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ASSESSING THE EFFICACY OF WASTE MANAGEMENT INITIATIVES ON PUBLIC HEALTH AND SANITATION. A CASE OF HATCLIFFE, HARARE NORTH, ZIMBABWE

BY

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APPROVAL FORM

I supervised Rutendo L Muringani in carrying out this research entitled "Assessing the efficacy of waste management initiatives on public health and sanitation. A case of Hatcliffe, Harare North, Zimbabwe", in partial fulfillment of the requirements of Bachelor of Science Honours Degree in Development Studies and recommend that it can proceed for examination.

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Declaration

I, Rutendo Lissa Muringani, (B220749B), affirm that the dissertation entitled "Assessing the efficacy of waste management initiatives on public health and sanitation. A case of Hatcliffe, Harare North, Zimbabwe" is entirely my own work. This research has not been presented for any other academic award. All materials from other sources have been duly referenced and credited.



Student`s signature: ……. Date: 21/05/2026

Dedication

In honour of my parents, I am thankful for all the sacrifices you made to support my journey.

ACKNOWLEDGEMENTS

I would like to express my sincere gratitude and appreciation to my supervisor Dr. Musarandega for his exceptional guidance, invaluable expertise, support and unwavering assistance which have significantly contributed to my personal and professional growth. My heartfelt appreciation also goes to my family and colleagues for their unwavering support and encouragement. Finally I would like to thank God for guiding me through all the difficulties. Without his blessings, I would not have accomplished anything.

Abstract

The effectiveness of waste management programs on public health and sanitation in Hatcliffe, Harare North District, Zimbabwe, was evaluated in this study. The specific objectives of this study were, to identify the current waste management practices in Hatcliffe, to analyse community`s perceptions of waste management on public health and sanitation, to assess the implications of waste management services on public health and to propose sustainable strategies for waste management initiatives. The study used a mixed-methods case study design to gather data from residents chosen through stratified random sampling using structured questionnaires, observational checklists and secondary data analysis. Due to infrequent municipal waste collection and restricted access to legal disposal facilities, the results showed that the majority of households relied on unsafe and informal waste disposal methods, especially open burning and illegal dumping Through questionnaire data and field observations the study further identified a significant gap between existing waste management policies and their implementation at community level, as evidenced by widespread illegal dumping and absent of municipal clean-up initiatives. Residents` skin infections, respiratory issues and diarrhea have all been linked to poor waste disposal practices .The study area`s environmentally suitable landfill siting locations were found through spatial suitability analysis using Geographical Information Systems(GIS) in conjunction with the Analytical Hierarchy Process, offering a workable framework for sustainable waste management planning. The study concludes that improving waste collection frequency, increasing access to proper waste disposal infrastructure and strengthening community awareness programmes are essential in reducing environmental health risks while , improving public health and sanitation conditions in Hatcliffe.

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List of Acronyms

WHO	*World Health Organisation*
ST	*Systems Theory*
UN	*United Nations*
AHP	*Analytical Hierarchy Process*
EMA	*Environmental Management Agency*
GIS	*Geographic Information Systems*
CR	*Consistency Ratio*
CI	*Consistency Index*
HIA	*Health Impact Assessment*
ISWM	*Integrated Solid Waste Management*
LFA	*Logical Framework Approach*

CHAPTER 1: INTRODUCTION OF THE STUDY

1.1 Introduction

The background of the study, problem statement, the main aim and objectives of the research, research questions, justification of the study, definition of key terms, organisational structure and the chapter summary are the main topics of this chapter.

1.2 Background of the study

A major worldwide threat to sanitation and public health is inadequate waste management, especially within the rapidly expanding urban centres of developing nations (Maalouf & Mavropoulos, 2023). According to Mihai et al. (2022), this is a huge problem, affecting an estimated 2 billion people nationwide lack adequate garbage collection services. This leads to increased refuse accumulation in public open spaces and waterways (Ozoh et al., 2021). The World Health Organisation (WHO) has highlighted the importance of appropriate waste management in reducing the spread of diseases and promoting public health (WHO, 2018). Globally, inadequate waste management infrastructure has negative consequences, such as environmental degradation, increased health risks (Abubakar et al., 2022) and decreased quality of life for residents (Ifyalem & Mater, 2023). Therefore, this clearly shows that inadequate waste disposal practices are exacerbated because of fast urbanisation, population expansion and inadequate resources, which strain existing waste management systems.

The African continent is particularly affected by this worldwide issue, as many countries find it difficult to manage the strain of fast urbanisation and population growth (Echendu & Okafor, 2021). The UN estimated that Africa is expected to have the fastest population growth in the world, with half of its people living in cities by 2050 (Echendu & Okafor, 2021). This leads to lack of effective waste management infrastructure, which is a significant concern as many urban areas lack access to proper waste collection services (Carlos-Alberola et al., 2021). According to the African Development Bank, the continent generates approximately 174 million tons of waste annually, this amount is predicted to increase significantly in the coming years, reaching 269 million tons by 2030 (Adedara et al., 2023). The consequences of the systemic failure at hand is manifested in urban communities across Africa, where the absence of reliable services creates

severe health, environmental hazards and decreased economic productivity (Adedara et al., 2023; Omokaro et al., 2024). Thus, the African continent requires a comprehensive strategy to mitigate the waste management challenges.

Waste management issues are severe across the Southern African Development Community (SADC) region, which includes Zimbabwe (Brighton et al., 2024). Inappropriate garbage collection and disposal means is caused by the region`s rapid urbanisation and population expansion (Chisholm et al., 2021). According to Gizalew et al. (2021) many SADC nations lack effective waste management system resulting in significant health risks to the people. In light of this, it is clear that in order to preserve public health, safeguard the surroundings and advance environmentally friendly developments in the SADC region, efficient waste management is essential.

Zimbabwe is a Southern African nation that is recently facing a challenge of inadequate waste management (Nyarai et al., 2016). The pressure of rapid informal settlements and population growth has significantly outpaced the development (Marange et al., 2023) and maintenance of essential waste handling infrastructure. In Zimbabwe, the lack of effective garbage management has a number of negative effects on standards of living, health risks and environmental degradation. (Nhubu et al., 2021) .The country`s urban areas especially the Harare Metropolitan face serious waste management challenges due to inadequate infrastructure, limited resources and weak leadership (Masimba et al., 2024). According to Poshai & Intauno (2024). These persistence challenges highlight the pressures facing Zimbabwe`s urban areas in managing waste thereby, providing important context for examining community-level practices and outcomes in high density areas.

Narrowing the focus, Hatcliffe community of Harare North is a prime example of the local effects of this this national and international challenge. With a population exceeding 5 000 people producing an estimated 0.05 kg of waste per person daily (Foya, 2022), the community experiences significant sanitation challenges associated with lack of consistent and reliable waste collection systems (Poshai & Intauno, 2024). In response to this residents adopted informal disposal methods, including open dumping on roadsides or on open spaces and burning which contaminate the local environment (Chikowore, 2020). According to Nhubu et al. (2021) this

waste often finds its way into waterways and contaminates the water. The situation in Hatcliffe reflects broader waste management challenges observed in Zimbabwe and other African countries as supported by Chireshe et al. (2023).Therefore, the current waste management systems are under pressure due to inadequate waste management practices that are made worse by fast urbanisation, population growth and resource constrains.

1.3 Problem statement

The Hatcliffe community in Harare North, Zimbabwe, experiences widespread waste management initiatives by various stakeholder groups, all with a view to ridding the community of its waste (Foya, 2022). There are efforts to adhere to national regulations that were put in place by the Zimbabwean government. Environmental players like Environmental Management Agency (EMA) do regulates waste management through various statutory instruments which are derived from Environmental Management Act [Chapter 20.27] including Environmental Management (hazardous refuse management) regulations, Environmental Management (Importation and Transit of Hazardous Substances and Waste) regulations (Foya, 2022). The City of Harare also has its own waste management regulations intended to proper refuse handling through Integrated Solid Waste Management Plan (Masimba et al., 2024). Members of the Community in Hatcliffe participate in various ways to strengthen the waste management efforts. Despite the existence of these efforts by various stakeholders, there is a gap between waste management initiatives and the public health and sanitation status of Hatcliffe. Therefore, in order to close this gap, this study looks at how waste management initiatives relate to the existing public health and sanitation scenario in Hatcliffe thereby, providing practical community-level evidence to inform sustainable interventions that improve local waste management outcomes.

1.4 Main research objective

This study aims to investigate the intricacies related to solid waste management initiatives on public health and sanitation standards in the Hatcliffe community, and to propose sustainable strategies of waste management initiatives.

1.5 Sub research objectives

i. To reveal the current solid waste management practices in Hatcliffe.

ii. To analyse the community's perceptions of waste management services and health effects.
iii. To assess the implications of waste management on public health and sanitation.
iv. To suggest sustainable strategies for waste management projects.

1.6 Research questions

i. What are the current solid waste management practices in Hatcliffe?
ii. How do Hatcliffe residents perceive solid waste management services and their effects on public and sanitation?
iii. What are the public health challenges of waste management in the Hatcliffe community?
iv. What possible strategies can be imposed to promote sustainable waste management?

1.7 Justification of the study

The study is crucial for various stakeholders like policy makers, government agencies, local communities and the academic community. Through examining the effects of inadequate solid waste management on human health and sanitation standards in the Hatcliffe community, this study will produce evidence-based data that can guide the creation of effective waste management policies and public health interventions

Policymakers will gain crucial information as the study intend to assess the effects of inadequate refuse handling, community leaders can make informed decisions regarding waste disposal and public health initiatives. Consequently, it will provide critical data that can enhance sanitation practices and improve overall community health. Thus, findings will equip local authorities with reliable information on waste management conditions, enabling them to offer better support and guidance to Hatcliffe and other Harare city suburbs using this as a reference. The police makers will also use the information to make informed decisions aligned to the research and will be capable of making frameworks that guide the residents to manage the environment in a more sustainable way.

More so, based on particular community needs, environmentalists can create focused recommendations and interventions. In order to improve public health outcomes, local leaders should be empowered to monitor and manage waste management issues. Moreover, for environmental health practitioners, this research serves as a practical application of theoretical knowledge in assessing refuse handling consequences across urban settings. Environmentalists

can be able to see whether the already imposed frameworks and regulations are working in an efficient way. Thus, if the regulations are not being implemented well they will be able to come up with amendments so that they will increase the efficiency of the regulations for the targeted groups.

Furthermore, the study is crucial to public health researchers, as it outlines methodologies to effectively address waste management issues without compromising community health. As a result, the outcomes inspire further research into innovative solutions for managing waste and its impacts on public health. Thus, researchers will gain a platform to integrate different modern technologies to monitor and manage urban environmental health, refuse handling, in promotion of Sustainable Development Goals (SDGs), to understand complex relationships

This research is also important for local government organisations as it provides insights into community health challenges linked to waste management. For example, the City of Harare and the Environmental Management Agency (EMA) collect data on waste disposal practices can inform policy-making aimed at enhancing sanitation and public health initiatives. Thus, it offers a framework for implementing strategies focusing on sustainable waste management practices and community health improvement.

Hatcliffe as a community gains knowledge that enlightens residents about the medical challenges linked to inadequate waste control initiatives. That is the study promotes awareness by fostering community-led initiatives and encouragement for future waste management programs. This research is of paramount importance to the community people as it sheds more light on the impacts or consequences of improper garbage control as it affects their health and wellbeing. Henceforth, this promotes positive environmental health through more effective waste management systems and effective collaboration.

1.8 Definition of key terms

Solid Waste Management- the entire procedure for gathering, moving, processing and disposing of solid waste. This encompasses all activities aimed at effectively handling waste generated

from households, businesses and institutions to minimize human health challenges and environmental degradation (Carlos-Alberola et al., 2021).

Sanitation- gathering, removing and discarding human excrement, solid waste and used water. Promoting community health by preventing the spread of disease and maintaining hygienic living conditions through effective infrastructure and behaviours is the intended goal (Poshai & Intauno, 2024).

Public Health- scientific discipline aimed at protecting while improving health of populations through education, policymaking and research. It involves strategies for disease prevention, health promotion, and injury reduction to enhance the well-being of communities and individuals (*WORLD HEALTH ORGANIZATION*, 2018)

Informal settlements- urban built-up areas that arise outside of official land development and planning systems, mostly in peri- urban or central urban areas. They are developed without planning permissions and structures often do not comply with formal building standards (Atkinson, 2024)

Waste management initiatives- integrated systems and policy actions designed to reduce refuse production while, ensuring environmentally responsible refuse disposal and treatment (Rayfuse et al., 2023). United Nations Environmental Program further defined it as strategic interventions that promote sustainable consumption, waste prevention, resource recovery, and environmentally sound management of solid waste (Oral, 2023).

Communicable diseases- illnesses brought on by infectious agents that can be spread between people directly or indirectly or through environmental pathways such as contaminated water, food, air, or vectors, particularly in communities characterised by inadequate sanitation and inefficient refuse handling, as postulated by WHO (2024).

Disease prevalence- the total number of individuals in a population who have a particular disease at a specified time, indicating the overall burden of a disease within the community as noted by Fitzpatrick et al. (2017).

Stakeholders- people, organisations or groups that are impacted by the choices, deeds and results of project, policy or systems. This includes people or institutions that have interests, rights, responsibilities or power in the issue being addressed (Oluwagbayide et al., 2024).

Systems theory- an interdisciplinary framework that views phenomena as intertwined components that are made up of complex systems that work together to form a whole. It emphasises that analysing the entire system`s behaviour cannot be clearly understood when they parts are separately analysed, because the parts interact and influence one another, as highlighted by Rhodes (2011)

1.9 Organisation of the study

The study will highlight the background of the study, the problem statement, main aim, research objectives and questions, defining key terms, the study`s organisational structure and summary in the first chapter. Moving on to the second chapter, several theories are going to be used to reveal the relevant literature used in conducting the research. The third chapter is going to show the research design, the data collection procedure and data analysis. Proceeding to next section, where the data on the mitigation solutions are going to be interpreted and the results are discussed. Lastly, in Chapter 5, there are the recommendations and the conclusion as highlighted in the figure 1.



Figure 1: *Organisation of the study*

1.10 Chapter conclusion

In conclusion, the research explores the effects of inadequate refuse handling on community health and sanitation within Hatcliffe, Harare North, Zimbabwe. The area has fast expansion and inadequate resources resulting in unsafe waste disposal practices. The problem of the research is based on examining gap between waste management policy provisions and what is observed at community level. The goal of this study is to investigate effects of poor refuse handling on public health and sanitation with a view of proposing mitigation strategies to the problem. The study is justified by its potential to inform important stakeholders like community members, policymakers, the academia, environmentalists and the government so that there can be improvements in the community`s living conditions and a reduction in health risks in Hatcliffe.

CHAPTER TWO: LITERATURE REVIEW

2.1 Introduction

This section examines the literature on the evaluation of subpar waste management techniques and their impacts on sanitation and public health in Hatcliffe community, Harare North, Zimbabwe. The chapter starts by providing the theoretical framework that underpins the topic, the concepts that build the main theory, followed by themes of current waste management in Zimbabwe, case studies of waste management in urban areas, health effects of poor refuse handling techniques, and monitoring and evaluation of waste management practices. It identifies the research gap.

2.2 Theoretical conceptualisation

2.2.1 Systems theory

This research is guided by the Systems Theory (ST), which was pioneered by Ludwig von Bertalanffy in 1968 (Kristof & Vladislav, 2019). The theory views society as a set of connected parts that depend on one another for proper functioning (Rhodes, 2011), meaning if one part of the system fails, it affects all others. In relation to the study, systems theory helps one to view waste management, public health and the community`s perceptions as a connected web whereby the failure of one-part triggers consequences on the other. ST has become more relevant as environmental disasters, poor urbanisation systems and public health challenges continue to spread internationally. (Hiver et al., 2022; Katrakazas et al., 2020) Heavily supported by showing that recent public health policies are relying on systems thinking to make a better understanding on how environmental hazards impact public health outcomes. Therefore, this global view helps one to clearly identify the current waste management practices by showing that these practices cannot be studied in isolation in order to produce robust mitigation programs.

In African context, ST is of paramount importance as it shows that waste management problems are interconnected to other systems (Mensah et al., 2018). The current waste mismanagement practices are due to rapid informal urbanization while there is limited health infrastructure to help the affected population. Africa’s major cities Lagos and Nairobi show that people face difficulties pertaining their trash handling, resulting in strained health facilities (Andersen et al.,

2021). According to Kitole et al. (2024) this situation has culminated to increased pollution in many water sources and weakened trust between the community members and local authorities. Therefore, this further exacerbates the prevalence levels of poor waste management related illnesses. Taking note of Nairobi`s informal settlements clearly evidenced poor coordination between the main stakeholders like waste collectors and residents may lead to increased disease outbreaks (Andersen et al., 2021). Henceforth, the systems theory clearly shows the reason why community`s views and health are shaped by people`s living conditions, while highlighting that when one part of the community is affected, other systems are also affected.

Furthermore, Zimbabwe has been facing waste management challenges, especially in the cities of Harare and Bulawayo, where growing populations make waste management even more challenging (Poshai & Intauno, 2024). There is an increased disease prevalence due to garbage piles in streets affecting neighborhoods and local businesses suffering as dirty areas are avoided (Sani & Zimucha, 2022). This can be clearly evidenced in places like Mbare Musika and Magaba areas in Harare, where poor waste management affects market activities, food safety and people's daily livelihoods (Masimba et al., 2024). However, this argument is limited because Mbare and Magaba are central markets, not isolated settlements. All in all disease outbreaks emerge from a network of interconnected failures thereby highlighting the need of improved sustainable mitigation strategies

Bringing the focus to the Hatcliffe community, systems theory is very crucial because the area operates just like a small interconnected system (Grewatsch et al., 2023). Theoretically, there is a connection between these rapidly expanding settlements and their environmental management challenges which cannot be separated from population growth, community behaviour and socio-economic conditions (Brooks et al., 2019). For example, if the waste is not properly disposed of, the problem will affect drainage lines, open spaces or even nearby markets, thereby resulting in increased spread of diseases and low safety conditions on food sold in the available markets, since there will be an increased breeding of rodents and flies as supported by Gizalew et al. (2021). Therefore, the systems theory provides a more realistic way of understanding the study area`s current waste handling challenges as a wider network of community, environmental and health interactions.

Moreover, systems theory argues that improving waste management can be achieved by improving combined efforts among different actors like local authorities, residents, private partners, environmental agencies and health practitioners (Katrakazas et al., 2020). This ensures a complete sustainable waste management system and restores balance in the system (Mahajan, 2023). This framework helps to understand how failures in one part of the waste management system create negative implications on other parts like health and sanitation (Poshai & Intauno, 2024). Therefore, this is clearly shown in Figure 2 as it illustrates how one affected system can impact other systems in a community thus requiring a comprehensive approach to promote clean and sustainable cities.

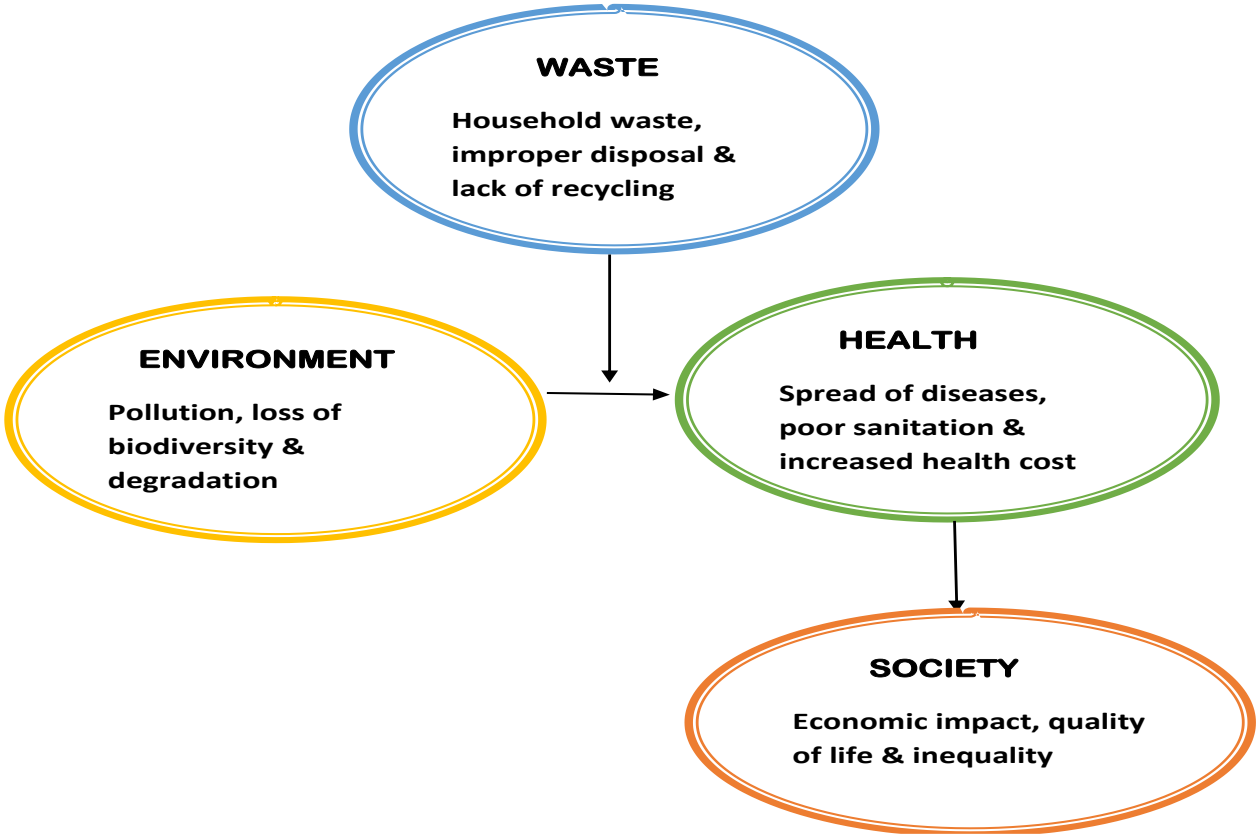


Figure 2: *Systems theory showing interaction between waste, environment, health and society Source[(adapted from Von Bertalenfy, 1968, as cited in Oluwagbayide et al., 2024, p. 19-34)]*.

2.3 Concepts that support the systems theory

The interconnectedness concept articulates that all the components of the system are inseparable and each one is controlled by the other, as noted by Grewatsch et al., (2023). For example, improper waste disposal may result in unsanitary conditions, which directly impact public health, thereby affecting the quality of life. There is an increased prevalence rate of communicable diseases in societies where waste is not properly handled, increasing the economic burdens as people face increased health care costs while reducing life expectancy (Oluwagbayide et al., 2024). These connections help stakeholders to monitor and manage waste while enhancing public health outcomes, as supported by Chikowore (2020). However, this concept can be difficult to operate effectively as limited education and poverty hinders community`s knowledge pertaining to health impacts related to waste mismanagement.

In addition, another concept is feedback loops, which demonstrate how systems run through the interaction of various systems. Researchers, Nelson et al. (2021) & Kitole et al. (2024) noted that there can be a positive feedback whereby the community engages proper waste disposal systems which in turn improve the health outcomes as stakeholders enlighten each other on improved hygiene and sanitation practices. When residents focus on reduced prevalence of diseases due to improved waste handling practices, they may be interested in participating in community-based clean-up initiatives. On the other side there can be negative feedback loops whereby persistence of inadequate refuse handling leads to exacerbated health crisis (Kitole et al., 2024). These feedback mechanisms are essential as they help to identify the effectiveness of some community interventions which reduces negative cycles and promotes positive health thereby improving sanitation outcomes as supported by Venkataramanan et al. (2018). However, there can be cooperation withdrawals and a complete loss of hope from waste management efforts by the community members due to the reliance on feedback loops which can sometimes be problematic.

Emergence can be viewed as implications between the interactions and relationships of the components within the system which cannot be predicted by examining the behavior of a component in isolation as noted by Artime and De Domenico (2022). In this case, when Hatcliffe residents cooperate in response to inadequate waste management that may result in

emergent public health situations like increased prevalence of communicable diseases (Ziraba et al., 2016). For example, if waste piles up in public spaces, it may lead to an increase in vector populations like mosquitoes, leading to malaria outbreaks. When emergent properties are recognised that will give stakeholders a leeway to come up with potential public health strategies while designing possible interventions to solve the source of the health problems (Katrakazas et al., 2020). Moreover, it can be difficult to apply generalised solutions to emergent properties as they vary widely among different communities as stipulated by Nelson et al. (2021). However, the fact that emergent properties cannot be predicted may pose difficulties in planning and intervention, while policy makers may struggle to anticipate the implications of waste mismanagement practices which may result in reactive rather than proactive measures.

2.4 Definition and scope of waste

Gizalew et al. (2021) described waste as any item that is thrown away after used primarily material that is discarded after primary use because it is undesired or unusable. The definition reflects the process that is relatively linked to the patterns of production and consumption within the community between the transitions of materials from utility to the disposal process. Solid waste was further defined by World Health Organisation (WHO) as undesired and unwanted items produced by residential areas, street cleaning and business and agricultural activities that result from mass activities (WHO, 2018).Therefore, these definitions clearly show that garbage is not only an outcome of domestic life but the reflection of urban expansion, demographic growth and socio-economic transformation.

Poshai & Intauno (2024) highlighted that rapid urbanisation and industrialisation have increased production and consumption processes, resulting in the generation of waste from a variety of sectors, including agricultural, domestic, community activities and industrial. Expanding urban populations usually consume more processed foods, packaged goods and disposable products (Kumari & Raghubanshi, 2023). In most cases, the agricultural and industrial sectors produce more hazardous waste as they usually use chemicals, when these chemicals expire or are disposed in an unsustainable manner, which will affect the environmental efforts practiced by different stakeholders to reduce illegal waste disposal (Ziraba et al., 2016). These actions further increase percentage of non-biodegradable products like plastics and metals. Therefore, municipal

waste streams become more diverse and difficult to handle due to intensified economic activities across different sectors.

These wastes build up and typically have detrimental effects on public health and the environment (Foya, 2022). The dominant type of waste in the area of study is household waste, which includes food leftovers, vegetable peeling, paper, plastics and tins (Ziraba et al., 2016). Some households often generate small quantities of hazardous waste like expired medications, batteries and sanitary products which are frequently disposed of in public spaces (Jerie et al., 2024).Despite the fact that the hazardous household waste can be produced in smaller quantities, they cause serious environmental and health concerns if disposed ,while mixed with general refuse (Gautam et al., 2024). In order to identify the current waste management practices in Hatcliffe, it is crucial to comprehend the types of waste produced. Thus, Figure 3 clearly illustrates the classification of household waste in high-density areas.



Figure 3: *Household waste categorisation. [Source: Sultana et al., (2023) p. 3].*

2.5 Waste management as a concept

Waste management is the systematic procedure of waste handling from the generation stage to elimination stage (Chireshe et al., 2023). Waste management involves different activities such as waste gathering, logistics, treatment, recycling and final disposal. The concept of refuse handling also highlights reduction of refuse production, while enhancing reuse and recycling practices (Oluwagbayide et al., 2024). Sustainable waste management involves different stakeholders, like households, local authorities, private companies and community groups, which is important in ensuring that garbage is handled responsibly (Pluchinotta et al., 2022). Therefore, this clearly shows that waste management as a concept provides a structured approach of waste handling that supports both environmental conservation and public health and sanitation.

Waste management also involves the policies, systems and strategies used to control how waste is handled within a society (Kumari & Raghubanshi, 2023). It encompasses planning and decision-making processes that determine how waste services are delivered and regulated. The concept is guided by principles such as the waste hierarchy which prioritises waste reduction, reuse and recycling before elimination (Brighton et al., 2024). Across urban areas, effective waste management requires nexus between infrastructure development, public awareness and regulatory enforcement (Awino & Apitz, 2024). Bearing this in mind, understanding waste management as a concept is crucial as it provides a foundation for analysing how waste practices are organised and implemented in different contexts.

2.5.1 Waste management practices

The interconnectedness of routine activities and systems used to handle waste from the generation stage to the ultimate disposal means within a community is referred to as waste management practices (Kitole et al., 2024). The waste management practices include how waste is handled in households, collection services by the local authorities and where the waste is finally disposed (Chikowore, 2020). Proper waste management systems reduce exposure to disease-causing organisms while improving living conditions. In communities such as Hatcliffe, waste management is mainly informal, as community members often dispose of household garbage in public open areas and through burning (Chireshe et al., 2023). The waste management system in Hatcliffe remains weak and uncoordinated due to limited stakeholder engagement (Foya, 2022). Therefore, clear identification of these waste management practices helps develop

solutions such as effective waste collection strategies, regular disposal services, and public education to improve cleanliness and reduce health risks.

2.5.2 Case studies of waste management in urban areas

2.5.2.1 The global perspective on waste management in urban areas

Case studies of waste control range from the global perspective to the local in this case global case study include São Paulo, Brazil. In this area refuse handling systems are influenced by fast population expansion, high consumption patterns and complex urban infrastructure (Gutberlet & Besen, 2020). The local authorities coordinate and collect waste using compactor trucks on scheduled routes (Mahajan, 2023). Residents generate a variety of refuse types, including decomposable matter, plastics, metals, paper and glass (Ozoh et al., 2021). Households are encouraged to separate recyclables where local programs exist in order to make recycling easy. Community awareness campaigns and public education initiatives are done to promote proper waste disposal and recycling practices (Ifyalem & Mater, 2023). Informal waste pickers also recover recyclables at disposal sites, contributing to partial recycling and reuse (Brighton et al., 2024). Municipal landfills on the outskirts of the city receive the collected waste, where it is deposited in designated areas. São Paulo demonstrates how governance, stakeholder coordination, technological investment and community participation interact to support operational waste management systems in large, densely populated cities as noted by Gutberlet & Besen (2020). Hence, this clearly shows the importance of collaboration among the major actors to prevent waste mismanagement.

More so, in Delhi of India waste management is affected by high population density, informal settlements and variable municipal capacity across districts (Batra et al., 2022). Households and commercial premises generate mixed waste which include food scraps, plastics, metals, paper and glass (Gautam et al., 2024). Residents store refuse in bins outside the yards awaiting the municipal trucks, private contractors and informal collectors to remove on arranged days. Illegal dumping occurs in the area due to inefficient waste collection and irregular scheduled services leading to illegal dumping, which further pollutes the land, air and water (Hasan et al., 2019). In high density communities, the majority of waste is left untreated with little sorting for recycling

or composting due to poor disposal processes (Batra et al., 2022). Some local initiatives encourage separation of organic and inorganic waste, although coverage is limited (Mani & Singh, 2016). Delhi is a valid case study area that illustrates the operational complexities of urban waste management in diverse socio-economic settings. Bearing this in mind, the above information highlights how municipal collection systems interact with informal community practices to handle large volumes of waste efficiently.

2.5.2.2. Regional perspective on waste management of urban are as

At the regional level, a case of Nairobi in Kenya provides insight into waste management in rapidly urbanising African cities with limited resources. In low-income communities such as Kayole-Soweto organic waste form the majority of household refuse is collected and recycled (Wekesa and Khakasa, 2024). Residents store refuse in mall containers or on temporary open spaces as highlighted by Omokaro et al. (2024). Municipal trucks collect waste on scheduled routes (Nwanege, 2024). Even though the refuse trucks collect waste on scheduled days, irregular services in informal settlements often result in temporary dumping or open burning (Kipkoech & Thuo, 2025). Spatial inequalities affect access to collection, highlighting the importance of locally adapted planning tools (Andersen et al., 2021). This clearly shows how urban growth, settlement patterns and municipal capacity influence operational practices for collection, transport and disposal, providing valuable insight into African urban waste management systems.

In Cape Coast, Ghana, rapid urban growth, budgetary limitations and logistical constrains present challenges for municipal waste management (Gyimah et al., 2021). Residents generate household and commercial waste, which is stored in bins or temporary piles awaiting collection. Municipal trucks and private contractors carry out scheduled collection routes, while informal disposal occurs when skips or collection points are full (Alani et al., 2024). Limited coordination among municipal authorities, private operators and residents affects the overall efficiency of waste handling (Omokaro et al., 2024). Atta-Gyan et al. (2025) have it that waste is gathered and delivered to local landfills outside urban areas. Informal recyclers often collect plastics, metals and paper for resale (Gyimah et al., 2021). Cape Coast exemplifies how administrative capacity,

settlement density and urban growth pressures shape operational routines for municipal waste management in mid-sized African cities.

2.5.2.3 Current waste management systems in Zimbabwe

In Zimbabwe, local authorities are responsible for waste collection and disposal services (Sani & Zimucha, 2022). These collection services should be done regularly to reduce waste accumulation in communities but poor funding and a shortage of equipment have made the service inefficient as supported by Poshai & Intauno (2024).This results in illegal dumping, open burning and disposing of waste in open spaces. Inappropriate waste management practices influence how residents view the relationship of waste and health while increasing the vulnerability of people to diseases (Oluwagbayide et al., 2024). Therefore, this is essential as it helps in explaining how institutional weaknesses translate into public health challenges while showing the importance of improved mitigation strategies.

Waste management in Zimbabwe operates within an established legal and institutional framework that guides urban centres. Municipal authorities are tasked with collecting, transporting and disposing of solid waste by the Environmental Management Agency (EMA) and the City Council (Makamba, 2022). Local councils make use of by-laws to regulate household storage, collection schedules and disposal locations (Singh & Kalamdhad, 2016). The EMA oversees compliance at major disposal sites, while municipal health departments monitor waste handling in residential, commercial and institutional areas (Masimba et al., 2024). In Harare, these institutions coordinate daily waste collection across both low and high-density suburbs and in Bulawayo, the same arrangements regulate storage, collection and transport of refuse (Mkumbuzi, 2020). Smaller cities such as Mutare, Gweru and Masvingo operate under the same framework, with councils managing collection schedules and disposal site operations (Chireshe, 2020; Maregere, 2021). This legal and institutional structure provides the foundation for all current waste management activities in Zimbabwean urban areas.

Waste generation and storage form the first stage of urban waste management practices (Kumari & Raghubanshi, 2023). That is households, markets, commercial premises and institutions generate a mixture of organic and inorganic waste, such as food scraps, plastics, paper, metals

and glass (Gautam et al., 2024). In Harare, low-density suburbs typically store waste in covered bins, while high-density areas rely on plastic sacks and small containers placed outside houses (Phyllis, 2023). In some high-density neighborhoods of Bulawayo, residents place sacks of waste at street corners for collection and communal skips are shared by multiple households in several suburbs like Nkulumane (Mkumbuzi, 2020). In Mutare and Gweru, markets and households use open spaces and temporarily store it in sacks near pathways awaiting collection (Marange et al., 2023). In Masvingo, both household bins and communal containers are used depending on the layout of the settlement. These practices show how waste is temporarily stored before collection, including both formal and informal storage methods.

Collection of municipal waste is the central activity of current practices across Zimbabwean cities (Dissanayake et al., 2025). Municipal councils and private contractors carry out collection using compactor trucks, open trucks and in areas with narrow streets there is the use of hand-pulled carts. Poshai & Intauno (2024) have it that in Harare, scheduled collection routes operate throughout the week, serving low-density suburbs daily and high-density areas twice a week. In Bulawayo, collection vehicles cannot always access narrow roads in high-density suburbs, so some waste is collected from communal points or manually loaded as supported by Mutemani et al. (2022) . In Mutare and Gweru, municipal crews work alongside private operators to collect mixed waste from households, commercial centers and markets (Marange et al., 2023). Masvingo relies on municipal trucks to pick up waste from bins and skip points, with collection schedules communicated to residents via ward notices (Brighton et al., 2024). Collection practices currently include both regular municipal services and informal approaches in areas where access is limited.

Transportation and disposal represent the final stage of waste management (Mihai et al., 2022). Collected waste is transported by municipal or contracted vehicles to designated disposal sites located outside residential areas. In Harare, refuse ultimately disposed to Pomona dumpsite, which handles waste from across the city as noted by Masimba et al. (2024). Bulawayo uses the Richmond disposal site, while areas like Mutare transport waste to municipal landfill sites on the outskirts of the cities (Maregere, 2021). In some peri-urban areas, small settlements in Masvingo rely on local dumpsites for final disposal (Chireshe et al., 2023). Waste is deposited in bulk form,

generally without separation or treatment (Gyimah et al., 2021). Some sites also experience informal scavenging by individuals who collect recyclable materials. Organic and inorganic waste is often mixed at disposal sites, representing the final stage of waste management in urban Zimbabwe (Brighton et al., 2024). This includes both formally designated sites and areas used informally when municipal services are limited.

Supporting operational practices complement the main stages of waste management across Zimbabwean cities (Mihai et al., 2022). In Harare, municipal authorities carry out routine streets cleaning and manage communal skips, with public announcements reminding residents of collection schedules (Masimba et al., 2024). In Bulawayo, scheduled clean-ups are conducted in collaboration with community groups, while high-density suburbs sometimes leave waste temporarily in streets or open spaces before collection. Cities like Mutare and Gweru organise public cleaning exercises for markets, schools and residential streets as noted by Maregere (2021). Masvingo uses ward notices and announcements to guide waste handling (Chireshe, 2020). Informal disposal practices, such as temporary placement of waste at corners or scavenging at disposal sites, coexist due to formal municipal operations (Dissanayake et al., 2025). Together, these supporting activities illustrate the current operation of refuse handling from production to elimination stage in Zimbabwean urban suburbs.

In Harare, particularly in high-density suburbs such as Highfield, Glenview and Mabvuku (Masimba et al., 2024). Communal skips are shared among households, while low-density areas like Mount Pleasant, Highlands and Borrowdale benefit from direct household collection (Masimba et al., 2024; Poshai & Intauno, 2024). Informal dumping occurs when skips are full or collection is delayed and residents also recover recyclable materials for resale. Waste is transported by municipal trucks to designated landfills like Pomona dumpsite (Mandevere & Jerie, 2018). Socio-economic variables such as education, income and housing type influence how residents engage with municipal collection services (Makamba, 2022). This demonstrates a blend of formal municipal services and informal community practices. Hence, this highlights how formal and informal practices interact to manage household and community waste operationally, reflecting the existing urban waste management system. Therefore, Figure 4 clearly illustrates how waste management is being done in Harare.

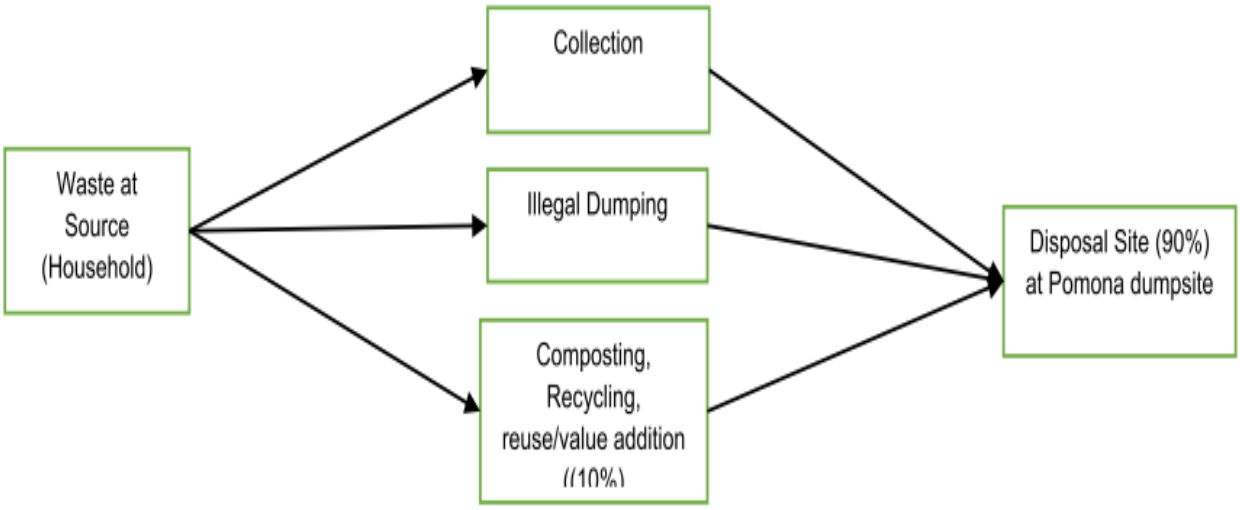


Figure 4: *Household solid waste management in Harare*. [Source Mandevere & Jerie, (2018) p. 18].

2.6 Impact of poor waste management on public health

Waste mismanagement poses significant health risks through both direct contact with waste and indirect exposure to contaminated environments (Ozoh et al., 2021). Individuals handling waste without appropriate protective equipment are at risk of cuts, abrasions and skin infections, which can become severe if untreated (Kitole et al., 2024). In addition, pathogens present in household and industrial waste can lead to digestive diseases including diarrhoea, dysentery and food poisoning. Poorly managed garbage in urban communities often exposes children and waste collectors to these hazards more frequently, increasing their vulnerability to infections. Handling sharp or contaminated materials without gloves or protective clothing therefore remains a critical occupational and public health concern (Poshai & Intauno, 2024). Understanding these direct health impacts emphasises the importance of proper waste handling procedures and protective measures for both communities and workers.

Indirect exposure to polluted air, soil and water is another serious consequence of waste mismanagement (Dubey & Res, 2024). Toxic fumes and particulate matter are released into the atmosphere through open dumping and uncontrolled burning of waste, further causing respiratory illnesses including asthma, bronchitis and other chronic lung conditions (WHO, 2018; Raphela et al., 2024). Moreover, smoke from burning plastics and other hazardous

materials contains chemicals like dioxins and furans, which are linked to long-term cardiovascular and respiratory complications (Siddiqua et al., 2022). These findings highlight that waste mismanagement affects not only those handling the waste directly but also entire communities exposed to contaminated air.

Waste accumulation in open spaces also creates favourable conditions for vectors, which transmit a wide range of diseases (Sani & Zimucha, 2022). Piles of garbage provide food and shelter for rodents, flies and mosquitoes, while blocked drains and stale water from discarded containers serve as favourable areas for mosquito breeding (Ozoh et al., 2021). In urban areas such as Hatcliffe, these conditions increase the risk of vector-borne illnesses like malaria, dengue fever and leptospirosis (Foya, 2022). Vector proliferation in densely populated areas is exacerbated by poor sanitation, overcrowding and limited waste collection services (Mamidi, 2024). This demonstrates how environmental conditions caused by improper waste disposal which leads to increased prevalence rate of vector-transmitted diseases within communities.

Contamination of water sources represents another significant health risk associated with inadequate waste control (Hasan et al., 2019). When waste is dumped near rivers, wells, or household water supplies, pathogens and chemical pollutants infiltrate water bodies, resulting in outbreaks of waterborne diseases (Mihai et al., 2022; Poshai & Intauno, 2024). According to scholars (Abubakar et al., 2022; Angmo & Shah, 2021; Nelson et al., 2021) urban residents who rely on these water sources are at heightened risk of diarrhoeal illnesses, cholera, typhoid and dysentery, particularly during rainy seasons when flooding disperses waste more widely. Industrial and chemical waste further exacerbates the problem by introducing heavy metals and toxic substances that can have long-term consequences on liver and kidney health as noted by Abubakar et al. (2022). This shows the critical relationship between refuse management initiatives and the quality of water available to urban populations.

Psychosocial and community-level impacts are also linked to poor waste management. Areas with persistent waste accumulation often experience unpleasant odours, unsightly environments and increased public anxiety about health risks (Marange et al., 2023). Such conditions can reduce the quality of life, discourage outdoor activity and diminish community cohesion (Gharagozloo & Ghazizade, 2023). Also, the perception of unsanitary conditions may lead to

social stigma for residents living near poorly managed dumpsites (Dubey & Res, 2024). These indirect psychosocial effects highlight that waste mismanagement influences both physical health and community well-being.

2.7 Vulnerable populations and health inequities

Poor waste management unevenly affects different age groups cross populations (Omokaro et al., 2024). There are more vulnerable groups to waste related hazards due to their living conditions and limited access to services including children who are particularly susceptible to health hazards arising from poor waste management, as their immune systems are still developing and are less capable of fighting off infections (Omokaro et al., 2024). They are frequently exposed to contaminated surfaces, soil and water in their immediate environment, either at home, in schools, or in play areas near open waste sites. This direct contact significantly increases the risk of gastrointestinal illnesses such as diarrhoea, dysentery, cholera and other infectious diseases. Children are also more vulnerable to airborne pollutants produced when waste is burnt openly, which can trigger respiratory conditions including asthma, bronchitis and other chronic lung problems (Gwinji, 2020). Exposure to chemical contaminants in household or industrial waste, such as heavy metals or toxins from plastics, may affect growth and cognitive development. Studies indicate that children in high-density urban settlements face compounded risks because of both poor sanitation and restricted availability of medical services (Mihai et al., 2022). Understanding children's vulnerability emphasises the need for strategies that protect young populations by ensuring safe play areas, proper waste collection and public health education (Gwinji, 2020). Targeting children in waste control initiatives plays a crucial role in reducing preventable illnesses and enhancing overall community health outcomes.

Pregnant women are another population group highly affected by inadequate waste management practices, with significant consequences for and fetal and maternal health (Raphela et al., 2024). Pregnancy complications like preterm birth, low birth weight and infections can be made more likely by exposure to contaminated soil, water and waterborne toxins from burning waste (Dubey & Res, 2024). Heavy metals and endocrine-disrupting substances are examples of toxic chemicals that can build up in the body and affect foetal development, potentially causing long-term health consequences (Jerie et al., 2024). In urban settlements with irregular waste collection, pregnant women may live in close proximity to open dumping sites or overflowing drains,

heightening their exposure to vector-transmitted diseases (Ozoh et al., 2021). These environmental hazards are worsened by restricted access to medical care, inadequate nutrition and poor housing conditions (Oluwagbayide et al., 2024). Psychological stress related to living in unsanitary environments may further compromise maternal health, increasing the likelihood of complications. Recognising the vulnerability of pregnant women underscores the importance of incorporating maternal health considerations into urban waste management policies (Anyanwu et al., 2024). Addressing these risks through protective interventions and improved environmental sanitation can safeguard maternal and infant health in high-density communities.

Low-income households are disproportionately impacted by poor refuse management because both socioeconomic and environmental factors (Gharagozloo & Ghazizade, 2023). Residents in these communities often live in high-density settlements where municipal waste collection is infrequent or absent, resulting in increased garbage accumulation in streets, open spaces and drainage channels (Sani & Zimucha, 2022). This situation exposes households to a range of pathogens, harmful microorganisms and vectors such as mosquitoes, flies and rodents that transmit diseases (Ozoh et al., 2021). Limited financial resources also restrict residents' ability to adopt protective measures, including purchasing secure waste containers or paying for private waste collection services (UN-Habitat, 2018). Inadequate waste disposal contributes to contaminated water and soil, leading to increased waterborne and vector-transmitted disease challenges (Omokaro et al., 2024). Additionally, children and elderly household members are more likely to suffer severe health consequences because of repeated exposure (Ifyalem & Mater, 2023). These conditions reduce the quality of life, affect household productivity and increase healthcare burdens. Targeted interventions that addresses low-income communities` needs, like subsidised garbage services and environmental sanitation programmes, can reduce exposure to health hazards and improve living standards (Raphela et al., 2024). Focusing on low-income households ensures that waste control solutions are equitable in protecting the most at-risk populations.

Elderly individuals represent another vulnerable group that experiences serious health risks from poorly managed waste (Mutemani et al., 2022). Age-related declines in immunity and the presence of chronic conditions such as asthma, cardiovascular diseases, and diabetes increase

their vulnerability to infections and environmental hazards (Omokaro et al., 2024; Raphela et al., 2024). Elderly residents are less likely to have the physical capacity to handle household refuse safely, which heightens their direct exposure to contaminated materials (Ifyalem & Mater, 2023). Living near open dump sites or in poorly serviced high-density urban areas further increases their contact with pathogens, toxic substances and vectors such as rodents and mosquitoes (Gwinji, 2020). Inhalation of fumes from burning waste can exacerbate pre-existing respiratory conditions, while contaminated water sources can worsen gastrointestinal problems (Ozoh et al., 2021). Social and mobility limitations also mean that older adults are less able to access healthcare services promptly, compounding the severity of health risks. Also, poor waste handling results in reduced quality of life, stress and a sense of insecurity in older populations (Phan et al., 2021). Understanding the vulnerabilities of elderly individuals is critical for designing inclusive waste management programs that protect high-risk residents and promote community well-being.

2.8 Interventions and sustainable approaches to improve waste management

Sustainable approaches like public education campaigns are crucial in promoting proper waste management initiatives (Nyarai et al., 2016). Education campaigns are essential as they inform community members concerning the dangers of poor waste disposal to health and the environment (Chileshe, 2018). They also teach practical skills like waste sorting, composting and sustainable disposal methods (Dissanayake et al., 2025). In countries like Zimbabwe campaigns often make use of radio programs, community workshops, schools and social media to reach a wide audience (Mkumbuzi, 2020). When people understand the nexus between waste and disease prevalence, they are more likely to adopt safer practices while, enabling them to take personal responsibility for waste generated in households (Oluwagbayide et al., 2024). Children and youth education programs on waste management are particularly effective because they create environmental friendly lifelong habits. Education campaigns can reduce littering and illegal dumping especially in high density urban settlements (Nyarai et al., 2016). Henceforth, public education enlightens communities to act responsibly and fosters a culture of environmental conservation.

There are community-based waste management projects funded by NGOs that strengthen local cooperation of waste initiatives as supported by Rangeti et al. (2018). Community-based projects often involve organised clean-up initiatives, small-scale recycling programs and the

establishment of community composting sites (Poshai & Intauno, 2024). Residents are actively consulted in planning and implementing these activities to increase accountability and to issue them a sense of ownership. Community engagement is essential as it promotes social cohesion among neighbors who work together towards a desired common goal (Kitole et al., 2024). Community-based projects also provide opportunities for skills development and informal employment in waste collection and recycling though giving the private garbage man some money to regularly collect waste in the neighborhoods (Sani & Zimucha, 2022). Nelson et al. (2021) has it that success depends on consistent support and guidance from project coordinators and local authorities (Nelson et al., 2021). Projects are more effective when aligned with municipal waste collection schedules and policies. Therefore, community-based sustainable initiatives clearly show that active local participation is important for environmentally friendly urban waste management.

Residents' associations and local groups have a significant contribution to urban waste management. These associations organise clean-up campaigns and recycling initiatives more often in high-density areas where municipal services are not regular (Mandevere & Jerie, 2018). They also deploy volunteers, organize refuse collection points and monitor waste disposal practices (Hemidat et al., 2022). Local knowledge of streets, drainage channels and problem areas makes these groups highly effective in targeting interventions. Residents associations often collaborate with schools, youth groups and small businesses to expand the reach of these activities (Ziraba et al., 2016). They also encourage civic pride and responsibility, motivating neighbours to maintain cleaner surroundings. Such community-level initiatives often generate informal employment opportunities in sorting and recycling work. When the local government support these groups they can be able to complement formal waste collection systems efficiently (Hemidat et al., 2022). Therefore, this demonstrates that community organisations and leadership are key to effective waste management at the neighborhood level.

Capacity building and institutional support are very important to the progress of waste control interventions (Ifyalem & Mater, 2023). Capacity building helps municipal staff with training that improves planning, collection efficiency and monitoring of garbage control services. Capacity building is crucial in communities as it improves the service delivery based on waste collection

and disposal methods. Community awareness programs are more successful when backed by trained and resourced institutions (Abubakar et al., 2022). Environmental conservation can also be promoted through workshops and recognition schemes (Poshai & Intauno, 2024). Capacity building enlightens the vulnerable people and also increases accountability and encourages compliance with disposal regulations (Kabah, 2025). Therefore, capacity building ensures that both local authorities and communities can work together for a cleaner, healthier environment.

2.9 Monitoring and evaluation of waste management practices

Monitoring is a critical process in understanding how waste management systems operate on a daily basis in urban areas. It involves the continuous observation of activities such as waste collection frequency, availability of disposal facilities and cleanliness of public spaces (Oluwagbayide et al., 2024). Regular monitoring allows local authorities to detect operational weaknesses, such as missed collections or illegal dumping, before they escalate into serious environmental or health concerns (Jerie et al., 2024). In urban settlements, monitoring also helps to assess whether waste services are reaching all areas equally (Nshimyimana & Rabie, 2024). When monitoring is weak, poor waste handling practices may persist unnoticed, leading to deteriorating sanitation conditions (Nwanege Carine Kiche, 2024). Monitoring helps maintain consistent waste services and protects public health and the urban environment through systematic observation while providing real time data that demonstrates timely decision making.

Evaluation focuses on assessing effectiveness and efficiency of waste management services over a given period. It uses collected data to determine whether waste management activities are meeting their intended goals and standards (Koo & Yang, 2025). Evaluation examines aspects such as service reliability, coverage and adherence with environmental laws (Jerie et al., 2024). It also considers how well local authorities utilize available resources to deliver waste services. Unlike monitoring, which is continuous, evaluation is conducted periodically to measure performance and outcomes (Chireshe, 2020). This process allows stakeholders to compare planned objectives with actual achievements. Evaluation findings provide evidence that can inform policy adjustments and service improvements (Mutemani et al., 2022). Therefore, by measuring performance against set goals, evaluation supports accountability and informed planning in urban waste management systems.

Monitoring and evaluation together offer a thorough framework for comprehending the relationship between waste management procedures and public health outcomes as noted by Chireshe (2020). From a public health perspective, this combined approach helps track changes in disease patterns. Cholera, diarrhea and vector-borne diseases outbreaks are linked to inadequate waste management Gloria & Kigozi (2017). Monitoring identifies ongoing waste practices, while evaluation assesses their broader impacts on environmental and health conditions. This integrated approach enables early detection of health risks and supports evidence-based interventions (Nshimyimana & Rabie, 2024). It also strengthens the ability of authorities to respond to emerging sanitation challenges in urban areas. Henceforth, monitoring and evaluation offer a structured way to analyse refuse management initiatives and their effects on public health and urban well-being.

2.9.1. Frameworks and indicators for evaluation of waste management practices

In order to effectively monitor and evaluate waste management initiatives there are various types of frameworks that are used. In this case, the frameworks discussed in this study include the logical framework approach, pressure-state-response approach, integrated sustainable waste management framework, health impact assessment framework and the results-based monitoring and evaluation framework.

2.9.1.1 Logical Framework Approach

This method is particularly useful in evaluating municipal waste management projects because it links activities to measurable outputs and outcomes (Banda et al., 2024). The framework uses a structured logical matrix to ensure that all the activities done are tied to the desired objectives and intended goal (Lotchi, 2024). Initiatives like the provision of refuse bins, deployment of collection truck and public sanitation campaigns can be organised to achieve the expected results (Lotchi, 2024). Therefore, this clearly shows that the framework is very important as it ensures that each step is measurable and verifiable especially when assessing if municipal waste services are achieving their intended goals or not.

The LFA in waste management plays a crucial role as it improves accountability by clearly defining the project`s objectives and indicators. Municipal authorities can monitor the performance of waste collection teams, track the functionality of disposal sites and to assess

community compliance with sanitation rules as postulated by Banda et al., (2024). Conducting a research using this type of framework helps to provide observable metrics, such as frequency of waste collection, number of households served and volume of waste collected in order to get evidence of operational efficiency in the area. The Logical Framework Approach allows researchers to connect municipal actions to sanitation outcomes in a structured manner (Zhang et al., 2024). On the other side, this framework has limitations as informal waste volumes increase in daily basis thereby, undermining planned interventions. However, the framework is not fully suitable for this research because it is mainly based on planned activities and measurable outputs as it does not adequately capture informal waste practices and community behavior which are common in Hatcliffe.

2.9.1.2 Pressure State Response Framework

This framework is of paramount importance as it ensures a broader understanding on how human activities influence public health outcomes and environmental conditions (Kazuva & Zhang, 2018). This framework focuses on the human pressures like rapid urban growth and informal dumping showing how they change the environmental status like overflowing dump sites, blocked drains and accumulation of waste in residential areas (Zhang et al., 2024). This framework allows stakeholders like the local authorities and researchers to gain knowledge pertaining the chain of the interaction between poor service provision and land deterioration. Harfadli et al. (2024) noted that Pressure State Response framework also focuses on the response component, which involves municipal interventions, enforcement of environmental laws and public education campaigns. Responses can be evaluated in terms of their effectiveness in mitigating environmental deterioration and reducing sanitation-related health risks (Kazuva & Zhang, 2018). This makes it possible to assess whether municipal actions are proportionate to the pressures and environmental challenges faced.

On the enforcement of environmental laws the Pressure State Response framework is also informed by national policy instruments and guidelines implemented by government agencies such as the Environmental Management Act (chapter 20:27). The framework provides environmental protection and pollution control (Rastogi et al., 2024). This national policy framework often use indicators such as the number of reported illegal dumping sites, incidents of

open waste burning, the number of inspections conducted by the Environmental Management Agency and enforce actions taken against the regulation offenders (Chireshe et al., 2023). These indicators are very important as they provide nexus between institutional performance and public health protection, which helps to come up with sustainable mitigation strategies. However, despite the framework`s usefulness, it is limited in this study because it provides a general overview of environmental changes without clearly measuring the efficiency of municipal service delivery.

2.9.1.3 Integrated Sustainable Waste Management framework

Provides a comprehensive approach to evaluate waste management by looking at technical, institutional and social dimensions (Phyllis, 2023). The framework identifies that the sustainability principles, stakeholders and infrastructure are the components that shape the socio-technical networks of waste management systems. ISWM assesses how municipal authorities and other responsible authorities collaborate to ensure efficient collection, transportation, recycling and disposal of waste in urban waste control as suggested by Wirani et al. (2024). The collaboration of different actors on waste management issues makes the framework more efficient as diverse strategies can be suggested to provide sustainable waste management practices in communities. Service delivery performance reports are used in this framework but usually applied by municipalities to assess waste management based on reliability and responsiveness (Schoeman & Chakwizira, 2023). The key indicators of this framework include the frequency of waste collection, proportion of households that have services and regular checks of responsiveness on waste collected in response to the resident`s complaints (Phyllis, 2023). These indicators are of paramount importance in high density areas like Hatcliffe where irregular waste collection services influences community behaviour due to a bigger population size that will be affected health wise.

ISWM is of a paramount importance in today`s life as it examines the environmental, economic, and social impacts of waste management initiatives, thereby fostering sustainability (Schoeman & Chakwizira, 2023). For instance, the framework assesses whether municipal programmes are environmentally friendly, financially viable and socially equitable. In this case, ISWM allows researchers to evaluate the sustainability of service delivery provided by formal and informal

actors, while assessing the long-term system resilience and efficiency as highlighted by Wirani et al. (2024) . However, the fact that Integrated Sustainable Waste Management is broad and multi-dimensional, shows that it may not be able to always provide clear performance metrics relating to municipal inputs and processes to health and sanitation outcomes (Awino & Apitz, 2024). However, the ISWM framework is not entirely suitable for this study because it is broad so this makes it difficult to directly assess the effectiveness of garbage collection and sanitation services in the area of study

2.9.1.4 Health Impact Assessment framework

The framework directly link the municipal interventions to public health outcomes as supported by WHO (2024). The framework evaluates how environmental conditions, sanitation practices and waste management initiatives increase the prevalence rate of communicable diseases (Ozoh et al., 2021). HIA provides empirical evidence of the health implications of inadequate waste management in high-density areas by considering clinical data, community assessments and environmental assessments from the environmental agencies (WHO, 2023). HIA also encourages local authorities to follow a preventive approach as it help to identify susceptible communities due to irregular waste collection schedules enabling targeted interventions before outbreaks strike.

The Health Impact Assessment is also important as it uses health surveillance data from clinics and other health centres to monitor disease trends of waste related diseases such as diarrhoea, cholera, dysentery and typhoid (Kitole et al., 2024). Evaluation frameworks integrate health outcome indicators to assess the impact of waste management practices (Omokaro et al., 2024). Indicators such as reported causes of water borne diseases, blocked drainage systems and pest infestations help to provide a nexus between waste management and health outcomes (Ozoh et al., 2021). These indicators play a crucial role by enabling assessment of public health implications caused by poor waste management, while demonstrating the need for preventive interventions

The framework also provides a structured methodology to identify and evaluate indirect health risks, such as vector proliferation or contamination of water sources (Ozoh et al., 2021). Health Impact Assessment framework plays a critical role by showing the nexus between operational

waste management practices and public health outcomes (WHO, 2023). Moving on the other side of the coin, the framework only measures outcomes and does not evaluate operational inputs or service delivery efficiency (Omokaro et al., 2024). Also, it does not show whether resources are being effectively allocated or processes are being followed, while demonstrating the health impacts of municipal activities (Kitole et al., 2024). Although the HIA framework is important, it is not fully suitable for this study as it is mainly based on health outcomes making it difficult for it to independently explain the causes of poor waste management in the study area.

2.9.1.5 The results-based monitoring and evaluation framework as the selected framework for the study

The results-based monitoring and evaluation framework was selected for this study because it assesses waste management through inputs, process, outputs and outcome (Diane et al., 2014). It is commonly used by Zimbabwean institutions such as government ministries, government agencies and local authorities in order to evaluate the service delivery performances (Kiche, 2024). Inputs may include the availability of waste bins vehicles and personnel, while process measures the waste collection frequency and safe disposal means (Koo & Yang, 2025). Outputs measure the quantities of collected waste and outcomes bases on assessing improvements in environmental cleanliness and public health situations.

The results-based monitoring and evaluation framework was selected for this study because it captures both service delivery efficiency and public health outcomes at the same time (Xue et al., 2013). It also allows researcher to see whether municipal interventions are actually making things better for residents especially in high-density areas like Hatcliffe (Kiche, 2024). The results based monitoring and evaluation approach uses a framework that allows the study to measure how effective municipal waste management is, assessing how resources are being used, help to evaluate service delivery performance and enables tracking of public health and sanitation status (Koo & Yang, 2025). The diagram in Figure 5 shows how the results-based monitoring and evaluation framework operates.

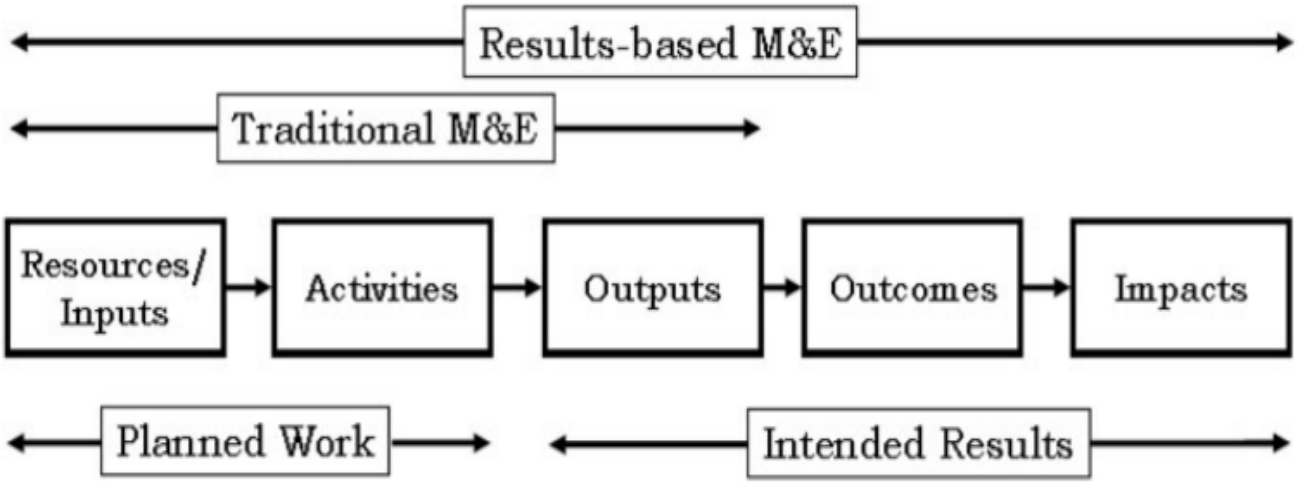


Figure 5 : *Results based monitoring and evaluation logical framework.* Source[(Xue et al., 2013) p.5.]

Basing on the diagram in figure 5, it is crystal clear that the framework is of a paramount importance in the study as it clearly shows the planned work process to the intended results. The framework clearly highlights the need for improvements in some areas of the waste management process as highlighted by Xue et al. (2013). Project monitors and other stakeholders will be able to see if the waste management initiatives are going to be efficient and benefit the desired groups or not (Diane et al., 2014). The results-based monitoring and evaluation framework is also selected in the study because it clearly shows where the projects are failing from the sequence of areas that will be monitored.

The results-based monitoring and evaluation framework goes beyond environmental conditions or health outcomes as it is able to evaluate both service delivery performance and its impacts on environmental sanitation and public health (Diane et al., 2014). The framework is important to the study as it examines how resources such as waste collection vehicles and refuse bins are utilised, while assessing if these leads to improved service delivery (Kiche, 2024). RBME also determines the effects on community and sanitation conditions through the assessment of municipal waste management practices (Koo & Yang, 2025). Therefore, the framework is considered the most appropriate because it offers a comprehensive and balanced analysis of both operational performance and public health outcomes.

2.9.2 Lessons learned from previous studies

Prior research on community`s wellbeing and refuse management has improved our knowledge while clearly supporting the study`s goal of evaluating the effects of inadequate waste control and vector-borne diseases outbreaks in Kenya as noted by Ziraba et al. (2016). This study clearly highlighted lessons that demonstrated direct effect of inadequate garbage handling on public health outcomes especially in low income communities and high density areas. Henceforth, this clearly aligns with the study`s research objective on assessment of the effects of inadequate waste management on public health outcomes in Hatcliffe community.

Moreover, a study conducted in Nairobi`s informal settlements by Andersen et al. (2021) reflected the importance of proper stakeholder engagement. The study supported the importance of collaboration among different beneficiaries and service providers in reducing public health risks. It also emphasised that poor collaboration between actors, such as residents, waste collectors from private companies and the local authority`s weakened system may contribute to an increased vulnerability to the informal settlers at large. Venkataramanan et al. (2018) supported this view by demonstrating that community-based interventions are more sustainable when residents are more actively included in waste management planning and monitoring processes. The key lesson learnt is that proper waste management cannot be improved with isolated ideas. Therefore, this supports the systems theory view used in the study to strengthen integrated mitigation strategies that include community participation to curb the problem identified in Hatcliffe.

Furthermore, another important lesson learned from previous studies is that community perceptions are shaped not only by waste conditions but also by institutional performance. For instance, the study by Sani and Zimucha (2022) examined that waste management challenges in Harare are derived from limited resources, poor planning and weak enforcement of regulations, which often reduces the effectiveness of waste collection systems in Harare. Therefore, this is important as it assists the researcher to analyse community perceptions of the relationships between public health and poor waste management.

2.10 Research gap

Despite the existence of national regulations, municipal by-laws and the involvement of stakeholders such as the Environmental Management Agency and the City of Harare, waste management problems still continue in Hatcliffe. Illegal dumping, open burning and poor sanitation remain common in the community. This demonstrates the difference between waste management initiatives and Hatcliffe`s actual state of public health and sanitation. There is limited community-level evidence that clearly explains why these waste management efforts fail to improve the current public health and sanitation conditions. Therefore, there is a need to examine the dynamics shaping the relationship between refuse handling programs and the existing public health and sanitation situation in Hatcliffe.

2.10. Chapter summary

Numerous studies on waste management and consequences of insufficient waste were reviewed in this chapter .Due to inadequate disposal facilities and low public awareness, major health issues like management of sanitation and public health. It demonstrated that inadequate waste collection in Zimbabwe leads to serious health problems like cholera, malaria and other infections. The review also explained the key lessons learnt from previous studies, waste management practices currently done in Zimbabwe and monitoring and evaluation strategies being conducted. Systems theory and the concepts were used to help explain the link between waste management and health outcomes. The literature reviewed gap which showed that there is gap between waste management initiatives and public health and sanitation status in the area of study.

CHAPTER 3: RESEARCH METHODOLOGY

3.1 Introduction

This chapter explains how the study was carried out. It describes where the research took place, the methods used to collect and analyse data. It also explains how the researcher made sure the information gathered was accurate and trustworthy, as well as the challenges faced during the process.

3.2 Description of the study area

The research was conducted in Hatcliffe, a fast-growing suburb located in Harare North District, Zimbabwe. The area has both formal and informal settlements and has seen a rapid increase in population over the past years (Foya, 2022). Like many urban communities, Hatcliffe faces challenges of poor waste collection, open dumping and limited sanitation services. These problems have contributed to pollution and outbreaks of diseases such as cholera, malaria and typhoid. Hatcliffe was selected as the study area because it clearly represents how poor waste management affects people`s health and the cleanliness of their environment.

This study area is located in agro-ecological region II which is well known for its relatively good agricultural conditions (Mupangwa et al., 2021). The area plays a crucial role in supporting local farming activities as it receives an average annual rainfall of 750 to 1000mm (Mupangwa et al., 2021).The soils in Hatcliffe consist of loam, which is capable of holding moisture over time. Bearing that in mind, these soils are also prone to increased soil density and air pollution especially when waste is not properly managed (Poshai & Intauno, 2024).These soils are susceptible to contamination when solid waste is disposed in open areas. These characteristics make environmental management an important concern in the area of study. Henceforth, by understanding these geographical and ecological contexts of the area, one can be able to assess the efficacy of waste management initiatives on public health and sanitation.

The environmental conditions of the area influence sanitation and health outcomes as the community's climate on temperature variations are characterized by an average daily high which often reach between 25°C and 30°C during warmer months. Warmer conditions accelerate the rate of organic waste decomposition resulting in unpleasant odours and the attraction of rodents and flies (Rastogi et al., 2024). During the winter season the night temperatures can drop to

around 10°C (Dissanayake et al., 2025). The study area map in figure 6 clearly shows the location of Hatcliffe community.

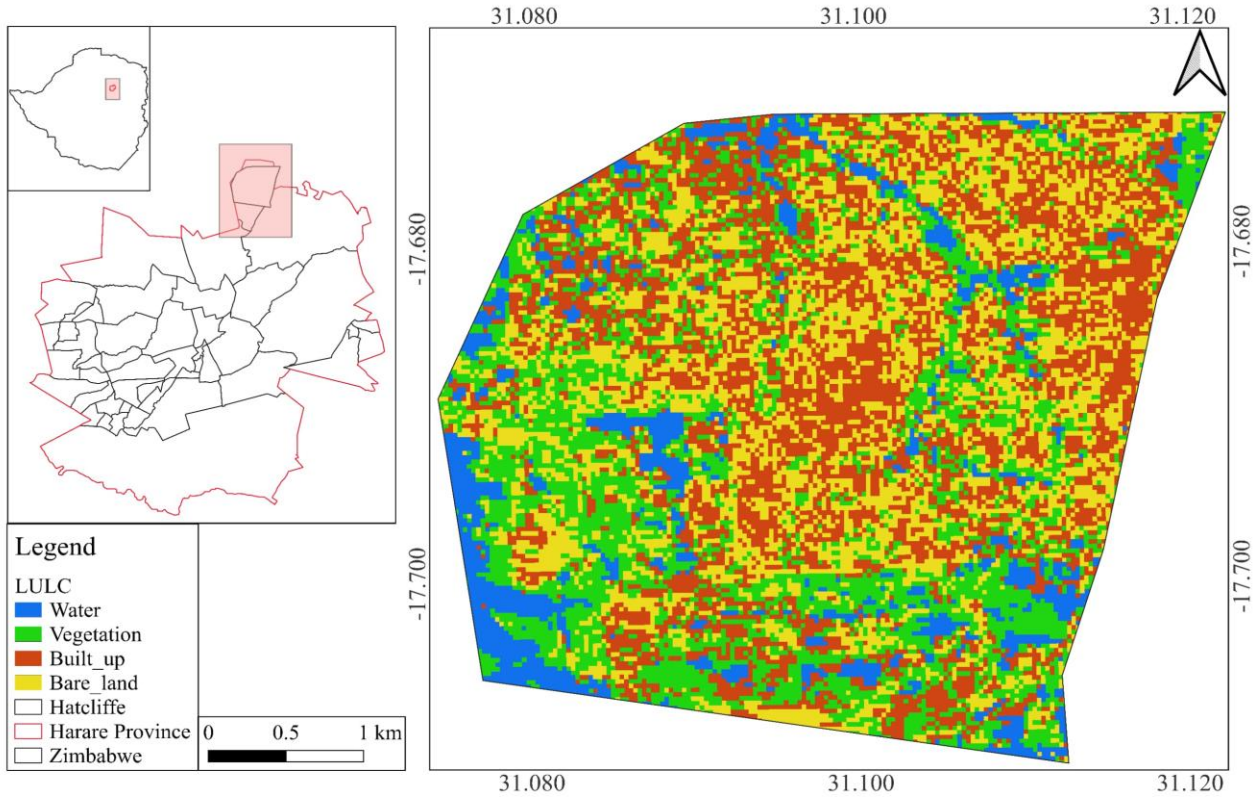


Figure 6: *Location of Hatcliffe, Harare North Province, Zimbabwe [Source: Created by the researcher using data from Google Earth Explorer (retrieved 28 November 2025]*

3.3 Research design

This research used a case-study based design in which both qualitative and quantitative research methods was used to gather information on the assessment of poor waste management practices on public health and sanitation in Hatcliffe under the Harare North district in Zimbabwe. Topics that deal with public health and environmental challenges require a case study design as it allows the researcher to focus on specific public health challenges and explore real-life environmental health challenges in detail as supported by Guetterman et al. (2015). In community-based environmental studies, this study design is recommended because it promotes credibility through the use of different data analysis methods (Poshai & Intauno, 2024). The design was therefore justified due to the fact that it allowed the researcher to gather measurable

health risks, while exploring the community perceptions and behaviours on waste management practices.

3.4 Primary data sources

The primary data was collected from Hatcliffe residents. This primary data was very crucial to the study as it provided the current situation on waste management practices in the area. The data was gathered using structured questionnaires, and through observations. All these methods were useful as they helped the researcher with the knowledge on household waste disposal behaviours, recognising the waste management current sanitation, challenges faced in the area and to understand the health impacts associated with poor sanitation and waste disposal practices (Chireshe et al., 2023). According to Carlos-Alberola et al. (2021) primary data provides first-hand information that gives the researcher ideas of hidden and emerging issues that needs to be addressed. Some related researches on environmental health, demonstrated that primary data is more effective and reliable since it provides a better understanding on how communities practice waste management systems and the challenges they are directly facing as supported by Kitole et al. (2024); Mangoro & Kubanza (2023). Informal interviews were also done while the researcher was collecting data. Proper collection of data allowed the researcher to be able to clarify unclear responses from the community while managing to verify reported environmental hazards through direct observation. Therefore, this was of paramount importance as it strengthened both the credibility and the richness of the findings.

3.4.1 Secondary data sources

Secondary data was drawn from academic literature. According to Mohajeri & Karami (2025), secondary data is of paramount importance since they help researchers to make their field findings valid. The researcher managed to compare the research findings with revealed literature. Some researches such as Poshai & Intauno (2024); Rayfuse et al. (2023) on urban environmental governance in Zimbabwe highlighted that secondary data plays a crucial role as it helps in understanding institutional weaknesses, policy anomalies and long-term waste management trends. Therefore, bearing this in mind the use of multiple data collection methods helped in strengthening the accuracy, validity and better interpretation of the study.

The study used different institutional repositories including Google scholar, PubMed and JSTOR databases to gather data (Mohajeri & Karami, 2025). Government databases and reports from different organisations were also used in the research. The review period for secondary data ranged from 2018 to 2025 in order to capture the current important perspectives that should be covered in the study. The selected timeframe was to ensure that both current policy debates involving waste management and foundational perspectives were included. Key search words played a crucial role in the identification and selection of relevant literature (Mohajeri & Karami, 2025). These key words included public health and sanitation, waste management practices in Zimbabwe and municipal waste management challenges. This systematic approach to keyword selection ensured that the literature reviewed was directly aligned with the objectives of the study and helped to reduce the likelihood of omitting important sources.

3.5. Data collection instruments

3.5.1. Structured questionnaires

Structured questionnaires were the primary quantitative data collection instrument used in gathering data as recommended by Islam et al. (2025). These questionnaires allowed the researcher to gather measurable and comparable data from various participants in Hatcliffe as 100 community members were selected using the Yamane formula as shown in section 3.6, which was calculated to get the sample size (Oluigbo et al., 2024). This was done in order to get current disposal methods, perceptions and behaviours of different age groups, gender and locations (those who stay near dumpsites and those who stay far from dump sites) as supported by Oluigbo et al. (2024) .Closed-ended questions focusing on household waste disposal practices, frequency of waste collection, observable environmental risks and self-reported health symptoms associated with poor waste management designed the structure of the questionnaire guide. This enabled the respondents to easily complete the questions and ensured uniformity in data collection. According to Koo & Yang (2025), in community-based public health studies structured questionnaires are highly effective because they simplify the quantification of trends and reduce bias from interviewers. The structured questionnaire`s questions were derived from the gaps which were identified in previous researches done in Southern African region to measure exposure to waste-related health risks (Chisholm et al., 2021; Omokaro et al., 2024). Furthermore, the questionnaire format allowed the researcher to reach many households within a

relatively short timeframe. Henceforth, this tool contributed significantly to the reliability and representativeness of the study`s quantitative findings.

3.5.2 Observation checklists

An observational checklist was used in order to capture the current waste management conditions in the area of study as recommended by Raghu & Rodrigues (2021). The checklist focused on key aspects like waste accumulation sites, the presence of flies and rodents, drainage blockages, proximity of waste to homes, public spaces conditions and availability of waste bins. All these observations were recorded systematically to enhance consistency across different days and locations in the area. Some scholars such as Atta-Gyan et al. (2025); Mangoro & Kubanza (2023); Venkataramanan et al. (2018) argue that environmental health researches require observations as an important tool because it provides direct evidence of current conditions that will be taking place in the area of study. Scholars like Nhubu et al. (2020) used similar approaches in assessing waste management patterns in Harare which therefore shows the importance of observing environmental hazards in collecting data. This clearly shows that the checklist ensured that all important environmental indicators were captured thoroughly, thus strengthening the trustworthiness of the study.

3.6 Target population and sampling techniques

This study targets Hatcliffe residents with an estimated population of 69 234 according to ZIMSTATS (2022). Different respondents were selected to stand for different sections of the study area from the total population.

A stratified random sampling was applied to make sure that individuals from different age groups and locations participate equally. This sampling technique involved general community members who responded to the structured questionnaires. This method was used because the community has different groups of people and the researcher wanted to make sure that each group was considered. The groups were formed based on demographic factors, socio-economic status, and proximity to the waste disposal sites. After dividing this population into strata, respondents were randomly selected from each group. This type of sampling used Yamane formula to come up with the stratified sample size suggested by Oluigbo et al. (2024) as follows:

$$n = N \div (1 + N(e)^2$$

Where:

n =Sample size
N =Population size
e= Margin error

Therefore, using a population of 69 234:

$$0.10^2 = 0.01$$
$$69\,234 \times 0.01 = 692.34$$
$$1 + 692.34 = 693.34$$
$$69\,234 \div 693.34 = 99.85$$
$$n = 100$$

The formula above is showing how the researcher came up with the selected quantitative sample size using Yamane formula (Oluigbo et al., 2024). In this case, a margin error of 10% was used to come up with a total sample size of respondents. To come up with the sample size, firstly, there was need to square the margin error. Secondly, the researcher multiplied the answer with the total population of the study area. The third step was to add one to the brought down answer, then divide the population size by the result, the answer was 99.85. The researcher then rounded up to the nearest whole number and the final answer was 100.

3.7 Data analysis methods

3.7.1Descriptive statistical analysis

Descriptive statistical analysis was used to analyse questionnaire data that was gathered in the area of study. Esmaeilizadeh et al. (2020) have it that quantifiable patterns within the community such as types of waste generated and common disposal methods were captured by questionnaires and it was made simple for better analysis using the descriptive statistical analysis. The analysis method was chosen to present the results through pie charts, graphs, tables and simple cross-tabulations. Results were analysed using SPSS and excel. Descriptive statistical analysis allowed the researcher to clearly understand the current waste management situation in Hatcliffe as recommended by Esmaeilizadeh et al. (2020). The analysis method also allowed the researcher to identify the rate of residents' reported illnesses, which was vital in understanding the waste mismanagement implications on public health. Therefore, descriptive outputs also informed the development of feasible mitigation strategies for the current situation.

3.7.2 Qualitative descriptive analysis

Qualitative descriptive analysis was used to interpret observational findings collected through the checklist. These were essential since they managed to provide enhanced narratives on community experiences, perceptions of health risks and attitudes towards existing waste management services as supported by Weyant (2022).Through this analysis the researcher observed environmental conditions such as illegal dumping and waste accumulation and burning sites which were grouped into common themes for interpretation, as recommended by Guetterman et al. (2015). This method played a significant role to the structured data obtained through questionnaires, while it allowed the researcher to get a deeper understanding of existing practices and the reasons why these poor waste management practices were done in the community (Pluchinotta et al., 2022). Henceforth, this type of analysis was essential as it helped the researcher to provide informed recommendations for practical and community views to come up with better mitigation strategies.

3.7.3 Content analysis

Content analysis was used in the study to examine secondary data sources such as related researches which were done currently and before. This type of analysis was recommended by different scholars who used it as they researched on public health situations that were triggered by poor waste management (Abubakar et al., 2022; Chireshe et al., 2023; Khosravani et al., 2023). This study used the content analysis method because it included systematic reviews on texts to clearly see the key patterns that tallied with the concerns raised during data collection like the consistency of current waste practices, health effects of poor waste management and mitigation strategies which align with the current policies (Brooks et al., 2019). Content analysis enhanced the interpretation of first hand-data by cross-checking the community perceptions with institutional and scholarly evidence. Bearing this in mind, it clearly shows that content analysis ensured that insights from policy documents were aligned with national waste management frameworks in order to come up with sustainable recommendations to policymakers.

3.7.4 Geographical Information Systems mapping

Visual interpretation of geographical allocations of waste dumping sites and their proximity to areas essential to people, like their households, water sources, health facilities and schools, required GIS Mapping to allow the researcher to analyse data collected through observational

checklists. Observational data capture enhanced the physical visibility and the exact geographical location of waste thus showing the importance of incorporating GIS mapping for clearly highlighting how environmental exposure may influence public health outcomes, as supported by Gloria & Kigozi (2017). The GIS maps illustrated spatial patterns that complemented both the descriptive statistics and observational insights, enabling the researcher to create a more holistic understanding of the risks linked to poor waste management and for easy identification of suitable landfill areas in Hatcliffe. This clearly shows that spatial representation was particularly useful for the researcher as it helped to identify priority areas where targeted mitigation strategies would be most effective to be able to produce sustainable research outcomes.

3.7.5. Analytical Hierarchy Process

The research employed the Analytic Hierarchy Process (AHP) to determine the weighting of various factors influencing how inadequate waste management impacts on public health and sanitation, following the approach suggested by Barbosa et al. (2025). The researcher used the AHP because it provides a structured, scientific and logical framework which helps to solve waste management-related issues. A pairwise comparison matrix was first constructed; each factor, such as Land Use Land Cover (LULC), roads, Digital Elevation Model (DEM), rivers, and soil type, was compared against every other factor using a simple scale ranging from 1 to 10. A score of 1 was assigned if two factors were equally important and 10 was assigned for one that was extremely more important than the other. This step helped determine the relative significance of every component in a systematic way.

To ensure the comparisons were not contradictory, the Consistency Index (CI) was used to measure how logically consistent our comparisons were, with lower values indicating greater consistency. It is calculated using the formula where λmax (lambda) is the maximum eigenvalue of the pairwise comparison matrix, and n is the number of factors (or criteria) being compared. λmax is calculated by multiplying the pairwise comparison matrix by the weight vector. The first step is to divide each element of the resulting vector by the corresponding weight in the weight vector, followed by averaging these values.

Additionally, the Consistency Ratio (CR) was calculated, comparing the CI to a standard value (Random Index or RI), which depends on the number of factors being compared. A CR value of

less than 0.10 indicates that the comparisons are consistent and can be trusted (Barbosa et al., 2025). In this study, a CR of 0.06 fell within the acceptable range, confirming that the weighting process was reliable. The weighted factors were then integrated into Geographic Information System (GIS) software to create a final map highlighting the spatial distribution and complexity of public health issues related to poor waste management in the Hatcliffe community. The analysis captures how various factors, such as waste accumulation and disease incidence, interact within the context of sanitation, ultimately aiding in strategic decision-making for public health interventions in the area.

3.8 Reliability of the study

Many procedures were done to ensure that there was reliability through the production of consistent and dependable outcomes. Tshabalala & Dhanpat (2022) suggested that all questionnaire sessions used standard guides to ensure uniformity among interviewed participants. GPS spot checking was done during observations and the proximity to households was calculated to come up with reliable data. Field guides were compared with responses provided to ensure consistency of interpretation of the results, as suggested by Weyant (2022), who advocated for using structured instrument like questionnaires consistently and checking responses against the guide to ensure data reliability.

3.9 Validity of the study

Methodological data analysis was done to enhance the validity of the study. Different types of sources were used to cross-validate the findings through the use of secondary data, questionnaires and observations as supported by Malone et al. (2022). To ensure content validity, the questionnaire was reviewed by some public health experts, aligned with recommendations by Marange et al. (2023). To match the literacy level of the community face validity was ensured as there was the use of simplified language in questionnaires. Data triangulation allowed comparison of designs across different instruments and respondent groups thereby ensuring that the findings reflected real community conditions rather than researcher bias.

3.10 Ethical considerations

The researcher explained the study`s purpose, risks associated with poor waste management and benefits of conducting the study in a more simplified and accessible language like vernacular in

order to get informed consent from all the participants. There was the use of voluntary participation and Hatcliffe residents were encouraged to participate while those who tend to withdraw were not charged any form of penalty. There were no names written on questionnaires in order to ensure anonymity. Information gathered was securely stored to ensure confidentiality. These procedures were linked to the Zimbabwe Research Council (ZRC) Research Ethics Guidelines of 2016. This was of paramount importance since it helped to protect the dignity and privacy of everyone involved.

3.11 Limitations of the study

The study faced challenges as some community members were initially reluctant to participate due to fear of political or municipal repercussions. This hindered the residents from being open when giving responses. Therefore, the researcher managed to emphasise voluntary participation, anonymity and confidentiality assuring the respondents that the provided information will only be used for academic purposes. There was also poor road access in Hatcliffe which slowed down data collection. However, the researcher managed to use non-motorised transportation such as walking and bicycles while carefully planning visits based on the proximity to reduce time loss and fatigue in order to effectively collect data. Additionally, language barriers and varying levels of understanding among respondents affected the clarity and accuracy of some responses. To address this the researcher simplified questions and sometimes used local language for clarification while making sure that the interviewed people understood the questions.

3.12 Chapter summary

This chapter described how the research was planned and carried out. It explained the study area, the research design, the data collection instruments and the ways used to analyse the data. It also discussed the ethical considerations and challenges faced during the study. The next chapter presents and discusses the findings from the Hatcliffe community.

CHAPTER 4: RESEARCH FINDINGS AND DISCUSSION

4.1 Introduction

This chapter shows the presentation of data, analysis and the discussion of the research findings. Different methods were used to analyse data as descriptive statistical analysis was used to analyse quantitative data, descriptive qualitative analysis for observations and content analysis for secondary data which was used to compare the study`s results and those from reviewed literature. The results are organised by the research objectives in order to examine the gap between waste management initiatives and public health outcomes in Hatcliffe.

4.2 Response rate

A total of 100 questionnaires were all returned and successfully completed though some sections were not completely answered. These questionnaires were distributed to different parts of Hatcliffe for effective data collection as there were given to residents who reside in Matombo area, Consortium area, Hatcliffe Extension area and others to the old Hatcliffe. Questionnaires were distributed to 100 Hatcliffe community member and all were returned. This yielded a response rate of 100%.

4.3 Demographic characteristics

To establish context for interpreting the study findings, there was need to provide demographic data for easy understanding. Table 4.1 clearly presents the demographic profile of 100 residents surveyed in Hatcliffe with the use of different variables such as gender, age group and occupation, which informed the stratified sampling as shown in Chapter 3.6.

Table 4.1: *Demographic information*

VARIABLE	CATEGORY	FREQUENCY	PERCENTAGE %
GENDER	Female	51	51
	Male	49	49
AGE GROUP	18-25 yrs.	32	32
	26-35 yrs.	22	22
	36-45 yrs.	22	22
	46-55 yrs.	15	15
	56+ yrs.	9	9
OCCUPATION	Formal employment	25	25
	Self employed	33	33
	Informal employment	16	16.0
	Unemployed	26	26.0
TOTAL		100	100

Source: *Field survey, 18-04-26 to 03-05-26 Analysed using SPSS v27*

Table 4.1 shows gender distribution with females and males which is fairly balanced. The questionnaire included the socio-economic status of the respondents as occupational status of each respondent was asked. The high proportion of self employed and unemployed respondents is consistent with Poshai & Intauno (2024), who characterised Hatcliffe as a low–income community with a limited percentage of formally employed residents. This clearly tallied with the researcher`s observations as a larger number of respondents came from people who were available at home and from some residents were openly selling their goods in open spaces. Therefore, capturing a mix of economically active and inactive participants was important since waste management practices vary with the availability and time spent at home

4.4 Current solid waste management practices in Hatcliffe.

The current solid waste disposal practices in the study area are clearly presented in Figure 7, as it reveals the mixed patterns of waste disposal both formal and informal means.

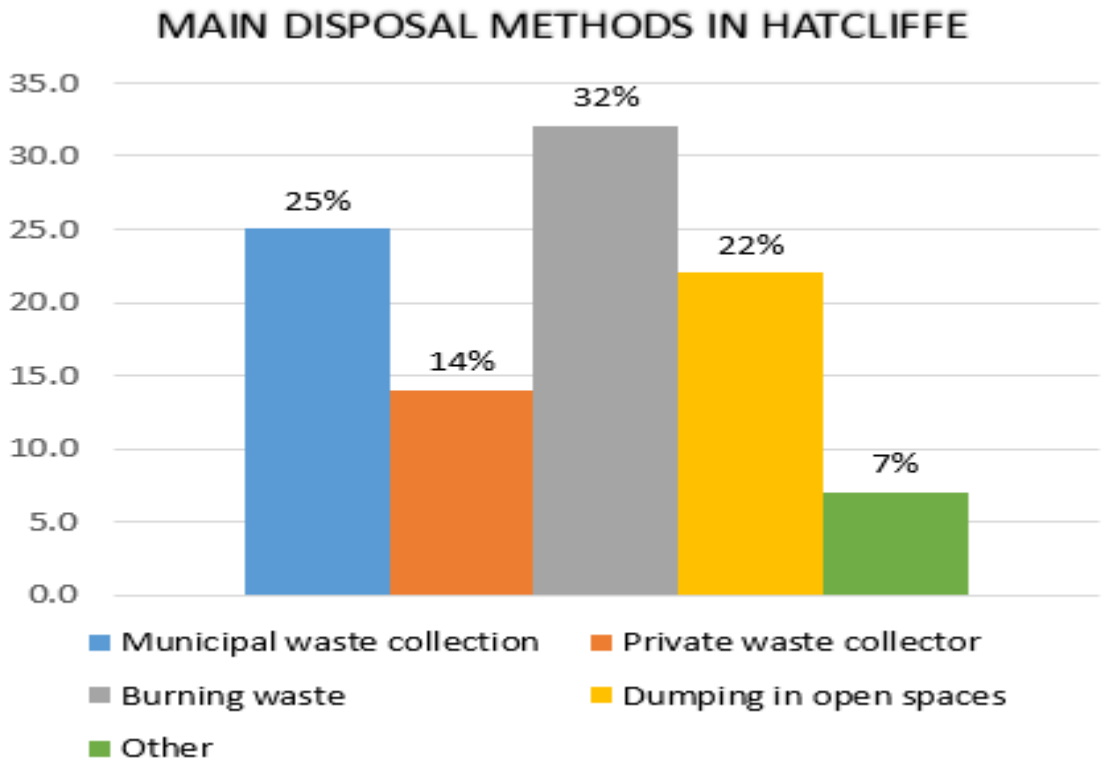


Figure 7: *Source: Field data surveyed 18 April 2026- 3 May 2026*

Figure 7 clearly shows that the findings revealed over half of the households in Hatcliffe rely on informal and hazardous methods of waste disposal namely open dumping and burning in the area which aligns with Abubakar et al. (2022), who reviewed that uncontrolled dumping and open air incineration are the most disposal methods in Global South cities. There are some residents with responses such as burying of waste and sometimes no regular waste disposal which were presented by the other category. High proportion of households burning waste increases the rate of air pollution in the area further exacerbating public health risks. This was further supported by what the researcher observed as some residents were seen burning their waste on roadsides or backyards. Therefore, despite the presence of waste management initiatives, unsafe disposal means remain the major environmental and public health concern in the area

4.4.1 Frequency of waste collection and proximity to legal dumpsites

To understand the factors influencing the disposal means, variables like frequency of solid waste collection and distance to the nearest legal dumpsite were examined as shown in Table 4.2.

Table 4.2: *Frequency of waste collection and proximity to legal dumpsites n=99*

FACTOR	CATEGORY	FREQUENCY	PERCENTAGE %
FREQUENCY OF SOLID WASTE COLLECTION	Once a week	26	26
	Once every two weeks	20	20
	Once a month	14	14
	Rarely or Never	39	39
DISTANCE TO NEAREST LEGAL DUMPSITE	<100 metres	22	22
	100-500 metres	30	30
	>500 metres	47	47
TOTAL		99	99

Source: *Field survey, 18-04-26 to 03-05-26 Analysed using SPSS v27*

Table 4.2 clearly highlights the frequency of waste collection and the distance of households from the nearest legal dumpsite in the study area. The results revealed that some households rarely or never receive waste collection, while some residents live more than 500 metres away from a legal dumpsite, especially in areas like Hatcliffe Extension and Consortium. A few respondents from the old Hatcliffe mentioned that they receive waste collection regularly and they have large legal bins like the one placed near Hatcliffe shops. During data collection some residents openly highlighted that the only problem is the scarcity of large legal bins and there are very few, considering the population that relies on it. This clearly shows that most households do not have easy access to proper waste disposal services. Bearing this in mind, many people in informal settlements are forced to burn their waste or just dump it in open spaces near their homes rather than travelling long distances to find the legal refuse bins. One respondent did not answer this sections resulting in a total 99 respondents.

4.5 Community`s perceptions of waste management services and health effects

This section analyses community perceptions of waste management services and their effects on public health. The results are shown as a cross tabulation as shown in table 4.3.

Table 4. 3 *Reliability of waste management services versus perceived health risks in Hatcliffe*

RELIABILITY OF SERVICES	PERCEIVED HEALTH RISK	DO NOT PERCEIVE HEALTH RISK	TOTAL
Reliable	73%	27%	100%
Unreliable	84%	16%	100%

Source: *Field survey, 18-04-26 to 03-05-26 Analysed using SPSS v27*

Table 4.3 shows that there was a higher proportion of residents who perceived waste management as unreliable, these respondents also perceived that there are more associated health risks, as compared to those who perceived services as reliable. This highlights that in this sample, residents who view waste services as unreliable tend to report more health risks and disease outbreaks among Hatcliffe residents. The unreliability of these services were observed as the researcher found large amounts of waste accumulation in different areas. Additionally, the remaining 18 respondents who were not sure about the health risks were excluded from this comparative assessment. Therefore, this clearly shows that residents still experience health concerns despite existing initiatives.

4.6 The implications of waste management on public health

Respondents who reported that they are currently experiencing health symptoms that are related to poor waste management were further asked to specify the most common symptom they faced. The results are presented in Figure 8.

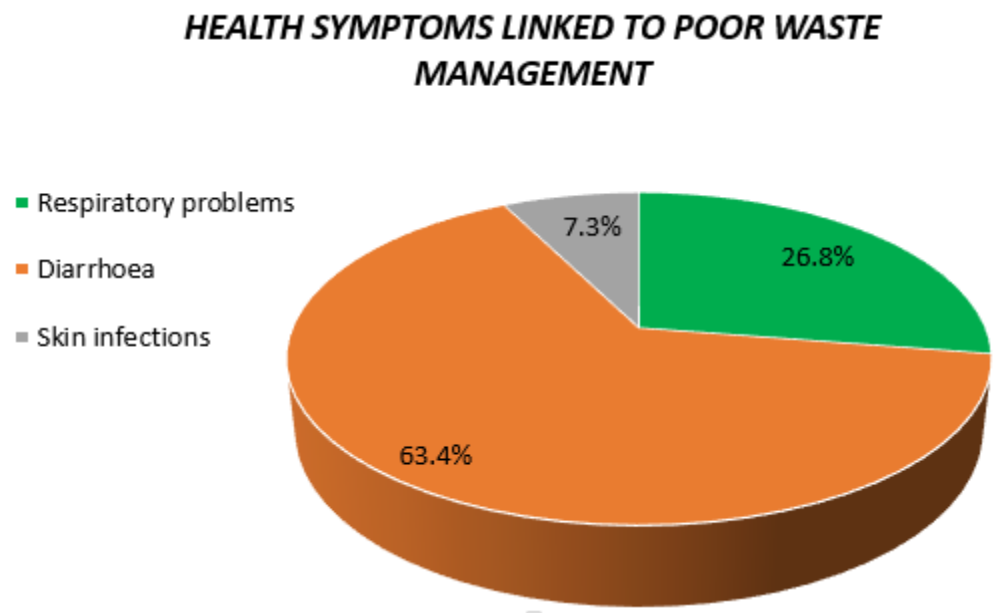


Figure 8: *Health symptoms linked to poor waste management (n=41)*

Figure 8 shows that among the 41 affected households, diarrhoea was the most prevalent health symptom experienced in Hatcliffe, respiratory problems and skin infections are the most common health symptoms linked to poor waste management. This finding highlights that respiratory illness is the predominant health complaint linked to poor waste management, followed by gastrointestinal illnesses. This was also reviewed by Mangoro & Kubanza (2023) who postulated that respiratory disorders are a consequence of poor waste management. Therefore, it is clear that if poor waste management persist in the area study, disease prevalence will increase.

4.6.1 Environmental implications caused by waste management

Respondents were asked to identify the most prevalent environmental challenge resulting from poor waste management in Hatcliffe. The results are presented in Figure 9.

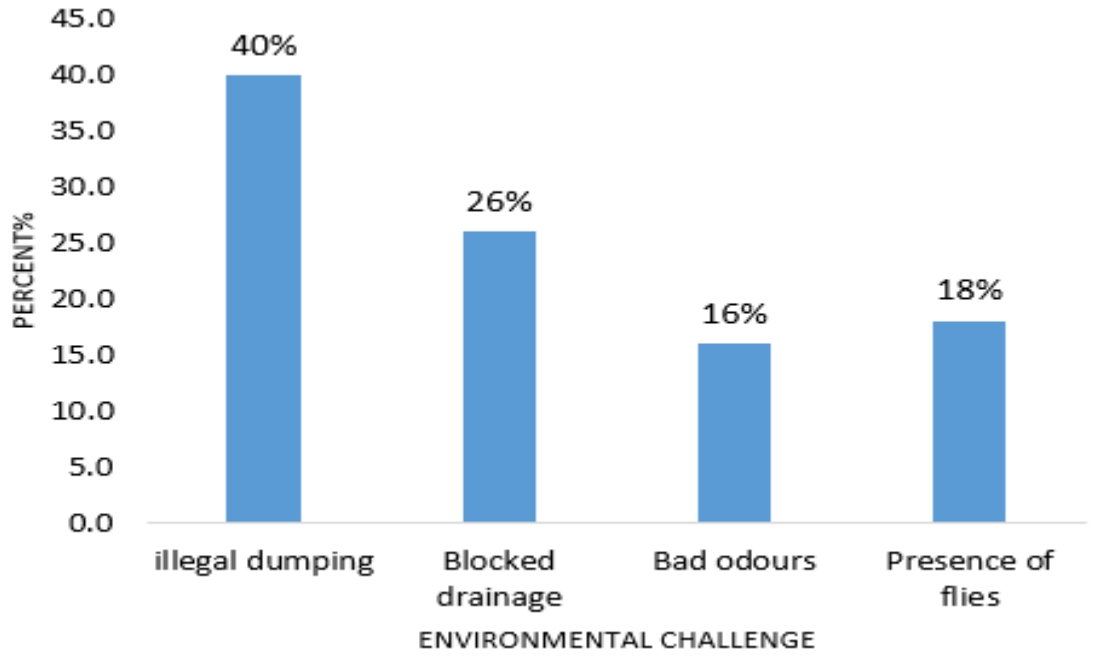


Figure 9: *Environmental challenges linked to poor waste management initiatives in Hatcliffe (n=100)*

Figure 9 shows that illegal dumping was the most commonly observed environmental challenge in the study area. Another common challenge is of blocked drainage reported. This was largely reported by people who stay in the Matombo area and the researcher saw the blocked drainage in the area. Some residents reported the presence of flies and bad odours which are caused by the availability of illegal dumpsites closer to their homes. Together, the results show that poor waste management in Hatcliffe is triggering environmental risks that may increase the rate of health challenges within the community.

4.7 Spatial analysis for sustainable waste management strategies

GIS mapping was carried out using spatial weights obtained from AHP, the specific methodology and computations of which are described in section 3.7.5 .This was done to identify appropriate areas for waste disposal in Hatcliffe. The AHP assigned weights to key environmental and spatial factors, yielding a consistency ratio of 0.06 which is within the acceptable range of less than 0.10. Appendix 3 contains the complete AHP calculation workings. Therefore, this provided a scientific basis for identifying environmentally suitable landfill locations within the study area. Therefore, these results were further used to come up with the final suitability analysis map shown in section 4.7.1.

4.7.1 Suitability analysis map for a landfill in Hatcliffe

To complement the survey findings on public health status, suitability analysis was conducted to identify areas within Hatcliffe that are more appropriate.

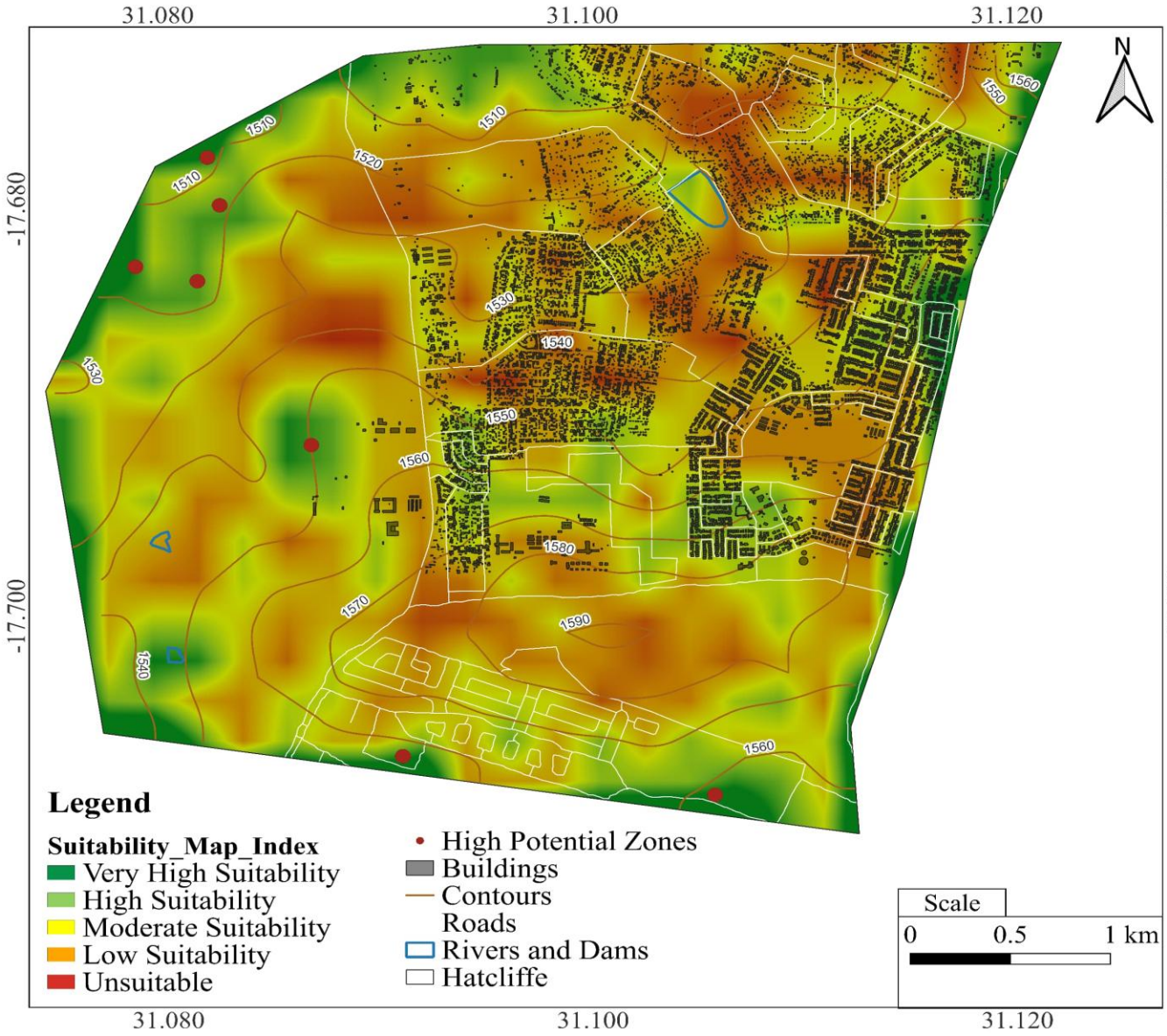


Figure 10: *Spatial suitability analysis for landfills in Hatcliffe: [Source: Created by the researcher using data from Google Earth Explorer (retrieved 28 November 2025]*

The suitability analysis map reveals a concerning pattern for waste management in Hatcliffe. Zones with high population density and proximity to schools were classified as unsuitable, shown in red. Areas classified as very high suitability are limited and shown in small patches especially on the western side of Hatcliffe were there are no water sources low level and not too

close to residential homes. This clearly shows the most appropriate areas for landfill siting which were highlighted in the map as high potential zones. Spatially, the results suggest that waste management cannot be uniformly applied across the study area. Residents allocated in unsuitable areas which are currently have illegal dumpsites may continue facing high health risks if they do not get more frequent waste collection, drainage maintenance and community education. Therefore, the map provides a long-term sustainable strategy to reduce the prevalence of health risks in the area.

4.8 Qualitative descriptive analysis of observational findings on waste management conditions in Hatcliffe

4.8.1 Illegal dumping and waste accumulation

The researcher found illegal dumpsites in Hatcliffe, especially in the Matombo area, Hatcliffe extension near the dam and the consortium (Gabella area). Large amounts of uncollected waste were observed along roadsides and very close to households. These results highlight that residents mostly depend on illegal dumping because of inadequate collection services. The researcher observed community members from informal settlements have limited access to official waste collection services. Waste build-up in residential areas cause environmental contamination and expose occupants to pathogens. The community's sanitation conditions were reduced by the presence of flies and bad odours, especially those who stay very near, less than 100 metres from dumpsites. Therefore, these findings support the concerns expressed in the problem statement about the gap between current waste management programs and the study area`s actual environmental health conditions. Photography 4.1 shows the illegal dumpsite that was captured on camera.



Photograph 4.1. *Illegal dumpsite at Matombo area; Captured 3 May 2026: coordinates - 17.689849- 31.114767*

4.8.2 Burning of waste near residential houses in Hatcliffe

Field observations conducted in Hatcliffe revealed that waste burning is a common waste disposal practice within residential areas. Dumped waste was observed being openly burned near homes, particularly in areas with limited municipal waste collection. With that in mind, this supports quantitative findings which highlighted that refuse incineration was the common disposal method used by residents. The continued burning of waste in open spaces further contribute to air pollution due to smoke`s release and toxic fumes produced into the atmosphere. This increases the public health risks specifically to residents who reside close to those areas. The findings also revealed that limited municipal service delivery on waste collection is forcing residents to adopt unsafe waste management practises in Hatcliffe. Therefore, bearing this in mind it is clear that despite the existence of waste management initiatives inadequate sanitation and public health problems persist to affect Hatcliffe residents. The burning of waste can be evidenced in the Photograph 4.2.



Photograph 4.2. *Burning waste observed near residential houses in Hatcliffe Consortium, Alpha area: Captured 27 April 2026: Coordinates:-17.68109- 31.112230*

4.8.3 Observations on existing waste initiatives

During the field visit, the researcher observed that there are no ongoing clean-up efforts in the study area. This was so because there were no announcements or posters about forthcoming campaigns. The researcher even walked through different sections of Hatcliffe including Consortium and Hatcliffe extension on the first Friday of May but no clean-up activities were witnessed in the area. No council workers were seen conducting the initiative on the day. There were no indication that any environmental enlightenment campaign had recently taken place. Several local members said they had never taken part in a council-led clean-up when questioned casually. Another resident remarked that “one ever come to organise us for the clean-ups”. “We clean our own yards, but the open spaces are not our concern,” another resident remarked .These observations directly contradict with the provisions of Environmental Management Act (Chapter 20:27 and the City of Harare`s Integrated Solid Waste Management Plan which mandate regular waste collection and environmentally responsible disposal. The absence of active clean-up initiatives and widespread illegal dumping in Hatcliffe therefore confirms that, legislative frameworks are not being effectively translated into practice at community level.

4.8.4 Cross-validation of findings

The quantitative data is further validated by these observational findings as the direct visual evidence supported the quantitative findings which showed that there is 32% reported frequency waste burning and 40% concern about illegal dumping. Also, the survey found high rates of respiratory symptoms and diarrhoeal illnesses which is therefore clearly highlighted through these observations which shows residents directly exposed to toxic smoke , this was validated by Abubakar et al. (2022) who noted that uncontrolled dumping and open burning are typical unsustainable practices done in the Global South cities. Flies moving from contaminated waste to households also supports high rates of diarrhoeal illnesses caused by waterborne pathogens as supported by Omokaro et al. (2024). This clearly shows that these field notes shed more light on the precise exposure pathways that connect environmental factors that affect public health outcomes. Poshai & Intauno (2024) have it that, there is sporadic refuse collection in Zimbabwe`s urban areas and community clean up initiatives are undermined by the residents which clearly aligns with the researcher`s observations as no ongoing clean-up initiatives were witnessed and some respondents even said they are not interested in being part of the clean-up initiatives.

4.9 Discussion of findings

The first objective`s results reflect that 39% of households rarely or never receive waste collection, which is directly consistent with results found by Poshai & Intauno (2024), who revealed that the lack of garbage collection vehicles and fuel has led to irregular refuse collection in Zimbabwe`s urban areas. Nhubu et al. (2020) analysed solid waste options in Harare and found that landfilling has negative environmental impact risks, while the current study found that 32% of households practice open burning, which was referred to as a catalyst to increased environmental risks according to Nhubu et al.'s (2021) framework.

Mangoro & Kubanza (2023) revealed that community perceptions directly relate inadequate Solid Waste Management to negative health outcomes. The current study clearly supports the finding by quantifying the perception gap, showing that even among residents who find services reliable, 73% still perceive health risks. This suggests that perceived health risks cannot be a function of service satisfaction only, but also of observable environmental conditions. The

current study`s findings showed that 84% of residents who view services as unreliable perceive health risks as supported by Poshai & Intauno (2024), who observed that health risk awareness may be a driver to community initiatives, as the continuous dumping behaviour shows that awareness alone does not change behaviour.

The current study also revealed that illegal dumping has 40%, burning has 32% and blocked drainage has 26%, which directly reflect the patterns described as characteristics of unsustainable solid waste handling in Africa by Abubakar et al. (2022). Nhubu et al. (2020) focused on environmental impact potentials of different refuse handling options, while the current study complements their work by documenting the health outcomes associated with the current waste control initiatives. According to Omokaro et al. (2024), waterborne diseases like cholera and dysentery spread through contamination of water sources from unregulated dumpsites near human settlements in Sub-Saharan Africa. Therefore, diarrhoea is the most common health symptom in Hatcliffe, with 63.4%, this illness is consistent with 40% illegal dumping and a 26% of blocked drainage observed in Hatcliffe. Hence, the current study validates other researchers' findings in the context of Zimbabwe.

The Analytical Hierarchy Process offers an organised, logical and scientific framework for resolving waste management-related problems, as shown by Barbosa et al. (2025). The current study revealed a Consistency Ratio of 0.06, which is within the acceptable range (CR< 0.10), specified by Barbosa et al. (2025), confirming the reliability of the pairwise comparisons. Therefore, these findings enabled the validity of the suitability analysis map, strengthened by this methodological alignment. Uncontrolled dumpsites are frequently located near households and water sources in Sub-Saharan Africa, according to Abubakar et al. (2022). The current study provides a mitigation strategy to reduce this challenge by showing suitable sites that are far from households to promote sustainability within the community.

4.10 Chapter summary

This chapter revealed that a large number of residents rely on burning waste as a common waste disposal practice. This was due to limited legal dumpsites and the available large bins are very far away which results in man residents illegally dumping near their households. The findings also revealed that even when some residents are satisfied with waste services, they still worry

about getting sick, meaning the visible waste in the community creates fear regardless of service quality. Diarrhoea is the biggest health problem and illegal dumping together with blocked drains makes the situation worse. Finally, the AHP and map produced in this study provide a scientific way to decide where to put waste facilities in the future.

CHAPTER 5: SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

5.1 Introduction

This section concludes research`s key findings, explains their implications for Hatcliffe residents, draws conclusions and provides useful suggestions to the Environmental Management Act, the local council and the residents. The section is divided into four sections, a summary of findings, an interpretation of findings, conclusions drawn and recommendations

5.2 Summary of findings

This study examined the health effects of Hatcliffe residents` waste management practices and the researcher used GIS techniques, walked around the area taking pictures and observing the situation at hand. One hundred local people answered the researcher`s questionnaire. The majority of people either burn their waste or dispose it in public open spaces, according to the study`s findings. This happens due to lack of legal dumpsites in the area and poor service delivery from the municipal waste collectors. On the findings pertaining community perceptions,

locals are concerned of falling ill because even those who are getting better services are also afraid of prevalence of diseases which are related to poor waste management. This is due to the widespread presence waste in open areas, which makes people feel unsafe at all times. Health issues are the subject of the third finding .The most prevalent illness associated with waste is diarrhoea. The researcher observed children playing near dumpsites and breathing smoke, this provides an explanation for why people are becoming ill in the area. During field visit, the researcher observed that no clean-up campaigns were active in the area and some residents confirmed that they had never participated in such initiatives. This clearly shows that sustainable waste management efforts only exist on paper and do not reach the ordinary people and they are not effectively followed. Therefore, the researcher managed to come up with a suitability analysis map, which was made based on factors like roads, water sources, land use and elevation. The suitability map illustrated the ideal locations for waste facilities in Hatcliffe, so as to reduce poor waste management initiatives that affect public health and sanitation.

5.3 Conclusions

The purpose of this study was to assess the effectiveness waste management initiatives on public health and sanitation status in Hatcliffe. The conclusion is evident after examining the evidence based on the management of waste which is not properly done. The residents are not blamed for that due to the fact that they are limited dumpsites and the council does not offer routine waste collection. Majority of residents burn or dump their waste because of this failure. Community members get sick as a result of these behaviours. During observational visits children were playing near trash, smoke and flies everywhere. Locals who are content with their own collection are still concerned about becoming ill because the entire area appears hazardous and unclean. Therefore, a map created in this study indicates the precise locations of waste facilities for the community. However, the community must be involved, the council must take action and laws must be applied equitably to effectively manage the existing initiatives.

5.4 Recommendations

Firstly, recommendations to the city of Harare, the study revealed that 39% of households receive waste collection rarely or never. This is the primary cause of waste being burned or dumped by the majority of community members. This is because residents are forced to handle their waste when it remains at home for weeks with nowhere to go. The municipality should

collect waste in every household in once a week or twice in all areas of Hatcliffe. When legal dumping sites are far, according to the study, 47% of households live more than 500 metres away, for a person carrying bulky bag of smelling waste that is too far leading to open dumping. Every home should have a small collection point within a walking distance. When all these are collected they should be officially disposed to the landfill sites mentioned in the suitability analysis map. There is also need to clean up the existing illegal dumps and post signs that prohibit illegal dumping.

In addition, another recommendation is to the Environmental Management Agency, according to the study 32% of households primarily dispose their waste through burning. The researcher witnessed smoke rising from several yards and residents were there breathing those harmful fumes while attending to the fire. EMA should monitor the community`s air quality especially in informal area like Hatcliffe extension and Consortium. Environmental Management Agency should also make sure that all landfills that are going to be approved should adhere to environmental regulations.

Also, to Hatcliffe residents, there is need to create clean-up teams for hotspots where illegal dumping occurs. According to the study, 40% illegal dumping is the largest environmental problem. The residents have to take action not entirely waiting for the council. There is need to post straightforward signs that refrain community members from dumping after cleaning. According to the study, many locals are impacted from waste to food, residents can lessen that issue by covering their waste before disposing it of .They can use a bin with lid, old sack or large plastics to cover the waste. Besides that some local people witness other residents openly dumping their waste in open areas. Residents should report any illegal dumping to the council.

5.5 Chapter summary

This chapter summarized the study`s main conclusions, explained what they mean to Hatcliffe residents, made final judgements regarding waste management and public health. Helpful suggestions to the municipality, Environmental Management Agency and Hatcliffe residents was offered. The primary conclusion is that the waste management in Hatcliffe is failing due to infrequent waste collection and limited dumpsites which are very far. People are already

becoming ill as a result of this failure, especially with diarrhoea and respiratory issues. Therefore the study`s suitability map was the suggested mitigation measure to the problem.

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APPENDICES

Appendix 1: BUSE Research Clearance Letter

Bindura University of Science Education

SUSTAINABLE DEVELOPMENT DEPARTMENT

BINDURA,ZIMBABWE
WhatsApp : +263773281212
E-mail: jbowora@buse.ac.zw or jb.bowora@gmail.com

BINDURA UNIVERSITY OF SCIENCE EDUCATION

CHAIRPERSON'S OFFICE

Friday, 17 October 2025

TO WHOM IT MAY CONCERN

Dear Sir/Madam

RE: RESEARCH SUPPORT LETTER FOR SUSTAINABLE DEVELOPMENT STUDENT

This is to confirm that **MURINGANI RUTENDO LISSA** Registration Number **B220749B** is our fourth-year student doing Bachelor of Science (Honours) Degree in Development Studies (HBSc.DG) at Bindura University of Science Education in the Sustainable Development Department.

In the fourth-year, students are required to do field research which require them to do data collection for their research purposes from various sources as part of their degree programme.

Kindly accord him/her the due cooperation the student truly deserves.

Yours faithfully,

CHAIRMAN
GEOGRAPHY DEPARTMENT
FACULTY OF SCIENCE

Dr. J. Bowora (PhD)
(Chairperson)

CITY OF HARARE
DEPARTMENT OF CORPORATE SERVICES AND HOUSING
02 MAR 2026
DISTRICT OFFICER
HATCLIFFE DISTRICT OFFICE

Appendix 2: Structured questionnaire

STRUCTURED QUESTIONNAIRE GUIDE

NOTE: Please tick the correct box for your answers

Demographic information

Gender

e Female

Age group

18- 25 yrs. 46- 55 yrs.

26- 35 yrs. 56 yrs and above

36- 45 yrs.

Occupation

Formal employment

Self-employed

nformal employment

Unemployed

Objective 1: To reveal the current solid waste management practices in Hatcliffe

What is the main method your household uses to dispose of solid waste?

Municipal waste collection

Private waste collector

Burning waste

Dumping in open spaces

Other

How frequently is solid waste collected from your area?

Once a week

Once every two weeks

Once a month

☐ Rarely or never

Does your household store waste in containers before disposal?

☐ Always

☐ Sometimes

☐ Never

How far is your household from the nearest legal dumpsite or waste disposal area?

☐ Very near (less than 100 metres)

☐ Moderately near (100–500 metres)

☐ Far (more than 500 metres)

Objective 2: To analyse the community's perceptions of waste management services and health effects

How would you rate the reliability of waste collection services in your area?

☐ Very reliable

☐ Reliable

☐ Unreliable

☐ Very unreliable

Do you believe that waste management services in Hatcliffe are adequate?

☐ Yes

☐ No

☐ Not sure

In your opinion, does poor waste management contribute to health problems in your community?

☐ Yes

☐ No

☐ Not sure

How concerned are you about the effects of waste disposal on community health?

☐ Very concerned

☐ Concerned

☐ Slightly concerned

☐ Not concerned

Objective 3: To assess the implications of waste management on public health and sanitation

Have you observed environmental problems caused by poor waste management near your household?

☐ Yes

☐ No

Which environmental problem is most common in your area.

☐ Illegal dumping

☐ Blocked drainage systems

☐ Bad odours

☐ Presence of flies or mosquitoes

Have you or any member of your household experienced health symptoms that you think are related to poor waste management?

☐ Yes

☐ No

If yes, which health symptom has been most common?

☐ Respiratory problems

☐ Diarrhoea

☐ Skin infections

☐ Headaches

Objective 4: To propose sustainable strategies for waste management initiatives

Do you think community participation can improve waste management in Hatcliffe?

☐ Yes

☐ No

☐ Not sure

Are you willing to participate in community clean-up campaigns?

☐ Yes

☐ No

☐ Maybe

Which strategy do you think would most improve waste management in Hatcliffe?

☐ More frequent waste collection

☐ Public awareness campaigns

☐ Recycling programmes

☐ Stricter waste disposal regulations

Appendix 3: AHP pairwise comparison matrix and consistency ration calculations

CR Value = 0.060 Reasonable Consistency

PAIRWISE COMPARISON MATRIX

	F1	F2	F3	F4	F5
FACTOR	Soil Type	Topography	Land Use Land Cover (LULC)	Rivers	Roads
Soil Type	1.00	0.30000	0.25000	0.50000	0.50000
Topography	3.00000	1.00	0.50000	1.00000	2.00000
Land Use Land Cover (LULC)	4.00000	2.00000	1.00	3.00000	3.00000
Rivers	2.00000	1.00000	0.33000	1.00	0.33000
Roads	2.00000	0.50000	0.33000	3.00000	1.00
Sum	12.00	4.80	2.41	8.50	6.83

STANDARDIZED MATRIX

		Soil Type	Topography	Land Use Land Cover (	Rivers	Roads	Weight
F1	Soil Type	0.08	0.06	0.10	0.06	0.07	7.6%
F2	Topography	0.25	0.21	0.21	0.12	0.29	21.5%
F3	Land Use Land Cover (LULC)	0.33	0.42	0.41	0.35	0.44	39.1%
F4	Rivers	0.17	0.21	0.14	0.12	0.05	13.6%
F5	Roads	0.17	0.10	0.14	0.35	0.15	18.1%

CONSISTENCY INDEX (CI) & CONSISTENCY RATIO (CR) WORKSHEET

		Soil Type	Topography	Land Use Land Cover (	Rivers	Roads	SUM	SUM/Weight
F1	Soil Type	0.08	0.06	0.10	0.07	0.09	0.40	5.21
F2	Topography	0.23	0.22	0.20	0.14	0.36	1.14	5.29
F3	Land Use Land Cover (LULC)	0.31	0.43	0.39	0.41	0.54	2.08	5.31
F4	Rivers	0.15	0.22	0.13	0.14	0.06	0.69	5.11
F5	Roads	0.15	0.11	0.13	0.41	0.18	0.98	5.39

count	5.00
lambda max	5.268
CI	0.067
CR	0.06
constant	1.12

Saaty's CIr values for matrices are given by the following table

Size of Matrix	Random Consistency (CIr)	
1	0	1
2	0	2
3	0.58	3
4	0.90	4
5	1.12	5
6	1.24	6
7	1.32	7
8	1.41	8
9	1.45	9
10	1.49	10