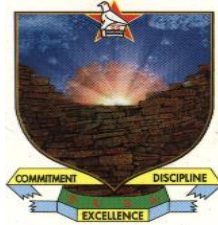


BINDURA UNIVERSITY OF SCIENCE EDUCATION
FACULTY OF SOCIAL SCIENCES DEPARTMENT OF PEACE AND
GOVERNANCE



IMPLICATIONS OF IMPROPER URBAN SOLID WASTE DISPOSAL
ON HUMAN SECURITY: CASE OF BEITBRIDGE

By

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ABSTRACT

The essence of the research was to unpack the implications of improperly disposed solid waste on human security in Beitbridge particularly introspecting on health security and environmental security. In pursuit of the foregoing, the researcher used questionnaires, observations and interviews to gather data. The study looked at waste disposal in all the six Beitbridge urban wards and how they are a threat to the health of the residents and the environment. Study findings revealed that there are so many places with improperly disposed solid waste especially in wards 3, 4, 5 and 6. The implications of the identified improperly disposed solid waste to the health security of residents were laid bare and inter alia included exposure to gastro intestinal infections, malaria from breeding mosquitoes, injuries because of exposure to sharp objects especially by waste pickers and high risk of infectious diseases. Also, the improperly disposed solid waste in Beitbridge was adjudged as a threat to environmental security through the pollution of groundwater through leachate, increased risk of veld fires as waste dumpsites are burnt and the pollution of the Limpopo River by plastics, pampers, human faecal matter carried by floods. In light of the findings, the researcher recommended that the Municipality of Beitbridge do away with the Dulivadzimu dumpsite and construct an engineered landfill that is environmentally friendly. Also recommended was the execution of anti-litter campaigns, enforcement of by-laws and education of residents to be responsible in handling litter.

DECLARATION

I declare that this research project titled, “**Implications of Improper Urban Solid Waste Disposal on Human Security: Case of Beitbridge**” for the award of the Masters of Science in Peace and Governance at Bindura University is my original work. I generated the information presented in this research and in situations where sources were used or quoted, acknowledgement was done by means of complete references.

Signed..... Date.....

Shupikayi Chivhaku

Approval

This project has been submitted for examination with my approval as supervisor:

Signed..... Date.....

Dr C.K. Muchemwa

DEDICATION

I dedicate this research project to my son Tavonga O'Neal and daughter Jewel Mary Attidaishe. Hope one day you will take the research to the next level. God bless you .I love you.

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I'm particularly indebted to my supervisor Dr CK Muchemwa for the tireless supervision that gave meaning to this research. I have profound gratitude for his commitment and towering advice that gave grounding to the research project.

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To my family especially Dad, mom, wife and kids in particular, I'm grateful for your patience for I compromised my fatherly duties while pursuing the studies. I know I cannot mention all the people who contributed towards the research project just know I have you in my prayers and the contributions from my work peers will forever be indelible. To Chiedza, Gomo, Elliot and Solomon, I say, "there is your challenge." Thank you very much for inspiring me to complete this race.

ABBREVIATIONS & ACRONYMS

EMA	Environmental Management Agency
MOB	Municipality Of Beitbridge
ISWM	Integrated Solid Waste Management

TABLE OF CONTENTS

Contents	Page
Chapter 1	
1.0	
Introduction.....	1
1.1 Background of the study.....	1
1.2 Purpose of the study.....	5
1.3 Statement of the problem.....	5
1.4 Objectives of the study.....	5
1.5 Research Questions.....	6
1.6 Assumption of the study.....	6
1.7 Significance of the study.....	6
1.8 Delimitations of the study.....	7
1.9 Limitations of the study.....	7
1.10 Definition of key terms.....	7
1.11 Proposed Chapter outline.....	8
1.12 Chapter Summary.....	8
Chapter 2	
Literature Review and Conceptual Framework	9
2.0 Introduction.....	9

2.1 The Conceptual framework.....	9
2.2 Concept of Human Security.....	9
2.3 Integrated Sustainable Waste Management Model.....	11
2.4 Solid Waste.....	11
2.5 Sources of solid waste in the community.....	12
2.6 Waste classification.....	12
2.7 Functional elements of a Solid Waste Management System.....	13
2.7.1 Waste generation.....	13
2.7.2 Waste handling, storage and separation at the source	13
2.7.3 Collection.....	13
2.7.4 Transfer and transport.....	14
2.7.5 Recovery and recycling.....	14
2.7.6 Disposal.....	14
2.8 Methods of solid waste disposal.....	14
2.8.1 Indiscriminate waste disposal.....	15
2.8.2 Communal open dumping or dumpsite.....	15
2.8.3 Burial pit.....	15
2.8.4 Open burning	15
2.8.5 Sanitary landfill.....	15
2.8.6 Incineration.....	16
2.9 Improper solid waste disposal implications on health security.....	16
2.9.1 Exposure to medical solid waste.....	17

2.9.2	Exposure to solid waste among collectors.....	17
2.9.3	Exposure of neighbourhood to dumpsites.....	18
2.9.4	Exposure of solid waste to pickers and recyclers.....	20
2.10	Improper Solid waste disposal impact on environmental security.....	20
2.11	Case study: Rawalpindi City, Pakistan.....	22
2.12.	Legislative Framework Governing Waste Management in Zimbabwe.....	23
2.13	Chapter Summary.....	24

Chapter 3

	Research methodology.....	25
3.0	Introduction.....	25
3.1.	Research design.....	25
3.2	Methodology.....	26
3.3	Target population.....	26
3.4	Sample Size.....	27
3.5.	Data sampling techniques.....	27
3.6.	Data collection methods and procedures.....	28
3.6.1	Interviews.....	28
3.6.2	Questionnaires.....	29
3.6.3	Observations.....	29
3.7.	Primary sources of data.....	30
3.8.	Secondary sources of data.....	30

3.9. Data Analysis and Presentation Procedures.....	30
3.10. Data Validity and Reliability.....	31
3.11. Pilot Testing	31
3.12 Ethical Considerations.....	31
3.13. Chapter Summary.....	32

Chapter 4

Data presentation, analysis and discussion of findings	33
4.0 Introduction.....	33
4.1. Response rate of questionnaires.....	33
4.2. Analysis of questionnaire responses.....	33
4.2.1 Solid waste generation.....	33
4.2.2. Other improper solid waste disposal methods used by Beitbridge residents.....	34
4.4. Improper solid waste disposal sites in Beitbridge.....	35
4.5. Beitbridge Dulivadzimu Municipality Dumpsite.....	38
4.6. Implications of the improperly disposed solid waste on health security of Beitbridge residents.....	39
4.7. Implications of improperly disposed solid waste on environmental security in Beitbridge.....	42
4.8. Suggestions from respondents on what Beitbridge Municipality can do to improve waste disposal in Beitbridge.....	44
4.9. Chapter summary.....	45

Chapter 5

Summary, Conclusions, Recommendations And

Areas For Further Research.....	46
5.0 Introduction.....	46
5.1 Summary.....	46
5.2 Conclusions.....	47
5.3 Recommendations.....	47
5.4 Areas for further study.....	48
Appendices.....	49
References.....	55

LIST OF TABLES

Table 1.1 Showing Types of solid waste	12
Table 1.2 Showing effects of e-waste on health.....	21
Table 4.1 Showing number of questionnaires completed and response rate.....	33
Table 4.2 Showing Frequency of waste collection by MOB.....	34
Table 4.3 Showing Undesignated dumpsites in Beitbridge.....	35

LIST OF FIGURES

Figure 1.1 Showing linkages between poor solid management and health outcomes.....	19
Figure 4.1 Showing Solid waste disposal methods.....	34
Figure 4.2 Showing image of the industrial working site.....	36
Figure 4.3 Showing image of illegal dumpsite opposite House Number 5720 to 5810 in ward 6.....	37
Figure 4.4 Showing image of illegal dumpsite in ward 4	38
Figure 4.5 and 4.6 Showing MOB dumpsite.....	39
Figure 4.7 Showing MOB dumpsite in smoke.....	41
Figure 4.8 and 4.9 Showing collected waste ready for recyle.....	42
Figure 4.10 Showing Solid waste in the stream flowing to Limpopo river.....	44

CHAPTER 1

Introduction

1.1 Background of the study

The issue of solid waste management is a global concern that does affect all and sundry. Human security worldwide has come under serious threat as a result of increasing solid waste generation. According to the World Bank (2016), around the world, waste generation rates are increasing with the world's cities in 2016 generating about 2,01 billion tonnes of solid waste translating to a footprint of 0,74 kilogrammes per person per day. The high global waste generation cited does not have corresponding waste removal actions as the World Bank (2016) says that about 48% of waste generated in low income countries is collected for disposal. This implies that 52% of the solid waste remains uncollected threatening human security.

Solid waste generation across the globe is expected to continue increasing as a result of urbanisation and population growth. The foregoing is captured by the World Bank (2016) that highlighted that solid waste generation is expected to increase by 70% from the 2016 levels to 3,4 billion tonnes in 2050. Hoonweg and Bhadha-tata (2012) weigh in increasing global waste generation intimating that annual global municipality solid waste generation is expected to reach 2,2 billion tonnes in 2025 from 1,3 billion metric tonnes in 2012. The United Nations (2009) reinforced the relationship between population growth and waste generation indicating that in Africa and Asia the dramatic population increase in urban areas is a typical phenomenon that leads to the astronomical increase in municipal solid waste generation. At the global scale, the World Bank (2016) says that 33% of the waste is mismanaged through open dumping, burning or other irregular methods.

The improperly disposed solid waste pose health security concerns and the World Bank (2016) highlights that poorly managed solid waste is contaminating the world's oceans, clogging drains and causing flooding, transmitting diseases via breeding vectors, increasing respiratory problems through airborne particles from burning of waste, harming animals that consume without knowing and affecting economic development through diminished tourism. The fastest growing regions in the world according to the World Bank (2016) are sub Saharan Africa and South Asia, Middle East and North Africa where by 2050 solid waste generation is expected to triple, double and double respectively. The United Nations (2009) highlights that based on the volume of waste generated, it is understood that 1,6 billion tonnes of carbon dioxide

equivalent greenhouse gas emissions were generated from solid waste treatment in 2016 driven primarily by disposing waste in open dumps and landfills without landfill gas collection mechanisms.

The global trend in solid waste management points however to improved solid waste disposal systems in developed countries. The developed countries have managed to employ different methods to reuse generated solid waste including energy recovery, recycling, composting in addition to using incinerators and sanitary landfills. In Africa, according to UNEA 2009, poor waste management practices in particular the widespread dumping of wastes in water bodies and uncontrolled dumpsites aggravates the problems of generally low sanitation levels. UNEA (2009) says that in Africa, infrastructure and land use planning including waste management is not coping with growth of urban areas. Godfrey (2018) highlights that waste management in South Africa and other developing countries is typically characterised by dumping of waste often associated with open burning that contributes to greenhouse gases. Godfrey (2018) also says that unfortunately very little data on the cost of inaction exists for developing countries as uncontrolled dumping of waste in urban spaces increases the risks of disease, urban flooding and environmental pollution.

In Africa, according to Mugaga (2006), a person can generate about 0,5 kilogrammes of solid waste per day but this is not much compared to 2 -3 kilogrammes generated in the North but if poorly managed it can become dangerous to health, a threat to the environment and a nuisance but according to Scheinberg, Jgosse and Anschutz(2004) proper solid waste management could contribute to give residents a pride of their own town, a livelihood for poor people and a model for good governance for other public spaces. Local authorities in urban areas as observed by Jaensson (2008) lack funds and do not have the necessary equipment and vehicles to carryout proper service all the way to disposal sites. That explains mostly why there is a lot of dumped and uncollected solid waste in Zimbabwe's cities.

Several researches have been carried out on solid waste management in Zimbabwe including Beitbridge, but this researcher noted that in most of the researches not much has been done to unpack the implications to human security of some of the Solid Waste disposal methods used by the majority of urban local authorities. In Beitbridge the Municipality collects solid waste and improperly dumps it at the municipal dumpsite in ward 4 without due regard to the implications of the act to both health and environmental security. The implications of improper

solid waste disposal on human security can only be understood better by unpacking the concept of human security.

The concept of human security gained prominence in the post-cold war era where the conception of security shifted from being state centric and became focused on the individual. Menon (2007) highlighted that it was the United Nations Development Programme Human Development Report of 1994 which explicitly articulated the importance of human security. Menon (2007) explained that anything that affects the security of the individual and collective existence may come under human security. Though there are other components of human security as defined by UNDP (1994), this research will look at health security and environmental security as they are directly affected by improper and indiscriminate solid waste disposal. Health Security according to UNDP (1994) denotes to an individual's freedom from various diseases and debilitating illnesses and his or her access to health care. Environmental security was conceived of as the integrity of the land, air, water and vegetation which make human habitation possible. It is pertinent therefore for the urban local authorities to put forward human centric governance initiatives for the furtherance of human security.

Practical Action (2007) informs that Zimbabwe produces an average of 2,5 million tonnes of household and industrial solid waste per annum. Olusegan et al (2018) quips that improper management of solid waste has become one of the problems facing developing urban cities because of the boom in population growth and little attention is given to solid waste management practices as it is common to see heaps of waste in major cities, littering the streets, dumped indiscriminately in drainages, vacant plots and open spaces. Masocha and Tevera (2003) also said that solid waste is transported and dumped at dumpsites while the remainder is dumped in undesignated areas namely roadsides, storm water drains, open spaces and passages between buildings. MUTETWA et al (2016) reveals that in most urban areas in sub Saharan Africa half of the solid waste generated is not collected posing serious health and environmental impacts in Zimbabwe the problem of solid waste management is common in all the urban areas like Harare, Masvingo, Mutare Chitungwiza and Gweru. Having looked at solid waste management dynamics at the global level, continental level and national level the research is narrowed down and Beitbridge is used as a case study to understand, the implications of improper solid waste disposal on human security in Beitbridge.

Beitbridge town is a border town in Zimbabwe geographically located in Matabeleland South Province. The town according to the Zimbabwe statistics agency (2012) has a population of

40000 people making it one of the fastest growing centres in the country as its population doubled between 2002 and 2012. Its strategic location makes it a conduit of the movement of people and goods in Southern Africa. According to the statistics availed to the researcher by the Beitbridge Department of Immigration Assistant Regional Immigration Officer Memory Mugwagwa, Beitbridge Border Post supports a transit population of 10000 people per day and these leave solid waste at both designated and undesignated sites. Chanza (2011) says that demographic pressure emanating from natural increase and transit population added to economic challenges are evidently aggravating the problem of solid waste accumulation manifesting through dumping.

Beitbridge town has six urban wards namely Ward 1, Ward 2, Ward 3, Ward 4, Ward 5, Ward 6. To improve solid waste management, the Beitbridge municipality operates with a fleet of two tractors and two refuse collection trucks. Though the municipality has by laws that make it mandatory for each household to have a bin for waste collection, the enforcement has not been effective that some homes do not have bins and end up dumping waste in undesignated areas and even doing open air burning. For the waste collected by the municipality, there is no separation of solid waste at the collection point. The municipality collects the solid waste from households, Beitbridge Border Post, schools, churches, Beitbridge District Hospital and Dulivadzimu clinic, the Dulivadzimu bus terminus, shops, the industrial sites and other areas. Instead of depositing the solid waste in sanitary landfills, the refuse is dumped at the dumpsite in Ward 4. The dumpsite is about two kilometres from the Limpopo River, one kilometre from Dulivadzimu ward 4 houses and two kilometres from Beitbridge Border post. Residents scavenge at the dumpsite for food, recyclables and reusables to salvage a living at the stinking, drenched and fly haven.

Also critical to note is the WaMlala tributary that feeds into the Limpopo River. It enters Beitbridge town via ward 6 at the new stands and flows south wards to the Limpopo River passing through Mangava Business Centre, Mbedzi Business Centre, Mashakada Business Centre and Dulivadzimu bus terminus. It came to the attention of this researcher that residents dump solid waste into this tributary. Additionally, most of the houses in Beitbridge New Stands and in Ward 4 are not connected to the Municipality sewer system that in some instances people defecate in the tributary. Faecal matter is strewn all over from the point where the river enters town to the point it exits the residential suburbs enroute to the Limpopo river. The above clearly shows that solid waste is dumped indiscriminately at undesignated points by residents

in Beitbridge while the Beitbridge Municipality dumps the bulk of the solid waste at the unsanitary municipal dumpsite in Ward 4.

1.2 Purpose of the study

This research seeks to unpack the threats to human security posed by improper solid waste disposal in Beitbridge particularly examining the implications of the municipal dumpsite to health of residents and the environment.

1.3 Statement of the problem

Beitbridge Municipality unlike other municipalities like Bulawayo and Harare has no sanitary landfills for waste disposal and resorts to dumping solid waste at the Beitbridge municipal dumpsite in ward 4 about two kilometres from the Limpopo River and a kilometre from the nearest houses in the same ward. Additionally, there are also areas within the residential suburbs laden with uncollected refuse for lengthy periods of time and the waste includes faecal matter and that according to Chirisa (2012) reflects an environmental disaster which is not only catastrophic but also a drawback to the concept of sustainable development and health for all by 2020. The uncollected solid waste and that which is improperly disposed becomes a problem to the residents of the of Beitbridge town and as Mangizvo (2010) observes ,the solid waste contributes to the contamination of ground and surface water which affects human health.

1.4 Objectives of the study

- 1 Bring to the attention of Beitbridge Municipality areas that need solid waste removal
- 2 Identify the implications to health security of improperly disposed waste
- 3 Identify the implications to environmental security of improperly disposed waste
- 4 To design appropriate and sanitary waste disposal methods for adoption by the Beitbridge Municipality

1.5 Research questions

- 1 Which areas in Beitbridge town require solid waste removal?
- 2 What are the effects to health security of the improperly disposed solid waste?
- 3 What are the effects to environmental security of improperly disposed waste?
- 4 What are the appropriate and sustainable waste disposal methods that can be adopted by Beitbridge Municipality?

1.6 Assumptions of the study

The researcher has a coterie of assumptions in this research. The researcher assumes that the Beitbridge Municipality solid waste dumpsite in Ward 4 and other improper waste disposal sites in the town pose health threats to the urban population of the border town as well as causing critical environmental destruction. The researcher also assumes that respondents will cooperate with him during the execution of the research to give credence to the research and contribute positively in policy making for the betterment of the municipality and other urban local government authorities. Also, the researcher assumes that Beitbridge Municipality will adopt some recommendations from the research so that health and environmental security some tenets of human security are guaranteed.

1.7 Significance of the study

This research will immensely contribute to policy making and also enrich the academia. In addition, it is imperative to also note that this research has the wherewithal to horn the research competences and skills of the researcher. Information gained in this research on the threats to health security and environmental security posed by improper waste disposal in Beitbridge town will be used as a baseline to explore new areas related to it. The Beitbridge Municipality might consider adopting some recommendations proffered on waste disposal to ensure that human security is attained and maintained. Anastas (2012) highlighted that research studies should contribute to fundamental knowledge or provide solutions to the real world problems and so will this research be pivotal in ensuring that proper waste disposal is done in the border town.

1.8 Delimitations of the study

This research will be conducted in Beitbridge town, a border town that is in Matabeleland South Province that is adjacent to Musina, a South African town only separated by the Limpopo River. Solid waste generation and disposal will be examined in all the six Beitbridge urban wards that have according to the Zimstat 2012 a total of 40000 people. Implications to human security of solid waste disposal in Beitbridge town will be examined especially the effects of the unsanitary dumpsite.

1.9 Limitations of the study

The research has a lot of costs which include but not limited to, travelling costs from the working station of the researcher to the area of study. Furthermore, there are also costs to print data collection tools like questionnaires. Time constraint is also a factor as researches of this nature and magnitude need more time since they influence policy. Also, there are fears that some solid waste management stakeholders at the Beitbridge Municipality, Environmental Management Authority (EMA) and Ministry of Health and Child Care might hide the truth in the fear that the research might expose their inadequacies and incompetence that have risked both health security of the people and environmental security.

1.10 Definition of key terms

Solid waste : this refers to waste products that are produced in households, clinics ,industries and other sites that are hard and not liquids and are deemed no longer of use by the owner and examples include beer bottles, pampers, construction debris and food leftovers

Solid waste generation: Tevera and Masocha says that this is the stage at which resources become valueless to the owner and are thrown away or gathered together to be taken for final disposal or reuse by other waste stakeholders

Solid waste disposal: this is the ultimate disposition of refuse that is not salvaged or recycled

Health : the World Health Organisation (2012) defined health as the state of complete , physical ,mental and social wellbeing and not merely the absence of disease or affliction.it is the responsibility of the government , both central and lower tiers and the community itself to make sure that the health of the residents is maintained.

Human Security: according to the UN (2016) human security approach provides a new thinking about the range of challenges the world faces and how the global community responds to them. In this research it entails health security of residents and environmental security.

Sustainable solid waste management: this describes the basic principles and recent advances for handling solid waste in an environmentally sustainable way.

1.11 Proposed Chapter Outline

Chapter 1 is the introduction of the research. It comprises the background of the study, purpose of the study, statement of the problem, objectives of the study and research questions, assumptions of the study, significance of the study, delimitation and limitations of the study and conclusion. Chapter 2 is the Literature Review and theoretical framework and it reviews what has already been written on the topic and literature cited supports the theoretical argument being made. It demonstrates that the author has a grasp of what has been written on the area being researched. Chapter 3 gives sufficient detail about the methodology used and encompasses the research design , research approach , discussion of data collection methods , data sampling methods as well as data analysis techniques . Chapter 4 is a discussion of the findings of the research and in Chapter 5; the researcher will give recommendations to the problem that has been clearly stated in Chapter 1.

1.12 Chapter Summary

In Chapter 1, the researcher zeroed in on the background of the study and also reflected on the purpose of the study, the statement of the problem, objectives of the study and research questions, assumptions of the study and significance of the study. The researcher also beamed on the delimitations and limitations of the study as well as providing the proposed chapter outline. The next chapter will focus on literature review and theoretical framework.

CHAPTER 2

LITERATURE REVIEW AND CONCEPTUAL FRAMEWORK

2.0 Introduction

The fundamental objective of the chapter is to show the literature available from many scholars and schools of thought on solid waste disposal and its effects on human health security and environmental security. This means that focus will be zoomed on what has been written on solid waste disposal and how people, animals and vegetation have been harmed by some improper waste disposal methods. Communities that are affected by diseases that result from improper solid waste disposal systems are bereft of peace as they grapple with the attendant challenges on a daily basis compromising human security.

2.1. The Conceptual Framework

Solid waste management is a universal problem with no real solution fitting all towns and cities and it is thus imperative for urban municipalities to call for institutional, political and social changes in order to deal effectively with solid waste as in some cases waste management problems might not be having anything to do with financial resources but attitudes from waste management staff, residents or other private players. Against this backdrop it is thus crucial as noted by Pakzynski(2002) for the development of an integrated approach where the public and community sectors work together to develop local solutions and promote sustainable solid waste management and give chance for human security to be guaranteed. In light of the foregoing, the model of integrated sustainable waste management will be preferred to ensure that health security and environmental security are guaranteed in the face of increased improper solid waste disposal.

2.2 Concept of Human Security

Menon (2007), highlighted that in the era of multiplying and escalating risks both at national and international level, security of the individual popularly known as human security from pervasive threats and fears became an area of intellectual discourse and debate. Human security lacks conceptual clarity and an exclusive paradigm for intellectual discourse, so anything that affects the security of the individual and collective existence may come under human security and naturally the scope of the concept is full of ambiguity (Menon, 2007:3)

The concept of human security gained prominence in 1994 and shifted the focus away from the state and makes the primary unit of analysis, the individual who is meant to live in freedom

from fear and freedom from want. Human security was articulated by the UNDP in 1994 in the Human Development Report that gave a clear definition of security as freedom from fear and freedom from want giving equal weight to its territories and to people (Menon, 2007). Government of Canada (1999) said that human security entails taking preventive measures to reduce vulnerability and minimise risk taking remedial action where prevention fails. UNDP (1994) gave the components of human security as

(a)Economic security which is an individual's enjoyment of basic income, either through gainful employment or from a safety net

(b)Health security referring to an individual's freedom from various diseases and debilitating illnesses and his or her access to health care

(c)Food security. This is the individual's access to food via his or her assets, employment or income

(d)Environmental security. The integrity of the land, air and water which makes human habitation possible.

(e)Personal security. This is the individuals freedom from crime and violence especially women and children who are vulnerable

(f)Community security. This refers to cultural dignity and to inter community peace with which an individual lives and grow

(g)Political security which is the protection against human rights.

The predicament faced in Beitbridge is that of improper solid waste disposal and this research will introspect on how two from the seven components of human security discussed afore are violated. Focus will be placed on reviewing literature on the implications of improper solid waste disposal systems on both health and environmental security.

2.3Integrated Sustainable Waste Management model (ISWM)

Problems of solid waste management globally are proliferating day by day and this affects health security of residents and environmental security. Seadon (2010) says that a sustainable waste management system incorporates feedback loops, is focused on processes, embodies

adaptability and diverts wastes from disposal. Scheinberg, Klundert and Anschutz (2001) highlighted that ISWM concept has four basic principles and these are effectiveness, equity, efficiency and sustainability. The trio said that on equity the citizens have entitlement to proper solid waste management systems for environmental health security and also said that on efficiency the management of solid waste should ensure the maximisation of benefits at the same time minimising the cost and optimising the use of resources. On effectiveness they said that the waste management sector must safely remove all the waste and on sustainability said that waste management system should be appropriate to the local conditions and feasible from a technical, environmental, social, economic, financial, institutional and political perspective and it can maintain itself over time without exhausting the resources upon which it depends.

2.4 Solid Waste

Tchobanoglous (2002) highlighted that solid waste in a broader sense is understood as any household, industrial and agricultural materials that have been used up and since such waste accumulates in the territories managed by municipalities responsible for its removal and storage, it is termed municipal solid waste. The United Nations Statistics Division (UNSD 2010) says that solid waste refers to all materials that are not prime products for which the person generating the material has no further use in terms of his /her own purposes of production, transformation or consumption and which he /she wants to dispose and that is not intended to be disposed using a pipeline. Mader (2011) added that it is differentiated from sewerage, a term used to refer to liquid waste.

The Practical Action Southern Africa (PASA 2006) revealed that more than 2, 5 million tonnes of household waste and industrial waste are produced per annum in urban areas across Zimbabwe. Trying to quantify waste generation in low income countries, Cotton et al (1999) highlighted that about 300 -600 grammes of waste are generated per person. Based on the foregoing, it can be estimated that since Beitbridge town has a population of 40000 people as per the Zim Stat (2012) population figures, 12 tonnes of waste are generated on a daily basis. However, according to Grinivas (2003) and Medina (2010), many cities in Africa and Asia collect less than half of the waste generated and dump it in open spaces and Beitbridge is no exception. The improperly disposed solid waste causes both health and environmental health security concerns.

2.5 Sources of solid waste in a community

The sources of solid waste in a community are varied and Tchobanoglous and Kreith (2002) identify the sources of the solid waste in a community as residential, commercial, institutional, industrial, construction and demolition, municipal services, treatment facilities, industrial and agricultural. The sources, location where the solid waste is generated and the types of solid waste generated in a community are depicted on **table 1.1** below.

SOURCE	TYPICAL WASTE GENERATORS	TYPES OF SOLID WASTE
Domestic	Single and multifamily dwellings	Food wastes, paper, cardboard, plastics, cans, yard waste, textiles, leather, wood, glass, and household hazardous waste
Commercial	Stores, markets, office buildings, restaurants, shops, bars	Packaging and container materials (cardboard and plastics), used office paper, wood shavings, food waste, hazardous waste, electronic waste
Industrial	Light and heavy manufacturing	Housekeeping waste, packaging, food waste, demolition materials, slag, mineral tailings, electronic waste, batteries, pesticides, coolants, lubricants etc
Institutional	Police camps, barracks, schools, hospitals, prisons	Food wastes, used paper and plastics, used needles, syringes, and gloves, wood, steel, concrete waste etc
Municipal Services	High Density neighborhoods	Dust /sand, leaves, paper and plastics, used needles syringes and gloves
Construction Debris	New and old building sites	Wood, brick –stones, concrete, glass and metals

Waste Volumes Generation
(*International Labour Office, 2007:16*)

2.6 Waste classification

According to Zirabal et al (2016), Municipal solid waste is categorised into organic and inorganic elements. Zirabal et al (2016) divided the organic municipal solid waste into three elements namely putrescible, fermentable and non-fermentable. Further to that, they highlighted that putrescible solid wastes include products such as food stuffs that decompose fast while fermentables were conceived of as those that decompose rapidly but without the unpleasant accompaniments of putrefaction. The non fermentables were defined as those that tend to resist decomposition and tend to breakdown very slowly. Zirabal et al (2016) also highlighted that inorganic waste includes articles like metals, plastics and other non-biodegradable materials. In developing countries, solid waste characteristically has high content of organic matter compared to that in developed countries.

2.7 Functional elements of a Solid Waste Management System.

Tchobanoglous and Kreith (2010) identified the functional elements of a solid waste management system as comprising waste generation, waste handling and separation, storage and processing at the centre, collection, separation, processing and transformation and waste disposal.

2.7.1 Waste generation

This is where materials that are no longer of value are identified and resultantly are gathered for disposal or thrown away.

2.7.2 Waste handling, storage and separation at the source

This encompasses activities associated with management of solid waste until placement in storage containers for collection. Zhu et al (2008) highlighted that storage pertains to where the waste is deposited before it is collected to the dump site and this includes galvanised steel bins, plastic bins and at times plastic bags. Tchobanoglous and Kreith 2010 quips that on sight storage are of primary importance because of public health concerns and aesthetic considerations and also highlighted that separation of waste is an important step in the handling and storage of solid waste at the source. In Beitbridge and other towns, landlords are mandated to provide the bins at their houses.

2.7.3 Collection

Collection refers to the gathering of the solid waste and the associated transport of the materials to the point where the collection vehicle is emptied and such areas include transfer station or the landfill. Chaudhary Singh and Gupta (2014) stated that the collection and transportation process includes garbage put up at pick up points mainly outside houses which is then carried by trucks to the disposal site.

2.7.4 Transfer and transport

Transfer usually takes place at a transfer station. Motor vehicles, railway cars and barges are used to transport waste.

2.7.5 Recovery and recycling

As Chaudhary Singh and Gupta (2014) observed, other materials from the solid waste can be used as secondary resources and amongst these are plastics, bottles paper and aluminium metals. These must be separated from the solid waste before they are recycled.

2.7.6 Disposal

According to Zaloksnis (2011), today disposal by landfilling or land spreading is the ultimate fate of all solid wastes, whether they are residential wastes collected and transported directly to a landfill site, residual materials from MRF , residue from the combustion of solid waste , compost or other substances from various solid waste processing facilities. Same authors added that a landfill is not a dump, but it is a method of disposing of solid wastes on land or within the earth's mantle without creating health hazards or nuisances. Robert (2012), highlighted that waste from the transfer station is usually transported 30km away from the towns and city.

2.8 Methods of solid waste disposal

Taru and Kuvarega (2005) highlighted that methods used in household solid waste disposal in most residential suburbs in developing countries include illegal burning, burying, crude dumping in open spaces, rivers and drainage basins as well as composting. Marere (2010) says that this is attributed to poor household solid waste collection systems and residents attitude towards household solid waste. Other methods include landfills, composting, incineration and dumpsites. Curran et al (2007) stated that landfills are common sights in high income countries like America, Japan and England. Illegal burning, burying, crude dumping and composting are improper methods of solid waste disposal with diverse implications on health and environmental security.

2.8.1 Indiscriminate waste disposal

The Open University (2016) says that indiscriminate waste disposal occurs when an individual leaves waste by the roadside, on a piece of disused land, in a field, by the side of a riverbank or in a river. This solid waste disposal method is also called open dumping.

2.8.2 Communal open dumping or dumpsite

This method according to The Open University (2016), is practised in most developing countries where a convenient area of land near the town is identified and waste is deposited at the site and gradually accumulates over time. Usually there is no barrier to keep animals out, no equipment to move or compact waste, no site staff and there are no environmental control measures. The Open University (2016) highlighted that the adverse effects include contamination of ground water and surface water by leachate.

2.8.3 Burial pit

The Open University (2016) informs that this is practised mainly in the yards of individual households where waste is covered by earth every day and also has dangers of contaminating ground water through leachate.

2.8.4 Open burning

Open burning as observed by The Open University (2016) is a solid waste disposal method where many individual householders burn waste in the open air and the remaining ash is buried or spread on the ground. This however has its own negatives and The Open University (2016) says that the smoke is an annoyance to the neighbours and can be a health hazard.

2.8.5 Sanitary landfill

This is an engineered solid waste disposal system for larger cities and towns. The Open University (2016) says that the site is designed and operated to minimise public health and environmental impacts and the control measures should include a system to collect and treat leachate, better gas venting systems and good amenities for site staff.

2.8.6 Incineration

This according to Zaloksnis (2011) is a waste treatment process that involves the combustion of organic substances contained in waste materials. Same writer added that flue gases must be

cleaned of gaseous and particulate pollutants before they can be dispersed into the atmosphere and the heat generated can be used to generate electric power.

Improper management of solid waste is one of the main reasons for environmental pollution and degradation in towns and cities of the third world respectively and hazardous waste can bring severe health effects to residents due to its characteristics as infectious , toxic and radioactive (Selin ,2013). Ziraba et al (2016) say that the interlinkage between poor solid waste management and adverse health outcomes may be overt and direct but may also be indirect and not obviously linkable to poor health outcomes of a population. The next phase of this literature review is thus dedicated to aid the understanding of interlinkages between poor solid waste management and health security and as a result give the rationale for making proper solid waste management as an investment in preventing ill health and promoting wellbeing.

2.9 Improper solid waste disposal implications on health security

The impact of solid waste on health is varied and may depend on numerous factors that include the nature of waste, duration of exposure, the population exposed and the availability of preventions and mitigating measures (Ziraba et al 2007).

2.9.1 Exposure to medical solid waste

People may be exposed to solid waste at the source from where the waste is generated. Poorly managed medical waste is a major source of infection for patients, health care workers waste handlers and general public (Franka et al 2009). Be (2006) says that while medical waste

requires stringent management, it is not uncommon to find medical waste being handled like household waste. There are medical instruments like scalpels and needles that are supposed to be disposed in specific and safe containers but this is not done all the time and as result according to Ream et al (2014), needle stick injuries from misplaced used needles are a common occurrence among health care providers. Additionally, Ream (2014) highlights that other than penetrating injuries or cuts, medical waste and contaminated surfaces may contain highly infectious microbial agents such as Ebola and Hepatitis B and C which can be transmitted to exposed workers. Other important pathogens that can be transmitted from medical waste include pathogenic bacteria such as the one that causes tuberculosis, anthrax, pneumonia, meningitis and other infections of gastro intestinal system (Franka et al 2009)

2.9.2 Exposure to solid waste among collectors

Ziraba et al (2007) quips that occupational exposure to solid waste is a constant risk waste handlers are faced with. Abdel Wahab et al (2014) say that exposure can happen depending on the level of protective ware, knowledge of risk , standards about practices of waste sorting and equipment available to such workers. Same adds that in many developing countries, Municipal waste is handled by cheaply hired workers with limited protective gear and limited appreciation of the risk involved in handling such solid waste.

2.9.3 Exposure of neighbourhood to dumpsites

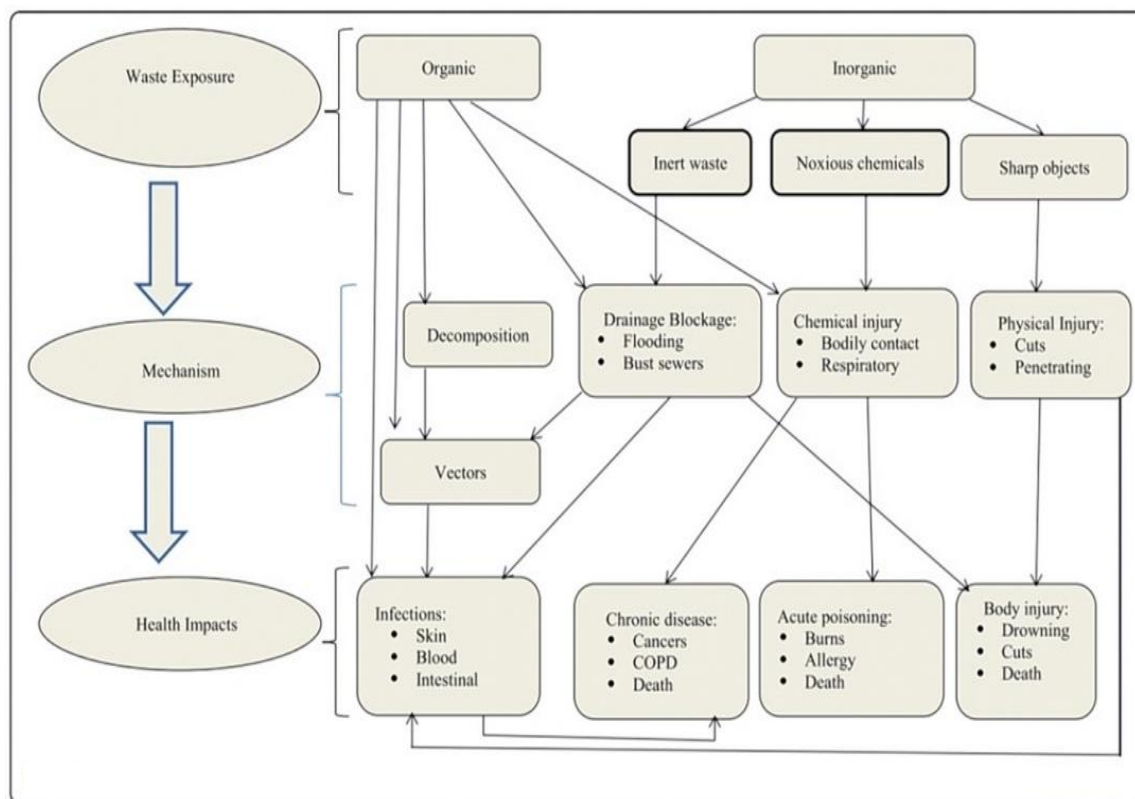
Residents in the neighbourhood of dumping sites have an ever present risk of infection transmission through vectors and rodents that are abound at dump sites and inhalation of fumes from the burning waste (Al Delaimy, Larsen and Pezzoli, 2014). Ziraba et al reinforces the

foregoing saying that decomposing and festering solid waste attracts all manner of vectors including house flies that are very efficient in transmitting disease causing germs and children living in such neighbourhoods are exposed to triple risk of infectious diseases, injury and inhalation of dangerous fumes from continuous burning of waste. Salam (2010) says that the said situation produces gastro intestinal, dermatological, respiratory, and genetic and several kinds of infectious diseases. Loredan and Maria (2009) also reinforce the foregoing intimating that hazardous waste has been shown to influence the likelihood of developing lung, brain cancer and bladder cancer.

Dumpsites often produce leachate which is dangerous to human health. Ziraba et al posit that many urban residents do not get their water supply from the Municipal sources and get it from shallow unprotected wells that are often contaminated by leachate from dumpsites. Fatta, Papadopolus and Loizidou (1999) highlighted that as the rainwater soaks through layers of solid waste in a landfill, chemical, biological and physical processes cause the leaching of hazardous chemicals from various waste materials to form hazardous leachate and some of the toxic pollutants that are known to leach include heavy metals, polybrominated biphenyls, biphenyl A, and other potentially toxic organic compounds. Some authors say that non-essential metals such as lead, cadmium and chromium have serious health effects on humans with lead and cadmium linked to neurological, kidney and brain damage.

Improper human faecal matter and waste from abattoirs disposal is poor in many places and yet these are rich sources of disease causing bacteria posing a serious health risk to individuals using contaminated water (Nyenje et al 2012). In addition, solid waste containing noxious chemicals at dumpsites is burnt and this process may produce toxic fumes which cause respiratory complications and allergic reactions in some people.

Gastro intestinal infections such as typhoid fever, polio virus infection, hepatitis E infection and cholera are often transmitted through contaminated food or water (Cabral 2010). Ziraba et al sums up the relationship between poor solid waste management and health outcomes as illustrated on **Fig 1.1** below:



There are also some psychological or emotional impacts to residents that dwell closer to dumpsites. Ziraba et al highlights that residents living next to dumpsites are usually affected by stench, the sight of scavenging animals and social stigma and in extreme cases solid waste has been reported to contain human body parts or aborted foetuses which may be distressing and could affect the mental wellbeing of the residents and those involved in waste picking.

2.9.4 Exposure of solid waste to pickers and recyclers

Oguntoyinbo (2012) reveals that in many African cities, solid waste dumpsites are located on the outskirts of the city which are also home to a huge urban poor population often living in slums with no proper means of livelihood and the dumping sites are a source of economic livelihood to many who pick and retrieve articles for direct use or recycling. Waste products that can be picked at the dumpsites range from household utensils, clothes, food, ornaments

plastics, batteries and scrap metal among other items. Waste pickers are therefore exposed to risks of infection, injuries from sharp objects and respiratory complications.

2.10 Improper Solid waste disposal impact on environmental security

Poorly managed solid waste might have serious impact on the environment. Petroleum products including paints laden with lead are discharged in open spaces and water channels and while some chemicals discharged might have short term effects on animal and plant life, others are carried through the food chain where they accumulate and have deleterious effects much later (Manay et al 2008). Un-Habitat 2006) reinforced the afore saying that chemicals may also leach out of these dumps into water supplies and pollute surface water such as streams and ponds and the sites will be harmful to wildlife that lives around them . EMA (2013) added that animals consume chemicals found in dumps or become trapped amongst the mangled mess of tires, plastic containers wires and metal scrap. Same authors added that heavy metals such as lead, arsenic and mercury are of particularly high public health importance yet no clear measures are enforced to control their disposal and help limit environmental contamination. Fatta, Papadopulus and Loizidou (1999) added that non-essential metals such as lead , cadmium , chromium and mercury are highly toxic even at low concentrations and in addition lightens that these metals have been shown to accumulate in plant and animal tissues therefore even low exposure concentrations can bio accumulate during prolonged exposures to cause toxicity.

Amoako (2012), says that while poor urban physical planning may be blamed largely for the increasing phenomenon of urban floods, partly the problem can be attributed to rampant blockage of drainage systems. Inappropriate disposal of waste especially the non-biodegradable plastic paper bags results into these being swept downstream resulting into blockage of drainage systems. Amoako (2012) further says that floods not only destroy property , they have claimed lives both on roads and homes and damage sewerage systems leading to widespread environmental contamination with human waste and associated risk of infection transmission. Also, Thompson et al (2009) observes that plastic wastes are of increasing global concern as they persist for long periods and are ingested by organisms causing health impacts through the food chain potentially including humans .Njeru also says that consumption of the plastic by livestock can cause death for example the plastic bags are non-biodegradable and also noted that, their presence in agricultural fields decreases soil productivity.In addition, the burning of plastic produces toxic gases like furan and dioxin

dangerous to the environment while unhealthy residue including lead and cadmium remain on the ground.

Chifamba (2007) highlights that burning of materials found in undesignated places can lead to the release of toxic smoke and harmful substances into the atmosphere only to comedown as rain wash in surrounding areas and even areas far off the original place of household solid waste generation. The resultant rain is acid rain that is destructive to crops buildings, human and animal health. Musademba et al (2011) says that illegal dumping is a problem not only because it spoils the aesthetic value of the environment but also because it creates serious health risks.

Electronic waste is slowly emerging as a serious health threat in developing countries because of poor handling .Shah and Sheikh (2008) say that e -waste is simply any unwanted device that has an electrical plug or runs on batteries. The potential health effects posed by e waste are better summed up by the California Department of Public Health (2012) as shown on **table 1.2** below;

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

Source: California Department of Public Health (2012)

2.11 Case study: Rawalpindi City, Pakistan

Rawalpindi city is a place in Pakistan where dumps of solid waste have caused impact on the health and environmental security. Ejaz et al (2010) say that the city is facing miserable solid waste management crises due to rapid industrialisation, urbanisation and insufficient funding.

Ejaz et al (2010) highlights that open dumping, open burning and unengineered sanitary landfills are common practice throughout the country .the improper solid waste management systems in Rawalpindi city has resulted in a range of negative impacts on the environment.

Ejaz et al (2010) observed that dispersed solid waste from illegal dumps caused blockages of drains were that caused flooding and unhygienic conditions in the city. In addition, the above cited authors also observed that during summer flies increased in population due to the waste dumps and are very effectual vectors that spread disease in the community. Ejaz et al 2010 further observed that flooding due to blocked drains also support mosquitos breeding and are spreading malaria and dengue in the Rawalpindi city.

Tchobanoglous et al (2010) highlighted that discarded polythene bags in collected solid waste from Rawalpindi city are generating an aesthetic nuisance and they also cause the death of grazing animals which eat them. Davis and Conwell (2009) highlighted that a lot of dangerous items (such as broken glass, razor blades, hypodermic needles and other health care wastes, aerosol cans and potentially explosive containers and chemicals from industries) are causing injury and poisoning particularly to scavengers and school going children.

Ejaz et al (2010) illustrates that improper solid waste management cause health security scare in the Rawalpindi city indicating that during the rain season leachate produced causes serious pollution to water bodies in the city. Same also revealed that a high percentage of collected solid waste from the city is being disposed of in unsatisfactory way causing severe aesthetic nuisance in terms of smell and manifestation. Akio (2002) highlighted that liquids and fumes escaping from deposits of chemical wastes are creating fatal or other serious effects to the community such as illness and reducing visibility.

2.12. Legislative Framework Governing Waste Management in Zimbabwe

In Zimbabwe EMA is the regulatory body that control waste management at the national level while municipality by- laws at the lower level play the complementary role. EMA was set up in terms of Section 9 of the EMA Act Chapter 20:27 of 2003. Mulaudzi (2017) says that the purpose of EMA was preparation of the environmental plans for the management and protection of the environment by monitoring and regulating the discharge or emission of any pollutants or hazardous substances into the environment. Section 69 of the EMA Act penalises wanton pollution of the environment and those caught discharging waste at undesignated sites are liable to a fine while Section 83 says that illegal dumping in roads , water , streets, land or any place is not allowed but to dispose in proper places.

Among the legislative framework on waste management in Zimbabwe is the Public Health Act of 1996 that highlights according to Government of Zimbabwe (1996) that it is the task of the every council to take responsibility and reasonable practical measures for maintaining its districts, in a clean and sanitary condition by preventing accumulation of waste which may be injurious or dangerous to health. The above means that local authorities are mandated to craft their own by laws to regulate waste handling. Chakaipa (2010) says that local authorities are given powers to control their areas in terms of the Urban Councils Act Chapter 29:15.

Municipality of Beitbridge had no By-Laws for solid waste management till 2019 when the Minister of Local Government , Public Works and National Housing in terms of Section 229 of the Urban Councils Act Chapter 29:15 approved the Beitbridge Anti-Litter By-Laws 2019. Section 4(1) of the by law says that no person shall deposit, abandon or cause or permit to be deposited or abandoned any form of litter in a public place. Persons found to be violating the above section are liable to pay prescribed fine not exceeding level three. However, despite the presence of the waste management legislative framework, Beitbridge town has loads of improperly disposed solid waste with potential to harm the health security of residents and the environment.

2.13 Chapter Summary

The literature reviewed indicated that improper solid waste management has serious implications on health security and environmental security. Residents exposed to solid waste are likely to suffer from injuries when they pick waste for recycling, various ailments as explored while animals may die from ingesting plastics. The ground water is affected by leachate causing vegetation to die and pollution of the clean water sources. The gap in literature is that researches done in Zimbabwe on solid waste management focused mainly on challenges faced by local authorities and not much has been done to reflect on the health risk to the residents and the environment emanating from improper solid waste management.

CHAPTER 3

RESEARCH METHODOLOGY

3.0. Introduction

In this chapter, the researcher unravels the research design and the research methodology that was deployed. A case study was used as the research design. In this research, the researcher used qualitative methodology and also constituent to the chapter is the discussion of data sampling techniques, data collection methods, data analysis strategies and attendant research ethics that are considered when conducting research.

3.1. Research design

Akhtar (2016) says that research design is the conceptual blueprint within which research is conducted. The same writer highlights that research design must at least contain a clear statement of the research problem, procedures and techniques to be used for the gathering of data or information, the population to be studied and the methods to be used in processing and analysis of data. Zikmundi (1988) defined research design as a master plan specifying the methods and procedure for collecting and analysing the needed information. While De Langen (2009) described a research design as a plan and structure of enquiry conceived to obtain answers to the research questions, this researcher unpacks research design in this study as the blueprint that is followed by the researcher in gathering information on the implications of improperly disposed solid waste on the health and environmental security in Beitbridge town.

In research literature, there are various literature designs that are used and inter alia encompass descriptive research design, explanatory research design and exploratory research design. The researcher used exploratory research design in order to generate new ideas of inquiry on solid waste management issues. Several research done in Zimbabwe on solid waste management focused mainly on challenges faced by municipalities in handling waste. This researcher had to break the research ground and explore by way of using Beitbridge as a case study to unpack health and environmental challenges faced in the town because of improperly disposed solid waste in many places. The researcher chose the research design over others as he sought to explore the area of research to generate some initial ideas about the hazards of solid waste in the border town and allow for scientific tests to be conducted to ascertain the level of health security and environmental security risk faced in Beitbridge.

3.2. Methodology

Research methodology is conceived of by Haralambos and Holborn (1995) as the procedures in the gathering and analysis of data. This research will use qualitative research methodology as it is richer in data collection. Crossman (2020) says that qualitative research is a type of social science research that collects and works with non-numerical data and that seeks to interpret meaning from these data that help understand social life through the study of targeted populations or places. Same adds that within sociology, qualitative research is typically focused on the micro level of social interaction that composes everyday life.

Crossman (2020) highlights that qualitative researchers use their own eyes, ears and intelligence to collect in depth perceptions and descriptions of targeted populations, places and events. Qualitative research findings are collected through a variety of methods and the researcher will employ at least two or more methods.

In light of the foregoing, this study will use qualitative research methodology where interviews, observations and questionnaires will be commissioned to gather data. Interviews will be done with various solid waste management stakeholders in Beitbridge Town to unpack diseases suffered from or are likely to be faced because of poor solid waste management. Interviews will also be done with various stakeholders to get a glimpse of what environmental hazards are brought by the improperly disposed solid waste. Non participatory observation will also be employed to establish dangers being posed to residents and the environment due to the improperly disposed solid waste. Qualitative research was used by the researcher who used the viewpoint by Crossman (2020) that because it focuses on everyday life it lends well to creating new theories which can then be tested with further research.

3.3. Target Population

According to Sidhu (2003), population is the aggregate or totality of objects or individuals regarding which inferences are made in a study .this research will look at the implications of poorly disposed solid waste, in all the six Beitbridge urban wards, to human and environmental security. In this regard samples will be drawn particularly examining households that are close to the improperly disposed solid waste. Creswell (2003) justifies the need for a sample instead of studying the whole population for the research to be manageable given a large study population as well as reducing the financial costs of the research. Haralambos and Holborn 2000 postulate that a sample for social research should be at least 33, 3% of the study

population. A respondent will be picked from each household or site close to improperly disposed solid waste for questionnaire completion.

3.4 Sample Size

Purposive sampling will be employed to pick for interviews 10 key informants in strategic departments to include Ministry of Health and Child Care, Environmental Management Agency, Beitbridge Municipality Department of Health, MOB councillors and doctors in private practice whose knowledge on the town's solid waste management situation is broad. Also, purposive sampling will be used to select for interviews 10 informants that is, waste pickers and other people involved in activities at the Beitbridge municipality Dulivadzimu dumpsite. 30 questionnaires will also be distributed to residents purposively sampled to respond to a battery of questions aimed at understanding how solid waste improperly disposed is a threat to their health. Purposive sampling was employed in this study because of its advantage that it saves money and time resources as the researcher will not use a few selected respondents instead of the whole population. Also, only the right persons for the study were accorded the opportunity to respond because of the sampling method used.

3.5. Data sampling techniques

Majid et al (2018) says that sampling is the process of selecting a statistically representative sample of individuals from the population of interest. Browner, Newman, Cunnings and Hully (1988) highlight that sampling is an important tool for research studies because the population of interest usually consist of too many individuals for any research project to include as participants thus a good sample is a statistical representation of the population of interest and large enough to answer the research question.

This research will use purposive sampling and convenience sampling when dealing with the targeted population. Purposive sampling is a major tool of research where a few number of people may be well sufficient for understanding human perceptions, problems, needs behaviour and context. The researcher will purposively interview employees at the Beitbridge Municipality, Environmental Management Authority (EMA), Ministry of Health and Child Care and residents to unpack the risks associated with improperly disposed solid waste to the residents of Beitbridge and also to the environment. Convenience sampling is defined by Saunders et al (2012) as a specific type of non-probability sampling technique that relies on data collection from population members who are available to participate in the study. This

sampling technique is also called availability sampling where the researcher will sample those who will be available at the moment the researcher will be doing his work. The sampling technique will be used to gather data from various stakeholders that deal with solid waste to include solid waste pickers at the municipality dumpsite, Beitbridge Municipality workers responsible for waste removal and some residents residing close to improperly disposed solid waste in Beitbridge Town.

3.6. Data collection methods and procedures

These are methods which are used to collect data in the field when one is carrying out a research. This research is qualitative in nature and as a result this researcher used interviews, questionnaires and non-participatory observation to get information necessary for the study from the sample populace

3.6.1 Interviews

According to Bhat (2020), an interview is generally a qualitative research technique which involves asking open ended questions to converse with respondents and collect elicited data about a subject. Same writer adds that the interviewer in most cases is the subject matter expert who intends to understand respondent opinions in a well planned and executed series of questions and answers. Interviews will be conducted with residents residing close to places with improperly disposed solid waste checking if they suffer from ailments that are related to the unhygienic practice. This will also be done with waste pickers at dumpsites in Beitbridge. Officials from EMA, Ministry of Health and Child Care and Beitbridge Municipality Health Department will also be interviewed.

Bhat (2020) says that interviews make it extremely easy for researchers to try and rapport with participants and this lead to gaining insights in extreme detail without much conscious effort. Same writer also says that participants can clarify all their doubts about the questions and the researcher can take each opportunity to explore intention for better answers. Also, interviews are flexible.

Bhat (2020) highlights that interviews however have no structure so researchers take time to execute these interviews. The same writer says that absence of a standardised set of questions and guidelines indicates that the reliability of unstructured interviews is questionable

3.6.2 Questionnaires

Key (1997) defined a questionnaire as a way of stimulating people's beliefs, attitudes and experiences through a set of questions asked on paper. A questionnaire can be used to gather data for both qualitative and quantitative research designs. As Bulmer (2004) also observes, a questionnaire is a set of well-established questions asked in a chronological order so as to attain information on the participants' behaviour, attitude and reason for action with respect to the topic under study. In this research, questionnaires will be personally delivered so that respondents fill in the papers according to the research questions and the attendant research objectives.

3.6.3 Observations

Crossman (2020) says that with direct observation, a researcher studies people as they go about their daily lives without participating or interfering. Crossman (2020) further highlights that this research is often unknown to those under study and as such must be conducted in public settings where people do not have a reasonable expectation of privacy. Observations will be done on sites with improperly disposed solid waste to see if animal life, vegetation and human life is no being exposed to danger.

DeMunck and Sobo (1998) highlight that observation affords access to backstage culture, allows for richly detailed description of phenomena. DeWalt and DeWalt (2002) add that it improves the quality of data collection and interpretation and facilitates the development of new research questions or hypothesis. The researcher settled for observations to gather data on how the Dulivadzimu dumpsite and other improperly disposed waste sites are a hazard to human health and the environment. Respondents will go about their business and information gathered uninterrupted. It also has advantage of saving time as effort is directed at monitoring events only from a vantage point. Money is also saved as in other data collection methods researcher may end up giving tokens of appreciation to respondents.

However, there are some disadvantages of using observations .DeWalt and DeWalt (2002) says that observation is conducted but a biased human serves as the instrument for data collection .Miller (2019) highlights that observation has the disadvantage that researchers can sometimes struggle to determine what the exact cause of behaviour or choices is due to the presence of outside variables. Miller (2019) also adds that people will always react differently

when they know that they are under observation even though they are in a natural setting. The other disadvantage is that it takes time to complete observations.

3.7. Primary sources of data

To address the research objectives, information was gathered using primary sources of data. Zikmundi (2013) says that primary sources of data are those original sources of data from the targeted respondents and generally provides problem specific data of a current nature hence the researcher adopted the use of primary data because it enables the collection of data direct from the respondents. Interviews, questionnaires and observations were adopted in this research to gather data on the implications of poorly disposed solid waste in Beitbridge town to human and environmental security. In using primary data, the researcher is supported by Wilson 2006 who opines that primary data is more valuable since it addresses the exact problem at hand not basing on history to predict the future.

3.8. Secondary sources of data

According to Thomas (2010), secondary data refers to data that is readily obtainable from other writers but it is not for the study at hand. Secondary data has the capacity to answer certain research questions and Jewel (2010) identified some secondary sources as including newspapers, journals, textbooks and various publications. The data will be used to make comparisons of works of various authors and analysing relevance towards the current research.

3.9. Data Analysis and Presentation Procedures

In presenting data, the researcher used pie charts, tables and photographs taken during the data collection field trips. Data analysis denotes to gathering of data following similarities in the views and opinions of participants and in this research, following data collection, the researcher integrated information from interviews, observations and questionnaires .photographs taken at disposal sites were also taken and analysed. For statistical information tables and pie charts were used to present data.

3.10. Data Validity and Reliability

As noted above, more than one method of data collection was used in order to make sure that findings would be reliable. Silverman (2004) says that reliability is the degree to which the

findings of the research are independent of accidental circumstances. Interviews, observations and questionnaires triangulated to ensure that findings were valid and reliable. In addition the researcher verified the collected data to ensure that it addressed the stated objectives of the research. Also, the research findings were compared with those of previous researches to note for consistency.

3.11. Pilot Testing

To detect mistakes in the data collection instruments, pre testing was conducted. Grey (2009) says that pre testing avoids occasions where some questionnaires are not responded. In this research pre testing was conducted using a small group of residents to establish if the questionnaire and interviews were understandable and addressing research objectives.

3.12. Ethical considerations

Resnik (2007) defines research ethics as guiding rules which assist a researcher in carrying out research. Flick (2014) adds that ethical considerations deal with giving a brief outline of your research to participants notifying them about your objectives of the study and your expectations. In light of the foregoing, in this research the researcher embraced a litany of ethical steps to ensure that this research was ethically acceptable.

The researcher will write a letter to the Beitbridge Municipality seeking authority to carry out the research. To give assurances that the research is meant for academic purposes only, participants of the project will complete an ethics consent form. The researcher will advise the Beitbridge municipality of the days on which photographing will be done to include visits to the dumpsite. The purpose of the research will be clearly explained to the participants so that they will not be involved without their knowledge and consent. The researcher will ensure that privacy of participants is respected. Also, the researcher will give participants the freedom to decide for themselves where and when to respond. Identities and confidentiality of research participants will be upheld. In research ethics, participants have the right to withdraw at any given time so this will be clarified before the participants commence participating.

3.13. Chapter Summary.

The Chapter the researcher explained the research design that was employed in the study. The researcher used explorative design and qualitative research methodology where observations, interviews and questionnaires were used as data collection tools to understand the implications

of improperly disposed solid waste on the health of Beitbridge residents. Also discussed were data sampling issues, validity and reliability, data analysis and procedures used as well as pilot testing and ethical considerations issues.

CHAPTER 4

DATAPRESENTATION, ANALYSIS AND DISCUSSION OF FINDINGS

4.0. Introduction

This chapter gives a summary of the research findings on the implications of improperly disposed solid waste on the health of Beitbridge residents and on the environment. To this end, the framework of findings is given through presentation and analysis of the collected data using questionnaires, interviews and observation. In presenting the data pie charts, tables and photographs taken during the field trips will be used to give clarity to the subject under study.

4.1. Response rate of questionnaires

In trying to understand the implications of the improperly disposed waste on the health security of the Beitbridge residents and the threats of the same on environmental security, a total of thirty questionnaires were distributed to residents. A total of twenty seven questionnaires were completed, two were not returned while one was returned uncompleted.

Table 4.1.below shows the number of questionnaires completed and attendant response rates.

Questionnaires distributed	Questionnaires completed	Questionnaires returned uncompleted	Questionnaires not returned	Questionnaire response rate
30	26	1	3	

The above table shows that 27 questionnaires out of the distributed 30 were returned giving a response rate of 90%. In the same vein 26 out of the thirty questionnaires were completed giving a completion rate of 87%. Respondents gave different responses.

4.2. Analysis of questionnaire responses

4.2.1Solid waste generation

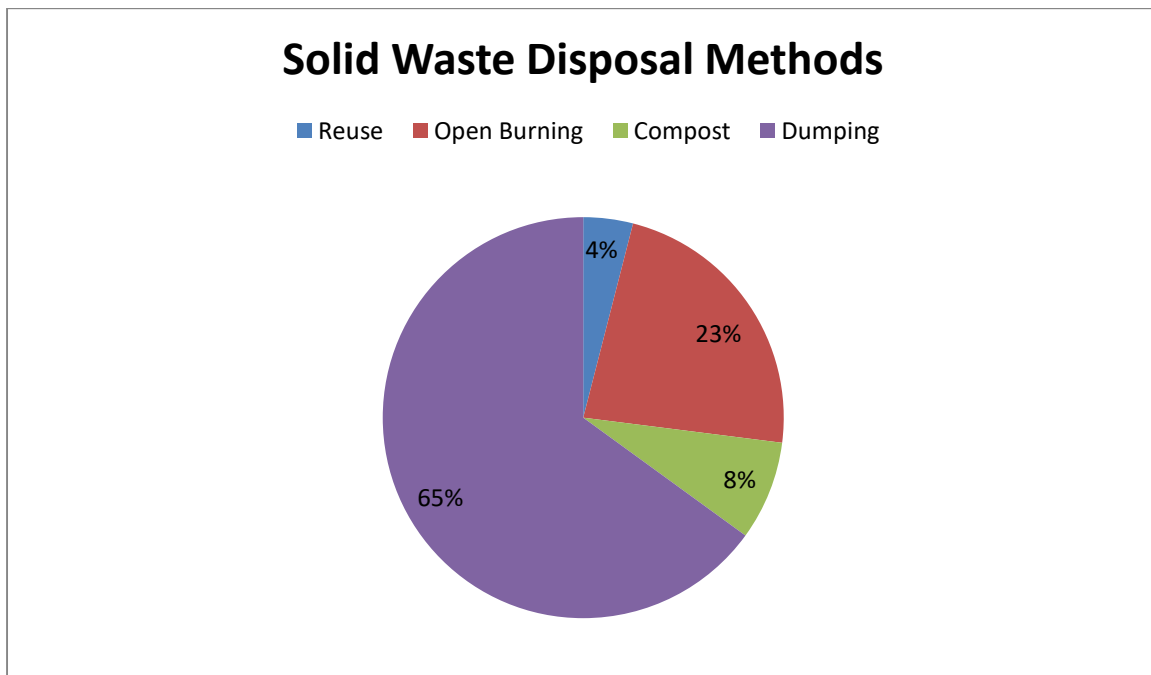
From the 26 questionnaires completed, respondents gave variant responses on the type of solid waste generated in their homes. An analysis of the responses from the questionnaires administered , interviews held and observations made revealed that in Beitbridge town , the solid waste produced at household level include among others ashes, plastics , cardboard boxes, newspapers, vegetables ,pampers, beer bottles pesticide cans , construction debris, hair pieces , plastic bottles, metals , magazines , perfume cans , batteries, syringes , cotton wool, saw dust , tyres, needles , glass and obsolete tools.

4.2.2. Other improper solid waste disposal methods used by Beitbridge residents

From the completed 26 questionnaires, respondents gave different views on the means of waste disposal methods they use when the Beitbridge Municipality does not collect refuse.17 out of 26 respondents said that they resort to dumping when solid waste is not collected by the Beitbridge municipality .This means that 65% of the residents resort to dumping and that

explains the existence of numerous illegal dumping sites in the town. 6 out of the respondents said that they resorted to open burning in the backyards of their homes and that is 23%. 2 respondents indicated that when the Beitbridge Municipality has not collected solid waste produced in the homes, they resort to composting and that is 8% of the respondents. One out of the thirty respondents revealed that they resort to reusing the generated waste and that is 4% of the target population.

Fig 4.1 below is a pie chart showing other solid waste disposal methods used by Beitbridge residents



4.3. Solid waste collection frequency by the Beitbridge Municipality

Table 4.2. below illustrates responses by the respondents on the solid waste collection frequency by the Beitbridge Municipality

Frequency	Number of respondents
Daily	0
Twice a week	1
Weekly	23
Monthly	0
Never	2

The solid waste collection frequency indicates that 23 out of 30 respondents, which is 88 %, highlighted that Beitbridge Municipality collects refuse from households once every week. The town is one of the fastest growing towns in Zimbabwe supporting a big population that produces about 1000 tonnes of solid waste monthly with the local authority able to collect 700 to 800 tonnes of litter (The Herald, 2 October 2020). This result in bins quickly getting full

that people end up dumping waste or resorting to other means of solid waste disposal. 2 respondents out of 30 said that the Beitbridge Municipality never collects waste from their places of residence and that is 12% of the target population. This means that the residents end up dumping litter, burning or resorting to other means that are improper. 1 respondent out of the 30 said that the Municipality of Beitbridge collects litter twice a week and that is 4%.

4.4. Improper solid waste disposal sites in Beitbridge

Litter abounds in Beitbridge town at undesignated points and respondents reached out during the data gathering field trips using questionnaires, interviews and observations noted that the following areas on table 4.2. Below have improperly disposed waste that requires removal as they are health time bombs.

Table 4.3 showing places in Beitbridge and respective wards with improperly disposed waste.

Place	Ward
Area between Mashavire business centre and Beitbridge –Masvingo highway	6
Area between Beitbridge District Country Club And St Marys high school	1
WaMlala Tributary flowing from northern part of Beitbridge	6,5 and 4
Passing through Mangava, Mbedzi and Mashakada Business centres to Limpopo River	6,5 and 4
Eastern and western entrance of industrial site complex	3
Bush south of Auckley House Primary School	3
Space opposite house numbers 4656 near White Lodge	6
Space opposite house numbers 5720 and 5810 at the new stands	6
Mfalendaonye area going up to Forit stands	4

Below are selected photographs showing sites with improperly disposed solid waste in Beitbridge

Fig 4.2 showing the Industrial working site Ward 3 illegal dumpsite



In the photograph are heaps of uncollected refuse being dumped at the eastern entrance of the industrial working site complex in Ward 3. The solid waste shown include used tyres, beer bottles, plastic bottles, pampers, scrap metal, food leftovers wood shavings and ashes among other things. Donkeys are seen scavenging for food leftovers.

Fig 4.3 shows illegal disposal site opposite House Numbers 5720 to 5810 in Ward 6



At the illegal waste disposal site above are heaps of used pampers, used toilet tissue papers, plastic bags, human faeces, kaylites, plastic drink and water bottles and beer bottles among other solid wastes .The place is a breeding ground for flies, rodents that transmit bacteria to nearby houses and mosquitoes which bite residents in the surrounding homes and also cause malaria. Animals such as donkeys, cattle and dogs visit the site for food.

Fig 4.4 is a Photograph showing improper waste disposal site in Ward 4



The photograph above shows an improper solid waste disposal dumpsite in Mfalendaonye Ward 4 opposite house numbers 100 and 1564. From observation made by the researcher, the solid waste dumped comprises cardboard boxes, water bottles, pampers, wood shavings, plastic paper bags, beer bottles, wire clothes, shoes, food leftovers and other materials. People were observed scavenging for food and other items for reuse at the site resulting in people being risked to gastro intestinal infections, injuries because of exposure to sharp objects such as broken glasses, wire and other metals. Residents with homes facing the dumpsite were interviewed and complained of mosquito bites and putting them at high risk of contracting malaria. In the photograph children were observed looking for reusable items from the illegal dumpsite.

4.5. Beitbridge Dulivadzimu Municipality Dumpsite.

The Dulivadzimu dumpsite is the recipient of all the solid waste that is collected by the Municipality of Beitbridge. The dumpsite, according to the Beitbridge Municipality records, measures five hectares. The Beitbridge Municipality does not have a landfill and in that light, disposes the collected refuse at the dumpsite where municipality workers at times set fire to burn the waste and at times use graders to bury the waste. Observations made by the researcher indicated that about two hectares are currently being used for dumping the solid waste. The site is about 2km from the nearest houses in Dulivadzimu and shops at the Dulivadzimu rank in ward 4. **Below are the photographs showing heaps of solid waste disposed** at the dumpsite and a summation of what happens at the site as captured by the researcher during interviews held with respondents who frequent the place picking waste for reuse and resale.

Fig 4.5 showing Beitbridge municipality dumpsite



Fig 4.6 showing animals scavenging for food at Municipality of Beitbridge dumpsite



4.6. Implications of the improperly disposed solid waste on health security of Beitbridge residents

The researcher conducted interviews with 20 residents of Beitbridge, distributed 30 questionnaires and carried out observations in critical areas premised on understanding the health implications posed by improperly disposed solid waste at dumpsites at undesignated points in the residential suburbs and more prominently at the Dulivadzimu dumpsite. Health experts interviewed by the researcher said that dumpsites in Beitbridge especially the Dulivadzimu Beitbridge Municipality waste disposal site, pose monumental health scares to human health security. Some doctors from the Ministry of Health and Child care highlighted that leachate is produced from the sites and contains enormous quantities of trace metals in addition to hazardous compounds and that mix with surface water causing the pollution of water and soils of nearby agricultural lands. On that they said that during the rain season

leachate pollutes the water in the Limpopo river. Islam et al (2013) conceived leachate as the aqueous effluent generated as a consequence of rainwater percolation through wastes and the inherent water content of waste themselves. He added that precipitation percolates through the waste and gains dissolved and suspended components from the biodegrading waste through several physical chemical reactions.

From the questionnaires administered and interviews held with residents of Beitbridge, 80% of the respondents said that improper waste disposal dumpsites such as the Mfalendaonye Ward 4 dumpsite, Ward 6 dumpsite opposite house number 5720, dumpsites surrounding the Ward 3 industrial working site and principally the Beitbridge Municipality Dulivadzimu dumpsite are the breeding grounds for insects such as flies, mosquitoes and rodents that transmit diseases. 60 % of respondents from the administered questionnaires highlighted that flies from the dumpsites fly a few metres in droves into homes and contaminate food risking them to cholera, dysentery and other gastro intestinal complications. The same residents said that the dumpsites are havens of mosquitoes that fly from dumpsites into homes for example the undesignated site near house number 5720 and the researcher observed that the irregular waste site is about 20 metres from the houses neighbouring it and the residents are exposed to mosquito bites. Relatedly, interviews done with respondents working and residing at the Dulivadzimu Beitbridge Municipality dumpsite picking various items for resale intimated that they have to contend with mosquitoes that breed at the site and bite them daily and expose them to the risk of contracting malaria. Some said that they also develop wounds from the mosquito bites.

Waste pickers at the Dulivadzimu dumpsite were observed by the researcher operating without protective clothing. They had no safety shoes and gloves to protect them as they said that they get so little in terms of financial returns from selling materials for recycling and that is inadequate to purchase the required protective gear. The respondents revealed that they get injuries in the hands and foot from sharp objects such as wire, broken glasses and other metals that will be hidden in the composite rubbish dump. The researcher observed that there are loads of broken and sharp empty beer bottles disposed at the site. 60% of the respondents showed their hands with old and fresh wounds. According to the health professionals that were interviewed by the researcher, metals cause wounds and that lead to the transmission of diseases such as Hepatitis B, HIV and even Covid 19. This implies that the residents that pick waste at the dumpsite for reuse are exposed to the risk of contracting the aforementioned diseases threatening their health security. In addition, waste pickers said that the process of trying to retrieve goods from the dumpsite for reuse is tedious and taxing and at times people get muscle, back and ligament sprain that compromises their well-being and suffer in silence in most cases as they cannot afford proper health care. Also, some health practitioners advised that the waste pickers at the Dulivadzimu dumpsite are exposed to dust particles and methane gas released by the decomposing biodegradable substances like vegetable matter and other food elements. Some interviewees said that the Municipality of Beitbridge periodically sets fire on the dumpsite in the bid to reduce the amount of litter at the site, the waste pickers and passers-by are exposed to the smoke that contains carbon monoxide. The same respondents said that the waste pickers at the dumpsite are risked to respiratory infections such as lung cancer, asthma and tuberculosis among other infections. The fire also was reported as a scare to the health

security of resident especially waste pickers who can be burnt by ravaging fire. The **photograph below Fig 4.7. shows the Dulibadzimu Beitbridge Municipality dumpsite in smoke balls** polluting the environment and threatening the health security of residents



Health experts interviewed also said that working at the dumpsite poses challenges such as skin infections and burns. Waste pickers said that at times they get exposed to poisonous substances such as acids in some containers and even in discarded batteries resulting in skin infections and damages to eye sight. Commenting on exposure to fumes from burning dumpsites, some health experts interviewed by the researcher opined that pregnant women also bear the brunt of having stillbirths and low weight in delivery babies. The researcher observed that residents living close to the dumpsites are exposed to the odour that comes from decomposing matter. The Forit stands are approximately 100 metres from the site and new houses are being constructed at the stands and the residents constructing houses there will be exposed to the odour and that has some psychological impact on people and there affecting their wellbeing. One respondent informed that working at the site is challenging and cause stress. Same said that at some point he came across a decomposing foetus in a plastic bag dumped at the sight and went for days in mental and psychological torture.

The researcher observed that some waste pickers collected items such as soft drink bottle, beer bottles, cans and plastic water bottles for resell. Photographs below shows waste pickers with collected waste contraband at the Municipality of Beitbridge Dulibadzimu dumpsite ready for dispatch to recycling plants.

Fig 4.8 showing plastics picked ready for recycle



Fig 4.9 showing recollected beer bottles set to be taken for recycling



Though some respondents said that they sell plastic ware to reputable companies like Tragers and Weverly from Harare and Bulawayo, some sell collected wares locally for immediate reuse. Such items like water bottles are refilled with water for sell by water vendors. If not properly disinfected the water bottles will be conduits in the transmission of diseases like typhoid, dysentery and even cholera. Some health experts interviewed by the researcher said that dumpsites such as the Beitbridge Dulibadzimu dumpsite produce methane gas from decomposing food wastes .The respondents said that methane gas contributes to smog and ailments such as asthma and even death by asphyxiation thus threatening the health security of residents especially those working at the site as waste pickers.

4.7. Implications of improperly disposed solid waste on environmental security in Beitbridge.

Respondents gave varying responses in the 26 questionnaires returned and the 20 interviews conducted in trying to understand the threats to environmental security posed by improperly disposed solid waste in Beitbridge. Some health experts interviewed gave detailed explanations on the threats to environmental security of the previously identified illegal dumping sites

including the Dulibadzimu Beitbridge Municipality dumpsite. 70% of the health experts interviewed said that the dumpsites produce leachate that is an environmental health scare. According to them, rain water will flow through improperly disposed waste at the site and percolate to the ground leading to the contamination of groundwater with toxic substances from waste that it passes through. The respondents said that leachate from the Dulibadzimu dumpsite has the potential to pollute the Limpopo river and the ground water making it unusable for consumption by animals and people. This means that water from boreholes that are drilled at the Forit stands might be contaminated and has potential to kill vegetation.

Observations made by the researcher revealed that the Beitbridge Municipality Dulivadzimu dumpsite is burnt by municipality workers to minimise the rate at which disposed matter is blown away by wind and further spread by waste pickers. To this end, the dumpsite is always churning billows of smoke that pollute the air and according to some respondents, the smoke produced by the fire at the disposal site is an environmental concern that also affects visibility. Health experts interviewed said that the dumpsite fire also has the potential to cause veld fires as it is uncontrolled leading to the death of animals, insects and other living organisms and vegetation

Health experts interviewed said that methane gas is approximately eight four times more dangerous than carbon dioxide though it does not stay in the atmosphere much like carbon dioxide. The respondents said that although the amount of methane produced by the dumpsites in Beitbridge is insignificant and does not immediately affect residents, the methane gas contributes to the overall global picture of climate change where it contributes to global warming.

Some respondents highlighted in the questionnaires and the interviews that improperly disposed solid waste at the Dulibadzimu dumpsite and that laden in the whole tributary beginning at Mangava business centre passing through Mbedzi business centre flowing southwards into the Limpopo river, is carried by flowing water during the rain season and end up blocking waterways and bridges resulting in flooding. Photograph below shows **Fig 4.10** that shows part of the stream laden with discarded solid waste that include pampers, beer bottles and plastic water bottles, plastic bags and kaylites among other discarded materials.



Some plastics, pampers and other non-biodegradables are carried into the Limpopo river polluting the water and even killing aquatic life. More so, the solid waste disposed in the stream cause water pollution. Some respondents were of the opinion that animals such as donkeys, cattle ,dogs and wild animals that scavenge for food at the dumpsites in Beitbridge are at risk as some of them eat contaminated food, poisoned food and even plastics which cannot be digested easily and they end up dead.

4.8. Suggestions from respondents on what Beitbridge municipality can do to improve waste disposal in Beitbridge

Respondents reached out by the researcher using the questionnaires and the interviews gave varying responses in suggesting what the Municipality of Beitbridge can do to improve solid waste disposal and guarantee health security of residents and environmental security.70 % of respondents from the administered questionnaires suggested that the municipality of Beitbridge should make sure that it constructs an engineered landfill as an alternative to the Dulivadzimu Beitbridge municipality dumpsite. The waste dumped at the municipality dumpsite is not being well taken care of resulting in a battery of health security and environmental security threats as previously discussed. The American society for civil engineers defines an engineered landfill as a method of disposing of refuse on land without creating nuisance or hazard to public health or safety, by utilising the principles of engineering to confine the refuse to the smallest practical area, to reduce it to the smallest practical volume and to cover it with a layer of earth at least at the conclusion of each days operation or at such more frequent interval as may be necessary. Health experts interviewed said that landfills make it easier to deal with leachate and methane gas as shown in the diagram below adapted from Zaloksnis (2013). 100 % of interviewed health experts concurred that a landfill will help in ensuring health security of residents of Beitbridge as the ground water will not be polluted by leachate that is contained by clay or rubber lining while methane gas is harnessed to provide energy in homes. The respondents said

that issues of injuries to waste pickers and other occupational health hazards will cease to exist once the landfill is constructed. Lew (2018) however says that landfill construction and operation require high capital cost. The Beitbridge municipality might not be able to construct one given its limited finance potential. 30 % of the respondents from the administered questionnaires said that as an alternative to the Beitbridge Municipality dumpsite, the municipality should have an incinerator for disposal of organic waste by combustion. The combustion plant uses extremely high temperatures for the waste to completely burn. However, Lew (2018) highlighted that incineration is expensive and requires high capital cost which the Municipality of Beitbridge might not be able to afford.

90 % of the respondents suggested that the Municipality of Beitbridge should regularly carry out clean up campaigns in Beitbridge visiting the areas with the previously noted improperly disposed waste and collect to the dumpsite. 60% of respondents from the questionnaires administered suggested that the Municipality of Beitbridge should expend energy educating the residents of Beitbridge on the essence of being hygienic and the implications of having solid waste at undesignated points to the health security of residents. The foregoing also entails the need for the municipality to ensure that every house has a bin.

80% of the respondents from the administered questionnaires suggested that the Municipality of Beitbridge should collect solid waste from households at least twice a week so that there is no chance of some residents offloading overflowing bins on undesignated points or resorting to burning or composting in their backyards. Respondents said that the roaster in which the solid waste is collected once a week by the municipality does not suffice to completely deal with the challenges of improper waste disposal hence the need for increased frequency.

50% of respondents in the administered questionnaires suggested that the municipality of Beitbridge should fence the municipality dumpsite so that there are no intruders. As observed by the researcher, the dumpsite is frequented by waste pickers with some of them now residing at the site living in makeshift tents. These people are exposed to various health complications such as asthma and other infectious ailments, gastrointestinal complications and injuries among other health security challenges. These people and animals that also throng the place scatter further the disposed waste bringing environmental challenges. It is against this background that they suggested that the dumpsite be protected to ensure health security of residents.

65% of respondents in the interviews held and 50% of questionnaires administered suggested that the Municipality of Beitbridge have strong by laws that criminalises improper solid waste disposal. By laws are important as they are easily enforced at the local level and that has an extra motivation in that offenders are charged thus contributing to municipality revenue. Chakaipa (2010) says that local authorities are given powers to control their areas with the Urban Councils Act 29:15 which mandate that each local authority is required to have by laws guiding the manner in which certain activities are done in respect of waste management.

4.9. Chapter summary

The chapter gave a summary of the research findings where it zeroed in on the implications of poorly disposed solid waste on the health security of Beitbridge residents and also on

environmental security. The researcher used pie chart, tables and photographs to present the collected data. Analysis of the data collected was done and it was shown that solid waste poses serious challenges to the health of residents and the environment.

CHAPTER FIVE

SUMMARY, CONCLUSIONS, RECOMENDATIONS AND AREAS FOR FURTHER RESEARCH

5.0. Introduction

This chapter is premised on giving a summary of the research, conclusions and recommendations which the Beitbridge Municipality should adopt to ensure proper solid waste disposal that guarantees health security of Beitbridge residents as well as ensuring environmental security. As has been observed, health security and environmental security in Beitbridge is under siege from improperly disposed solid waste at dumpsites near residential suburbs and at the municipality of Beitbridge dumpsite.

5.1. Summary

The study was necessitated by the deplorable nature of solid waste management in the country as evidenced by the proliferation of illegal dumpsites in almost all the cities exposing the citizens to numerous health security scares and environmental security concerns. As a result of the deteriorating economic conditions in Zimbabwe, most urban local authorities have failed to properly deal with solid waste management and most municipalities make do with dumpsites and have no engineered landfills. This research used Beitbridge as a microcosmic illustration to understand the implications to health security and environmental security of improperly disposed solid waste.

In this study the researcher used a mixed methodology approach. The research had clearly stated research objectives and research questions that addressed the demands of the research topic. To this end, both the relevant theoretical and empirical literature was reviewed. The researcher used interviews, questionnaires and observations to gather data on the implication of solid waste to the health security of Beitbridge residents and to the environment. Areas noted in Beitbridge to be laden with solid waste that pose health security scares include but no limited to the industrial working site in ward 3, area behind Whitelodge facing house numbers 4656 to 4669 in Ward 6 , Mfelandaonye in ward 4 and more prominently the Beitbridge municipality dumpsite .

The study revealed that in Beitbridge the solid waste produced by residents is extensive and mainly include beer bottles, glass, wood shavings, food waste, plastic water bottles, and plastic bags, pampers, faeces, kaylites, used batteries, scrap metal, asbestos pieces and other construction debris, carcasses used tyres and other wastes.

This study looked at researches that were done by other prominent scholars globally on waste management with particular emphasis on the threats posed by illegal solid waste management practices on the health of people and the environment. The research managed to lay bare the fact that Beitbridge residents are exposed to solid waste that cause gastro intestinal infections, bodily injuries, malaria and other health challenges. The study also revealed that solid waste in Beitbridge is washed by rains into the Limpopo River causing pollution of the river while leachate from dumpsites pollutes ground water. Other environmental security threats posed by the dumpsite is air pollution from carbon monoxide released by burning of litter and also the

threat of fire as the surrounding vegetation might be burnt if the fires from the dumpsite are not controlled. The residents of Beitbridge highlighted that solid waste is dumped at undesigned places because the municipality collects litter once a week which is not enough and proposed two times per week while other areas are not at all visited for waste removal resulting in people resorting to dumping. Others said that if the municipality does not collect refuse, they resort to dumping, composting or open burning and that poses a fair share of challenges to people's health security.

5.2. Conclusion

Beitbridge requires proper solid waste disposal systems that are in sync with the latest international trends that guarantee people's health security and clean environments. Such best practices include but are not limited to landfills and incinerators. Methane gas produced in landfills is used to provide energy for use in households while heat generated by incinerators can be used to generate electricity thus deriving positives from materials that could have otherwise have been detrimental to health. However such disposal methods require huge capital outlay and possibly need partnerships with private players.

5.3. Recommendations

The Beitbridge Municipality should insulate the health security of residents by enforcing its Anti-litter 2019 by laws and ensure that people who dispose litter at undesigned places are slapped with level three fines as directed by the by law. This is meant to ensure that solid waste, that has serious health implications, is well handled

The Beitbridge Municipality should prioritise waste management with comprehensive budget lines as it is a social service. Capacitating waste management with adequate resources means that the municipality will have enough manpower that will pick and collect refuse from bins and waste that is strewn at undesigned points timeously before the waste becomes a health bomb.

The municipality of Beitbridge should engage and educate all the stakeholders in waste management to include residents with the mandate of inculcating sense of interest and responsibility and that clearly unpacks to residents the problematics of improper solid waste handling and disposal on health security. Responsibility by residents would begin from conducting some council led clean up campaigns in wards and give no chance for litter to accumulate

The Municipality of Beitbridge should encourage the culture of recycling waste as it helps in reducing the amount of waste, volume and the need for exploiting new raw materials. The bulk of waste at the dumpsites are plastics that have a read market from recycling companies so it is pertinent that the municipality provide educative platforms that link waste recyclers and residents.

The Municipality of Beitbridge should sell refuse receptacles at affordable prices and make sure that they always have them in stock so that people do not dump the waste at illegal points.

Bins have lids that cover the waste minimising exposure to rodents, flies and mosquitoes that transmit diseases thus residents should not be allowed to use receptacles that do not have lids.

The Municipality of Beitbridge need to have a properly engineered landfill in place of the Dulivadzimu dumpsite that has negative implications on the health security of residents and the environment. Landfill will help contain all the litter that is blown from the dumpsite, will stop waste pickers and scavengers from accessing the place and be exposed to a battery of ailments. Landfill will help and positively contribute to health security as it harnesses methane gas for domestic uses and contain leachate that pollutes groundwater

If the Beitbridge municipality is overwhelmed in solid waste collection, the municipality can hire some private waste collectors and guarantee clean environments.

5.4. Areas for further study

The research unpacked the implications of the improperly disposed solid waste on the health security of residents and the environment. However, there is need for a detailed and scientific research from health experts that will take samples to the laboratories to establish the extent of damage the improperly disposed sites can have on people and the environment. This implies testing groundwater at the Forit stands to see if it is not affected by leachate from the Dulivadzimu dumpsite, taking checking whether injuries to waste pickers exposed to sharp objects has not caused much damage to health, assessing health damage posed by mosquitoes breeding at dumpsites, analysing the implications of e- waste and other dangerous substances. The research was a theoretical perspective that needs to be supported by science thus forming the basis for further study to test the veracity of the theoretical findings.

APPENDICES

Appendix A

Interview guide for waste pickers and other people involved in activities at Dulivadzimu dumpsite

Dear respondent,

My name is Shupikayi Chivhaku, a Master of Science Peace and Governance Student at Bindura University of Science Education. I am carrying out a research in Beitbridge to unpack the implications of improper solid waste disposal on health and environmental security, so I kindly request your help by answering a few questions. I assure you that your responses will be strictly confidential and be used for academic purposes only.

1. How old are you?
2. Are you married?
3. What level of education do you have?
4. What is solid waste disposal?
5. What are you doing at the dumpsite?
6. When did you start visiting this place?
7. Do you pick solid waste at the dumpsite for reuse? If so explain.
8. What health effects do you face because of your working at the dumpsite?
9. Do you think the improperly disposed waste at the dumpsite is a health hazard to Beitbridge residents? Explain.
10. How is the dumpsite affecting the environment? Explain your answer.
11. What can be done to improve solid waste disposal at the dumpsite?

Thank you for your cooperation

Appendix B

Interview guide for strategic informants

Dear respondent,

My name is Shupikayi Chivhaku, a Master of Science in Peace and Governance student at Bindura University of Science Education. I am carrying out a research in Beitbridge to unpack the implications of improper solid waste disposal on health and environmental security, so I kindly request your help by answering a few questions. I assure you that your responses will be strictly confidential and be used for academic purposes only.

1. How old are you?
2. Where do you work in Beitbridge?
3. What is solid waste management?
4. Which areas in Beitbridge town require solid waste removal?
5. Have you ever visited the Beitbridge Municipality Dulivadzimu dumpsite?
6. What type of solid waste do you find at the dumpsite?
7. Did you notice that the place is thronged by hundreds of people?
8. What health risks do these people face?
9. How is methane gas released by the dumpsite handled by the Beitbridge Municipality and what are its environmental effects?
10. How is leachate produced by the dumpsite handled by the Municipality of Beitbridge?
11. Do you think the leachate has adverse health impact to residents of Beitbridge?
12. What do you suggest as the proper solid waste disposal methods that can be adopted by the municipality of Beitbridge?

Thank you for your cooperation

Appendix C

Observation checklist

Implications of improperly disposed solid waste on health and environmental security: case of Beitbridge.

1. Is the Beitbridge Dulivadzimu dumpsite fenced?
2. Who visits the dumpsite?
3. Why is the place visited?
4. What type of waste is found at the dumpsite?
5. Are there noticeable health effects being posed by the dumpsite?
6. Are there noticeable environmental effects being posed by the dumpsite?
7. Which other areas in Beitbridge Town have improperly disposed solid waste?

Appendix D

Questionnaire (for residents)

Dear respondent,

My name is Shupikayi Chivhaku a Master of Science Peace and Governance student at Bindura University of Science Education. This research is being carried out to understand the implications of improperly disposed solid waste on health and environmental security in Beitbridge, Zimbabwe. In that respect, I kindly ask you to help by completing this questionnaire and I assure you that your responses will be strictly confidential and will be used for academic purposes only. Thank you for participating

Instructions to respondents

1. You will not write your contact details or name on the questionnaire.
2. For closed questions, tick in the spaces provided and for open ended questions fill in the blank spaces provided.

Section A

Background information

Please tick in the applicable box

1. What is your gender Male Female
2. What is your age 21-30 31-40
41-50 51-60
61+
3. What is your level of education? Primary Secondary
Tertiary Others
4. How many people reside at your house
.....

Section B

Solid waste generation, collection and disposal

5 (a) What type of waste do you generate at your house or site?

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

(b). Besides Municipality of Beitbridge collection, how else do you dispose your waste? Tick below:

Reuse	<input type="checkbox"/>	Open air burning	<input type="checkbox"/>
Compost	<input type="checkbox"/>	Dump	<input type="checkbox"/>
Recycle	<input type="checkbox"/>	Others	<input type="checkbox"/>

5. How often is solid waste collected by the Beitbridge Municipality?

Daily	<input type="checkbox"/>	Twice a week	<input type="checkbox"/>
Weekly	<input type="checkbox"/>	Monthly	<input type="checkbox"/>
Never	<input type="checkbox"/>		

6. Is there an improper waste disposal site near your home?

Yes	<input type="checkbox"/>	No	<input type="checkbox"/>
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If Yes indicate where:

.....
.....

7. How are such sites a threat to your health?

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.....
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8. How are such sites a threat to the environment?

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.....

10. What can the Municipality of Beitbridge do ensure that solid waste is well handled to avoid endangering lives of people and the environment?

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.....
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Thank you for your cooperation

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