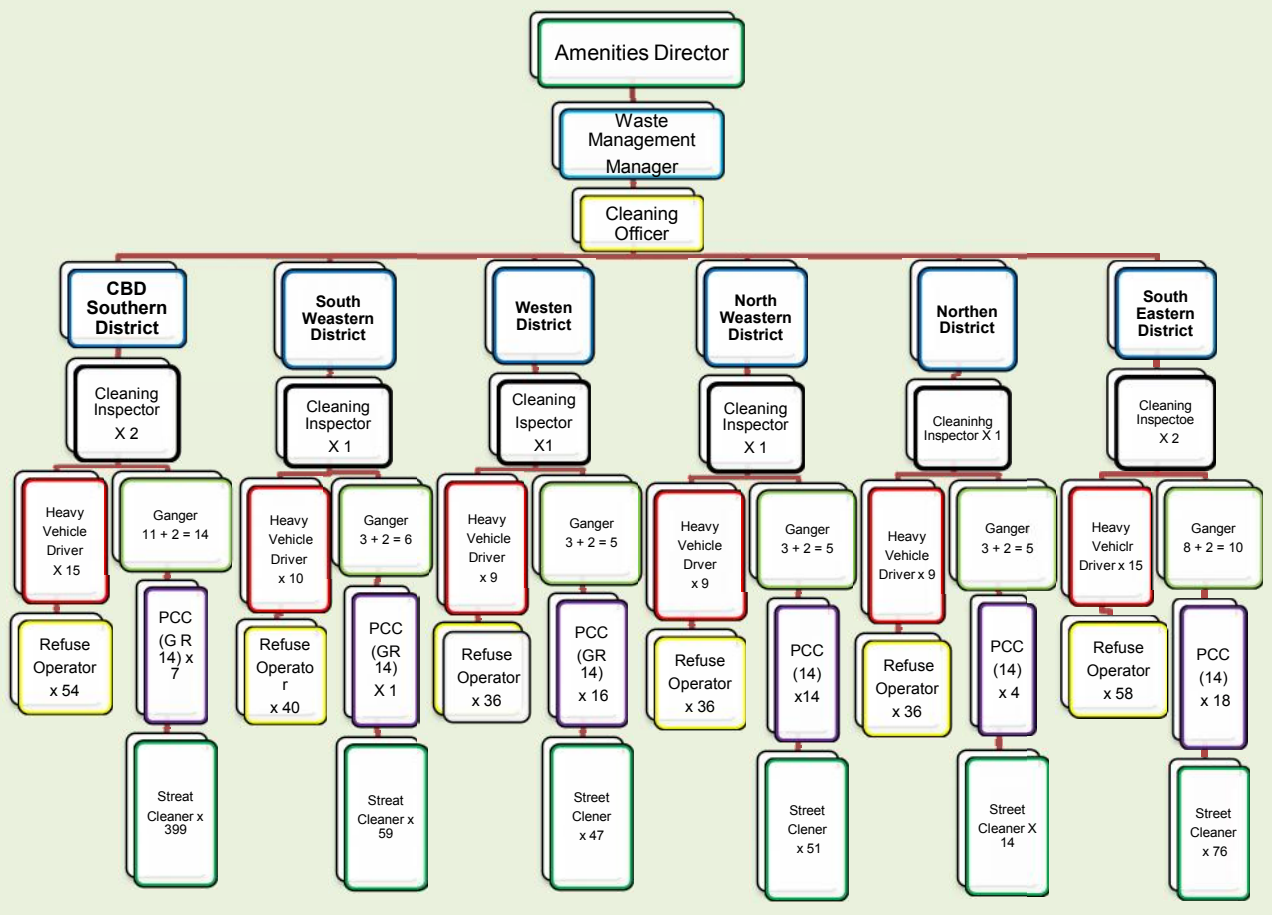
4.2 Organizational Structure of Waste Management Department in Harare

The organizational structure of Harare waste management consists of eleven (11) personnel at the management level and these include the Amenities Director, Waste Management Manager, Cleansing Officer and eight (8) Cleansing Inspectors. The rest are drivers, gangers, refuse operators and street cleaners. There are street cleaners on the organogram who are responsible for cleaning the streets in the inner city and not residential streets. In the residential areas the management of household solid waste is left to members of the public, drivers and their crew who collect household solid waste as indicated in the timetable in Appendix 6. This is done from house to house. There is therefore need to add sections into the organogram to include an educational department that is responsible for educating households and members of the public on waste management. This also ensures that households that do not have receptacles are provided with such especially during the distribution of bills by the city authorities.

It is also important to increase the number of inspectors for the purposes of ensuring effective inspection and assessment. This is more important in the residential areas where waste dumping is very common and is witnessed on all open places along roads and open ground. There is also need to ensure that the general number of workers in this department is increased for effectiveness. More so, there is need to increase the number of compactors as this will ensure increased coverage of waste collection and

also reduces the time spent collecting waste. Figure 4.1 is the organogram for Harare waste management department.

Figure 4.1: Organizational Structure of Harare Waste Management Department



Source: Harare City Council (2014) **Total = 1167**

Figure 4.1 shows a total staff compliment of 1167 in the waste management department of the City of Harare. These are responsible for collection and disposal of waste from the residential, industrial and commercial districts of Harare. Considering the size of the population and the number of illegal waste dumps in Harare the compliment is too small to bring about meaningful household solid waste management to the City of Harare. This is against the background that Harare has a total population of 4485615 which generates household solid waste daily, as well as industries (formal and non-formal) and the commercial zone. This against the fact that household solid waste should be

collected within 48 hours to reduce the proliferation of household solid waste related pathogens.

4.3 Characteristics of Solid Waste Generated by Households

To ascertain the type and composition of wastes in the various households in low, medium and high density residential areas, first, the wastes at each randomly selected household was examined. The use of random selection was based on the justification that all the selected households in each residential suburb were true representatives of the households in that particular residential suburb. At each randomly selected household, the researcher took the wastes available (from rubbish bins or compost pit) and sorts the wastes into various categories. Moreover, the researcher randomly selected and examined the wastes from noticeable and eye-catching open dumping areas in each of the residential suburbs. This was done to compare and validate the types and composition of wastes found in each residential area

In sorting the wastes, the researcher grouped the wastes into two broad and generic areas, which are organic and inorganic wastes. This was based on the universally accepted classification of wastes and supported by Jerie 2005 who says that wastes can be organic and decays or inorganic which takes longer to change its chemical substance. Under the organic waste, there were substances such as food leftovers, papers, wood and yard waste like tree leaves and dry grass. These are also regarded as compost materials which can easily decompose. The inorganic materials include glass, metals, plastics, electronic materials and others not listed above. The major objective was to ascertain the composition of waste in each residential area and examine the sorting of wastes by the households themselves as they dispose off their wastes and to evaluate the compliance of waste disposal by households to the environmentally ideal standards of sorting the wastes (Jerie 2005).

The solid waste generated by households in Borrowdale, Mandara, Gunhill, Waterfalls, Milton Park, Westlea, Mbare, Budiriro, and Highfield consists largely of organic waste such as food leftovers, yard waste and wood. Inorganic waste contributed a small percentage of the total waste as shown in Table 4.1.

Table 4.1: Composition of Weekly Household Solid Waste by Residential Areas (% by mass)

	Residential areas of Harare								
	Low Density Suburbs			Medium Density Suburbs			High Density Suburbs		
Type of waste	Borrowdale	Gunhill	Mandara	Westlea	Milton Park	Waterfalls	Mbare	Budiriro	Highfield
Organic									
Food leftovers	15	18	17	25	26	23	54	49	55
Papers	35	32	33	30	31	29	10	14	13
Wood	9	8	8	10	8	7	9	9	9
Yard waste	1	2	2.5	7	6	9	2	1	2
Inorganic									
Glass	4	5	4	6	2	4	1	2	3
Metals	3	4	3	5	2	3	5	4	3
Electronic	4	5	5	2	2	2	7	6	4
Plastics	18	16	16.5	22	21	20	9	10	8
Miscellaneous	11	10	11	3	2	3	3	6	3
Total	100	100	100	100	100	100	100	100	100

Source: Primary Data (2014)

Low density suburbs have an average of 831 people per suburb and an average of 166 households of five people each. It produced an average of 731.3 kg per capita per day of household solid waste per week. Each household therefore produced 4.4 kg per capita per day of household solid waste per week. Papers contribute the largest share of waste generated which is 32% to 35% (234 kg to 256 kg per capita per day) of total waste in low density residential areas of Borrowdale, Mandara and Gunhill. The papers include old newspapers, containers of washing powder, invoices, books, flyers, used mobile phone airtime cards and receipts. Another significant proportion of household solid waste is in the form of food leftovers and plastics which contributed between 15% (110 kg/capita/day) and 18% (132 kg/capita/day). Organic matter forms the larger part of household solid waste generated in the low density areas of Borrowdale, Gunhill and Mandara. This may be due to their high incomes which enable households to spend more than low income earners in the high density residential suburbs as also noted by

Tevera, (2012) However, waste such as wood and others here referred to as miscellaneous waste formed a significant share of the total waste in these low density areas. An insignificant proportion of waste was made up of yard waste, glass and metals which contributed between 1% (7 kg/capita/day) and 5 % (37 kg/capita/day) of total waste. Similarly, in the medium density suburbs a larger percentage of waste comes from organic waste such as papers, food leftovers, wood and yard waste. This is probably due to relatively higher purchasing power by households. On average, each household in the middle density areas (Westlea, MiltonPark and Waterfalls) had lower amounts of glass, metals, electronic and other waste. These inorganic wastes contributed less than 17% (124 kg/capita/day) but at least 10% (70 kg/capita/day) of the total volume in the medium density suburbs.

In high density suburbs which have an average total population of 12065 per suburb and also an average of 2413 households of five people each produced an average of 29921 kg/capita/day of household solid waste per week. Which means each household produced 12.4 Kg/capita/day of household solid waste per week. In the suburbs of Mbare, Budiriro and Highfield it was found that about 50% (14961 kg/capita/day) of household solid waste is food leftovers. This is because the high number of households equals a high population which generates more food leftovers. Papers, wood and yard waste constituted between 8% (2394 kg/capita/day) and 14% (4189 kg/capita/day) each. This could be due to a relatively larger family size per household including children who generate a lot of waste. Yard waste made up the least proportion of waste with not more than 2% (598 kg/capita/day) in these high density areas. This is probably due to small stand sizes per household which makes it impossible or difficult to accumulate a lot of waste on small backyards. Electronic waste makes an average of 6% (1795 kg/capita/day) of the total waste generated in high density suburbs. This could be due to buying of low and poor quality electronic gadgets which are not durable and quickly breakdown and this could also explain the inability by residence from the high and medium density suburbs to buy proper and durable electrical gadgets due to lower incomes. Glass waste makes an average of 3% (898 kg/capita/day), metals 6% (1795 kg/capita/day) and other waste 4 %(1197 kg/capita/day).

The bulk of solid waste generated in the low and high density areas comprises organic matter. Similarly, yard waste constitutes the least percentage (2%) of total waste in both low density and high density suburbs. The reason for this similarity could be due to differences in waste generation and management strategies and not that because they generate the same mass of household solid waste. However, food leftovers constitute more than half of total household solid waste whereas papers constitute the largest proportion of waste in low density areas with an average of 33% of the total mass of household solid waste. This shows that the bulk of the waste is biodegradable in nature and if not properly managed can cause the spread of diseases such as cholera,malaria, typhoid, dysentery as well as the proliferation of flies and odours.

4.4 Waste generation and household size

In general it is generally accepted that as household size or population increase the amount of waste generation also increase as was found by Jerie (2005) and Zerbock, (2003). A chi-square test was run to establish the relationship between the size of household and the amount of waste generated.

Table 4.2:Chi-Square Test for Household size and Waste Type

		Types of Waste						
Number of People per Household		**No Response**	**Food Leftovers**	**Electronic Waste**	**Paper**	**Textile**	**Grass or leaves**	**Total**
1 -3	0	7	1	1	3	0	1	13
4 - 6	0	18	5	0	9	1	0	33
7 - 9	0	12	7	1	15	2	0	37
12 -10	0	14	3	0	24	1	0	42
Total	184	54	16	2	53	4	1	316

Households were grouped into ranges with numbers for example 1-3, 4-6, 7-9 and 10-12

	Value	**df**	**Asymp.Sig.(2-sided)**
Pearson Chi-square	3.821E2a	30	0.000
Likelihood Ratio	451.503	30	0.000
N valid Cases	316		

a. 28 cells (66.7%) have expected count less than 5. The minimum expected count is 0.02.

Source: Primary Data (2014)

Table 4.2 shows the chi-square test to establish whether the size of household is related or associated with the type of waste produced. The chi-square value is

substantiated, accepted or rejected at 1%, 5% and 10% confidence level. The alternative hypothesis states that household size is related to the type of waste generated. The value of 3.82 E 2a is statistically significant at 1 % level, implying that we are 99 % confident that there is a relationship between the size of waste of household and the type of waste generated. So by the same thinking the medium and high density households generate more waste than the low density households because they are more peopled. This is supported by the mushrooming of illegal dumps in most cases along roads and on open spaces and findings by Jerie, (2005). The proliferation of waste related diseases is also common in the high and medium density areas according to the epidemiology section of the City.

Table 4.3: Chi-Square Test of Waste and Residential Types

	Types of Waste Generation						
Residential Type	**No Response**	**Food Leftovers**	**Paper**	**Metals**	**Clothing**	**All**	**Total**
1 (Low Density)	2	5	6	0	0	31	50
2 (High Density)	7	16	3	3	1	45	80
Total	9	21	9	3	1	76	130

	Value	**df**	**Asymp.Sig.(2-sided)**
Pearson Chi-square	9.809a	6	0.133
Likelihood Ratio	11.265	6	0.081
N valid Cases	130		

a. 7 cells (50.5%) have expected count less than 5. The minimum expected count is 0.38.

Source: Primary Data (2014)

Table 4.3 shows a chi-square test to establish the association or correlation between residential types and the types of waste generated. The chi-square value of 9.809a is statistically insignificant at 90% confidence level since 0.133 is greater than the conventionally accepted levels of 0.05. Therefore the null hypothesis that there is no association between types of waste and residential type is insignificant. Thus residential type and the type of waste generated are not significantly related. It does not matter whether the waste has been generated from low or high density

4.5 Solid Waste Management Strategies

4.5.1 Collection and Transportation of Household Solid Waste

Households in Harare use plastic receptacles. These are provided by the city authorities. However for financial reasons the authorities do not provide more than one receptacle to enable separation of waste. These receptacles are placed by the gate once a week for collection on the designated day for each particular area, usually in the morning. In cases of breakdown of the compactors, the Council does not collect waste; this problem is further exacerbated by the fact that the City only has 47 vehicles to collect waste from 46 wards as well as the city centre and other shopping areas. The plastic bags full of waste are placed on the outer side of the gates by the roads for collection. If for any reason the authorities fail to collect, the waste will never be kept instead they will find their way to the illegal dumps across the streets. The inefficient waste collection system was substantiated by a woman in Harare who noted that:

"….Household solid waste cannot be kept indoors if not collected, because it produces odours, invites flies, rodents, mosquitoes and other disease-causing pathogens. Because we fear for our lives we throw it into the streets. It's like throwing away the waste and its related problems. This is why you see the streets dirty. This throw away culture is very rampant here and will remain a part of us if waste collection is not improved".

The Harare City Council's timetable for collecting household solid waste shows that waste is collected every day from Monday to Sunday although it's done in different locations on designated days. It is however important to note that some days are open and this shows that there will be no collection on that given day. Despite the fact that waste in the sub-tropics is supposed to be collected at least twice a week the timetable shows that in Harare it is done once a week and not adequately. The indications on the timetable are also unlikely because currently the city has only 47 compactors which save all the residential, industrial and commercial zones of the city. This shows that the collection strategy is not effective as the frequency of waste collection is often compromised due to compactor breakdowns. There is no room for breakdown of any vehicle in the system yet the director of the department of waste management reiterated

that their greatest challenge is the breakdown of compactors. He further indicated that they are allocated about 20 million dollars from the annual city budget for all their requirements such salaries, fuel, receptacles, and vehicle maintenance and servicing. This problem is further exacerbated by the fact that the spares for the compactor vehicles are imported from other countries. This shows that the strategies employed in the management of household solid waste in Harare are mired with a legion of drawbacks hence they are not effective.

Of note on the timetable is the absence of specific times on which the vehicles will be in a given locality. This could help in making follow ups by residents in the event that their receptacles are not emptied. The researcher also discovered that the collection crew sometimes do not cover the whole area stipulated on the timetable on a given day. This gives an impression that an area has been covered when in actual fact some areas would have been left out. This again supports the findings that some residents indicated that they rarely see the crew; in fact, some indicated that their waste is collected once a month, which has given rise to illegal dumping of waste in open spaces. Table 4.4 is an extract of the timetable showing three of the residential areas covered in this research; the rest of the timetable is presented in appendix 6.

Table 4.4 Harare City Waste Collection Timetable Extract

MAIN AREA	MONDAY	TUESDAY	WEDNESDAY	THURSDAY	FRIDAY	SATURDAY	SUNDAY
Budiriro B Ward 33 AAE5760	Budiriro 58- Northern Side up to Current Shops	Budiriro 5A &Budiriro 4 area to the East of Budiriro 4 main Road	Budiriro 4 area to the west of Budiriro 4 main Road &Budiriro 4 Extension	Budiriro 3 - area to the North of 8th Drive	Budiriro 3 - area to the South of 87thdrive bounded by 17th Avenue, Willowvale Road and 2ndRoad and 2nd Road	Budiriro 5- Current Consortium	-
Waterfalls Wards 23 AAE 9058	Houghton Park and Ardbennie residential	Parktown and Shortstone area Picnic area	Mainway Meadows up to Second gate	Mainway Meadows from second gate to Main gate	Uplands, Cheviot Derbyshire, Amazvimbakupa / Boka Adelaide	Prospect flats & HopelyTownship	-
BORROWDALE 'B' Ward 29 (relief) AAE 7836	Area bounded by Newbold Road, Stonechat Road, Wheeldon Avenue, Carrick Creagh Road and Domboshawa	Area bounded by Helvetia road, Harare Drive, Stonechat lane, Wooton Road and Gaydon Road	Borrowdale Brooke	Area bounded by Harare Drive. Enterprises Road, Beeston Avenue, Yellow-Woodlane and Ard-Na-Lea (The Grange)	Area bounded by Crowhill Road, Domboshawa Road, Deacon Road and Gilmour Road	-	-

Source: Harare City Council Waste Management Department (2014)

The timetable is not available for public inspection and does not give specifics as to what action will be taken in the event of a vehicle breakdown. During the collection of household solid waste most plastic bag receptacles break down because the crew sometimes pulls them along the tarred roads thus dropping waste all over the roads resulting in environmental pollution. Plate 4.1 is a photograph showing waste in plastic receptacles awaiting collection opposite OK Supermarket in Mbare's Ardbennie suburb. The council uses these plastic bags for the packaging of waste despite the requirements of Statutory Instrument Number 98 of 2010, which came into effect in 2011, discouraging the use of plastic papers for packaging.

Plate 4.1: Waste in Plastic Receptacles Awaiting Collection

Source: Primary Data (2014)

The frequency of collection ranges from two (2) times a week to once a month. It was found that in the high density suburbs where the household size was big, a lot of solid waste was in the form of food leftovers. It was also observed that open burning of waste is common in areas along roads and open spaces where residents dump their household solid waste especially when council fails to collect and residents want to get rid of the waste. This is against the fact that EMA (2014) indicated that open waste burning practices contribute to ground level ozone pollution (smog) which can worsen

respiratory, heart and other health problems. This can also lead to eye, nose and throat irritation as well as damage of the central nervous system (EMA, 2014).

Plate 4.2 shows illegally dumped waste along Willowvale Road in Budirio which is almost blocking the road. This according to one female respondent is a product of failure by council to collect waste as stipulated by the timetable, rules and regulations. The sentiments were echoed by the Combined Greater Harare Residents Association chairperson when he said:

"…the system has collapsed such that waste has become part of our backyard stuff yet it is a threat to our health…..We have no option but do our mini-waste management of burning the waste or carrying it at night to the dumps outside the houses."

Tevera (2012), Masocha (2005), Jerie (2006) and others also noted that waste management in Zimbabwe has collapsed and night dumping is a common problem.

Plate 4.2: An Illegal Dump along Willowvale Road

Source: Primary Data (2013)

Contrary to this waste infested status of the high and medium density areas, it was observed that illegal dumps are rare if any in low density areas. This can be linked to the differences in knowledge, income and ownership of waste receptacles between residents in high and low density areas. Generally residents in the low density areas own receptacles that are big and durable. These are sold by companies such as Bins for Africa and 26 other companies listed in the directory for companies that are into waste management kept by Environment Africa. Prices of some the receptacles are shown in Table 4.5 below. It must however be noted that some hardware shops are also selling receptacles for US $20 for an 85 litre bin.

Table 4.5: Receptacle sizes and current prices

Bin Size in Litres	Current prices
50 litres	$ US 95
130 Litres	$ US 105
240 litres	$ US 115
660 Litres	$ US 680
1000 Litres	$ US 790

Source: Bins for Africa Zimbabwe (2014)

Table 4.5 shows the prizes of receptacles by size. More than 90% of high density households cannot afford to buy these receptacles. They are expensive and also too big. It was also observed that the bin liners that come with these receptacles are the daily receptacles for the majority of high and medium density households. This is because most of them use these plastic papers as receptacles.

Observations and interviews revealed that waste collection in low density suburbs is done more frequently (twice per week) than in high density suburbs. This is however not reflected on the timetable. More so most politicians and policy makers or rather the elite class resides in the low density areas and this explains the mismatch in the collection of household solid waste between these areas. Collection and disposal of household solid waste in the low density areas is the responsibility of several stakeholders who include the municipality, private organizations paid to collect waste by individuals and individual households' themselves taking their waste to Pomona dumpsite. This implies that strategies used in low density suburbs are better in household solid waste management

compared to the high and medium density areas. This gives the area a generally clean environment dominated by well-cut loan and well maintained vegetation and outside gate appearance. The general picture is that despite the bigger residential stands (above 1000 m^2) low density areas are cleaner. The high and medium areas are dominated by waste dumping all over with some dumps less than 3 metres away from houses. Plate 4.4 illustrates the general appearance of the low density areas in Harare.

Plate 4.3: General Appearance of the Low Density Residential areas in Harare

Source: Primary Data (2014)

In medium and high density residential areas the level of environmental education is generally lower than in the low density areas. This has resulted in over-reliance on council allocation of household solid waste receptacles in the medium and high density residential areas as well as household solid waste collection, yet the council is incapacitated. Infect according to the Combined Greater Harare Residents Association (CGHRA), one of the main focuses of the 2014 Harare council budget was on refuse collection with about 2 million dollars allocated for zero littering programmes and a total of US $1500000 for fuel for refuse collection. This amount, according to the Waste

Management department, is too little to sustain meaningful household solid waste management in a city as big as Harare. This is because collection of household solid waste is solely the responsibility of the council especially in the medium and high density areas. Despite this trust in council by households, various respondents lamented that council collects waste infrequently (once a month) giving residents no choice but to illegally dump household solid waste in open spaces as shown in Plate 4.2.

However, even though the municipality has the major role in waste management in both the low and high density areas, it is incapacitated due to inadequate compactor vehicles. Currently the Harare City Council has the equivalent of one (1) vehicle per ward. This is because they have 47 vehicles for the 46 wards they must serve. The same vehicles also serve the commercial and industrial zones of the city. The vehicles frequently break down and require spares from abroad and this complicates the household solid waste management system as the authorities sometimes do not collect waste as a result of vehicle shortages. Below is Table 4.6 showing a list of all the types of vehicle that the Harare City Waste Management Department is currently employing in the day to day household solid waste management process.

Table 4.6: Number of Vehicles Used in Waste Management by Harare City Council

Type of vehicles	Number
Compactors	47
Tractors	12
Tippers	6
Skip trucks	6
Frontend loader	2
Landfill compactor	1
Dozer	1

Source: Harare City Council (2014)

The unavailability of the necessary vehicles in adequate numbers makes the bucket–at-night system or night dumping the order of household solid waste disposal and the only option for some residents of Harare. Table 4.6 shows that Harare is ill-equipped to be close to effective household solid waste management. According to the operations

manager residents in the high density areas pay six dollars (US$ 6) per household and those in low density areas pay nine dollars (US$ 9) per household toward waste collection. The low charges for household solid waste collection together with the ever breaking down vehicles constitute an ineffective household solid waste management system for the City of Harare. This is because the revenue collected is too small to bring about quick servicing of vehicles in the event that they break down. A man from Mbare had this to say about household solid waste management in Harare:

'…People do not even have receptacles and in most cases use old buckets as receptacles which are dumped every night because they are too small for waste generated by more than 7 people and is not collected in time. In fact waste generation far exceeds the processing of waste especially the collection aspect of it. Worse still council is ill-equipped to deal with the current waste generation scenario. This is because of the dollarization of the Zimbabwean economy and more so Harare is the place where everyone wants to be...Surely Harare has a long way to go with regards to household solid waste management'

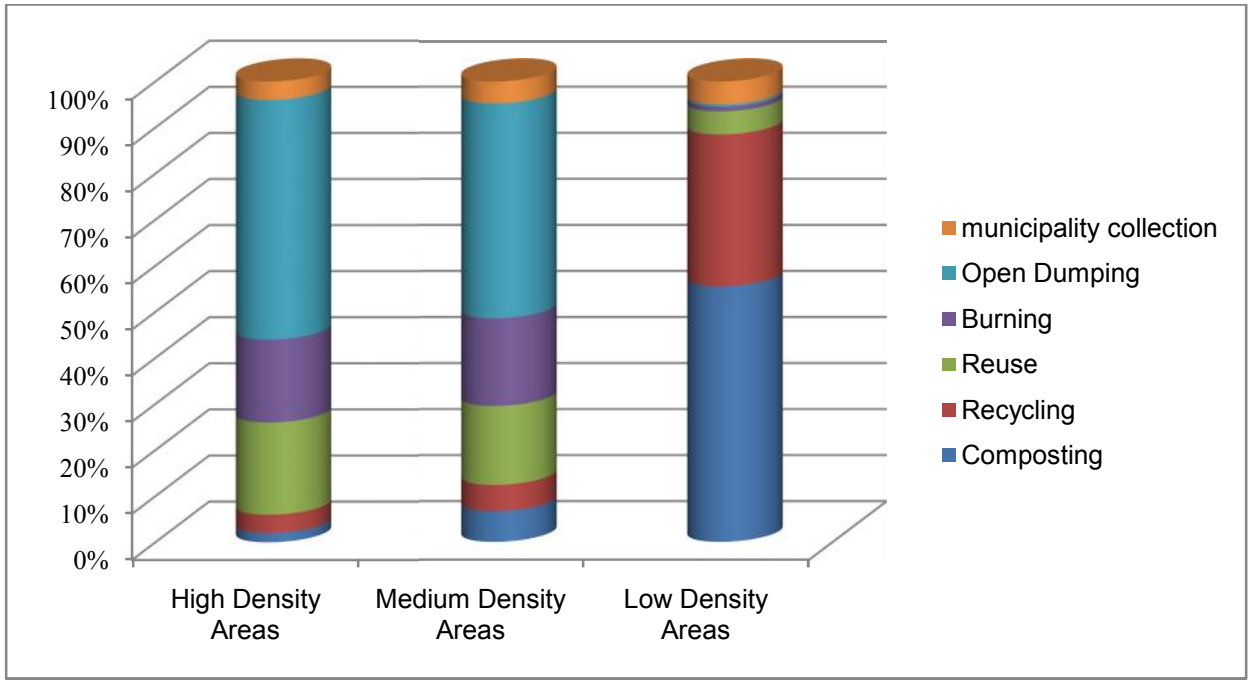
4.5.2 Household Solid Waste Disposal in Harare

Disposal forms the last and least expected phase of the waste management hierarchy and need to be avoided since an efficient system ensures that minimal solid waste reaches the landfill. Disposal of solid waste in the high, low and medium density residential areas is done mainly by council which collects household solid waste from households. Council also clears illegal dumps in various places in residential areas mostly the high and medium density areas. This is done using the seven (7) tippers and two (2) front end loaders listed in Table 4.6. According to residents in Waterfalls in some cases these tippers do not take waste to Pomona. Instead, they dump the waste in open gravel pits in nearby farms. In cases where council fails to collect bins residents, especially those in high density areas, dump the waste in open spaces at night.

The general view is that in Harare waste generation in the high and medium density areas exceeds waste collection and disposal and the opposite is true with low density areas. This is because the low density residents do not rely on council only for collection of waste because they hire private waste collectors due to their financial abilities to

collect their non-biodegradable waste. The biodegradable waste is composted in the low density areas, while there is a high resort to the open dumping system in the high and medium density suburbs. Figure 4.2 shows how the residents of Harare dispose their waste.

Figure 4.2: Waste Disposal in Harare by Type of Suburb



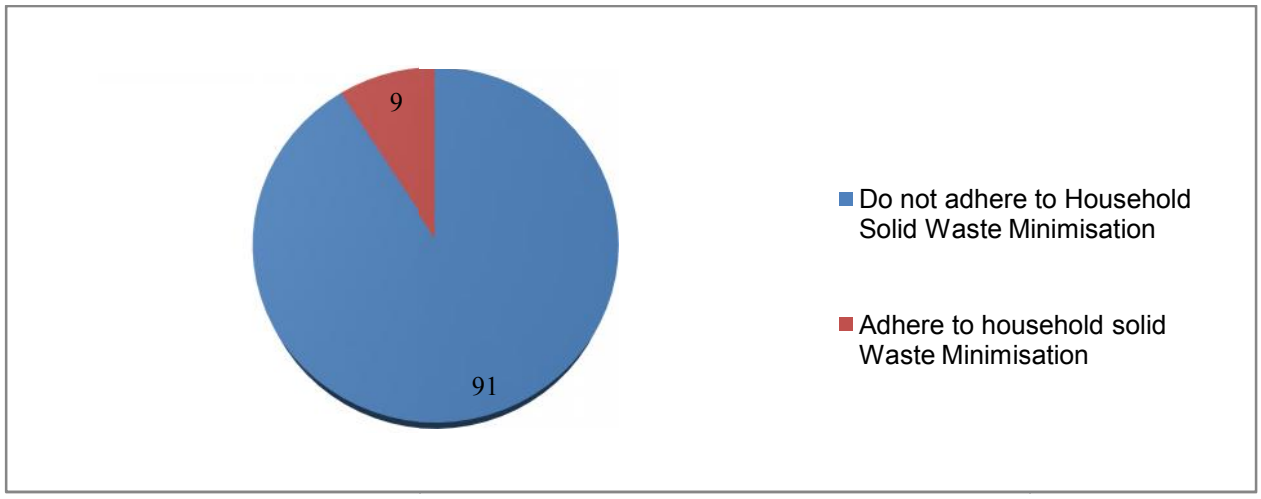
Source: Primary Data (2014)

In high density areas stands are small ranging from 200 square meters to 400 square meters thus residents do not have enough space to do meaningful composting. If they compost, they are very small composts which consist of mixed rubbish of all sorts of waste showing that they do not have knowledge of the correct types of waste to be composted to ensure proper results. However in low density areas residents separate waste and appropriately dispose of it; there are gardeners who do composting and work all day. The gardeners at least know what to exclude from the compost and how to dispose of other non-biodegradable waste effectively.

4.5.3 Household solid Waste Minimization Strategies

The conventional and effective waste minimization strategies are recycling, reducing, reusing and avoiding (Jerie, 2006; EMA, 2014). Empirical evidence, cross examination of interview responses and observation show that in high and medium density areas residents do not adhere to these conventional principles. They largely dump and do open burning of waste. This could be due to many factors such as lack of knowledge, failure to collect waste by the responsible authorities, inadequate facilities such as receptacles and financial constraints. Musademba, *et al.* (2011) also noted that constrains in waste management were financial and material. Various views were expressed as to the position of adherence to waste minimization strategies in Harare. This is presented in Figure 4.3

Figure 4.3: Respondents' views on Adherence to Waste Minimization Strategies



Source: Primary Data (2014)

Figure 4.3 shows that the generally known waste minimization strategies are not fully adhered to in Harare with 91% of the respondents indicating that recycling, reusing, reducing, avoiding and composting are not employed by residents as the best options in waste management. Only 9% of the respondents supported the use of these conventional strategies. This means that the strategies of waste management in Harare are not near to being effective. Evidence observed on the ground shows that the practices are done in the low density areas than the high density areas. It must however

be noted that there is minimal reusing and recycling in the high and medium density suburbs, especially with respect to containers that are used to store food stuffs such as salt, butter, sugar and other items.

Recycling is generally done at a very small scale in Harare and this is done by unemployed people who pick items from the dumpsites for reselling. Plate 4.5 shows some items produced from products that could have been left for the dumpsite. The City of Harare recently issued 300 recycling licenses to individuals. This is however a small number and suggests that people still shun waste recycling or it explains that the council had never thought of formalising recycling of waste.

Plate 4.4: Products of Recycled waste

Source: Nyanzou, (2013) Unpublished

Recycling in Harare includes the use of plastic containers such as empty bottles of water for other domestic purposes. Bottle tops of beverages are also recycled to produce handbags, candle stand, caps and several other products.

Despite the evidence of recycling above, it is important to note that recycling is done at very low levels because most industries are closed down yet they are the major consumers of the product and also that most people shun recycling waste this is worsened by lack of environmental education and resources. This is because in cases where they provide receptacles they only give one per household making separation difficult or rather not possible. One respondent in Budiriro lamented lack of receptacles as a major cause of poor if any recycling in Harare. Similarly studies by (Banjo *et al*. 2009, Nigeria; Simon and Observer, 2008, Tanzania; Dongo *et al*. 2010 Cote D'Ivoire and Guangyu, 1994, China) revealed that waste is better recycled when it is separated according to waste source and type, a process known as waste classification. The cause of this poor waste classification is a product of a multiplicity of problems ranging from lack of receptacles and other resources to poor environmental education amongst residents.

4.6 Health and Environmental Impacts of Household Solid Waste

A number of health, economic, social and environmental impacts were highlighted in the research. Some of the household solid waste dumped could be used as raw materials for other industrial activities. This can be through recycling and reusing for example papers, bottles, metal, plastic papers and containers (EMA, 2014).The aesthetic value of the environment is lost compromising other activities such as tourism, fishing and urban farming. The loss of aesthetic value results in lost national income (GDP) and employment because economic activities such as tourism are compromised as tourists shun waste. Jerie (2006) and Tevera (2012) also noted that people generally do not want to be associated with waste as these impacts negatively on their health.

Indiscriminate disposal of household solid waste can lead to environmental degradation and deterioration. Some organic solids decompose to produce odours, leachate and other acids which are destructive to plants, dissolve some important soil minerals and contaminate underground water. This may lead to growth of water hyacinth which kills aquatic life and causes water-borne diseases (cholera, diarrhoea, dysentery and typhoid) if they decompose in water. A number of cases of the prevalence of these

diseases have been reported since January 2014 to August 2014 as tabulated in Table 4.7.

Table 4.7: Common Waste Related Diseases and Cases Reported First Half of 2014

DISEASES	REPORTED CASES
Typhoid	300
Cholera	-----
Diarrhoea	35891
Dysentery	24430

Source: Zimbabwe Epidemiology and Diseases Control (2014)

These figures, according to the Director of Epidemiology and Diseases Control, could be even higher because some cases go unreported as people die before going to the hospital and others visit private doctors.

Some of the environmental problems associated with poor household solid waste management identified by respondents were ecological disruption and resource depletion, toxic smoke, climate change and poor visibility especially when fire breaks out at dumpsites. Findings of this study indicated that knowledge about the causes of climate change is still limited amongst the residents although they can easily identify effects of climate change in their areas. Studies by Mangizvo (2010) and Banjo *et al.* (2009) in Nigeria traced the causes of climate change to poor solid waste management in the urban environment; this situation could apply to Zimbabwe because the strategies of waste management in Harare are not effective.

The City Health Department also indicated that due to poor household solid waste management, incidents of diseases such as cholera, dysentery, diarrhoea and others are frequent and, according to the City Health Director, the diseases are more prevalent in the high density suburbs. The director made reference to the cholera outbreaks in Budiriro in 2008 and 2009 that killed thousands. The medical director also indicated that cases of about 2-3 people suffering from diarrhoea are reported each week at some of the various council clinics across residential areas. The problem of waste related diseases being common in Harare was also supported by the Ministry of Health and

Child Welfare which indicated that diseases related to waste mismanagement problems are commonly reported by government hospitals.

4.6.1 Solid Waste Management and the Legal Framework

The first principle of the Rio Declaration puts human beings at the centre of concerns for sustainable development. Humans are therefore entitled to a healthy and productive life in harmony with nature. Principle 5 of the Rio Declaration states that in order to achieve sustainable development, environmental protection needs to be an integral part of the development process. In Zimbabwe, Section 83 of the Public Health Act Chapter 15.09 of 1996 states that all local authorities are responsible for maintaining their areas of jurisdiction in a clean and sanitary condition and preventing the accumulation of waste which may be injurious to health. This is also supported by the Zimbabwean Constitution which gives every citizen the right to a clean environment. However, the City of Harare is not meeting these requirements since it is failing to collect household solid waste generated by its residents. The Harare Waste Management by-law of 1979, Statutory Instrument 477 of 1979, 127 of 1981 and 197 of 1987 give a description of a receptacle in Section 3 as (i) an approved rounded and lidded container in non-corrugated galvanized sheet metal which is reinforced and welded and is of a capacity not exceeding 0,1 cubic meters or (ii) an approved polythene bag of a thickness of not less than 200 microns and a capacity not exceeding 0,1 cubic metres when filled to within 200 mm of its open end or (iii) any other approved receptacle. The same instruments which define receptacles also indicate that it is the duty of council to remove waste from the residential areas. However the respondents in Harare showed that the council is failing both to provide the receptacles defined in the instrument and to ferry all the generated waste to Pomona dumpsite. Officials in the Waste Management Department also confirmed, in interviews,

CHAPTER FIVE

Summary, Conclusions and Policy Recommendations

5.1 Summary and Conclusion

The study examined the effectiveness of household solid waste management strategies in Harare's residential suburbs. The study used a mixed methodology approach to establish the effectiveness of these strategies. Relevant theoretical and empirical literature was reviewed; the researcher found several conventional ways of effectively managing household solid waste. These include recycling, reusing, reducing and avoiding. However, the triangulation of the findings from observations, interviews and questionnaires showed gross mismanagement of household solid waste by residents especially those in the medium and high density areas.

The responsible authorities for waste collection in these residential areas are also incapacitated, paralysing their household solid waste management strategies. The ineffectiveness of the strategies used in household solid waste management in Harare is largely explained by lack of funds, poor environmental education among the residents, limited expertise, shortage of suitable machinery and an upsurge in the generation of household solid waste due to the use of multicurrency in the Zimbabwean economy which has seen the residents' buying power increasing. Thus economic and environmental problems then resulted as waste generated is dumped all over polluting the environment and affecting economic activities such as tourism. This environmental pollution is a threat to public health as it gives birth to diseases such as cholera, typhoid, dysentery, malaria and other health problems that emanate from electronic waste. Harare is failing to provide a sustainable and satisfactory household solid waste management service especially in the high and medium density residential areas.

It is also concluded that although legislation is available a lot of homework needs to be done to ensure and guarantee an effective household solid waste management system. This calls for efficient enforcement of the legislative aspect of waste management.

Despite environmental and public health problems pointing to the ineffectiveness of the strategies in household solid waste it was also observed that the Harare City Council Waste Management Department is ill-equipped to do proper household solid waste management. According to the Amenities department the City needs more than 3 vehicles per ward to effectively collect waste within 48 hours yet they only have 47 vehicles to carry waste from all the 46 wards of the city. This situation is against the background that these vehicles regularly break down and need to be serviced using spares that can only be sourced from out of the country. This means that the strategies, especially collection, then become ineffective as the area of coverage is far too big to be effectively covered by such a small fleet.

On the other hand the research also showed that there are antagonistic tendencies in the management of household solid waste. This is because several Government Departments and Ministries are in one way or the other involved in waste management. For example evidence has shown that Ministry of Environment, Climate and Water, Ministry of Health and Child Welfare, Ministry of Tourism, Environmental Management Agency, Ministry of Local Government and some Non-Governmental organizations to mention just but a few are all in one way or another involved in waste management and this weakens the household solid waste management system of the city as various demands that are different are expected to play a part. This makes the available strategies ineffective and antagonistic.

The other problem that shows that the management of household solid waste is not effective is the lack of waste management education among the residence of Harare. This is evidenced by the fact that some respondents indicated that they illegally dump household solid waste and some do open air burning of household solid waste showing that they are not aware of the effects of such waste handling and management. This is further exacerbated by failure by the Harare City Council to provide receptacles to its residents. Harare City Council can only afford a single plastic bag for a household yet

most of these households are made up of multiple (not single) families especially those from the high and medium density areas. More so a single receptacle means “do not separate your household solid waste”.

The researcher also observed that the collection of household solid waste was marred with anomalies as the crew sometimes would drag the plastic receptacles along the tarred road and often tearing those, leaving waste scattered along the roads. This shows an ineffective system as there are no follow up mechanisms to ensure that such bad practices are avoided. It was also observed that at Pomona dumpsite waste is dumped indiscriminately without separation as food stuffs, e-waste and other forms of waste were just dumped in the same area. There is no covering of waste with soil and this makes the whole waste management system ineffective because in a normal system waste dumped should be covered to reduce flies, odours and other nuisance.

The majority of residents indicated the possibility of improvements in solid waste collection although some lack knowledge and information on how to reduce waste production at household level. It was also revealed that the majority of the residents of Harare do not have receptacles especially those in the high and medium density areas which make illegal dumping the order of the night in these areas. This situation is further exacerbated by rare and often partial collection of household solid waste by the Harare city council.

5.2 Policy Recommendations

Policy recommendations were derived from these conclusions. These could be very useful insights to policy makers, residents and environmentalists on how best household solid waste can be managed to keep the City of Harare clean, healthy and habitable.

The results show that household solid waste management strategies in Harare are not effective especially in the medium and high density suburbs and this is attributable to several factors. Therefore the following recommendations may be very useful in improving household solid waste management in different residential areas of Harare. These are:

(i) The waste collection and management department of the City of Harare should be capacitated to ensure effective household solid waste collection. This can be through:

- Increasing financial support by inviting private household solid waste collectors since the responsible authority has inadequate equipment and manpower.
- Allocating official landfills and more dump sites rather than relying on Pomona dumpsite only for a city as big as Harare.
- Intensifying awareness campaigns to educate the residents on effective household solid waste management especially on the 3R system. There should be educative programmes on all media and in all local languages to ensure effective education of the public on household solid waste management
- Supplying proper receptacles in the right numbers to allow for waste separation and stopping illegal dumping.

(ii) Enforce laws and regulations on waste management and appoint a Commission that will see to it that household solid waste is well managed by bringing in other players into the field of waste management. These other players could include non-governmental organizations and other independent players who can take household solid waste management as a business by recovering, reusing and recycling of household solid waste. In other words there should be private-public partnerships to ensure effective household solid waste management which incorporates residents, private waste collection organizations and government entities.

(iii) Setting up of recycling and reusing commercial-industrial entities which use some of this household solid waste can be an effective strategy since the supply of the solid waste would be met by the demand. For example, a biogas plant can be developed as most of the household solid waste produced in Harare is food leftovers and other biodegradable waste.

(iv) It is recommended that household solid waste be recycled and that which cannot be recycled be properly dumped at the official dumpsites this is

because 90% of the household solid waste generated in Harare can be recycled. This will ensure that the best waste management strategies are adopted in full for the benefit of Harare and its residents as well as the environment at large.

(v) There is need to add sections into the organogram to include an educational department that is responsible for educating households and members of the public on waste management. This also ensures that households that do not have receptacles are provided with such especially during the distribution of bills by the city authorities.

(vi) It is also important to increase the number of inspectors for the purposes of ensuring effective inspection and assessment. This is more important in the residential areas where waste dumping is very common and is witnessed on all open places along roads and open ground. There is also need to ensure that the general number of workers in this department is increased for effectiveness. More so, there is need to increase the number of compactors as this will ensure increased coverage of waste collection and also reduces the time spent collecting waste.

(vii) It is recommended that the city of Harare introduce communal skips on areas that are dominated by illegal dumps and establish a communal education team to educate the people on the importance of proper household solid waste management.

5.3 Area for Further Study

Electronic waste was also found as one of the household solid wastes which is inorganic and contains poisonous substances such as, lead and cadmium. Thus its disposal is also of great concern to minimize environmental pollution and degradation. Therefore another study can be done to establish the effectiveness of strategies to dispose off electronic waste. Possible solutions can be found to productively dispose this kind of waste since there is a possibility of its reuse and recycling.

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APPENDICES

Appendix One

Questionnaire

An Investigation into the effectiveness of household solid waste management strategies in Harare, Zimbabwe

Dear respondent

I am carrying out a research to investigate the effectiveness of household solid waste management strategies in Harare, Zimbabwe. I kindly ask you to assist by completing this questionnaire. Please be assured that your responses will be strictly confidential and will be used for the sole purpose of pursuing academic interests. Thank you for understanding and agreeing to participate.

Instructions to respondents

- Do not write your name or contact details on the questionnaire.
- Tick in the spaces provided for closed questions.
- Fill in the spaces provided for open ended questions.

Section A: Background Information

Please tick the appropriate and applicable box

1. What is your sex? Male [ ] Female [ ]

2. What is your age? 21-30 [ ] 31-40 [ ] 41- 50 [ ]
51-60 [ ] 61+ [ ]

3. What is your level of education? Standard [ ] Primary [ ]

Secondary [ ] Tertiary [ ]

Others please specify ……..

4. How many people reside at your house? 1- 3 [ ] 4 –6 [ ]

7- 9 [ ] 10 -12 [ ] 13+ [ ]

Section B Waste generation and collection

5(i) which of the following solid waste do you generate?

- Food leftover [ ]
- Paper and Plastics [ ]
- Metals and clothing [ ]

(ii) Of the waste you generate other than council collection what other waste management options do you use? Please indicate below.

METHOD	TYPE OF WASTE
Reuse	
Recycle	
Compost	
Burn in open air	
Others please specify	

6. How much in US ($) dollar do you pay for waste collection per month?

5-15 [ ] 16-25 [ ]

26-30 [ ] 31+ [ ]

7. (i). Do you have a refuse bin? Yes [ ] No [ ]

(ii) What type of bin is it?

- Plastic paper [ ]
- Plastic containers [ ]
- Metal containers [ ]

(iii). what is the size of the bin?

- Small (1 – 30 kg) [ ]
- Medium (31 – 75) [ ]
- Large (75 +) [ ]

(iv). Where did you get your bin from?

- Donors [ ]
- Government [ ]
- Harare Municipality [ ]
- Self [ ]

8 (i) How often is refuse collected by the authorities?

Daily [ ] Weekly [ ]

Monthly [ ] Never [ ]

(ii) What time is the refuse usually collected?

Morning [ ] Afternoon [ ] Night [ ]

(iii) Who is responsible for the disposal of waste generated in your household?

- City Council [ ]
- Private Organization [ ]
- Scavengers [ ]
- Self [ ]

9. Do you separate waste?

Yes [ ] No [ ]

Explain

……

……

10. Some people dump household waste in unauthorized places because?

- No Facilities [ ]
- To save cost [ ]
- No penalty [ ]
- Inadequate information [ ]

Section D: Waste policy and management strategies

15Indicate your response using the index:

[1] Strongly agree [2] Agree [3] Moderate [4] Disagree [5] Disagree strongly

	1	2	3	4	5
Environmental policies lack clear strategies for action					
Law dealing with waste in not adequate					
Waste management institutions are weak					
Limited funds available are sometimes misused					
Public Education on waste management is low					
Operational equipment is obsolete and insufficient					
Strategies being used to manage waste are not enough					

NB Please indicate any other factors that hinder effective solid waste management in the City of Harare.

……

……

Thank you for your cooperation.

Appendix Two

Interview guide for the key informants

An Investigation into the effectiveness of household solid waste management strategies in Harare, Zimbabwe

Dear respondent

I kindly ask you to assist me by answering a few questions. Please be assured that your responses will be strictly confidential and will be used for the sole purpose of pursuing academic interest. (Sex will be recorded and questions that have to do with age, marital status, educational level and time residence in Harare will be asked first and recorded.)

1. Who is your employer and what is your job title?
2. Kindly describe your job in relation to waste management.
3. What is the mission statement of your organization?
4. What is household solid waste management?
5. What are waste management strategies and which ones are used in Harare?
6. Do you think Harare is using effective household solid waste management strategies? Please explain.
7. Do you recommend any other strategies for the city of Harare?
8. How do you assess the waste management situation in Harare?
9. Is the city of Harare doing anything significant in managing household solid waste? Explain.
10. In your opinion, which factors hinder the city from doing proper household solid waste management?
11. What do you think can be done to ensure that there is proper waste management in Harare?
12. What are the authorities doing to ensure proper waste management?
13. How has the dollarization of the Zimbabwean economy affected waste management in Harare?
14. Do you think a poor household solid waste management strategy has some effects on the environment and human health? Please explain.

Appendix Three

An Observation checklist

WASTE MANAGENT STRATEGIES	YES	NO
Are the strategies varied?		
Are there plans for new strategies?		
Are compactors enough?		

WASTE MANAGENT POLICY	YES	NO
Is the policy available?		
Can it be accessed by everyone?		
Are the people aware of the policy?		

WASTE MANAGEMENT TRAINING MANUAL	YES	NO
Are they available?		
Are they informative?		
Are they available in all Zimbabwean languages?		

PROTECTIVE CLOTHING FOR WASTE COLLECTORS	YES	NO
Is it provided?		
Is it relevant?		
What is its condition?		
Is it suitable?		

DISPOSAL SITES	YES	NO
Location close to settlements		
Is the site fenced?		
Is waste quantified?		
Waste segregation done		
Waste recycling		
Fly infested		

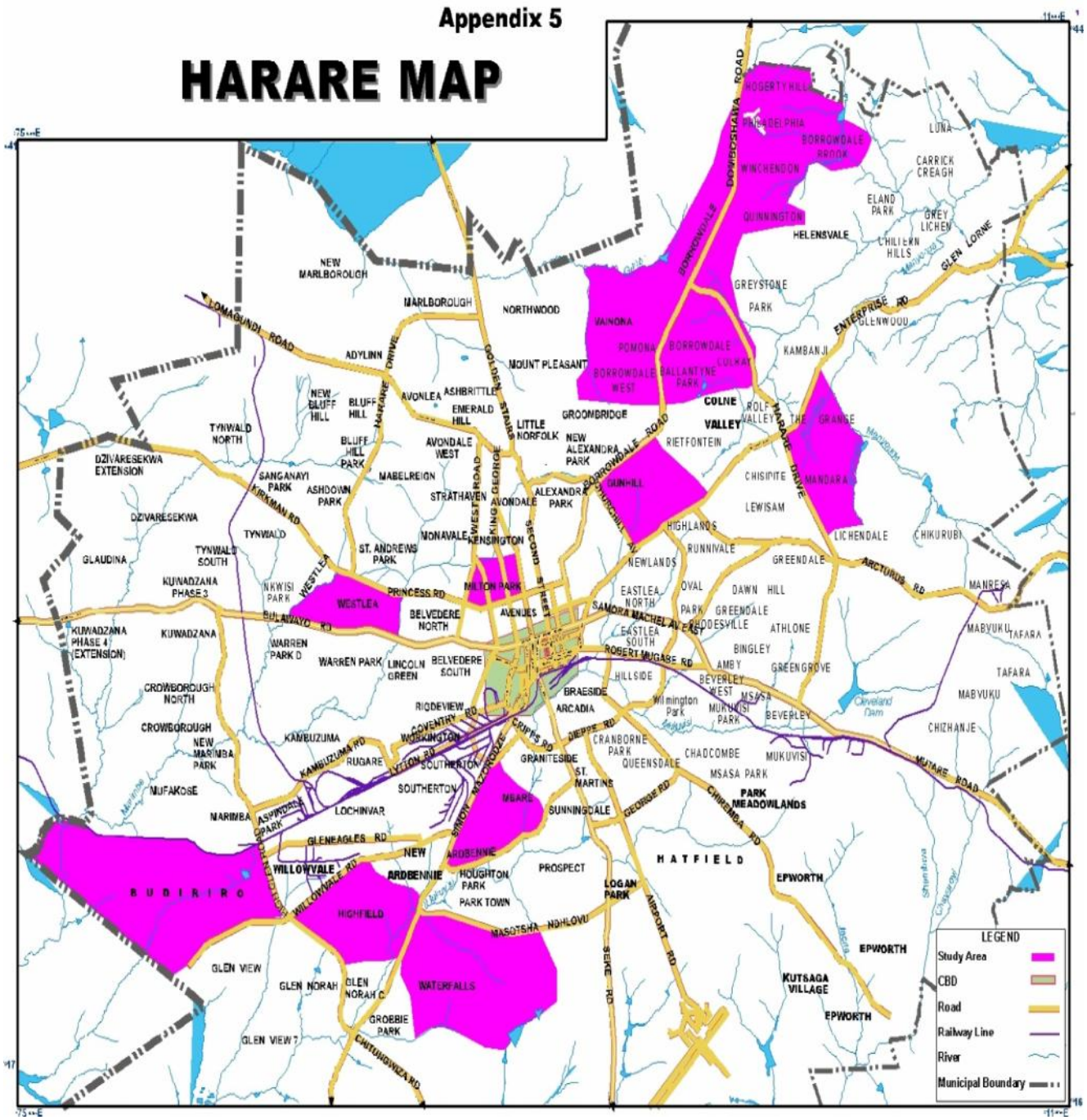
Appendix Four

A list of pieces of legislation in Zimbabwe Governing Waste Management

1. Environmental Management Act (Chap 20:27)
2. Urban Councils Act (Chap 29:15)
3. Public Health Act (Chap 15:09)
4. Water Act (Chap 20:22)
5. Rural District Act (Chap 29:13)
6. Regional Town and Country Planning Act (Chap 29:12)
7. Harare Waste Management by-laws 1979 (SI 477 of 1979)
8. Harare Waste Management Amendment by-law 1981 (SI 127 of 1981)
9. Harare (Anti-litter) by-law 1981 (SI 85 of 1981)

Appendix Five

Harare Map



Appendix Six

Refuse Collection Time-table

Revised Refuse Collection Time-table, Collection Days (specific areas) Toll free number: 770339

Main Area	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday	Sunday
Alex Park Ward 39 (Relief) AAE 5757	Gunhill	Borrowdale West and Dandaro	----------	----------	Old and New Alex Park	----------	----------
Avenues Ward 6 AAE 7827	Area bounded by J. Tongogara, L. Takawira, H. Chitepo, Sam Nujoma	Area bounded by J. Tongogara, 4th St. S. Machel and S. Nujoma	Areabounded by J. Tongogara, Prince Edward, H. Chitepo and L. Takawira St	Area bounded by J. Tongogara, 4th St, S. Machel and 7th St	i. Area bounded by S. Machel, 4thSt, R. Mugabe, & Enterprise Rd ii. Area bounded by Cork Rd, L. Takawira & S. Nujoma incl Parireny atwa.	Area bounded by J. Tongogara Enterprise Rd, 7thSt& S. Machel	Daily's ie Hotels, Restaurants, Hospitals& all Shops.
Avondale Ward 7 AAE 9057	Area bounded by Cork , Rd2"d St, Aberdeen Rd& King George	Area bounded by cork d Rd, King George West Rd & Lomagundi Rd	Area bounded by Lomagundi Rd, West Rd Kerry Rd& Suffolk Rd	Strathaven	Area bounded by King street Ext and Lomagundi George, Aberdeen Rd, 2nd	----------	----------
Belvedere Ward 5 AAE 7835	Belvedere North Area bounded by S.Machel, Prince Edward Str, Princess,Comerty& Beal Rd.	1 .Area bounded by Samora Machel,Beal Rd,Princess and Mutley Bend. 2. Lincoln Green area bounded by Garfield Rd up to Watermever Rd	Milton Park	Ridgeview and Lincoln Green area bounded by Garfield Rd and Bishop Gaul Rd.	Monavale	----------	
Budiriro 'A' Ward 33 AAE 9075	Budiriro 1 Southern Side. Area bounded by second Rd, Third Rd, Willowvale Rd up to Budiriro Park	Budiriro 1 Southern Side Area bounded by Second Rd and Third Rd	Budiriro 1 North (Clinic area) up to Nzou St	Budiriro 2	Budiriro 5B up to OK Shops - Southern Side	----------	----------

Budiriro 'B' Ward 43 AAE 5760	Budiriro 58-Northern Side up to Current Shops	Budiriro 5A & Budiriro 4 area to the East of Budiriro 4 main Rd	Budiriro 4 area to the west of Budiriro 4 main Rd& Budiriro 4 Ext	Budiriro 3 - area to the North of 8th drive	Budiriro 3 - area to the South of 87thdrive bounded by 17th Ave, Willowvale Rd and 2ndRd and 2ndRd	Budiriro 5-Current Consortium	
Borrowdale 'A' Ward 18 AAE 9036	Area bounded by Harare Dr, Gayden Rd, Warwick Rd, Winchcombe Rd &Newbold Rd	Area bounded by Campbell Ave, Harare Dr, Port-Glen Rd and Piers Dr	Area bounded by Borrowdale rd, Piers rd, Harare Dr Addington Lane and Rolf Ave	Area bounded by Arnold-Edmonds Dr, Enterprise rd, Manyonga East-Hills, Lytham Dr and Elshadai Rd	Area bounded Crowhill Rd, Carrick Creagh, Hessel Rd& Gaydon Rd	Area bounded by Shawasha Hills, Umwinsidale, Mujuru Homestead&Hogerly (new stands)	
Borrowdale 'B' Ward 29 (Relief) AAE 7836	Area bounded by Newbold rd, Stonechat r, Wheeldon Ave Carrick Creagh Rd and Domboshawa Rd	Area bounded by Helvetia rd, Harare Dr, Stonechat lane, Wooton Rd and Gaydon Rd	Borrowdale Brooke	Area bounded by Harare Dr. Enterprises Rd, Beeston Ave, Yellow-Woodlane and Ard-Na-Lea (The Grange)	Area bounded by Crowhill Rd, Domboshawa Rd, Deacon Rd and Gilmour Rd		
Central Business District	City 1 Evening Collection City 2 Evening rd	Daily Monday to Sunday Area bounded by J. Nyerere, H. Chitepo, 5th St, Kenneth Kaunda Daily Monday to Sunday Area bounded by J. Nyerere, Charter rd, Rotten Row, h. Chitepo					
Cranborne Ward 21 AAE 7879 (Relief)	i).Wilmington and Queensdale ii)Old Cranborne from Biddulph to George rd	i)New Cranborne ii)Old Cranborne – Area bounded by Dieppe Rd, Chiremba Rd & Biddulph Rd	Airport compound, 1 Commando 2 Brigade & George rd Army houses	Tomlison Depot Morris Depot and KG VI	……	……	……

MAIN AREA	MONDAY	TUESDAY	WEDNESAY	THURSDAY	FRIDAY	SATURAY	SUNDAY
DZIVARESEKWA Ward 40 AAE 5715	Dzivaresekwa 3 &Tynwald South	Dzivaresekwa 2	Dzivaresekwa Phase 3	Dzivaresekwa 1	Dzivaresekwa 4	Tynwald North	----------
EASTLEA	From GMB HQ, area bounded by S.Machel ,	1. Area bounded by Enterprise Rd, S.Machel,	Braeside area bounded	Upper Hillside area	Arcadia, St Martins &	----------	----------

Ward 2 AAE 7828	RMugabe, Glenara Rd, Enterprise Rd	BoundaryRd, Glenara Rd 2. Area bounded by Glenara South, R.MugabeRd , S. Machel Ave up to Cresta Lodge	by J.Nkomo , Cripps Rd, Brookes Rd, Braeside Police station	bounded by RMugabe Rd, Glenara Ave behind OK Mart, Hillside Nursery Park, VID- R Mugabe Rd	NRZ Complex Houses		
GLEN-NORAH Ward 27 AAE 7826	Glen. Norah B, (Mushayabal1.de)	Glen-Norah A (Spaceman)	Areabounded by Highglen re, Gumbie Rd, Zvimba Rd up to the Park (Sisk area)	Area bounded by Gumbie Rd, Zvimba Rd Sebakwe Rd (Long lines)	Glen-Norah C	Chitubu area	---------- -
GLEN-VIEW 'A' Ward 30 AAE 9074	Area 8. Area bounded by High-glen Rd , Willowvale Rd incl 17thAve	Glen-view 3. 10thave to 12thave	Area 8. from Willowvale Rd robots to Patrenda Way	New Glen view 7 stands & Glen view 1- 37 Cres up to Mataure Shops	Glen-view 2 & 4	---------- -	---------- -
Glen-View 'B' Ward 31 AAE 7829	Tichagarika to 13th $t incl High2 school and shops	From Glen-view 1 shops to Patrenda Rd incl ZBC houses	Glen View 1 from D.O Offices up to Mataure shops	1.From Glen-view 1 Clinic to Glen-view 1 Prim school 2.From Glen view 3 Prim to New G-view 7	to Amalinda & Old Glen- 1.Glen-view 1 Prim school view 7 2.01d Glen view 7	New Glen- view 7. (Behind Glen Norah Police Station)	---------- -
GREENDALE Ward 9 AAE 9078	Area bounded S.Machel, Rhodesville Ave, Coronation Ave &Acturus Rd	Area bounded by Eastern Rd , North Rd , Queen Elizabeth Ave, Acturus Rd	Area bounded by Harare Dr, Enterprise Rd, Beeston Pringle Rd, and Ave, Mandara shops, Donnybrooke houses	Area bounded Mutare Rd , Coronation Ave, Kennedy Dr&Harare Dr	Chikurubi Prison Complex, Chikurubi Support Unit and Manressa New Houses	----------	---------- -
HATCLIFFE Ward 42 AAE 5714	Area bounded by Scamway Rd, 1stSt, 13thSt, 25thSt and 36thSt incl Clinic	Area bounded by 15 St , Scamway Rd& Kuyanana Rd incl Hatcliffe High 1	Area bounded by Scamway Rd , 15St, Kuyanana Rd and Domboshawa Rd .ie	Area bounded by 15St, Kuyanana Rd& Domboshawa Rd i.e Zvakatanga Sekuseka, Kukura Kuroja, Mt-	----------	----------	---------- -

			Harare North Co-op	Pleasant and Mufaro Housing Co-ops			
HATFIELD Ward 22 AAE 5762	Msasa Park – Part A Area to the North of Msasa Dr	Msasa Park -Part B Area to the South of Msasa Drive up to Homestead	Chadcombe, Park Meadowlands and area bounded by Chiremba Rd, George Rd, and Twentydales, Kilwinning and Twentydales 2	Logan Park and area bounded by George Rd, Harare Dr, Twetydales 2, Kilwinning and Twentydales	1.Manyame Airbase 2.Area bounded by CranborneRd,Ceres Rd,Southway Rd & Seke Rd	----------	----------
HIGHFIELD 'A' Wad 25 AAE 9072	Old Cannan between Mangwende Drive West & Jabavu Dr to Red Cross & Mbizi School	Engineering from Main St robots to 77th St, New Cannan to ward25 offices, Jabavu Dr	Jerusalem and Egypt Lines	199thSt, Engineering up to Lusaka lines	199'" st up to Zororo and Western Triangle new houses	----------	----------

Main Area	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday	Sunday
Highfield B Ward 26 AAE 7876	Old Highfield, New Stands and Flats, old ZRP camp to Chinyaradzo, New Stands and St Lewis to PWD compound incl Messengers camp	New Cannan bounded by Jabavu Dr, Main St, Old Highfield, Stones area up to Chipembere school and BP Services Station	Cherima and Geneva, Cannnan bounded by 216thSt and 210thSt	Paradise Park, Suger refinery houses, Glennorah C ext	New Cannan bounded by Mangwende Dr and 216thSt, Willowvale flats	-	-
Highlands Ward 8 AAE 9059	Area bounded by Enterprise Rd, Glenara ave West, Boundary Rd, Connaught ave icnl Newlands Shops	Area bounded by Enterprise Rd, Glenara ave East, S Mache lave, Rhodesville ave, Wingate Rd Alexander Rd up to Acturus Rd incl Glenroy Shops	Area bounded by Enterprise Rd, Ridgeway North, Northend Rd, Orange Grove, Highlands D.O offices	Area bounded by Enterprise Rd, Harare Dr, Rolf ave Addington lane Ridgeway North incl Ballantyne shops	Area bounded by Enterprise Rd, Harare Dr, North Rd, Acturus Rd incl Chisipite shops	-	-
Industrial Areas AAE 7830	Msasa	Workington	Southerton and Ardbennie	Graniteside	willowvale	-	-
Kambuzuma Ward 13 AAE 5701	1 Sectio 1 and 2 2 Westwood	Section 3 & 4	Section 5 & 6	Cold comfort	1 Matidoda and Nkwisi Garderns 2 Tynwald plots	-	-
Kuwadzana A Ward 44 AAE 9073	Kuwadzana 1	Kuwadzana 2	Kuwadzana 3	Kuwadzana 4 and Part of Kuwadzana	Crowbrough North Phase 1 and 2		
Kuwadzana B Ward 37 AAE 5758	Kuwadzana 5	Kuwadzana 6 and 7	Kuwadzana ext Eastern side	Kuwadzana Ext Western side, Bulawayo Rd up to K 8 School	Kuwadzana ext western side, Sub D O Rd up to New Houses.		
Mabelreign ward 16 AAE 9076	1 Old Bluffhill area between Lomagundi Rd ,Harare Dr Lorraine Dr 2 Sentosa incl Zambezi flats	Greencroft area bounded by Hallingbury Rd, Stoney Rd, Suffolk Rd	Areas bounded by Girton Rd, Lomagundi Rd, Sherwood Dr, Warbury Albury,	Cotswold area bounded by stanstead, Harare Dr, Clavering, Sherwood Dr,	Ashdown Park	Haig Park, St AndrewsPark Meyrick	

		Lomagundi Rd Bloomingdale	Pardon and Hallingbury	Hilmorton, Queendon and Stortford Parade		Park	
Mabvuku Ward 19 AAE 5761	Area bounded by Mutare Rd, Donnybroke, Chizhanje Rd, Mabvuku Dr icl Makuwarara Shopping Centre	Area Bounded by Chizhanje Rd, Mabvuku way, Tafara way incl Simudzayi Prim school	Area bounded by Mabvuku Dr, Donnybroke Rd, Manressa Rd, Jonny Tapedza Stincl Mabvuku Police station	Area bounded by Mabviku Dr, Jonny Tapedza St and Manressa	Area bounded by Manressa Rd, Tafara way incl Kamunhu shoping centre, Clinic and Tashinga Prim School	-	-
Marlborough Ward 41 AAE 5708	Area bounded by 2ndSt, Ext Lomagundi Rd Avonlea Dr and The Chase	Area bounded 2ndSt Harare Dr, Lomagundi Rd, Avonlea Dr and the Chase	Area bounded by 2ndSt Ext Harare Dr Gilchrist Rd Henry De Chem Adylin Rd, Elizabeth Windsor Rd Mapereke Dr Manyuchi Ave, Old Mazoe Rd, Adylinn, Petersham	Area bounded by Churchill Dr Elizabeth, Windsor Rd Mapereke Dr, Manyuchi ave Old Mazoe Rd Adylinn Petersham	Goodhope surburb, Area bounded by Lomagundi Dr Goodhope Badza Surburb and Old MazoeRd		

Main Area	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday	Sunday
Mbare Ward 12 AAE	Area bounded by Remembrance Dr. Cameroon St, Harare North St, Waterfalls Ave and Boshoff Dr, Joburg Lines, Annex Flax, Marowa Shops	Area bounded by S.Mazorodze, Remembrance Dr, Ardbennie Rd, Pazarangu, Mhlanga Rd, Daniel Rdincl Tagarika flats	Area bounded by . Mazorodze Rd, Ardbennie Rd, Waterfalls Ave Mhlanga Rd	Area bounded by Remembrance dr. Cameroon St, Harare North St, Waterfalls Ave & Boshoff Dr, Joburg lines, Annex Flats , Marowa shops	Area bounded by S. Mazorodze Remembrance Dr, Ardbennie Rd, Pazarangu MhlangaRd, Daniel Rdincl Tagarika flats	Area bounded by S. Mazorodze Remembrance Rd, Ardbennie Rd, Waterfalls Ave Mhlanga Rd.	……. .
MtPleasant Ward 17 AAE 9077	Area bounded by UZ Pendennis & Bargate	Area bounded by 2ndSt Ext, Upper East & Norfolk	Area bounded by Norfolk 2nd St Ext , Harare fairway	Vainona Area bounded by Bargate, Harare Dr, Campbell & Glenelg	Manzil &Mt Pleasant	University Canteens and Staff Houses	…… …
Mufakose Ward 35 AAE 5765	Area bounded by Crowborough Way Monde & Mutamba Rd	Area bounded by Mutamba Rd, Muonde Rd, Mhishi Shops &area up to railway line	i.Old & New Marimba Park ii.Area bounded by Sekerani car park, Mupani Rd, Donhodzo Rd& Mufakose 1 High	Mupani Rd to Crowborough Rd, Murara Ave, MukonoRd, Ok Shops, Chitororo Rd,	i.Area bounded by Mupani Rd, Muriranyenze Rd, Mukonde Rd& Mukonono Rd ii.Mufakose flats	……..	…….. .
Southerton Ward 14 AAE 7859	Rugare	Southerton	Lochinvar	Aspindale Industry	Crowborough Phase 3	……..	…… …
Sunningdale Ward 10 AAE 7860	Sunningdale 1	Sunnigdale 2	Sunningdale 3	Area to the South of Runyararo grd, National up to S. Mazorodze Rd	……..	……	…… …
Tafara Ward 20 AAE 5766	Area bounded by Tafara way, Chizhanje Rd, Tafara H/way incl Tafara Hall, Tsinhirano Primary school	Area bounded by Tafara way and Nhundurwa St incl Tafara 5 primary	Area bounded by Tafara way and Dindindi St Incl Tafara 1 Primary and Old Tafara Shopping Centre	i.Area bounded by Mkuchindwe Rd, Sinini St , Nhedzi St&Acturus Rd ii.Lafarge complex & compound	……..	……	…… …

Warren Park Ward 15 AAE 9090	Area bounded by Bulawayo Rd, Heroes Acre, Warren Park Home Industry &Kambuzuma Rd	Area bounded by Kambuzuma Rd, 3rdAve up to Warren Park 2 Police Station	1.Area bounded by Kambuzuma Rd, 3rdAve, Bulawaoyo Rdonto Warren Park PTC Exchange 2.Area bounded by 1st Avenue and 1stCrescent(West of police station)	Warren park D. Area from Bulawayo Rd up to 123rd Street	1.Warren Park D Area from 123rd Street up to railway line 95th Street up to railway line – 95thStreet 2.Weastlea – Area bounded by Golden Quarry Rd , Bulawayo Rd, Kirkman Rd &the Vlei	Westlea- Area bounded by the Vlei, Bulawayo Rd, Kirkman Rd and Tynwald Rd	……..
Waterfalls Wards 23 AAE 9058	Houghton Park and Ardbennie residential	Parktown & Shortstone area Picnic area	Mainway Meadows up to Second gate	Mainway Meadows from second gate to Main gate	Uplands, Cheviot Derbyshire, Amazvimbakupa / Boka Adelaide	Prospect flats & Hopely Township	……
Westgate AAE 575	……..	…….	Westgate	Westgate	----------	----------	----------

Appendix Seven

Chie-Square Test Table

Chi-Square Test for Household size and Waste Type

		Types of Waste						
Number of People per Household		**No Response**	**Food Leftovers**	**Electronic Waste**	**Paper**	**Textile**	**Grass or leaves**	**Total**
1 -3	0	7	1	1	3	0	1	13
4 - 6	0	18	5	0	9	1	0	33
7 - 9	0	12	7	1	15	2	0	37
12 -10	0	14	3	0	24	1	0	42
Total	184	54	16	2	53	4	1	316

Households were grouped into ranges with numbers for example 1-3, 4-6, 7-9 and 10-12

	Value	**Df**	**Asymp.Sig.(2-sided)**
Pearson Chi-square	3.821E2a	30	0.000
Likelihood Ratio	451.503	30	0.000
N valid Cases	316		

a. 28 cells (66.7%) have expected count less than 5. The minimum expected count is .02.

Chi-Square Test of Waste and Residential Types

	Types of Waste Generation						
Residential Type	**No Response**	**Food Leftovers**	**Paper**	**Metals**	**Clothing**	**All**	**Total**
1 (Low Density)	2	5	6	0	0	31	50
2 (High Density)	7	16	3	3	1	45	80
Total	9	21	9	3	1	76	130

	Value	**df**	**Asymp.Sig.(2-sided)**
Pearson Chi-square	9.809a	6	0.133
Likelihood Ratio	11.265	6	0.081
N valid Cases	130		

a. 7 cells (50.5%) have expected count less than 5. The minimum expected count is .38.

Appendix Eight

Permission Letter to City Council

8847 Glen Norah C Extension

Harare

The Director

Harare City Council Waste Management Department

Harare

Ref: Application for Permission to undertake a research in your area of jurisdiction

I am a man aged 35 and I am studying towards a Masters in Environmental Management with the University of South Africa (UNISA). My research topic is:

An Investigation into the effectiveness of household solid waste management strategies in Harare, Zimbabwe

The areas that will be covered are: Mbare, Highfield, Budiriro, Gunhill, Borrowdale Brooke, Mandara, Waterfalls, Westlea and Milton Park. In the data collection process, I will observe the surroundings, administer questionnaires to a number of statistically selected residents in those areas, and interact with members of your staff to gather information for use in this study. I will also be taking photographs on issues that are in line with waste within your area of jurisdiction. Permission is also sort to follow your waste collection crew to establish certain issues on waste collection.

The Information that I will get will be used for the sole purpose of attaining the above named academic qualification. It will not be published or made known to anyone except to the institution and my research assistants.

It is my hope that you will permit me to undertake the study.

Yours Faithfully

Benjamin Mandevere

(UNISA: 51356244)

0773235572 / 0712351081

Appendix Nine

Permission letter to Ministries

NB This letter was copied to various ministries and departments in Table 3.2

8847 Glen Norah C Extension

Harare

Zimbabwe

The Permanent Secretary

Ministry of Environment Climate and Water

Harare

Ref: Application for Permission to interview your staff to gather information for academic use

I am a man aged 35 and I am studying towards a Masters in Environmental Management with the University of South Africa (UNISA). My dissertation topic is: **An Investigation into the effectiveness of household solid waste management strategies in Harare, Zimbabwe** I would like to interview some of your staff members so that I can gather information on the above topic. The Information will not be published or made known to anyone except to the institution and my research assistants.

The areas that will be covered are: Mbare, Highfield, Budiriro, Gunhill, Borrowdale Brooke, Mandara, Waterfall, Westlea and Milton Park.

It is my hope that you will permit me to interact with members of your staff to gather information for use in this study.

Yours Faithfully

Benjamin Mandevere

(UNISA: 51356244)

0773235572 / 0712351081

Appendix Ten

Focus Group Discussion Guide

An Investigation into the effectiveness of household solid waste management strategies in Harare, Zimbabwe

Dear Group

I kindly ask you to assist me by discussing the best and available options for effectively and efficiently ensuring that Harare's waste management strategies are fully implemented for the benefit of the city's household solid waste management. Please be assured that your responses will be strictly confidential and will be used for the sole purpose of pursuing academic interest.

All discussions should be done through the chair and also note that discussions will be recorded so as to capture all the relevant information to be discussed.

1. Is the city of Harare doing anything significant in managing household solid waste?
2. In your opinion, which factors hinder the city from doing proper household solid waste management?
3. What do you think can be done to ensure that there is proper waste management in Harare?
4. Do you recommend any other strategies for the city of Harare?

Ask for anything important, group members might want to discuss:

If any, allocate time for further discussion and then thank the group and close the discussion.