EXAMINATION OF PLASTIC BAG WASTE MANAGEMENT PRACTICES IN THE CENTRAL BUSINESS DISTRICT OF BULAWAYO, ZIMBABWE

by

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DECLARATION

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Examination of plastic bag waste management practices in the Central Business District of Bulawayo, Zimbabwe

I declare that this dissertation is my own work and that all the sources that I have used have been indicated and acknowledged by means of complete references.

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ABSTRACT

Plastic bag waste is a major environmental concern faced by countries across the economic development spectrum. In response, nations have adopted varied management practices to lessen the detrimental effects of plastic bags. The main objective of the study was to examine plastic bag waste management practices in the Central Business District of Bulawayo, Zimbabwe. The research was guided by interpretisvism paradigm and inductive reasoning. Qualitative data collection techniques used included semi-structured interviews, observations and documents reviews. Research findings identified the following shortfalls: inadequate waste bins; lack of colour coded bins; shortage of waste transportation vehicles; unlined landfill; limited recycling and incineration facilities; inadequate legislation enforcement and monitoring system; and limited support for plastic bag waste management commitment actions. In light of the findings, the researcher developed a plastic bag waste management model for Bulawayo City Council indicating the approaches, roles of stakeholders and mechanisms for financial development, to realise effective and efficient plastic bag waste management system. The plastic bag waste management model involved the three aspects that included technical and infrastructural approaches, legal and policy frameworks, and public private partnership approaches. The framework addressed technical and infrastructural shortfalls that include limited waste storage facilities, vehicles and plastic bag waste disposal/management infrastructure. Strategies to enhance legislation enforcement and monitoring and methods to enhance support for commitment actions are addressed.

Key Terms: Plastic bag waste management, plastic bag pollution, plastic bag legislation, Circular economy, recycling, landfilling, incineration, Capacity Building Concept, Institutional Theory, Bulawayo Central Business District

DEDICATION

To my late mother, who taught me the value of love and hard work, my father for his constant love and my siblings for giving me strength throughout the research process.

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ABBREVIATIONS

ABC	African Banking Corporation
BBC	British Broadcasting Corporation
BCC	Bulawayo City Council
BPBs	Biodegradable Plastic Bags
CBD	Central Business District
CBOs	Community Based Organisations
CCAQDA	Computer-Aided Qualitative Data Analysis Software
CCN	City Council of Nairobi
CNY	Chinese Yuan
CSIR	Council of Scientific Research
DEPA	Danish Environmental Protection Agency
EC	European Commission
EMA	Environmental Management Agency
EPA	Environmental Protection Agency
EU	European Union
GDP	Gross Domestic Product
HCC	Harare City Council
ILO	International Labour Organisation
ISWM	Integrated Solid Waste Management
KAM	Kenya Association of Manufacturers
KRH	Kenya Refuse Handlers
LCA	Life Cycle Assessment

MRF	Materials Recovery Facility
MSWM	Municipal Solid waste Management
NUST	National Univesity of Science and Technology
PB	Plastic Bag
PBs	Plastic Bags
PBW	Plastic Bag Waste
PBWM	Plastic Bag Waste Management
PhD	Doctor of Philosopy
QCA	Qualitative Content analysis
REMA	Rwanda Environment Management Authority
SA	South Africa
SAAN	Scientific Action and Advocacy Network
SATAWU	South African Transport and Allied Workers Union
SI	Statutory Instrument
SWM	Solid Waste Management
UN	United Nations
UNESCO	United Nations Educational, Scientific and Cultural Organisation
USD	United States Dollar
ZRP	Zimbabwe Republic Police

OUTPUTS FROM THE STUDY

The researcher published one article and is looking forward to publish two more articles in peer reviewed journals (Appendix 1) as outlined below:

1. Nyathi, B. and Togo, C. A. (2020). Legal and policy framework approaches for plastic bag waste management in African Countries, *Journal of Waste Management, 2020, 1-8.* DOI: 10.1155/2020/8892773.

2. Nyathi, B. and Togo, C.A. Analysis of technological and infrastructural approaches for plastic bag waste management in Africa, *Journal of Waste Management* (Submitted).

3. Nyathi, B. and Togo, C.A. Capacity building concept to MSWM in African countries, *Journal of Waste Management* (Submitted).

1 INTRODUCTION

Plastic bags (PBs) play a fundamental role in packaging consumer goods and are widely used (Flower, 2017; Plastic Bag Source, 2018). The PBs are preferred by consumers and retailers because they are inexpensive, more durable than paper bags, are easy to carry and are a flexible way of packaging goods (European Bioplastics, 2017). An estimated one trillion lightweight PBs are used annually worldwide (United States of America Environmental Protection Agency [USA EPA], 2018). Despite the popularity and importance of PBs, there is a downside on the waste they generate.

Plastic bag waste (PBW) is associated with environmental and socio-economic problems (Danielsson, 2017; Geyer *et al*., 2017; Chasse 2018; Behuria, 2019) that include the clogging of water drains, diseases and loss of aesthetic value. Blocked reticulation systems cause water bursts that lead to excessive loss of water (Jambeck *et al.,* 2018; Kulkarni, 2018). Plastic bag litter blocks urban drainage systems thus causing flooding (Zero Waste, 2017). This has economic repercussions as local authorities have to repair or acquire new water pipelines. Furthermore, PBW has been linked to the spread of disease by creating stagnant water for mosquito breeding in places like green markets, alleys and bus terminals (Mudzengerere and Chigwenya, 2012; Quartey *et al*., 2015). The light nature of PBs makes them easily spread by wind, causing loss of aesthetic value (Environmental Management Agency [EMA], 2015).

In Australia, PBW is associated with a wide range of adverse environmental impacts on soils, waterways, marine environments and fauna (Government of Western Australia, 2017; USA EPA, 2018). Plastic bags entangle animals causing them to drown (Jalil *et al.,* 2013; Zero Waste, 2017; Plastic Oceans, 2018). Countries like Ireland and Denmark have put a ban on lightweight PBs because of their negative environmental impacts (Chasse, 2018; Le Guern, 2018; National Geographic, 2018).

The impact of PBW is an immense problem in Africa for example, Kenya, Rwanda and Ethiopia (Masai, 2015; Alhindawi, 2017; The East African, 2017). Plastic bags take a long time to decompose (National Geographic, 2018). Thus, they have long term negative environmental impacts. Incinerated PB litter releases dangerous pollutants such as furans and dioxins that have adverse effects on life (Cancer Council, 2018; Ecological Centre, 2018).

According to capacity building concept, institutions, individuals and societies require technical skills, human resource management, knowledge and institutional capacity to achieve their full potential (Jacklin, 2005; Karunasena *et al.,* 2010; Bergeron *et al.,* 2017). However, local authorities in Africa experience financial and technical resource limitations to implement an effective PBWM system (Infrastructure News, 2013; McAllister, 2015; Bello *et al.*, 2016). Financial problems make it difficult for local authorities to implement waste management tools like Life cycle assessment (LCA), acquire proper and adequate waste management equipment and machinery in their waste management systems (Mmereki *et al.,* 2016; Jambeck *et al*., 2018). As a result, PB waste recycling in underdeveloped nations tends to be low as compared to the developed countries (McAllister, 2015; Kabera *et al*., 2019).

Municipal councils in developing countries do not regard waste management as a priority service in their budgets (Nyayiemi, 2012; Rinke *et al.,* 2014; Nkosi, 2015; Muchandiona, 2017). Waste management budgets tend to be low as the returns on investment are low (Igbinomwanhia and Ideho, 2014; Mmereki *et al*., 2016). It is difficult to implement an effective PBWM system under a limited budget.

Plastic bag law enforcement is a major challenge faced by developing countries (Kurian, 2013; Igbinomwanhia and Ideho, 2014). Legislation enforcement impediments include low PB price, limited human and capital resources (Alhindawi, 2017; Maema, 2017; Jambeck, 2018). In South Africa, effort to use PB tax in 2003 faced some problems

around variable pricing that discouraged recycling (Dikgang *et al.,* 2012). In contrast, a success story was observed in Botswana where PB consumption declined significantly due to high PB price (Dikgang and Visser, 2012; McLellan, 2014).

There is a limited coverage / consultation in the publicity of law through broadcast news such as television and radio (Kurian, 2013; United Nations, 2018). The private and public members feel that they are not adequately consulted and are often excluded in the formulation of PB legislation (Igbinomwanhia and Ideho, 2014). However, capacity building concept and institutional theory call for the participation of all stakeholders in waste management to solve problems and formulate solutions (Karunasena *et al*., 2010; Stewart, 2015; Bergeron *et al*., 2017).

In Kenya, PB legislation has been facing some resistance from stakeholders such as Kenya Association of Manufacturers (KAM) and the public in general. Kenya Association of Manufacturers challenged the ban on PBs arguing that if upheld, it would cause massive socio-economic losses in the affected communities and industries (Maema, 2017). For legislation to be effective, stakeholders must be adequately involved as this gives them a sense of belonging and buy in to the implementation of PB legislation (Kurian, 2013; Muthoni, 2014). This is supplemented by the institutional theory that calls for the involvement of relevant stakeholders in waste management (Brammer *et al.,* 2012; Jackson and Matten, 2012).

In developing nations, many people have limited understanding to PB ban legislation (Maema, 2017; Jambeck, 2018). Individual characteristics such as education and attitude influence legislation enforcement (Oyake-Ombis, 2012). For example, a person who is aware of PB ban and its negative environmental impacts is more likely to use a reusable bag. The capacity building concept holds that community capacity development through training and education can help to achieve an effective PBWM system (Jacklin, 2005; Stewart, 2015).

Informal waste pickers play a fundamental role in PBWM in developing nations such as Kenya (Oyake-Ombis, 2012). However, the society often despises them (Practical Action, 2014). They are shunned by the public and local authority officials, and exploited by waste management traders (Infrastructure News, 2017). Thompson (2014) claims that the public and local authorities do not appreciate the fundamental role played by waste pickers in PBWM. The researcher noted that lack of recognition of informal waste pickers is one of the factors making it difficult to implement a sustainable PBWM system.

Low public awareness of PBWM is another factor that is responsible for PB pollution in African countries like Somalia and Uganda (Global Voices, 2015; Masai, 2015). Private and public sectors participation in PBWM is un-regulated with few companies and a few Community Based Organisations (CBOs) are engaged in PB waste collection services (Oyake-Ombis, 2012). Involvement of the public in the PBWM helps to achieve an effective PBWM system. Community involvement motivates stakeholders to address the problem at hand (Tantalo and Priem, 2014; Lederer *et al.,* 2015).

Local authorities in Zimbabwe are struggling to implement an effective waste management system (Rinke *et al*., 2014; Muchandiona, 2017; Sinthumule and Mkumbuzi, 2019). Since the mid-1990s, Zimbabwe's economy has been unstable. This has negatively affected local authorities in terms of budgets and their waste management systems. Local authorities struggle to purchase modern waste management vehicles and spare parts (Mudzengerere and Chigwenya, 2012; Muringa, 2012; World Bank, 2012; McAllister, 2015; Mmereki *et al*., 2016). Plastic bag litter is evident along highways and in many urban communities, such as the central business district (CBD) of Bulawayo (Bulawayo Bulletin, 2018). Zimbabwe enacted legislation banning use of lightweight bags (serve for packaging bread, fresh fruits, vegetables and other consumables) following the negative environmental impacts associated with them. However, PBs are still used (EMA, 2015). Plastic bag legislation is ineffective if there is

no strict enforcement (Dikgang and Visser, 2012; Chitotombe, 2014; Chasse, 2018). The challenges imposed by poor PBWM are similar in both developed and developing economies.

Zimbabwe's economy has been unstable. This has negatively affected BCC in terms of budget and service delivery (Makwara and Magudu, 2013; Bulawayo 24, 2020; Kubatana, 2020). Bulawayo City Council required a supplementary budget of USD 2, 85 billion to provide normal service delivery for the remainder of 2020 (Bulawayo 24, 2020; Kubatana, 2020). The 2019 waste management budget (USD 7, 14 million) failed to provide normal service delivery due to the harsh macro-economic environment, high debt owed by ratepayers and fuel shortages (Bulawayo 24, 2020). Although economic factors are among the major problems of PBWM system in Zimbabwe, PBWM practices need to be examined in order to achieve an effective PBWM system. Plastic bag waste has the potential to result in adverse environmental impacts if urgent measures are not taken (Chasse 2018; Behuria, 2019). The study was undertaken to examine PBWM practices in the CBD of Bulawayo so as to develop a sustainable PBWM within the confines of ISWM.

1.1 RESEARCH PROBLEM

Plastic bag waste management (PBWM) is an immense challenge facing local authorities in Zimbabwe (Mudzengerere and Chigwenya, 2012; Chitotombe, 2014; EMA, 2015; Mahamba, 2015; Muchandiona, 2017; Bulawayo Bulletin, 2018). Increased PBW in Bulawayo, has resulted in negative safey, health and environmental problems that include environmental contamination, obstruction of water channels, spread of disease (by creating stagnant water for mosquito breeding), and is a blight on the landscape. In 2014 in the CBD of Bulawayo, streets were flooded after down pour (Bulawayo 24, 2014). Plastic bags along the roads and in the drainage ditches were among the major contributing factors to the rising up of the water level in the tunnels.

This scenario resulted in the closure of some buildings after their basements and elevator shafts were flooded.

Concerns about increased PB pollution have been expressed by many stakeholders such as Bulawayo City Council (BCC), EMA, private organisations and the public in the CBD of Bulawayo especially in green markets, bus terminals and alleys.

There is a limited understanding of technical and infrastructural approaches, level of private and public participation and legal and policy framework (McAllister, 2015; Mmereki *et al*., 2016; Muchandiona, 2017) to develop effective PBWM system.The root causes of PB pollution in BCC are not understood with stakeholder abdicating accountability (Mudzengerere and Chigwenya, 2012). Thus, it was the researcher's intention to examine the PBWM to determine the root causes of PB pollution and develop a relevant management system.

1.2 PURPOSE OF THE STUDY

The research findings enlighten the local authority, the public, policy makers and academic field of effective and sustainable PBWM practices in similar contexts.

1.2.1 Local Authority and the public

The research study has direct benefits to the public and the local authority. The researcher identified and examined key factors responsible for ineffective PBWM in the CBD of Bulawayo and suggested sustainable PBWM solutions to be used to contain the problem. The researcher proposed a PBWM framework for Bulawayo. To the best of the researcher's and BCC personnel's knowledge, this was the first time such a research was undertaken in Bulawayo. Thus, there was a uniqueness of context that cascaded to unique approach to the waste management. Recommendations from this study could be extended to other municipalities in Africa. The researcher published an article titled,

Legal and policy Framework Approaches for Plastic Bag Waste Management in African Countries and will publish more articles from this work that will be accessed by other public officials and the latter will be free to implement some of the recommendations.

1.2.2 Policy makers

Plastic waste is taking central stage in the national environmental policies of many countries (Rinke *et al.,* 2014; Muchandiona, 2017). Plastic bag law enforcement is a major challenge faced by developing countries (Alhindawi, 2017; Maema, 2017; Jambeck, 2018). This research provides information about how to improve PBWM system. Recommendations from the study are useful to policy makers in formulating effective policies relevant to PBWM.

1.2.3 Academics

This research is important in identifying gaps in the documentation of PBWM practices in the CBD of Bulawayo. To the best of literature search available fewer papers for example, Mudzengerere and Chigwenya (2012); Muchandiona (2017), have been published on sustainable solid waste management (SWM) practices in the CBD of Bulawayo. The region-specific studies have yielded varied results. Plastic bag ban has been applied in many countries but have yielded varied results (Danielsson, 2017; Chasse 2018; Behuria, 2019). Therefore the study contributes to the diversity of context/region-specific results.

1.3 RESEARCH QUESTIONS

The researcher sought to answer this main research question: What PBWM practices are employed in the CBD of Bulawayo? The main research question was answered through the following sub-questions, which are:

i. What is the status of PBW in the CBD?
ii. What role does the public and private parties play in PBWM in the CBD of Bulawayo?
iii. What are the legal and policy framework approaches for PBWM in the CBD of Bulawayo?
iv. What are the technical and infrastructural approaches for PBWM in the CBD of Bulawayo?
v. What can be done to improve waste management in the CBD of Bulawayo?

1.4 AIM AND OBJECTIVES

The study was aimed at examining PBWM practices in the CBD of Bulawayo to assist with the development of a PBWM framework.

The research aim was fulfilled through the following specific objectives, which were to:

i. determine the status (sources, extent, spatial distribution, etc) of plastic bag waste in the CBD;
ii. examine the level of private and public participation in plastic bag waste management in the CBD of Bulawayo;
iii. assess the effectiveness of current technical and infrastructural approaches for plastic bag waste management in the CBD of Bulawayo;
iv. analyse the current legal and policy framework approaches for plastic waste management in the CBD of Bulawayo; and
v. develop a sustainable plastic waste management model within the confines of integrated sustainable solid waste management for Bulawayo.

1.5 CHAPTER SUMMARY

This chapter contextualised the study by summarising the problems imposed by poor PBWM, touched on hurdles towards implementation of sound management practices. These led to the problem statement and objectives. This chapter set the scene for the research and more information on the SWM will be dealt with in the literature review.

2 LITERATURE REVIEW

This chapter presents a comparative approach to methods employed in PBWM around the world and in the study area. The literature review is divided into four sections namely:

i. plastic bag pollution;
ii. approaches to PBWM;
iii. public and private partnership initiatives; and
iv. theoretical framework (Figure 2.1).

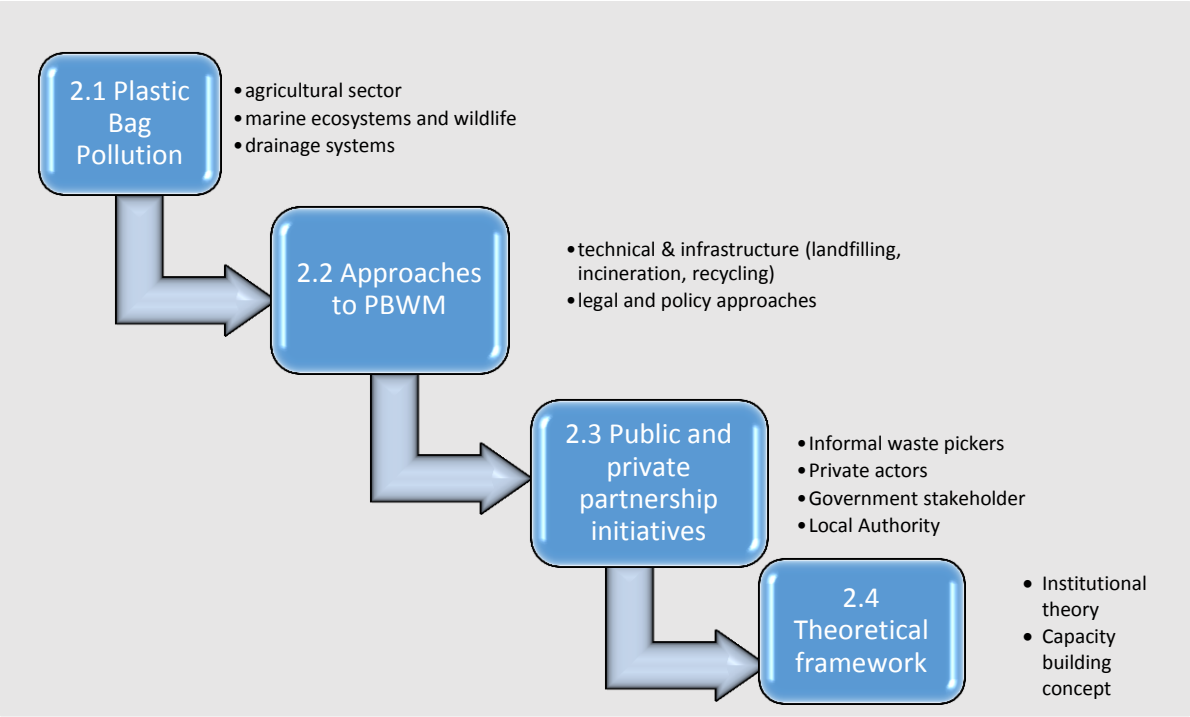


Figure 2.1: Schematic content flow

2.1 PLASTIC BAG POLLUTION

Plastic bags have been used since 1960s (Evans, 2019). However, human nature at times has a reactive tendency of addressing pollution only when a catastrophe strikes.

Hence the PB pollution impacts are felt globally. The impacts span across different environments and economic sectors that include agriculture, marine and municipal reticulation systems. In Australia, there is increasing evidence of the cumulative impact that plastic has on soils, waterways, marine environments and fauna (Clean Up Australia, 2015; Government of Western Australia, 2017). Floating PBs in oceans prevent direct sunlight for aquatic life. Marine animals such as sharks and dolphins easily mistake PB for a meal and get choked after consumption (Geyer *et al*., 2017; Government of Western Australia, 2017; Hardesty, 2017; Moss and Jambeck, 2017; Vince and Plastic oceans, 2018). Floating PBs also act as habitat for the transportation of alien species and can be a navigation hazard. Sea turtles, one of the endangered aquatic species, are at risk from PBW as they usually mistake them for jellyfish (Rochman *et al.*, 2016; Matsuguma *et al.*, 2017).

2.1.1 Effects in Agricultural sector

2.1.1.1 Livestock

Plastic bag litter has adverse effects on cattle and can cause economic loss to the agricultural sector (Kumar and Dhar, 2013; Priyanka and Dey, 2018). The unselective eating habits of cattle make them subject to ingestion of PB litter. Cattle face several pathological conditions due to ingestion of PBs that include indigestion, impaction, tympany, polybezoars and immune suppression (Ramaswamy and Sharma, 2011). According to Ramaswamy and Sharma (2011) and Priyanka and Dey, (2018) the common symptoms detected in affected cattle include:

i. bloating;
ii. weight loss;
iii. ruminal impaction; and
iv. reduction of milk yield.

Acute bloat cause more stress over the ribs and diaphragm in turn affecting respiratory movements. This causes hypoventilation and reduced venous returning to the heart (Ramaswamy and Sharma, 2011; Kumar and Dhar, 2013; Priyanka and Dey, 2018). Thus, bloat usually cause cattle mortality.

In developing nations, the impacts of PBW in livestock have been reported in countries that include Ethiopia, Nigeria and Pakistan. Cattle often mistake PBs for food (Figure 2.2; Joe, 2019; Two Oceans Aquarium, 2019). Ruminal impaction in the above-mentioned countries has caused low weight gain, low milk yield and high mortality (Kumar and Dhar, 2013; Priyanka and Dey, 2018). Prevalence of plastics in livestock has been reported in many countries that include:

i. Addis Ababa, Ethiopia - 23.2 % in goats and sheep;
ii. Jimma, Ethiopia - 13.22 % in cattle;
iii. Zango, Zaria, Nigeria - 11.6 % in ruminants; and
iv. Khyber Pakhtunkhwa, Pakistan - 59.14 % in cattle (Priyanka and Dey, 2018).

In a study conducted in Gondar city of Ethiopia about the adverse impacts of plastics, all animals observed displayed symptoms of grunting, pain, arched back and depression and a 75 % drop in milk yield (Ramaswamy and Sharma, 2011). Losses in livestock/animal husbandry occur in various ways that include:

i. general livestock death;
ii. disruption of normal farm operations;
iii. culling of bloat susceptible animals; and
iv. costs of preventive actions and treatment (Kumar and Dhar, 2013; Priyanka and Dey, 2018).

During remenotony, PBs and other foreign material were observed in the gastrointestinal part of ruminants, triggering ruminal occlusion (Ramaswamy and Sharma, 2011).

A B

Figure 2.2: Cattle often mistake PBs for food (Sources: Joe, 2019; Two Oceans Aquarium, 2019)

In Amman Jordan, approximately 2.5 % of 2.5 million cattle, goats and sheep lost weight as a result of the blockage of their digestion system by PB (Saidan *et al.*, 2017). In Netherlands, between 11 000 to 13 000 cattle suffered from plastic and metal related digestion problems in 2018 (Euronews, 2019). The above-mentioned studies indicate that PB litter is a threat to the agricultural sectors in both developing and developed nations hence the rationale to control it. Most landfills in African countries are not fenced off and livestock is left to graze freely in open space (Novella, 2014; Isugi and Niu, 2016; Olusola *et al.,* 2019).

2.1.1.2 CROPS

Annually, plastic fragments in European agricultural lands is expected to be 63,000-43,000 tonnes (Nizzetto *et al.,* 2017). Discarded PBs are finding their way into farms causing serious harm to agriculture (Tiglu, 2017). These bags are persistent into the environment and they disturb natural processes of plants through choking and distressing them (Jalil *et al.,* 2013; Corradini *et al.,* 2019). Some crop roots growth is impeded by PBs (Jalil *et al.,* 2013) leads to poor growth and yields. Reduction in

nitrogen fixation leads to loss of nutrients. Drop in organisms leads to loss of aeration and poor soil nutrients, and then the latter leads to reduced yields (Figure 2.3).

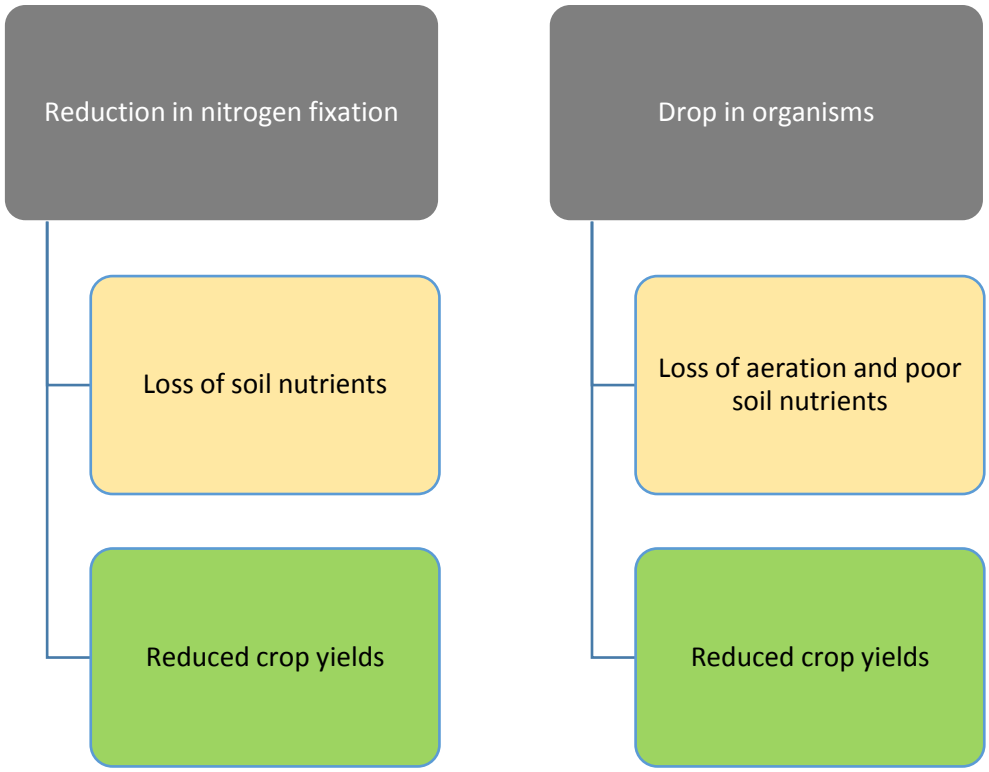


Figure 2.3: Effects of PBs on crops (adapted from Jalil *et al.,* 2013; Li *et al.,* 2018; Corradini *et al.,* 2019).

The pass way for plastics to agricultural land include sludge from wastewater treatment works as was noted by (Corradini *et al.,* 2019; Sun *et al*., 2019) and windblown plastics from ill-contained disposal facilities (Zubris and Richards, 2005; Coors *et al*., 2016).

2.1.2 Drainage and/or Reticulation Systems

Plastic bag litter in drainage systems is a worldwide problem. In several countries like Uganda, Kenya, South Africa, PBs pose negative environmental impacts to drainage systems (Marais and Armitage, 2004; Gambrah, 2013; Wachira, 2013; Adane and

Muleta, 2014; Mugisha and Diiro, 2015; United Nations, 2017). They clog water channels and affect the aesthetic quality of the environment (BBC, 2013, Masai, 2015). In turn, PBW in stagnant waters promote breeding ground for mosquitoes that cause malaria (Blom, 2015; Awasthi *et al.,* 2017; Horvath *et al.,* 2018).

In 2015, PB and other plastic packaging waste accumulated and obstructed drains during a heavy downpour in Ghana Accra. This scenario resulted in flooding in which at least 150 people lost their lives and infrastructure was damaged (Blue Tube, 2015; Plastic Pollution Coalition, 2015). The clogged drains promote the spread of diseases by providing stagnant water for mosquito breeding. This enables the spread of diseases such as and Zika virus and malaria (Owusu-Sekyere *et al*., 2013; Gambrah, 2015). In 2012 Amman Jordan, tunnels drainage system and streets were flooded after down pour. Plastic bags along the roads and in the drainage ditches were among the major contributing factors to the rising up of the water level in the tunnels (Al-Houri and Al-Omari, 2012). In 2013, PB and other plastic packaging waste accumulated and clogged drains during a heavy downpour in Harare Zimbabwe. This scenario resulted in flooding (New Day, 2013). However, developed countries like Germany and Australia employ effective drainage management systems that involve the following:

i. drain maintenance controls;
ii. permeable pavements to allow stormwater to seep underground; and
iii. use of filter channels to trap pollutants (Dierkes *et al.,* 2015).

Considering the above observations, it can be concluded that improperly discarded PBW causes socio-economic and environmental problems in both more economically developed countries and less economically developed countries, hence the need of a sustainable PBWM model.

2.2 APPROACHES TO PLASTIC BAG WASTE MANAGEMENT

This section presents public-private partnership approaches, technical and infrastructural approaches, and legal and policy framework approaches to PBWM (Figure 2.4).

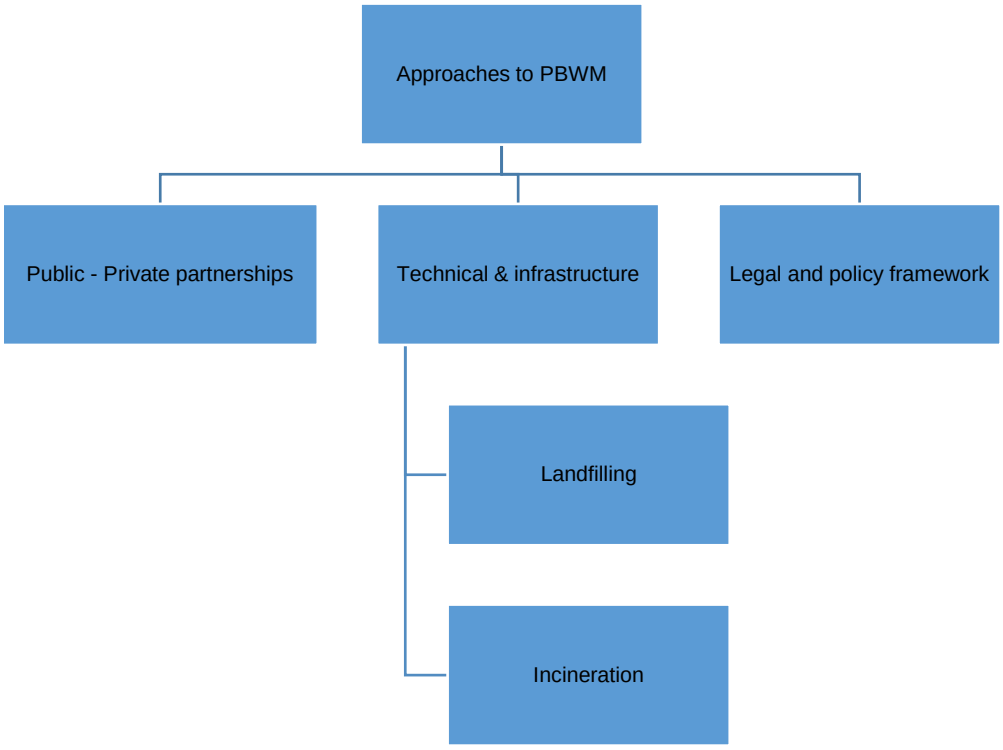


Figure 2.4: Approaches for PBWM

2.2.1 Public And Private Partnership Initiatives

Public and private participation is considered a key element in effective PB Integrated Solid Waste Management (ISWM) (Nkosi, 2015; Colombijn, 2017; Kumar, 2017). The ISWM approach is centred on cooperation amongst members of the public, Community Based Organisations (CBOs), waste pickers and the municipality in sustainable PBWM (Figure 2.5) The ISWM incorporates technological solutions, environmental, socio-cultural, economic, technical, institutional, political/legal linkages; involves all

stakeholders and integrate SWM hierarchy (reduction, reuse, recycling, treatment and disposal) (McAllister, 2015; Colombijn, 2017; Kabera *et al*., 2019).

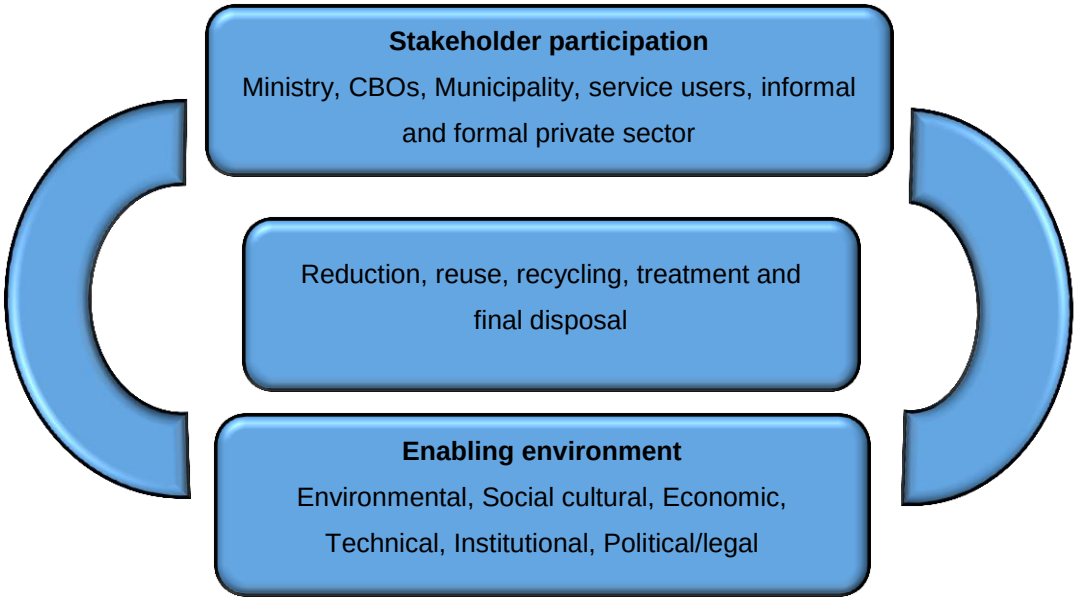


Figure 2.5: Public-Private Partnerships (Adapted from Pankaj, 2015)

The extent of public participation in PBWM is different between the economically and less economically developed countries. In more economically developed countries, there is high level of participation in waste reduction, sorting and recycling (Kurian, 2013; Mmereki, 2016). In Germany, most of household waste is sorted into colour-coded bins (Aktualisiert, 2016). In Denmark, different colour-coded bins are provided to households for waste to assist with the sorting of recyclable plastic bag waste (Danish Environmental Protection Agency, 2018). On the contrary, developing countries such as India, Ghana, Kenya and Nigeria face financial challenges in providing waste management technology such as colour coded waste bins to help in sorting the waste (Nyayiemi, 2012; Oyake-Ombis, 2012; Owusu-Sekyere *et al*., 2013; McAllister, 2015). If

there is unavailability of colour-coded bins it is a challenge for the public to actively participate in PBWM through efficient separation at source.

2.2.1.1 Informal Waste Pickers

Informal waste pickers play vital role in SWM, assisting formal waste management agents (Dias, 2016; Kumar, 2017; da Silver, 2018). Involvement of waste pickers and the public helps to achieve an effective PBWM system (Tantalo and Priem, 2014; Lederer *et al*., 2015).

In India, Kenya and Brazil, informal waste pickers are actively involved in PBWM (Oyake-Ombis, 2012; Kumar, 2017; da Silver, 2018). However, the society often despises waste pickers (Schenck and Blaauw, 2011; Practical Action, 2014). They are shunned by the public and local authority officials, and exploited by waste management traders (Infrastructure News, 2017). Thompson (2014) established that the public and local authorities do not appreciate the fundamental role played by waste pickers in PBWM. Oyake-Ombis (2012); Ramos (2013); Dias (2016); Joshi and Ahmed (2016); Colombijn (2017) and CSIR News (2018) found out that CBOs and waste pickers face challenges in their operations that include:

i. lack of proper machines, equipment, and transport to enhance efficiency;
ii. inadequate working capital for the business;
iii. inadequate space for sorting out waste as well as for storage;
iv. fluctuating unit prices for different waste streams; and
v. harassment by law enforcement agents.

The researcher notes that lack of recognition of informal waste pickers is seen as one of the factors making it difficult to implement a sustainable PBWM system in developing countries.

2.2.1.2 PRIVATE STAKEHOLDERS

Private stakeholders perform a wide range of SWM activities that include treet cleaning, plastic waste collection, provision of financial resources, equipment and storage facilities (Farahbakhsh and Marshall, 2013; Malik *et al.,* 2015; Shabani, 2015).

In several African countries like Kenya and South Africa, private stakeholders play a fundamental role in MSWM System (Schenck and Blaauw, 2011; Baker *et al.,* 2016; Dias, 2016). For example, Selema Plant in South Africa Hire was contacted by Greater Tzaneen municipality to provide street sweeping services (South African Transport and Allied Workers Union [ATAWU], 2016) and Kenya Refuse Handlers (KRH) in Kenya was contracted by Council of Nairobi (CCN) to conduct street sweeping, waste collection, transportation and disposal within the CBD (Oyake-Ombis, 2012). The involvement of private actors has lessened SWM problems on local authorities (Oyake-Ombis, 2012).

In Harare Zimbabwe, private stakeholders such as Nyaradzo Funeral Assurance, Delta Corporation and African Banking Corporation (ABC) provide financial resources, equipment and storage facilities to Harare City Council (HCC). Private organisations such as Waste Away and Skip It are involved in waste management services (Zamba, 2014).

2.2.1.3 GOVERNMENT STAKEHOLDER

Environmental Management Agency and police officers are empowered to ensure that people or companies comply with environmental legislation through criminal or administrative actions. However, legislation enforcement has been compromised by competing political interests. Governement officials encounter conflicts of interest while exercising their duties (Madebwe, 2015). Zimbabwe is ranked as one of the world's 20 most corrupt countries (Trading economics, 2020). The police force and other government officials are viewed as most corrupt institutions. The Environmental Management Agency suspended two of its Mashonaland Central province officers for

corruption (allegedly soliciting a bribe from mining companies) (NewsDay, 2019). In Bulawayo, several police officers have been arrested for allegedly soliciting bribes from civilians (Sunday News, 2020). Several cases of corruption are under-reported mainly because of fear of adverse consequences by the whistle blowers (Nyoni, 2017).

Barczewski, (2013) reported that Kenya National Environmental Management Agency (NEMA) suffered from corruption and lack of community engagement. A NEMA official was suspended for corruption (allegedly soliciting a bribe from petroleum tender) (Citizen 2014).

2.2.1.4 Local Authority

Unlike developed countries, local authorities in developing countries are struggling to implement an effective waste management system (McAllister, 2015; Mmereki *et al.,* 2016). Rinke *et al.* (2014); and Muchandiona (2017) found out that local authorities face challenges in their operations that include:

i. limited service coverage;
ii. irregular waste collection;
iii. limited waste bins; and
iv. corruption amongst council employees.

An internal audit report conducted at Msunduzi Landfill site in KZN South Africa revealed that there was rampant corruption among municipal officials. Officials were found to be soliting bribes from recycling companies and abusing municipal vehicles (The Witness, 2020). In Zimbabwe, local authorities like HCC and Gweru municipality struggle to realise effective SWM systems because of limited resources for waste management (Jerie and Tevera, 2014; Mahamba, 2015). The aforementioned problems place local authorities in developing nations at lower position in achieving an effective MSWM system because of financial constraints and corruption.

2.2.2 Technical and infrastructure

Technical and infrastructure approach include methods such as landfilling, recycling, incineration, open burning and underground burying and alternatives to PBs (Awasthi *et al.,* 2017; Jambeck *et al.,* 2018).

2.2.2.1 LANDFILLING

A landfill is a solid waste disposal facility (Cuartas *et al.,* 2017; Vaverkova *et al.,* 2018; Help Save Nature, 2020). If properly designed and operated, landfills can be the best method for waste management as recyclable PBs can be recovered (Van Eygen 2017 *et al*., 2017; Help Save Nature, 2020). However, landfills may cause ground water pollution if not properly engineered and maintained (Abd El- Salam *et al*., 2015; Kingsley *et al*., 2016). The construction and maintenance of a landfill is expensive for many developing countries (Weli and Adekunle, 2014; Yao, 2017; Lee and Wang, 2017).

Landfilling method is used both in developed and developing nations (Jambeck, *et al*., 2018; Kabera *et al*., 2019). However, developing countries lack properly designed and adequate landfills compared to more developed countries (Abd El- Salam *et al*., 2015; Awasthi *et al*., 2017; Geyer, 2017; Help Save Nature, 2020). Constricted budgets hinder the construction, operation and maintenance of landfills. In countries where there are improperly designed landfills, PBs are easily windblown into the surrounding environment (Cuartas *et al.,* 2017). Once discarded into the environment, PBs can take up to 1 000 years to degrade (Pramila and Vijaya, 2011; Kale *et al.,* 2015). Landfilling is considerably highly wasteful as chemical constituents and energy contained in PB is lost (Horvath *et al*., 2018; Vaverkova *et al.,* 2018; USA EPA, 2019). However, other European countries such as Italy and United Kingdom still use the landfilling method more than other waste management methods (incineration and recycling) (European Commission, 2013).

Several countries in Africa encounter landfilling challenges (Table 2.1). In South Africa, landfilling remains the major waste management technology (Pienaar, and Howard, 2014). Approximately 90 % of waste, including PB produced in South Africa is landfilled (Godfrey and Oelofse, 2017). This is compelled by low operational costs (of inadequately/poorly designed sites) and unwilling local authorities to find other PBWM technologies. There are currently few landfills in South Africa that have gas treatment system (Dlamini *et al*., 2019; Njoku *et al.,* 2019). Few landfills in South Africa comply with minimum standards (Novella, 2014; Olusola *et al.,* 2019). The issue of low cost is a fallacy/relative because quality is sacrificed for temporary savings that will backfire with the huge environmental impact.

Zimbabwe has several improper landfills that pose negative environmental impacts (Pawandiwa, 2013; Teta and Hikwa, 2017; Ngaza, 2018) In Bulawayo, solid waste is disposed at Richmond landfill and the surrounding area is heavily polluted with PBs. Kubare *et al*. (2010); and Teta and Hikwa (2017) found out that the leachate ponds are not lined to reduce leachate leakage into the ground. Therefore, leachate easily finds its way into the ground. In Rwanda Kigali, solid waste is disposed of at Nduba dumpsite. However, the dump site falls below the requirements for controlled waste disposal (Isugi and Niu, 2016). The dumpsite lacks leachate management, gas control, geo-membrane lining, gas control and daily cover (Conte *et al.,* 2018), hence PBs are easily windblown to surrounding areas, causing environmental pollution.

Table 2.1: Problems associated with landfills in Africa

Country	Name of landfill	Comments
South Africa	Hatherley	• non-engineering; • lack of lining; • limited soil cover; and • no leachate management system (Sibiya *et al*., 2017).
Kenya	Kadhodeki	• an open dumpsite; • no control; • lack of geo-membrane lining; and • no leachate management system (Njagi *et al*., 2013).
Rwanda,	Nduba	• lack of geo-membrane lining; • limited daily cover; and • no leachate management system (Isugi and Niu, 2016).
Nigeria	Aba-Eku Ajankanga Eneka Lapite Awotan Epe Igbatoro	• lack of waste compaction; • no daily cover; • lack of leachate management system; and • contamination in groundwater (Idowu *et al*., 2019).
Guinea Bissau	Antula	• lack of site feasibility study; • lack of fencing; and • controlled by one officer (Idowu *et al.*, 2019).
Zimbabwe	Richmond	• lack of geo-membrane; • gas collection management system; and • lack of fencing (Kubare *et al*., 2010; Teta and Hikwa, 2017).

Plastic waste slows landfill decomposition process, which takes up to 1 000 years (Pramila and Vijaya, 2011; Kale *et al*., 2015). In environments lacking both oxygen and sunlight like landfills, photo-oxidative degradation occurs slowly (Chamas *et al.,* 2020). Steensgaard *et al.* (2017); Van Eygen (2017); Vince and Hardesty (2017); and Kwesiga (2018) stated that plastics are made of toxic chemicals and when they decompose in landfills, they leak pollutants into the soil polluting underground water. The chemical composition of leachate affect bacterial species such as *Butyrivibrio fibrisolvens*, *Rhodococcus ruber* and *Clostridium thermocellum* that are important in the biodegradation of plastics, and weaken pipe walls, which may then fail (Sakharova, 2014; Njoku *et al.,* 2019; Olusola *et al.,* 2019, European Union, 2020).

2.2.2.2 INCINERATION

Incineration involves the combustion of organic substances in a furnace at high temperatures (850 °C) (Schneider and Ragossning, 2015; Nidoni, 2017). In contrast, open burning is the combustion of waste in an open space. Incineration is more effective in dealing with MSW as it takes a small space, reduces the volume of waste and may be used to generate electricity (Nidoni, 2017). Despite being a viable method for reducing environmental pollution, combustion of PB is a subject of debate as it is associated with harmful pollutants.

In developed countries (Sweden, Norway, Switzerland, Denmark, Estonia and Netherlands) close to half of the solid waste (PB waste included) is incinerated (Schneider and Ragossnig, 2015; Mmereki *et al.,* 2016). Energy recovered from incineration provides steam for generation of electricity. Plastic waste management in European countries is more about plastic waste diversion from landfills hence incineration or recycling are the most preferred waste management methods (Lino and Ismail, 2016; Nidoni, 2017). The Amager Bakke incinerator in Denmark is one of the most expensive incinerators in the world valued at 500 million euros. During its

construction, one of the large combustion furnaces failed costing additional 13 million euros. Since opening, the plant experienced a technical failure that greatly impeded its efficiency (Nicastro, 2017). Thus, there is high cost involved in constructing and maintaining an incinerator. Concerns have been raised about investment in incinerators at the expense of recycling, a more environmentally friendly alternative (Nicastro, 2017; Anastasio, 2019). The Goudingshan waste incineration plant in Wuhan China (Figure 2.6) has been blamed for producing a large amount of gas emissions and illegally dumping fly ash in the environment, a public health concern (Huang *et al.,* 2015; Hu *et al*., 2015).

Figure 2.6: Pollutants emitted by Goudingshan waste incineration plant in China (Source: Hu *et al.,* 2015)

In developing countries harmful pollutants (dioxins and furans) are released into the atmosphere and negatively affect human beings and biodiversity. The release of pollutants is exacerbated by the lack of proper combustion technology (Steensgaard *et al*., 2017). Dioxins and furans are carcinogenic and toxic chemicals which may cause neurological damage, and disrupt reproductive systems (Geyer *et al.,* 2017; Kabera,

2019). In order to avoid air pollution there is a need to use filters, that most African countries lack (Kwesiga, 2018). Strict measures are necessary to prevent the adverse environmental impacts associated with incineration. However, with the focus on banning plastics (Maema, 2017; Njugunah, 2017; Behuria, 2019) coupled with high operational costs (Nidoni, 2017; Steensgaard *et al*., 2017; Kabera, 2019), investing in incineration technology may not be the most sustainable option for effective PBWM.

Proper combustion of PBW technology can form an important part of SWM as it promotes energy recovery and reduce environmental pollution. Financial problems make it difficult for local authorities in developing countries to adopt, operate and maintain proper combustion technology (McAllister, 2015; Nkosi, 2015; Jambeck, 2017). Thus most developing economies cannot afford this technology.

Kobza and Schuster (2016); Van Eygen *et al*. (2017); and Hovarth *et al.* (2018) recommended the adoption of a circular economy that calls for the redesign of plastic incineration and manufacturing processes to reduce toxic substances and prevent the release of air pollutants into the environment. The circular approach promotes cleaner production and recovery of waste to energy for manufacturing into new plastic such as foot wear and for making roads (Mativenga *et al*., 2017; Whicher *et al*., 2017; Hovarth *et al.,* 2018). However, the adoption of incineration technology in economically challenged environments would require in-depth consideration and compelling business cases to win investments in light of other competing priorities.

2.2.2.3 RECYCLING

Recycling is a process which involves the conversion of waste materials into reusable products (Peprah *et al*., 2015; Mativenga *et al*., 2017; Van Eygen *et al*., 2017). From the 3Rs in waste management, recycling is least preferred as it is associated with high costs and involves complex processes (Figure 2.7; Whicher *et al*., 2017; Hovarth *et al*., 2018).

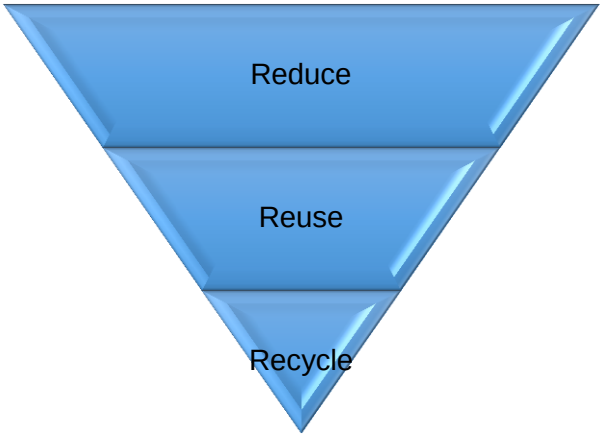


Figure 2.7: Waste Reduction Hierarchy (Adapted From Mativenga *et al.,* 2017; Whicher *et al.,* 2017; Hovarth *et al.,* 2018)

Recycling reduces the amount of plastic waste generated, saves energy and help to fight climate change (Kobza and Schuster, 2016; Van Eygen *et al*., 2017; Hovarth *et al.,* 2018).

In Europe, approximately 60 million tons of plastics were produced in 2016 (Plastics Europe, 2017). However, 31 % was recycled and the remaining was incinerated and landfilled (Plastics Europe, 2017; European Commission, 2018). Between 2004 and 2017, recycling rates for packaging waste increased by 16 % in Europe. Approximately 67 % of packaging waste produced in Iceland, Norway, Liechtenstein and the EU-28 was recycled in 2016, thus a positive move towards a circular economy (European Environmental Agency [EEA], 2020). Although the recycling trend in the European Countries is improving, equated to landfilling and incineration, landfilling is still a dominant waste management method (Davani, 2018).

In most developing countries, sound technologies such as recycling are not common due to high cost involved in the collection and transportation of recyclable materials (Mmereki *et al*., 2016; Moloney and Doolan, 2016). In Kenya, the estimated amount of

plastic packaging is approximately 270 000 tonnes per year but about 15 % (38 000 tonnes) of PBW is recycled (State of Green, 2018). However, In South Africa, the recycling of plastics is fairly well established (Muzenda, 2013). In 2018, South Africa recycled approximately 352 000 tons of plastics and had a recycling rate of around 46 % for all plastics. The majority (70 %) of the recyclable plastics are obtained from landfills and post-consumer sources (Plastic South Africa, 2018). As a result, most of PBW is landfilled. Therefore landfilling is practised in both developing and developed nations, but more in the former than the latter.

In Nigeria, Wecyclers (Nigerian community-based recycling organisation) collects recyclable waste items such as PBW from households (Figure 2.8; Africa News, 2019; Wecyclers, 2019). The company promotes socio-economic development, environmental sustainability and community health by providing recycling operations in Nigeria. Wecyclers provide incentives such as money, food and household items to consumers to collect and sort their used recyclable waste at home. These initiatives provide jobs to several disadvantaged groups in the society. The organisation won the Sustainia Award for promoting sustainable development (Gorvild, 2014).

Figure 2.8: Wecylcers Employees Transporting Recyclable PBW (Source: Wecyclers, 2019)

Rethaka Repurpose Schoolbags in South Africa manufactures schoolbags and billboard materials mainly for the disadvantaged learners using waste PBs (Rethaka Foundation, 2019). The organisation has handed over 10 000 repurposed school bags to children in African countries. The solar lantern on the bag charges while the child is walking and can hold up to 12 hours of light (Figure 2.9; The South African, 2015; Rethaka Foundation, 2019).

Figure 2.9: Repurpose Schoolbags (Source: Rethaka Foundation, 2019)

The City of Johannesburg in South Africa established programs meant to integrate waste pickers in MSWM system in 2010. The empowerment program entailed skills training, formalisation of waste pickers and formation of cooperatives (Baker, 2016). In Kwazulu Natal, (South Africa) the Department of Environmental Affairs handed trolleys to Mooi River Waste Pickers Association for easy transportation of collected waste. Before, waste pickers used to convert supermarket trolleys to transport collected waste materials (Meander, 2017).

Unconventional Waste and Recycling (Pty) Ltd (South Africa) provides safe and revamped trolleys to waste pickers (Figure 2.10) that also serve as mobile billboards

(for extra revenue from advertising), provide training and mentorship to waste pickers (Unconventional Media, 2019). Polyco and Industry Group (South Africa) spearhead the Pack-a-ching project, where the public are given incentives for taking plastic waste for compacting and recycling (Polyco, 2019). Proplast in Senegal collects and processes plastic waste into granules sold to local companies. The company provides over 250 jobs to disadvantaged groups in the society (atkisson.com, 2016).

Figure 2.10: Waste pickers with revamped trolleys from unconventional media [Source: Unconventional Media (pty) ltd, 2019]

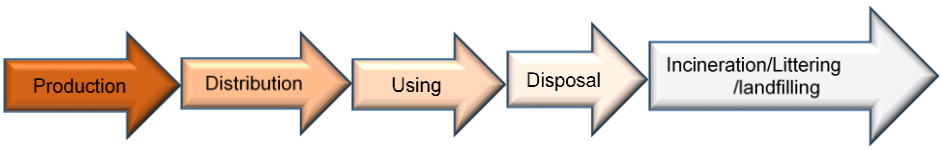
Recycling of PBs reduces negative environmental impacts and resource depletion (Kwesiga, 2018; Kabera *et al.,* 2019). Although PBs recycling have positive impacts on the environment, it is not fully harnessed due to the high costs related with the collection, sorting and reprocessing. Hence, it is cheaper to use new PBs than recycled plastic (Horvath *et al*., 2018). Furthermore, recycling is highly dependent on financial stability, public participation, availability of bins and waste collection trucks (Gambrah *et al*., 2013; Awasthi, 2017; Horvath, 2018). The aforementioned success factors to recycling place developing nations at lower position in embracing recycling of plastics because of limited economic resources and infrastructure. For example, Gambrah, (2013); Jambeck *et al*. (2018); Kwesiga, (2018); and Kabera *et al.* (2019) reported that African cities such as Lagos and Nairobi lack appropriate state of the art SWM technologies and equipment that hinder effective PBWM. Nigeria, Kenya and Zimbabwe

are all less developing countries; with certainty the problems are similar.

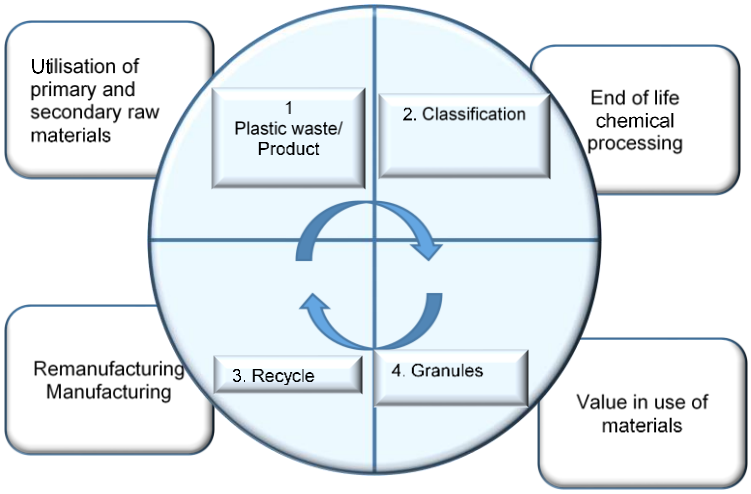
Plastic bag recycling can have a significant positive socio-economic impact if it is well supported. The impacts include job creation and poverty reduction (Owusu-Sekyere, 2013; Thompson, 2014; Horvath, 2018; Kwesiga, 2018; US EPA, 2019). Support for recycling entails government initiatives that include education and training about plastic sorting, provision of trolleys and sector formalisation (Practical Action, 2014; Infrastructure News, 2016). Volumes of PBW that go to the landfills can be reduced. Therefore, sustainable PBWM can be achieved through the integration of waste pickers into the MSWM system.

2.2.2.3.1 LINEAR AND CIRCULAR ECONOMIES

Van Eygen *et al*. (2017) and Hovarth *et al.* (2018) recommended the adoption of the circular model in managing PBW. Unlike the Linear economy model (Figure 2.11 A) that does not value recycling, the circular economy (Figure 2.11 B) involves reduction, reuse, and recycling operations (Mativenga *et al*., 2017; Whicher *et al*., 2017). The model is centred on a polluting input and a recyclable input resource (Van Eygen *et al.,* 2017; Hovarth *et al*., 2018).The linear model is based on the use of raw material to process a product that is discarded after use while the circular economy requires people and organisations to minimise waste and maximise resources by using the 3Rs in waste management (Kobza and Schuster, 2016).



A



B

Figure 2.11: Linear (A) and circular (B) economy approaches (adapted from George *et al.,* 2015)

2.2.2.4 ALTERNATIVES FOR PLASTIC BAGS

There are several environment-sound alternatives to PBs. Examples include jute bags, paper bags, biodegradable plastic bags (BPBs), and reusable bags (Saidan *et al.,* 2017; Plastic Bag Source, 2018; Iheukwumere *et al.,* 2019).

2.2.2.4.1 JUTE BAGS

This type of packaging bag is made from biodegradable material that is sourced from a plant fibre mainly produced in Bangladesh, India and Nepal. The products are widely used in the agricultural and industrial sectors for packing products (Jalil *et al.*, 2013; Iheukwumere *et al*., 2019). The benefits of jute bags include:

i. hydrocarbon free bags;

ii. biodegradable;
iii. re-usable;
iv. can be used as plant manure;
v. preserve the quality of dry food; and
vi. easy to handle (Iheukwumere *et al.,* 2019).

2.2.2.4.2 PAPER BAGS

Paper bags have customarily been considered as an ecological friendly alternative when equalled to PBs. Before the introduction of PBs, paper bags were the most commonly used packaging material (Jalil *et al.,* 2013). They are preferred because of the following benefits:

i. use natural fibre;
ii. can be composted;
iii. renewable resource;
iv. recyclable; and
v. not harmful to the environment as plastics (Iheukwumere *et al.,* 2019).

Notwithstanding, the above-mentioned benefits, paper bags have been criticised for the following reasons:

i. they perform poorly in wet environments;
ii. they are expensive; and
iii. weigh more than PBs (Plastic Bag Source, 2018; Iheukwumere *et al.,* 2019).

Wong (2011) revealed that the production of paper bags resulted in more waste water and consumed more water. However, Wong (2011) further argues that the fact that the paper bags can be recycled up to six times makes it a viable alternative for PBs.

2.2.2.4.3 BIODEGRADABLE PLASTIC BAGS

Biodegradable plastics have been used as a substitute to the toxic producing old PBs (Kale *et al.*, 2015; Iheukwumere *et al.,* 2019). They provide the similar benefits like paper and jute bags. The growing public awareness of global warming, climate change and overconsumption of resources have resulted in the production of biodegradable PBs to react to environmental alarms (Gambrah, 2013; Geyer *et al.,* 2017). The use of biodegradable bags offers several advantages that include the following:

i. reduce pressure on oil reserves;
ii. environmental friendlier as equated to no-biodegradable PBs; and
iii. provides new opportunities for the production of biodegradable plastic product (Saidan *et al*., 2017; Iheukwumere *et al.,* 2019).

Even though biodegradable PBs are considered as an ecological friendly alternative, they possibly cause related environmental problems, such as environmental contamination and increased litter (Gambrah, 2013; Kale *et al.*, 2015). Biodegradable plastics are being portrayed as safer than non-biodegradable plastics, nevertheless, they have adverse environmental impacts (Jalil *et al.,* 2013). Thus, the definition of biodegradable plastics has been misled and these types of bags are considered as biodegradable and not harmful to the environment. These confusing definitions have considerable impacts on the use of biodegradable plastics.

The word biodegradable has been used as tool in marketing; however, it does not certainly mean biodegradable plastics are non-harmful to the environment. Biodegradable means the ability of being decomposed by biological means (Saidan *et al.,* 2017; Iheukwumere *et al.,* 2019). The production of biodegradable PBs can involve starch-based synthetic plastics or synthetic plastics. However, not all by-products biodegradable PBs can be simply conjoined into environmental process.

Degraded PBs are likely to leave detrimental particles of polymers in the environment, comparable to polyethylene PBs when they wear down as litter into the environment (Jalil *et al.,* 2013; Iheukwumere *et al.,* 2019). The findings suggest that although biodegradable PBs are environmental friendlier than polythene PBs, caution has to be considered in their consumption.

2.2.2.4.4 REUSABLE BAGS

Several reusable substitutes for PBs have been developed and some of these include woven PBs, baskets, thick PBs and cotton bags. The use of reusable bags is determined by some of the following factors:

i. price;
ii. availability; and
iii. socio-economic status (Iheukwumere *et al*., 2019).

However, the use of reusable packaging bags can cause environmental harm if not used properly, particularly in the agricultural sector. Thus, the end-users in farms should be environmentally mindful to reduce their damage on crops and livestock. It is therefore advisable to use biodegradable shopping bags made of jutes instead of other bags as they are cheaper and reduce environmental damage.

2.2.2.5 SOURCE SEPARATION OF WASTE

Source separation is the segregation of waste at source according to waste composition (Waste Authority of Western Australia, 2014). Source separation promotes recycling and reduces the volume of residual waste to landfill (Aktualisiert, 2016; Rousta *et al*., 2017). Source separation of waste is widely adopted and is a standard practice in Australia, Japan, and Germany. Most of household waste is sorted into colour-coded bins (Authority of Western Australia, 2014). Local authorities in these countries have adopted a three bin kerbside collection system. In Denmark, different colour-coded bins are provided to households for waste to assist with separation at source (Danish

Environmental Protection Agency, 2018). On the contrary, developing countries such as India, Ghana, Kenya and Nigeria face financial challenges in providing waste management technology such as colour coded waste bins to assist with source separation of waste (Nyayiemi, 2012; Oyake-Ombis, 2012; Owusu-Sekyere *et al*., 2013; McAllister, 2015). In Zimbabwe, local authorities like HCC and Gweru municipality have limited waste management technology such as colour coded waste bins to assist with source separation of waste (Jerie and Tevera, 2014; Mahamba, 2015).

2.2.3 Legal and Policy Framework Approaches

Several countries have developed policies and regulations in order reduce the use of PBs that include bans and taxes. The effects of these measures have been mixed and researchers often argue whether taxing or banning PBs are viable. Law enforcement continues to be a challenge for many countries to solve environmental problems such as PBW. To add to the problem, scrutiny has intensified from the public and environmental pressure groups to solve environmental problems quickly.

2.2.3.1 Bans and taxes

Plastic bag litter is a major environmental problem faced by nations across the economic development spectrum (Mugisha and Diiro, 2015; The Guardian, 2018; Kish, 2018; Touhey, 2019). In response, counties have enacted laws against the use of PBs (Schnell *et al*., 2017; Surfrider Foundation Europe, 2017; Thomas *et al*., 2019).

Denmark (in 1994), Ireland (in 2001), Belgium (in 2007), Malta (in 2009); Hungary (in 2011), Portugal (in 2015) and England (in 2016) have adopted a fee on PBs to reduce the detrimental effects of PB litter (Card, 2016; Cabrera, 2017; Njugunah, 2017; Schnell *et al*., 2017; Surfrider Foundation Europe, 2017; Schnell *et al.,* 2017). The introduction of PB fee in England, Wales and Scotland led to approximately 80 % reduction in PB use (Schnell Surfrider *et al*., 2017; Foundation Europe, 2017; Thomas *et al.,* 2019). However, in Romania, the success in reducing PB usage was reversed when the PB

fees was changed from 0.05 to 0.02 USD (Card, 2016; Romania Journal, 2017; Chasse, 2018) due to the customers' perception of relative affordability.

In USA, several cities such as Seattle, Cambridge and San Francisco have successfully enacted a ban against the use of PBs (Scientific American, 2015; National Conference of State Legislatures, 2016). Other cities that have successfully implemented a ban in use of PBs include Coles Bay in Australia, Brussels and Wallonia in Belgium (minimum of 50 microns thick) (Card, 2016; Chasse, 2018). After the implementation of PB ban in Brussels, Environmental Administration found out that most supermarkets were adhering to the new legislation (Bruxelles Environment, 2018).

The African continent has the highest number of countries that has enacted legislation against the use of PBs. Some of these countries include Mali, Kenya, Zimbabwe, Guinea-Bissau, Ethiopia, Eritrea, Tanzania, Chad, Cameroon, Mauritania, Morocco, Niger, Somalia, Rwanda, Tunisia, Mozambique, Botswana and South Africa (Table 2.2) (Chitotombe, 2014; Danielsson, 2017; Chasse, 2018; Kish, 2018; Behuria, 2019). Legislation enforcement remains a challenge to many African countries mainly because of stakeholder resistance and inconsistent/ weak enforcement (Kish, 2018; Behuria, 2019).

Table 2.2: Examples of PB bans in Africa (Source Danielsson, 2017; Chasse, 2018; Kish, 2018; Behuria, 2019)

Country	**Year**
Botswana	2007 and 2017 (ban reinstated)
Burkina Faso	2014
Cameroon	2014
Cape Verde	2016
Chad	2005
Cote d'Ivoire	2014

Country	Year
Djibouti	2016
Egypt	2017
Eritrea	2005
Ethiopia	2016
Gambia	2015
Ghana	2015
Kenya	2007, 2011 and 2017 (ban reinstated)
Madagascar	2015
Malawi	2015
Mali	2013
Mauritania	2013
Mauritius	2016
Morocco	2015
Mozambique	2015
Niger	2014
Nigeria	2014
Republic of the Congo	2012
Rwanda	2004 and 2008 (ban reinstated)
Senegal	2015
Somalia	2005 and 2015 (ban reinstated)
South Africa	2004
Tanzania	2006
Togo	2014
Tunisia	2017
Uganda	2007
Zimbabwe	2010

In Africa, Rwanda carries the torch in PBWM. It has enacted strict laws against the use of PBs to the extent that passengers travelling to the country must hand over all PBs

before being allowed to enter the country (Njugunah, 2017). Kigali City (Rwanda) is currently ranked as one of the cleanest cities in United Nations ranking and in 2008 the city was awarded the United Nations Habitat Scroll of Honor Award for effectively implementing PBWM measures (Behuria, 2019). The PB ban has been instrumental in reducing litter. However, the rapid decision by Rwandan government to ban PBs gave manufacturing industry limited adjustment period and it led to job losses and loss of revenue in the plastic manufacturing sector (Danielsson, 2017).

Kenya banned use of lightweight PBs in 2017. The ban stemmed from the global trend of phasing out PBs which are blamed for disastrous effects on marine life and the environment in general (Maema, 2017; The Guardian, 2018). However, the ban of PBs has been condemned by other stakeholders in waste management. Kenya Association of Manufacturers (KAM) filed a suit in the Nairobi Environment and Land Court challenging the ban on PBs arguing that, if upheld, it would lead to massive losses in the affected industries. The Court, however, dismissed the suit holding that if KAM's orders were granted the PBs would bring about negative environmental problems (The East African News, 2017).

The researcher notes that there is complexity around application of legal or policy framework in the developing nations. The complexity emanates from the competing need for means of survival versus environment (Chitotombe, 2014). Most people feel that the PB ban move tends to negatively affect companies manufacturing PBs (All Africa Com, 2015).

Plastic bag law enforcement is a major challenge faced by developing countries (Kurian, 2013; Igbinomwanhia and Ideho, 2014). Legislation enforcement impediments include low PB price, limited enforcement officers and material resources (Alhindawi, 2017; Maema, 2017; Jambeck, 2018). In South Africa, effort to use PB tax in 2003 faced some problems. The normal fixed PB price (R0.46) was upheld for the first few months and

fell significantly as retailers began charging their own prices (Dikgang *et al.,* 2012). In contrast Botswana passed a PB tax in 2007 to curb PB pollution and after 18 months, PB consumption declined significantly due to high PB price (Dikgang and Visser, 2012; McLellan, 2014). The findings reveal that an increase of PB levy results in the decline of PB usage.

Zimbabwe passed a law banning all single use PBs in a drive to reduce pollution (EMA, 2015). Despite the growing unpopularity of PBs with Zimbabwean environmental groups, who are for the complete ban, Chitotombe (2014) is of the view that plastic regulation is better than total phasing out of the thin PBs. Furthermore, she called for adequate public consultation and extensive media coverage before the law is put in place. The researcher supports the idea of the ban on thin PBs as they are difficult to recycle. However, legislation of PBW tends to be ineffective and inefficient if there is no strict enforcement and poor change management strategy. If government departments and local authorities are reluctant to prosecute people who violate provisions of the legislation, PBWM becomes a challenge.

Poorly enforced and out-dated waste management legislation has been noted as one factor hindering sustainable PBWM in Africa (Nkosi, 2014; McAllister, 2015). In Zimbabwe, legislation pertinent to solid waste management was previously administered by more than four government ministries. Consequently, there was lack of co-ordination (Muza, 2018). The enactment of the Environment Management Act (EMA) (Chapter 20:27) into law in 2002, replaced most environmental legislation such as the Hazardous Substances and Articles Act (Chapter 15:05) and Natural Resources Act (Chapter 20:13) thereby bringing harmonisation in environmental legislation.

Daily News (2014); Rinke *et al*, (2014); and Muchandiona (2017), identified lack of public participation as one of the causes of waste problems in Harare, Zimbabwe. Effective community based solid waste management initiatives are mandatory (Bello *et*

al., 2016). Lack of community participation and throw away culture in Harare may relate to Bulawayo as both cities face PB pollution problems. Gweru, Chinhoyi and Masvingo also face the problem of throw away culture (Chitotombe, 2014).

There is shortage in the publicity of law on various media platforms (Kurian, 2013; United Nations, 2018). The general population, private and public organisations feel that they are not adequately consulted and are often excluded in the formulation of PB legislation (Igbinomwanhia and Ideho, 2014). Stakeholder participation and awareness are a priority if sustainable PBWM is to gain ground. The capacity building concept and institutional theory call for the participation of all stakeholders to solve problems and formulate solutions (Stewart, 2015; Bergeron *et al*., 2017). Several researchers Jerie and Tevera (2014); Shabani (2015); Bello *et al.* (2016); and Pholose (2019) applied institutional theory and capacity building concept to evaluate stakeholder participation and awareness and service delivery performance in developing countries such as Zimbabwe, Kenya, South Africa and Tanzania. These studies have underlined the need for adopting capacity building concept and institutional theory to improve institutional performance and strengthen stakeholder relationships in waste management. Municipalities need to effectively cooperate and communicate with stakeholders to resolve municipal waste management issues as they are directly involved in PBW generation (Nyayiemi, 2012; Marshall and Farahbakhsh, 2013; Shabani, 2015). Thus, capacity building concept and institutional theory promote sustainable PBWM as they require a problem-based, participatory, supportive and continued approach.

In developing countries, a significant proportion of the population has no deep understanding of PB ban legislation (Maema, 2017; Jambeck *et al.,* 2018). Individual characteristics such as education and attitude influence legislation enforcement (Oyake-Ombis, 2012). For example, a person who is aware of PB ban and the negative impacts of PB is more likely to use a reusable bag.

2.2.3.2 LESSONS FROM SUCCESSFUL GLOBAL POLICIES

Studies in several countries such as China, England, Ireland, Netherlands, Philippine and Australia have shown that that PB tax or fee is effective in controlling PB consumption (Chasse, 2018; Kish, 2018; Behuria, 2019; Scientific Action and Advocacy Network, 2019). China introduced PB fee of 0.20-0.50 CNY (0.03-0.07 USD) in 2008. He, (2012) observed a 64 % decline in the consumption of new PBs used on the surveyed shopping trip. England introduced a PB fee of five pence (0.07 USD) in 2015 on major businesses. Poortinga *et al*. (2016) conducted a study in an independent supermarket and revealed a 36 % decrease in PB consumption after the introduction of the PB tax. Portugal introduced a PB tax of 0.10 € (0.11 USD) tax on PBs in 2015. Martinho *et al*. (2017) found out that there was a significant reduction (74 %) in PB usage and an increase (61 %) of reusable PBs in one of the supermarkets four months after the implementation of a PB tax.

Wales introduced single use PB fee of five pence fee (0.07 USD) in 2011. The Welsh government established that there was a significant reduction (70 %) in the consumption of single use bags in a variety of retail shops. The number of people who used their own bags improved from 61 % to 82 % (Griffiths, 2012; Poortinga *et al*., 2013). Other countries that have implemented PB fee have shown significant reduction in PB consumption (Chasse, 2018; Kish, 2018; Behuria, 2019; Scientific Action and Advocacy Network, 2019). The combined effect of PB tax, PB ban, strict enforcement and educational awareness campaigns can help realise effective PB policies (Chasse, 2018; Kish, 2018; Behuria, 2019).

2.2.3.3 BEST LAW ENFORCEMENT PRINCIPLES

Modern law enforcement should be centered on the foundational principle that the effective control of PBW requires community involvement and backing (United Sates of America Department of Justice, 2019). Societies are vital sources of information about crimes, lawbreakers, or social ills. Communities provide interactive networks that form

social cohesion (Braga *et al.,* 2015; Bratton, 2015). Applying methods of community policing and engagement, law enforcers can easily get information they need to solve PB enforcement problems proactively.

For effective law enforcement, the United States Department of Justice (2019) recommended community partnerships: Community partnerships can be formal or informal. The goal line of community partnerships is to achieve smooth flowing communication. Social service providers such as church leaders, traditional leaders, business leaders and local governmental agencies are essential associates (Braga *et al.,* 2015; Sinclair, 2017). Community partnerships can happen even at an individual or organisational level. Law enforcers can foster community engagement in a many ways that include:

i. Conduct more foot patrols: Law enforcers should talk to the public, meet local business people, strengthen relationships with community leaders and even support youth related events. This can install the idea to the public that the actions of law enforcers are in the best interest of the environment (Braga *et al.,* 2015; United Sates of America Department of Justice, 2019).

ii. Train all personnel on community policing: It is vital to overcome public distrust of law enforcement. Agencies are required to develop strong connections, continually improve social networks into communities where they do not have bonds. Law enforcement officers should demonstrate a heartfelt intent of forming an environment for dialogue and teamwork. Law enforcement officers should have constant communication with members of the community. The work around legislation enforcement should become the mission of every law enforcer (Bratton, 2015; Sinclair, 2017). Environmental Management Agency and BCC officers should see their central assignment as not only dealing with crime, but also working together with other stakeholders to solve root causes of the crime.

iii. Adopt an atmosphere of transparency and openness: Transparency is an imperative component of developing trust. Law enforcers should on a regular basis share policies, information, investigative results and other important information about legislation. Enforcing agencies should have well defined policies that promote the sharing of information with the community. They should take into consideration people's reactions to any changes in legislation and should develop opportunities for the public to input their views. By doing this, community speculations are eliminated and stakeholders who are willing to work together for a common goal are easily identified (Bratton, 2015; United Sates of America Department of Justice, 2019).

2.2.3.4 POLICY ANALYSIS AND IMPROVEMENT

Policy analysis is a process of identifying, evaluating policies meant to reduce or manage socio-economic and physical problems (Patton and Sawicki, 1993). Policy analysis is vital in identifying and evaluating PB policies. A six-step model developed by Patton and Sawicki (1993) was adopted (Figure 2.12 and Table 2.3) was adopted to determine the effectiveness of PB policies in several African countries. The model can help develop effective policies that can help manage PBW problems in Africa.

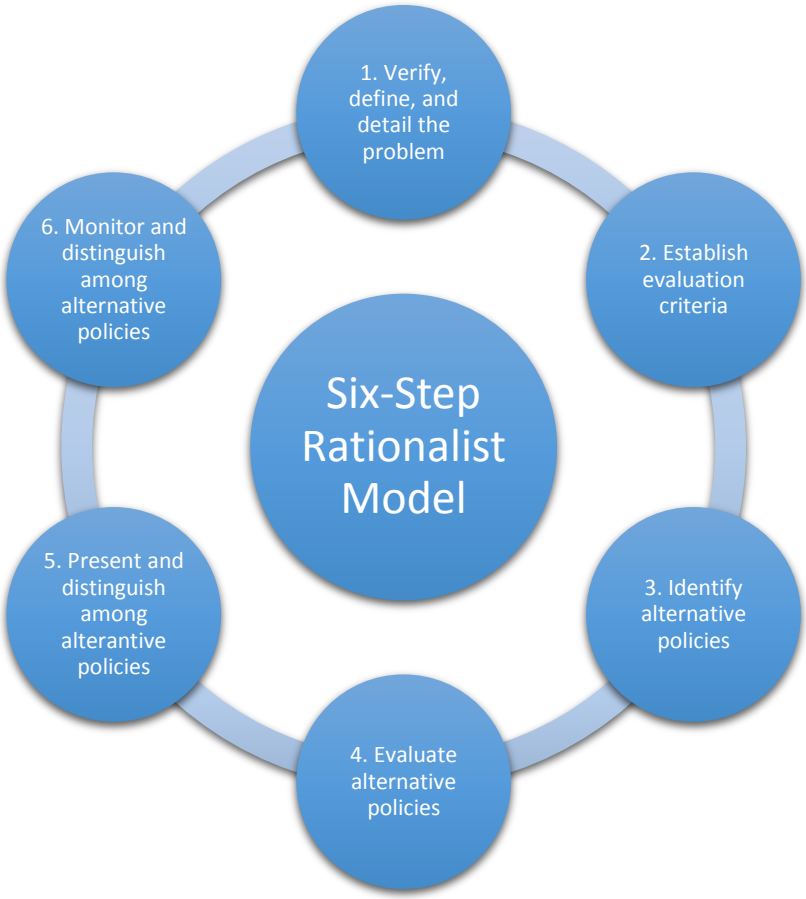


Figure 2.12: The Patton and Sawicki Six-Step Rationalist Model (Patton and Sawicki, 1993).

Table 2.3: Six-Step Rationalist model (adapted from Patton and Sawicki, 1993).

Step	**Description**
Step 1: Verify, define and detail the problem	This entails problem identification and description. This step is vital and forms a foundation for any effective and efficient PB policy.
Step 2 Establish evaluation criteria	Factors such as political acceptance, public compliance, public awareness, policy enforcement, reduction or consumption of PB, legality are considered to evaluate effectiveness of PB policies.
Step 3: Identify alternative policies	Several policies should be identified and combined to

Step	Description
	ensure their effectiveness and efficiency. Data can be collected from different governmental documents and journals.
Step 4: Evaluate alternative policies	Alternative policies are evaluated based on political acceptance, public compliance, public awareness, policy enforcement, reduction or consumption of PB, legality to ensure their effectiveness.
Step 5: Present and distinguish among alternative policies	After the alternatives are evaluated, findings can be used to determine alternatives that are most effective for PBWM.
Step 6: Monitoring the implemented policy	Policy analysis continues after policy implementation. A monitoring system has to be developed to ensure the effectiveness of PB policy. Policy analysis helps to establish whether the policy is being correctly implemented and help to determine if there are any modifications necessary to ensure improved compliance.

2.3 THEORETICAL FRAMEWORK

Theories help to understand, explain and make predictions about a given subject matter (Anfara and Mertz, 2006; Nilsen, 2015; Collins and Stockton, 2018). Institutional theory and capacity building concept complement the Integrated Solid Waste Management (ISWM) framework and were used to guide and understand what constitute an effective PBWM system.

2.3.1 Institutional theory

Institutional theory recognises that human behaviour is controlled by institutional structures (Figure 2.13) namely regulatory, normative and cultural systems (Thoenig,

2011; Iarossi, 2014; Palthe, 2014). These social structures shape behaviour and restrict certain human actions (Palthe, 2014). Although regulatory, normative and cultural systems are regarded as principal components of institutions, it is important to consider individual's behaviour and material resources as significant factors that can influence sustainable PBWM (Ball and Craig, 2010; Brammer *et al*., 2012; Jackson and Matten, 2012; Delbridge and Edwards, 2013).

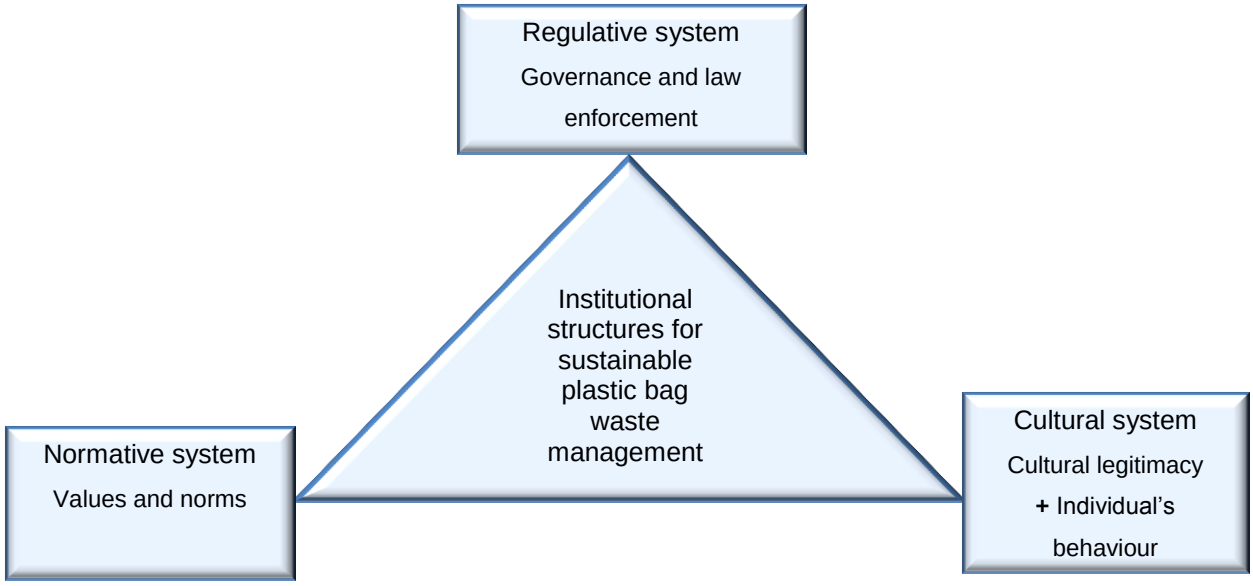


Figure 2.13: Institutional structures for sustainable PBWM (Adapted from; Tolbert, 1996; Brammer *et al*., 2012; Jackson and Matten, 2012; Palthe, 2014).

The regulative pillar constrains and regularises human behaviour (Tolbert, 1996; Palthe, 2014). Regulatory pillar activities include formulation of law, monitoring conformity, and authorising activities in an effort to influence human behaviour (Delbridge and Edwards, 2013). Government and local authorities govern and enforce laws to the public. However, legislation must be interpreted, conflicts resolved, and surveillance measures put in place to achieve intended objectives (Jackson and Matten, 2012; Andrew and Jennings, 2015). The regulative pillar underlines conformity to legislation as the bases

of legitimacy (Hatch and Zilber, 2012; Palthe, 2014). From the regulative standpoint, adhering to legislation is an important aspect of change, with fear and coercion as key ingredients of change. The public change behaviour not because they want to rather they have to (Madebwe, 2015). People who do not adhere to legislation undermine regulative changes. Licht *et al.* (2002); Stewart (2015); and Vallejo *et al*. (2015) depict organisations or institutions as largely dependent on the regulatory pillar. Licht *et al*. (2005); Vasudeva, (2005); and Ensminger and Henrich (2014) have applied institutional theory to explain how institutional environments influence organisations. They argue that legislation enforcement is one of the main drivers of sustainable development.

The **normative** pillar underlines the importance of norms in shaping human behaviour (Ball and Craig, 2010; Thoenig, 2011; Palthe, 2014). Values are principles that determines what is morally correct while norms define how to behave or things should be done (Aten and Howard-Grenville, 2012; Andrew and Jennings, 2015).

The **normative** pillar is an essential pillar of institutional that contributes to institutional change by instituting socially determined expectations for behaviour compelled by obligations and morals (Hitlin and Vaisey, 2013; Ensminger and Henrich, 2014). Normative systems outline goals and relevant ways to attain them. Sets of rules and routines control actions to provide order. Normative pillar is based on the notion that peoples' actions are controlled by seeking to act in a proper way related to a situation, the role being achieved, and the obligations inherent within the role (Patterson, 2014).

The **cultural** cognitive element gives emphasis to cultural legitimacy that comes from embracing a common mindset (Aten and Howard-Grenville, 2012). Although norms, values, rules and cultural beliefs are key ingredients of institutions, the theory must also consider material resources and an individual's behaviour (Brammer *et al*., 2012; Jackson and Matten, 2012; Palthe, 2014; Andrew and Jennings, 2015). Culture involves set of relationships, attitudes, values and behaviour that bind a particular community

(Swidler, 2013; Patterson, 2014). Society practices the shared assumption of value to adopt what is right and not right. Values are standards for what is upright or immoral in society (Brammer *et al*., 2012; Jackson and Matten, 2012). Values are deeply entrenched and significant for teaching a culture's beliefs. Rituals, conventions, fashion and are examples of values (Palthe, 2014; Patterson, 2014).

Many researchers (Mungure, 2008; Farahbakhsh and Marshall, 2013; Fakoya, 2014; Shabani, 2015) have established that sustainable waste management is dependent and deeply rooted in institutional structures (regulative, normative and cultural systems) in most African countries such as Tanzania, Uganda and South Africa.

2.3.2 Capacity Building Concept

Capacity building concept is the development of skills, knowledge, structures, systems and leadership to achieve sustainability (Jacklin, 2005; Stewart, 2015; Bergeron *et al*., 2017). It offers a clear picture regarding policy capacity, structural, technical and financial resources capacity and learning capacity of an organisation (World Bank, 2012; Stewart, 2015). The goals of capacity building are:

(i) human resource development;
(ii) organisational development; and
(iii) system development.

Capacity building concept is an all-inclusive approach to improving institutional performance and aims to strengthen stakeholder's ability to work together by providing skills to solve problems and formulate solutions (Jacklin, 2005).

Capacity building concept requires government, municipalities, private actors and local communities to develop the required skills to achieve sustainable PBWM. Capacity building concept underlines the influence of political, economic and cultural factors in waste management (Brammer *et al*., 2012; Jackson and Matten, 2012). Therefore,

effective PBWM is linked to commitment, skills, knowledge, structures, systems, and leadership, economic stability of the country, extent of public participation and human attitudes habituated by cultural factors.

Many researchers have established that capacity building concept is an essential component in sustainable development (Whittle, 2012; Stewart, 2015). In developing nations capacity building concept is fundamental in achieving sustainable development (Karunasena *et al*., 2010). Previous studies on waste management in developing nations established that municipalities are characterised by inefficient, inadequate and weak institutional capacity (World Bank, 2012; Joshi and Ahmed, 2016; Mmereki, 2016). According to Karunasena *et al*. (2010) adoption and implementation of capacity building concept ensures comprehensive planning and effective decision-making to improving institution performance in developing countries. Limited resources for waste management and poor enforcement of legislation are serious problems for waste management in developing nations (Makinde, 2005; Fakoya, 2014; Behuria, 2018; Behuria, 2019).

2.3.3 Applicability: Institutional theory and Capacity Building concept

Capacity building concept and institutional theory can be jointly applied to explain how an institution should be organised or structured underlining the importance of capacity development (Iarossi, 2014; Stewart, 2015). Institutional theory and capacity building concept call for the involvement of stakeholders (local authorities, public, private actors) to achieve an effective PBWM system (Palthe, 2014). Bulawayo City council is considered an institution with different stakeholders (EMA, public, private organisations) involved in PBWM.

Institutional theory and capacity building concept are useful in describing the role and capabilities of a local authority, non-governmental organisations and the local communities in sustainable development (Ball and Craig, 2010; Iarossi, 2014; Stewart,

2015). Consequently, Institutional theory and capacity building concept help to understand a relationship among different PBWM stakeholders (local authority, non-governmental organisations and the local community) (Tolbert, 1996; Iarossi, 2014). Since stakeholders are institutionally constructed it is importance to emphasise their potential as they are influenced by institutional structures. Institutional structures comprise of cultural, normative and regulatory systems (Brammer *et al*., 2012; Jackson and Matten, 2012). As a result, Institutional theory and capacity building concept are important in understanding policy and legislation approaches; private and public participation; and technical and infrastructural approaches to PBWM (Figure 214). Solid waste management responsibility is usually under the ministry of health or environment and local authorities for example, BCC.

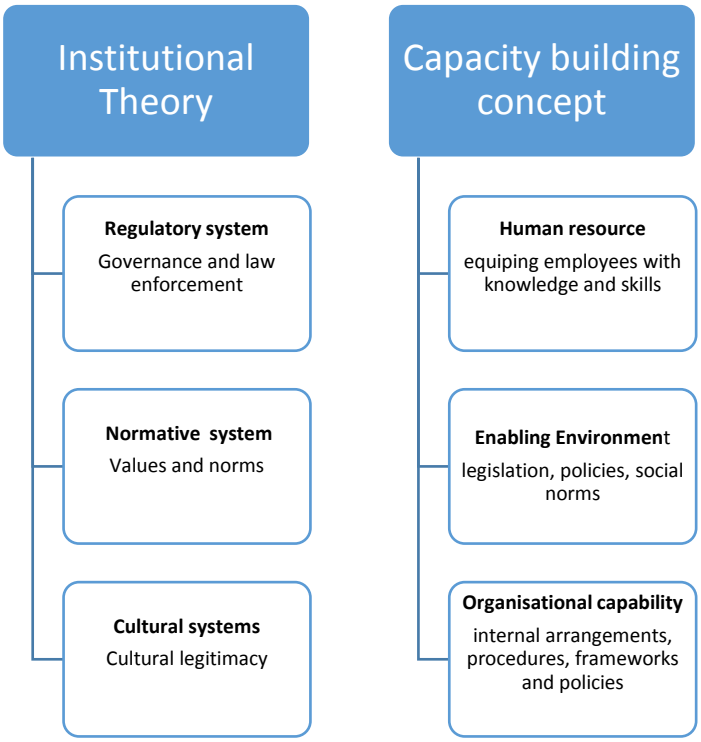


Figure 2.14: Capacity building concept and Institutional structures for effective PB sustainable waste management and their application to the current study (Adapted from; Tolbert, 1996; Jacklin, 2005; Brammer *et al*., 2012; Jackson and Matten, 2012; Palthe, 2014; Stewart, 2015; Bergeron *et al*., 2017).

The institutional theory holds that government and local authorities govern and enforce laws to the public (Thoenig, 2011; Iarossi, 2014). Although economic factor is among the major problems of MSWM systems in Africa, the institutional context is a fundamental element to be examined in order to achieve an effective PBWM system (World Bank, 2012; Palthe, 2014). Capacity building concept takes into consideration the impact of economic conditions on PBWM systems (Stewart, 2015). Thus, in the study area, the economic climate of Zimbabwe was taken into consideration in evaluating PBWM practices.

Unlike social norms and values, governments and local authorities operate through command and control approach (legislation, policies) (Thoenig, 2011; Brammer *et al*., 2012). However, the normative and cultural cognitive pillars also play a significant role as suggested by the Institutional theory (Stewart, 2015). People's attitudes or behaviour must be taken into consideration as one of the determinants of sustainable PBWM (de Maio, 2010; Geber and Macionis, 2011). Capacity building concept and the institutional theory were integrated in this study to understand factors influencing PBWM practices.

2.4 GAPS IN THE LITERATURE REVIEW

To the best of literature search by the researcher, there are few publications (Mudzengerere and Chigwenya, 2012; Muchandiona, 2017; and Sinthumule *et al.,* 2019) addressing the issue of SWM practices in the CBD of Bulawayo. None of the above-mentioned studies focused specifically on PBWM in the CBD of Bulawayo. Plastic bag waste management practices need to be explored in view of the adverse safety, health and environmental impacts of PBs (Chasse, 2018; Jambeck, 2018).

Mudzengerere and Chigwenya (2012); Mwanza and Phiri (2013); and Sinthumule *et al.,* (2019) adopted semi-structured interviews, observations and document reviews to explore in-depth insights about SWM problems in Bulawayo. Mudzengerere and Chigwenya (2012); Mwanza and Phiri (2013); and Sinthumule *et al.,* (2019) found out that that BCC face challenges in its operations that include limited service coverage, limited waste bins, irregular waste collection and limited public participation in SWM. Since none of the studies empirically focused on PBWM, there is need to consider the same factors influencing SWM, apply them on PBWM, adopt an integrated approach (technical and infrastructural approaches, legal and policy frameworks and public private partnerships). There is a need to develop a sustainable PBWM model within the confines of integrated PBWM.

Plastic bag legislation has been applied in many countries but yielded varied results (Danielsson, 2017; Chasse 2018; Behuria, 2019). Studies in several countries such as China, England, Ireland have shown that that PB tax or fee is effective in controlling PB consumption (Chasse, 2018; Kish, 2018; Behuria, 2019). However, in South Africa, effort to use PB tax in 2003 faced some problems. The normal fixed PB price (R0.46) was upheld for the first few months and fell significantly as retailers began charging their own prices (Dikgang *et al.,* 2012). In Zimbabwe, effort to use PB levy (0.08 USD) in 2010 faced some problems because of resistance from consumers (Chitotombe, 2014). The study contributes to the diversity of context/region-specific results.

2.5 CONCLUSION

Review of literature has established that most less economically developed countries are faced with problems that include poorly enforced legislation, limited publicity, reluctance by local authority to prosecute people who violate provisions of the legislation, inadequate budget allocation, plundering of resources and misplaced priorities. A review of literature about the research subject in the CBD of Bulawayo shows that a few studies have been done on the subject. It is against this backdrop that this study is conducted. The next chapter will look at research design and methodology.

3 RESEARCH DESIGN AND METHODOLOGY

The research methodology is the backbone of any research as it guides and helps secure credible results (Bloomberg and Volpe, 2019). This chapter presents the path followed from the research philosophy to data collection techniques (Figure 3.1). Interpretivism philosophy was used, induction approach was employed for theory development while qualitative case study was the methodology of choice (Figure 3.1). Issues of trustworthy, ethical and limitations are presented

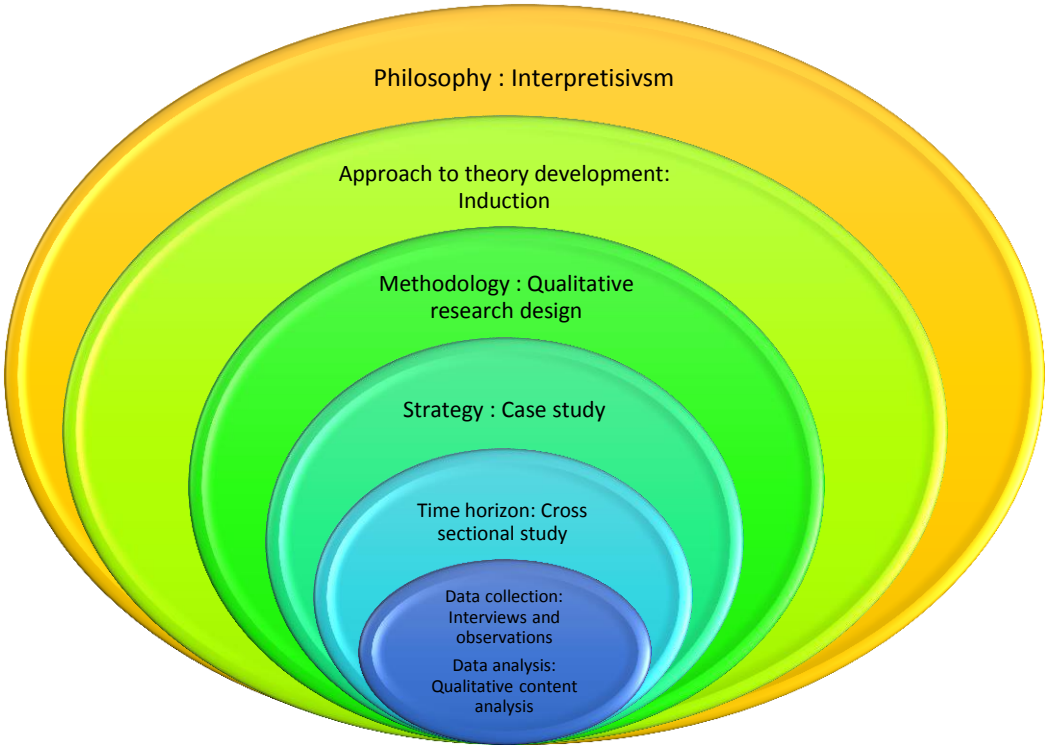


Figure 3.1: Research onion as applied to the current study (Adapted from Saunders *et al*., 2007)

3.1 RESEARCH PHILOSOPHY

A research philosophy refers to the approaches in which data about a phenomenon ought to be collected, analysed and used (Smith *et al*., 2009; Saldana, 2015; Idowu, 2016; Rossman and Rallis, 2017). The research was guided by interpretisvism paradigm that enabled the researcher to get subjective views of different respondents (Silverman, 2013; Bloomberg, 2019) such as EMA, BCC, public and waste collectors about PBWM practices in the study area. Intepretivism allows the researcher to understand the world from a subjective viewpoint through social constructions and interactions with respondents (Smith, 2009; Mkansi and Acheampong, 2012; Silverman, 2013; Grant and Osanloo, 2014; Idowu, 2016). Thus, data collected provided better understanding about PBWM practices in the study area.

However, interpretive research philosophy has been criticised for reliability and validity (Chowdhury, 2014; Paul, 2017; Bloomberg and Volpe 2019). Research results are influenced by the researcher's own interpretation which causes bias (Denzin and Lincoln, 2018). As a result, the researcher ensured trustworthiness (credibility, transferability, dependability and conformability discussed in section 3.9 as recommended by Lincoln and Guba (1985); Elo *et al*. (2014); and Korstjens (2018).

3.2 APPROACH TO THEORY DEVELOPMENT

The research adopted an inductive approach, a data-driven analysis (Stensheim and Jensen, 2015; Denzin and Lincoln, 2018). Inductive approach has been employed in several qualitative data researches and is consistent with the general patterns of qualitative data analysis (Silverman, 2013; Patton, 2015; Denzin and Lincoln, 2018). The inductive approach assisted in the reduction of collected data from participants by organising them into themes through coding (Rossman and Rallis, 2017; Bloomberg, 2019). The approach gave the researcher the ability to examine existing literature and theories in order to position the research findings within the discipline. However, the

inductive approach is criticised, because if the observations are incorrect the researcher is likely to end up with incorrect conclusions (Creswell, 2014; Denzin and Lincoln, 2018). Thus, the researcher conducted participant checks, peer debriefings for credibility and compared data collected with research results and interpretations for dependability (Elo *et al*., 2014; Leung, 2015; Korstjens and Moser, 2017).

3.3 RESEARCH DESIGN

The researcher employed a descriptive qualitative research design to help describe PBWM practices in the CBD (Payne and Payne, 2004; Bryman, 2011; Creswell, 2011). Descriptive qualitative research design provides in-depth and accurate information (Bernard, 2002; Geber and Macionis, 2011). Therefore, the descriptive research design helped to answer the main research question and sub-questions. Qualitative methods allow the researcher to gain deeper insights into the problem and generate ideas about solutions (Alshenqeeti, 2014; Mannay and Morgan, 2015). Bernard (2002), Bryman (2011) and Creswell (2011) recommended the use of qualitative method as it helps to explore issues about the typical research problem in question (examining PBWM practices).

3.4 CASE STUDY STRATEGY

Case study strategy aligns with interpretisvism paradigm (Stake, 2005; Dul, 2008; Yin, 2014; Ebneyamin *et al*., 2018). Yin (2018) and Schwandt and Gates (2018) argue that case study is an in-depth exploration of data from multiple sources. The strategy gave the ability to explore in-depth insights about PBWM practices in the study area from multiple data source (BCC, EMA, public). However, a weakness with this strategy is that results may not turn out as expected (Yin, 2018). The researcher thrived for trustworthiness as outlined in section 3.9.

3.5 CROSS SECTIONAL STUDY

Cross sectional study is a one-shot study, conducted at over a short period (Setia, 2016; Zangirolami-Raimundo *et al.,* 2018). It can be descriptive or analytic; however, the researcher employed the descriptive cross sectional study based on the research topic. It was the researcher's intention to be descriptive and explore in-depth PBWM in the CBD of Bulawayo for better understanding. A case study is open-ended and flexible in data collection and analysis, allows few carefully selected cases to be studied in-depth, and aligns with information oriented techniques like purposive sampling (Barrat, 2018; Kasemodel, 2018). However, cross sectional study is often critiqued for selection of an inappropriate control group, giving in to bias (Omair, 2015). Yin (2018) calls for careful investigation to reduce the chances of misrepresentation and to maximise the access needed to collect data. Hence the research ensured representativity across the stakeholder continuum.

3.6 STUDY AREA

The CBD is the commercial centre of Bulawayo and other provinces of Matabeleland. It has several important tourism buildings that include Victorian buildings which are heritage sites, the Railway Museum and the Bulawayo Art Gallery. Consumers produce large volumes of PBW on regular basis particularly in flea markets, vegetable markets and bus termini (Mudzengerere and Chigwenya, 2012; Jerie and Tavera, 2014; Mahamba, 2015; Newsday, 2016; Simango, 2017; Bulawayo Bulletin, 2018; Munhande, 2019). The study site was selected because it is the source of the problem (PB pollution) in Bulawayo, Zimbabwe. The study site was stratified according to intensity of activities into: high, medium and low activities zones (Table 3.1 and Figure 3.2). The trend (activities) decreases by the increasing distance from the heart of the CBD (Naik and Oldfield, 2010; Taubenbock *et al.,* 2012; Dickson, 2018).

Table 3.1: Areas of various activities in the CBD (Source: Fieldwork, 2019)

Activity level	Location
High	• Lobengula Street; • Herbet Chitepo and Fort Street; and • Fort Street, 4th and 3rd Avenue (supermarkets, commuter omnibus termini, vendors, flea markets and green markets).
Medium	• Robert Mugabe Road; • George Silundika Road; and • Fourteen Street (supermarkets, vendors and hardware shops).
Low	• First and Second Street; • Fifteen Street; • Samuel Parirenyatwa; and • Josiah Tongogara Road (mainly hardware shops).

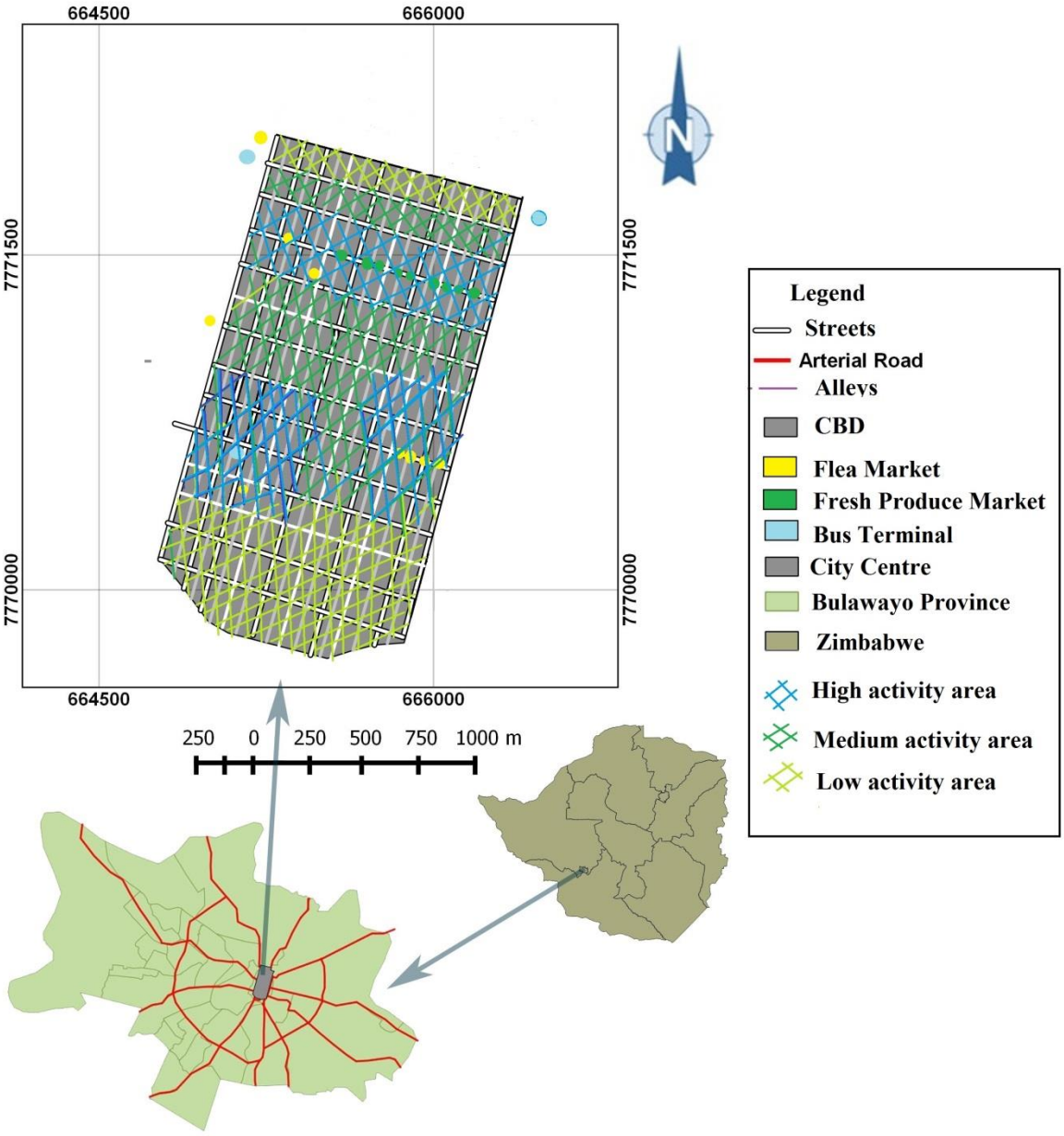


Figure 3.2: Study area and activity levels

3.7 SAMPLING TECHNIQUE

Purposive sampling technique was employed to select key informants. Purposive sampling allowed the researcher to fulfil the research objectives by selecting respondents who are knowledgeable about their subject area (Mcleod, 2014; Etikan and Bala, 2017). Semi-structured interviews were conducted with purposively selected BCC (Senior Health Environmental Officer) and EMA (Education and Publicity officer) officials; two municipality waste collectors; 12 waste pickers and four hundred members of the public. The researcher arrived at the sample size of 400 participants based on data saturation, as recommended by other researchers (Mason, 2010, Baker and Edwards, 2012; Walker, 2012; Morse, 2015). Researchers reach the saturation point when no new insights or themes are observed in the data collected (Morse, 2015). Mason's (2010) analysis of 560 PhD studies (universities in Great Britain and Ireland) that employed a qualitative interview established that the minimum sample size used was 15 participants, after data saturation was achieved. Guest *et al*. (2005) revealed that 88 % of the codes developed during data analysis from 60 qualitative interviews were generated by the time 12 interviews had been completed.

This sample was considered based on the fact that the selected respondents are important stakeholders in SWM (Mudzengerere and Chigwenya, 2012; Jerie and Tavera, 2014; Mahamba, 2015). The purposive sampling technique was beneficial as it permitted for a balance among different respondents (BCC, public and private waste collectors/ recyclers and EMA) to be considered (Hoglund and Oberg, 2011; Etikan and Bala, 2017). As a result, respondents selected had experience, knowledge and technical skill in a field relevant to the study (Palys, 2008; Etikan *et al.,* 2015).

3.8 DATA COLLECTION

The researcher used qualitative data collection techniques (interviews, observations and documents) to answer the research questions. Relevance of each data source is

explained. The researcher hired trained and experienced research assistants to collect data from selected respondents. Data collection process lasted for nine months, from April 2019 to January 2020. Data collection process encompassed planning, data gathering and analysis.

3.8.1 Interviews

Interviews allow the easy collection of information regarding people's feelings and facts, (Bryman, 2011; Astalin, 2013; Alshenqeeti, 2014). The Interview technique helped answer reality, highlight respondent's beliefs, and feelings about PBWM practices in the CBD of Bulawayo. Semi-structured interviews were used. A semi-structured interview technique is flexible as it ensures that all concerns are discussed (Bryman, 2011; Creswell, 2011; Alshenqeeti, 2014). Therefore, this method helped to explore the root causes of PB pollution by examining the PBWM practices in the CBD of Bulawayo.

Semi-structured interviews targeted all respondents from various categories namely the Education and Publicity Officer (EMA), the Senior Health Environmental Officer (BCC) municipality waste collectors, private collectors and the public (Table 3.2) (Appendix 3 and 4). Members of the public were regarded as part of the interviews because semi-structured interviews allowed the researcher to get specific data through asking questions that gave the researcher room to establish their level of awareness and perceptions regarding plastic bag litter in the CBD of Bulawayo. All respondents provided in-depth information about approaches for PBWM in the CBD of Bulawayo. Appropriate communications were done to schedule face to face interviews with BCC, waste collectors and EMA officials. The researcher first sought permission to use the sound recorder to ensure accuracy of data. An interview checklist was used to guide the interview process. Face to face interviews were done (guidance of the interview checklist) with the members of the public that were purposively selected.

Table 3.2: Interview questions with informants

Informant category	Type of questions and category of informant (superscript) asked	Research objectives	Sources
1.Environmental Management Agency (EMA) 2. BCC officials Municipality waste collectors 3. Private collectors 4. Public Members	• Is there any prevalence of PBW in the CBD? [1;2;3;4] • If yes, please indicate areas where PBW is widespread? [1;2;3;4] • What time of the day is PB waste most widespread? [1;2;3] • What causes PB pollution in the CBD? [1;2;3;4] • Please indicate the negative environmental impact(s) associated with PBW? [1;2;3;4] • What remedial measures /actions do you suggest should be taken to address the negative impacts you have identified? [1;2;3;4]	To determine the status of PB pollution in the CBD of Bulawayo	Mudzengerere and Chigwenya, 2012; Gambrah, 2013; Mwanza and Phiri 2013; Wachira, 2013; Adane and Muleta, 2014; Chitotombe, 2014; Mugisha and Diiro, 2015; Muchandiona, 2017; Saidan *et al.,* 2017; Sinthumule *et al*., 2019; and Touhey, 2019.
	• What is the private and public's attitudes towards PBWM? [1;2;3;4] • Do you feel disturbed when you see prevalent of PB litter? [4] • Are you willing to pay for waste service delivery to improve PBWM? If yes what is/are the reasons? [4]. • How is the public complying with legislation on PBWM? [1;2;3;4]	To examine the level of private and public participation in plastic bag waste management in the CBD of Bulawayo.	
	• How often are bins emptied?[1;2;3;4] • Do you have adequate waste bins? [2] • Do you have colour coded bins in the CBD?[2] • Do you repair and replace bins as and when required?[2]	To assess the effectiveness of current technical and infrastructural approaches for plastic bag waste management in the CBD of Bulawayo.	

Informant category	Type of questions and category of informant (superscript) asked	Research objectives	Sources
	• Is there any policy to standardise the vehicles and equipment used by the Department?[1;2;3] • If so, please outline how this policy is being implemented. • Which type of waste collection vehicles do you use? [1;2;3] • Do you have adequate vehicles for waste collection and transportation? [2] • What are the PB waste disposal methods practised in Bulawayo? [1;2;3] • Do you have plastic recycling facilities? [1;2;3] • Do you have enough manpower and human resources? [2;3] • Evaluate the waste management system in the CBD? (good, fair, not good, excellent) [1;2;3] • What technical and infrastructural problems do you encounter in handling PBW? [1;2;3] • How can these problems be solved? [1;2;3]		Mudzengerere and Chigwenya, 2012; Gambrah, 2013; Mwanza and Phiri 2013; Wachira, 2013; Adane and Muleta, 2014; Chitotombe, 2014; Mugisha and Diiro, 2015; Muchandiona, 2017; Saidan *et al.,* 2017; Sinthumule *et al*., 2019; and Touhey, 2019.
	• Briefly outline legislation guiding plastic waste management? [1;2;3] • What penalty provisions are given for non-compliance against waste management legislation? [1;2;3]	To analyse the current legal and policy framework approaches for plastic waste management in the CBD of Bulawayo.	

3.8.2 Observations

Observations give the researcher an opportunity to interact with people and observe a situation (Bryman, 2012; Astalin, 2013). Field notes were taken to record the observations. The researcher prepared an observation checklist (Appendix 5) and observed some of the following aspectsin the study area:

a) waste disposal and storage facilities;
b) frequency of waste collection;
c) type and condition of infrastructure, equipment and vehicles;
d) plastic bag disposal practices; and
e) activities of waste pickers or recyclers.

Observations helped to address the research objectives regarding private and public participation and technical and infrastructural approaches for PBWM.

3.8.3 Document Review

Government and local authority publish waste management-related documents. Document review (reanalysing data) leads to surprisingly new information (Creswell, 2011; Bryman, 2012; Astalin, 2013). The researcher requested permission from BCC and EMA to access documents related to PBWM that were imperative in exploring literature on PBWM practices, community participation in PBWM and negative environmental impacts of PBs (Table 3.3).

Table 3.3: Reviewed documents

Type of document	Nature of data collected	Objective addressed
Policy documents • Environmental Management Act (Chapter 20:27); • Urban Councils Act (Chapter 29:15); • Statutory Instrument 98 of 2010 Environmental Management (Plastic Packaging and Plastic Bottles); and • BCC Municipal by-laws.	Qualitative	Legal and policy framework approaches
BCC publications • City of Bulawayo Strategic Plan 2014-2018	Qualitative	• Technological and infrastructural approaches; • legal and policy framework approaches; and • role of public and private parties

3.9 ISSUES OF TRUSTWORTHINESS

Trustworthiness is the degree of confidence in data interpretation and methods employed to ensure quality of a study (Elo *et al*., 2014; Korstjens and Moser, 2018). Elo *et al*. (2014); and Korstjens and Moser (2018) further underline that researchers have a mandate to establish procedures necessary to ensure that the research findings are free from data misrepresentation. Though most researchers agree trustworthiness is essential, questions have been brought forward as to what constitutes trustworthiness (Leung, 2015). The approach adopted to enhance trustworthiness of this study included addressing credibility, dependability, confirmability and transferability, as recommended by several researchers (Lincoln and Guba, 1985; Graneheim and Lundman, 2004; Elo *et al*., 2014; Korstjens and Moser, 2018) and outlined in Table 3.4.

Table 3.4: Trustworthiness criteria (adapted from Lincoln and Guba (1985); Elo *et al*. (2014); Leung (2015); and Korstjens and Moser (2018)

Qualitative terminology	**Definition**	**Research strategies**
Credibility	Refers to accuracy with which the researcher interpreted data collected from participants.	• prolonged field engagement; • thick and rich description; and • triangulation (interviews and observations).
Transferability	It is the ability of research findings/ context to be applied to other contexts delivering similar findings.	• thick description; • detailed information; and • purposive sampling (selecting informants that differ - BCC, EMA, waste collectors and the public).
Dependability	Refers to quality, stability and consistency of the process of integration between data collection methods, data analysis and the framework generated from the data.	• triangulation; • presented transparent justification for research method choices; • explained how the data was collected and analysed; • maintained record of transcripts and field notes; • presenting the instrument (semi-structured interviews) to the supervisor and; • peer reviewers from UNISA.
Conformability	Refers to how well the data collected support the findings and interpretation of the researcher. It indicates how well the findings flow from the data.	• audit trail; • triangulation; • described the research process in detail; and • consulted literature from experts and previous researchers while formulating the questions, presenting the instrument (semi-structured interviews) to the supervisor.

Thick description involves detailed explanations by the researcher with the aim of building a clear picture of the situation under study while rich data involves in-depth insight into the phenomena under study, to allow the researcher to understand the phenomena under study (Morse *et al.,* 2014; Fusch and Ness, 2015). An audit trail

involves a clear description of all research steps undertaken by the researcher (Fusch *et al.,* 2018). The researcher described the research design, data collections methods, data analysis, interpretation and reporting as recommended by Lincoln and Guba (1985). The audit trail helped in establishing the credibility and conformability of the study.

The researcher used four types of triangulation namely:

i. Methods triangulation: the use of different methods of data collection (Fusch and Ness, 2015; Denzin and Lincoln, 2018). The researcher used semi-interviews and observations to develop an understanding of PBWM practices in the CBD of Bulawayo;
ii. Triangulation sources: is to examine the consistency of different data sources from the same method (Bekhet and Zauszniewski, 2012; Bloombergn and Volpe, 2019). The researcher compared viewpoints from different respondents that included public members, EMA and BCC officials; street sweepers and waste pickers.
iii. Analyst triangulation: the use of different observers to review research findings (Fusch and Ness, 2015). The researcher made use of peer reviewers from UNISA.
iv. Perspective triangulation: the use of different theories and concepts to help examine and interpret data (Bekhet and Zauszniewski, 2012; Bloombergn and Volpe, 2019). The researcher was guided by the institutional theory and the capacity building concept to help examine and interpret PBWM practices in the study area.

3.10 DATA ANALYSES AND INTERPRETATION

Data analysis is a process of reviewing, cleansing and transforming data to get meaningful information from data collected during research (Oxford Internet Institute, 2010; Creswell, 2011). Gribich (2013) states that categorisation is mostly used in qualitative data analysis and entails classification of things, persons or events. Data analysis (from the semi structured interviews) was done through qualitative content analysis.

Qualitative Content analysis (QCA) enhances understanding of the data by distilling words into fewer categories (Elo *et al*., 2014; Neuendorf, 2016; Roller, 2019). It allows researchers to make valid inferences from data to their context, with the purpose of providing new insights and knowledge (Graneheim and Lundman, 2004; Elo *et al.,* 2014; Vaismoradi and Snelgrove, 2019). The aim is to attain a comprehensive description of the phenomenon, in this case PBWM practices in the CBD of Bulawayo.

A key aspect of QCA is coding material to be investigated (Deborah, 2014; Mariette, 2016; Vaismoradi and Snelgrove, 2019). Gerbic and Stacey (2005); Saldaña (2011); and EvaSys (2018) argue that coding helps in the reduction of data. Thus, it helped in the reduction of data, identification, labelling and organising them. Coding was performed using Nvivo as explained in section 3.10.2.

3.10.1 Recording and transcription of data

Recording of data was done by taking notes down and audio recorder. Although it was time consuming, it was important for interviews be recorded verbatim. The researcher transcribed field notes and text was thoroughly read to identify content areas presented. This helped the researcher to be familiar with the data, begin the process of organizing and structuring the data (Bernard *et al*., 2017; Bloomberg, 2018; Bloomberg and Volpe, 2019). Maher *et al*. (2018); and Roller (2019) argue that data analysis require the

researcher to have a great awareness of the data as well and exercise caution to habitual threads to avoid bias. The researcher made comprehensive notes to highlight significant issues regarding PBWM in the CBD of Bulawayo (Patton, 2002; Korstjens and Moser, 2018).

3.10.2 NVivo software coding

NVivo is a Computer-Aided Qualitative Data Analysis Software (CAQDAS) used to help the researcher in data analysis (Bazeley and Jackson, 2014; Kaefer *et al.,* 2015). It allowed for easy storage, coding and retrieving text according to themes. However, software like NVivo has been criticised for not analysing the data for the researcher but simply provide tools to assist in the analysis process (Lyn, 2012, Maher *et al*., 2018). Unlike statistical software, the core function CAQDAS is to aid the analysis process (rather than analyse data) thus the researcher remained in charge of the research analysis process (Maher *et al.*, 2018).

The researcher created a project in NVivo, titled “Plastic bag management practices,” The project was divided into two folders namely audio and transcripts files. Data collected (Interview transcripts and audio files) were transferred in the NVivo. Thereafter coding was done and it involved assembling extracts related to each other. As research analysis follows inductive reasoning, transcribed notes and audio files were carefully read and listened to identify content areas. This helped the researcher to be familiar with the data, begin the process of organizing and structuring the data according to themes (Saldaña, 2011; EvaSys, 2018; Maher *et al*., 2018). Four content areas were created (technical and infrastructural aspects, private-public initiatives, legislation and PB pollution). Coding started during data collection process and it lasted for two months. Data saturation came into effect when there was a broader visual representation of data. Data saturation is a point in coding when no new codes themes emerge from data (Nelson, 2016; Denzin and Lincoln, 2018). Researchers reach the saturation point when no new codes and themes are observed in the data collected

(O'Reilly and Parker, 2012; Fusch and Ness, 2015). The researcher continuously collected and analysed data until no new codes and themes were observed from in the data collected (Bloomberg and Volpe, 2019).

3.10.3 Evaluation for relevance

Themes were evaluated for relevance to the research aims, waste management Capacity building concept and Institutuional theory (Section 2.4) and theoretical framework from the literature study. Conceptual framework guides the study and positions it within its correct theoretical and practical context (Neuendorf, 2016; Bloomberg and Volpe, 2019; Roller, 2019).

3.10.4 Interpretation of results

Interpretation involves making sense of the research results, making connections between research findings and relevant literature, and presenting possible explanations and conclusions (Paul, 2017; Bloomberg and Volpe, 2019). A researcher can use triangulation to solidify their final interpretations and implications, and the credibility of the study overall (Finfgeld-Connett, 2014; Vaismoradi and Snelgrove, 2019). Triangulation is the use of multiple sources of data to develop a comprehensive understanding of phenomena and to enhance the credibility of a research study. Triangulation helps to test validity through the convergence of data from multiple sources (Mariette, 2016).

During data interpretation, the researcher had the ability to make sense of the research findings by making inferences to relevant literature and offering potential explanations and conclusions (Osmer, 2008; Elo *et al.,* 2014; Neuendorf, 2016; Roller, 2019). This was meant to produce a more complete understanding of PBWM practices in the CBD of Bulawayo.

3.10.5 Data evaluation

Benchmarking entails comparing policies, products, programs, strategies performance with best standards (Business Dictionary, 2019; Collins English Dictionary; 2019). Since the mid-1990s, Zimbabwe's economy has been unstable. This has negatively affected local authorities in terms of budgets and their waste management systems. Local authorities struggle to purchase modern waste management vehicles and spare parts (Muringa, 2012; Jerie and Tevera, 2014).

Given the above situation, data gathered was benchmarked against highly recommended ISWM concept (Rinke *et al.,* 2014; Mmereki, 2016; Muchandiona, 2017) and comparing them to the issues raised in similar studies elsewhere. Benchmarking against the ISWM allowed for the evaluation of PBWM by focusing on the three aspects namely: stakeholder participation, technical and infrastructure elements and legislation approaches.

3.10.5.1 Public and Private participation

Several researchers (Crabbe and Leroy, 2012; Honeycutt, 2015; Pradhan, 2017) have considered availability of effective PB legislation; law enforcement and monitoring system; and political acceptability (public acceptance or resistance) as environmental evaluation criteria for legal and policy frameworks. The researcher adopted the criteria to evaluate legal and policy framework approaches for PBWM as indicated in Table 3.5.

Table 3.5: Level of Public-partnership criteria (Adapted from: Kurunasena *et al.,* 2010; Kurian, 2013; Kaloki, 2015; Shabani, 2015)

Evaluation Criterion	Measure
Support commitment actions	• clean up campaigns; • recycling initiatives; • educational awareness; and • provision of receptacles
Superficial participation	• level of awareness and implementation of PB legislation; • 3Rs in waste management (reduce, reuse and recycle); and • activities done by stakeholders

3.10.5.2 TECHNICAL AND INFRASTRUCTURE

Technical and infrastructure approaches were evaluated against the three components namely availability of waste bins and recycling facilities; waste management vehicles and plastic bag waste disposal facilities as indicated in Table 3.6. This evaluation method is a widely accepted sound practice on ISWM (Kurunasena *et al.,* 2010; Kurian, 2013; Rinke *et al*, 2014; van Baalen *et al.,* 2015; Jambeck *et al.,* 2018).

Table 3.6: Technical infrastructural evaluation criteria (Adapted from: Kurunasena *et al.,* 2010; Kurian, 2013; Rinke *et al.,* 2014; McAllister, 2015; van Baalen *et al.,* 2015; Jambeck *et al.,* 2018)

Evaluation Criterion	Measure
Waste bins	• Adequacy of storage facilities
Plastic bag Waste management vehicles	• Adequacy of waste transportation vehicles
Waste disposal facilities (Incineration, Landfills and recycling facilities)	• Availability of environmentally friendly facilities

3.10.5.3 POLICY AND LEGAL FRAMEWORK

Technical and infrastructure approaches were evaluated against the three components namely availability of waste bins and recycling facilities; waste management vehicles and plastic bag waste disposal facilities as indicated in Table 3.7. This evaluation

method is a widely accepted sound practice on ISWM (Kurunasena *et al.,* 2010; Kurian, 2013; Rinke *et al*., 2014; van Baalen *et al.,* 2015; Jambeck *et al.,* 2018).

Table 3.7: Legal and policy framework evaluation criteria (Adapted from: Patton and Sawicki, 1993; Crabbe and Leroy, 2012; Honeycutt, 2015; Pradhan, 2017)

Evaluation Criterion	Measure
Plastic bag legislation	Do legal and policy framework approaches for PBWM reduce consumption of PBs?
Enforcement and monitoring systems	Availability of enforcement and monitoring resources
Political acceptability/ public resistance	Are legal and policy framework approaches understandable to the public, acceptable, and politically saleable?

3.11 ETHICAL CONSIDERATIONS

This researcher strictly adhered to expected ethical conduct. Ethical issues that were addressed during course of the research include soliciting informed consent, providing information, ensuring participant confidentiality and anonymity.

3.11.1 Permission

The research proposal was submitted for ethical approval by the College of Agriculture and Environmental Sciences. Ethical clearance was given by the university (2019/CAES/006) (Appendix 6) and permission to proceed with work was approved from BCC (Appendix 7) and the researcher started collecting data. The researcher requested permission from BCC and EMA to access documents related to PBWM. All the information obtained from secondary sources was acknowledged.

3.11.2 Informed Consent

The researcher obtained consent from respondents before collecting data. The researcher prepared a participation information sheet and letter of consent for key informants (Appendix 8 and 9). For other respondents such as the public and private

waste pickers, the researcher explained the study verbally; an agreement to participate was taken as consent (Mantti and Licari, 2018).

3.11.3 Confidentiality

Information collected from respondents was kept confidential. There was no personalisation of responses in interviews. This was explained before the commencement of interviews. The data from semi-structured interviews, audio and text transcript of the interviews were filed and kept under a protected computer password which is inaccessible until the research is completed. Data will be securely stored for at least five years after final publication. Professional data disposal company will be used when the time for data disposal comes.

3.11.4 Dissemination of Research Findings

Effective dissemination of research findings involves getting the findings of research to stakeholders who make use of them, to maximise the benefit of the research (Chib *et al.,* 2015; Pouris and Pouris 2015). A summary of the research findings was delivered through seminars to stakeholders involved in waste management in Bulawayo such as the public, EMA and the Local Authority. Seminar offers one of the most efficient and effective ways to disseminate information, particularly to participants (Rao and Kate, 2012; Patel *et al.,* 2015). The researcher will submit a copy of research findings to the local authority after completing the research exercise. The researcher published one article and is looking forward in publishing two more articles in peer reviewed journals (Appendix 1).

3.12 LIMITATIONS

A limitation of Interpretivism philosophy relate to subjective nature of the approach and high chances of bias on behalf of researcher (Smith *et al.,* 2009; Ponelis, 2015). Although, the human factor is considered the great assert of qualitative inquiry, it can

also be a weakness (Paul, 2017; Bloomberg and Volpe, 2019). This is a barrier to credible interpretation as research analysis can be shaped according to the assumptions and researcher bias. Qualitative studies in general are limited by researcher subjectivity and participant reactivity, and interpretation and analyses of results (Korstjens and Moser, 2018; Mannay and Morgan, 2015).

To counter the problem of bias, the researcher applied an open mind, thought carefully about sound possibilities and then seeing whether those possibilities were similar to the literature and other research findings as recommended by Kaefer and Sinha (2015); Mariette (2016); Denzin and Saldana (2016); Neuendorf (2016) and Lincoln (2018). The researcher took into account all collected data relevant to the analysis and discussed all the themes. A careful step-by-step documentation of analysis was undertaken to ensure credibility of the study (Creswell, 2014; Elo *et al*., 2014; Roller, 2019; Vaismoradi and Snelgrove, 2019).

A related limitation to qualitative data in relation to interviews is participant reactivity (Idowu, 2016; Paul, 2017). Certain participants may be familiar with the researcher and these participants can be less open in their responses (Mannay and Morgan, 2015; Korstjens and Moser, 2018; Bloomberg and Volpe, 2019). This makes their responses to be affected promoting bias.

To address the problem of participant reactivity, the researcher sought experienced research assistants (who are used to participant reactivity) in an attempt to create a situation that allows for honest and open interaction (Bloomberg and Volpe, 2019).

3.13 SUMMARY

This chapter outlined the research methodology for the study. Interpretative research philosophy was adopted as it allowed the researcher to understand the world from a

subjective viewpoint through social constructions and interactions with respondents. The researcher employed a descriptive survey design to provide in-depth and accurate information regarding PBWM practices in the CBD. To ensure reliability, four techniques namely credibility, dependability, confirmability and transferability were used while content validity technique ensured validity of collected data. Content analysis method allowed the researcher to generate new concepts by blending together empirical and abstract concepts. Ethical issues included soliciting informed consent, providing information, ensuring participant confidentiality and anonymity. The research findings are presented in the next chapter.

4 RESEARCH FINDINGS, ANALYSIS AND DISCUSSION

4.1 INTRODUCTION

This chapter presents data on demographic, status of plastic bag pollution, level of private and public participation, current technical and infrastructural approaches, and legal and policy framework approaches in PBWM in the CBD of Bulawayo. The findings were explained in relation to information from existing researches of a similar nature. Inadequate financial resources were identified as the main barrier hindering PBWM practices in the CBD of Bulawayo. Limited resources impact all waste management approaches namely technical and infrastructural, legal and policy, and public-private partnerships (Figure 4.1).

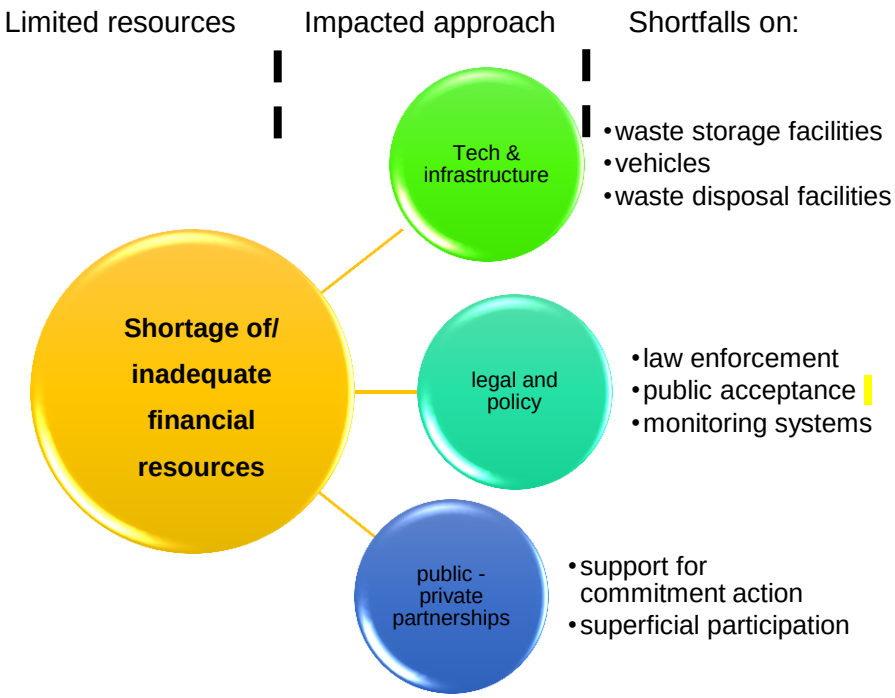


Figure 4.1: Summary of the main findings

4.2 DEMOGRAPHIC DATA

Semi-structured interviews were conducted with four hundred members of the public to collect data on PBWM practices in the CBD of Bulawayo. A response rate of 100 % was achieved. Demographic characteristics of respondents comprised of gender, age and education. The results revealed that 58 % (*n* = 232) of the interviewed were females and 42 % (*n* =168) were males (Figure 4.2). The findings reflect that women are more often involved in grocery shopping for their families than men. Chopra (2014) and Ramprabha (2017) argue that women are the leading consumers and they often handle the bulk of the grocery shopping for the family. Men often work in harsh environments in diaspora and heavy industry, leaving women to do household work (Bouchoucha, 2012; Kangas *et al.,* 2015). It is therefore important to involve women in PBWM systems as they are directly involved in plastic bag waste generation (Baba *et al.,* 2015; Lantara, 2015).

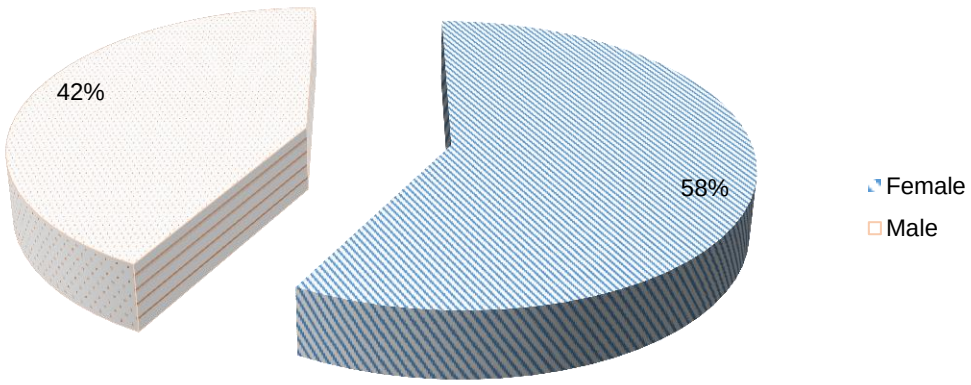


Figure 4.2: Proportion and Sex of respondents (*n* = 400)

Results from interview questions revealed that the highest age group was 31-40 years (39%, *n* = 156), followed by the 21-30 years (26 %, *n* = 104). The proportion of 41-50 years age group was 16 % (*n* = 64) while 20 years and below age group was 11 % (*n* = 44). The least age group was 51 and above (8 %, *n* = 32) (Figure 4.3). The findings reflect that the age groups 21-30 and 31- 40 years are the most active and mobile. Gano (2018) underlined that the 40 age group makes up the largest proportion of moves because of family related issues. Although these two age groups are the most mobile and are actively involved in grocery shopping, educating the young age group is crucial as early childhood environmental education is a fundamental phase in the development of environmental awareness and individual's behaviour (United Nations, 2018). This means that if the population is taught at a young age it will likely develop a well-founded environmental sound mind-set and can use it to solve PBWM issues with a strong commitment and a positive attitude. Economic distress in Zimbabwe has contributed to the growth of the formal sector thus pushing many people especially the active age group out of the formal job sector to the informal sector (Njaya, 2015).

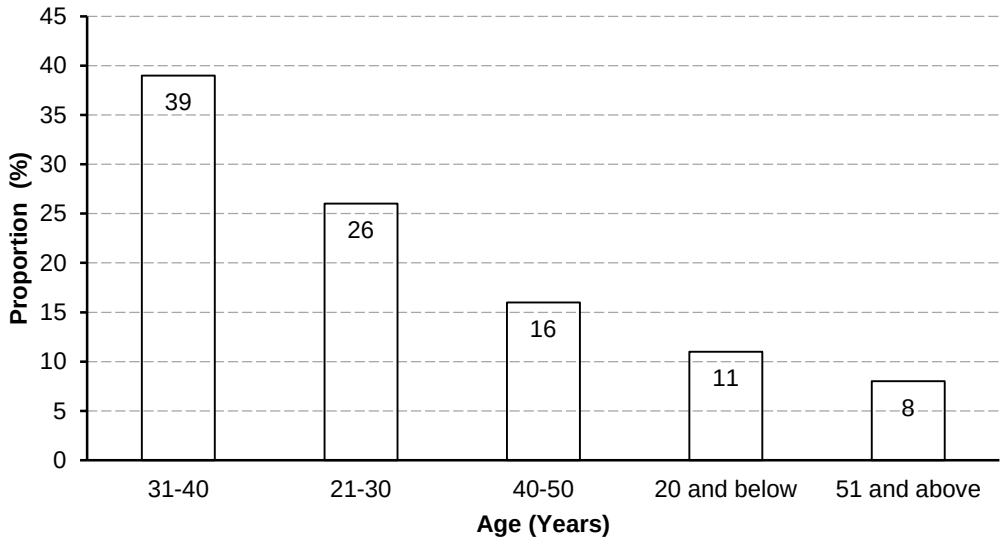


Figure 4.3: Proportion of respondent and their age distribution (*n* = 400)

The educational level of respondents helped in determining the level of environmental awareness amongst respondents (Figure 4.4). Sixty-six percent (*n* = 264) of the respondents attained secondary education while 26 % (*n* = 104) and 8 % (*n* = 32) attained tertiary and primary education respectively. The high percentage of educated respondents may reflect that people are well-aware of plastic bag management issues in the study area. According to UNESCO, (2019) educated citizens have high level of environmental awareness. Capacity building concept and institutional theory also underline the need to develop the skills and knowledge of individuals through education and training (Jacklin, 2005; Thoenig, 2011; Iarossi, 2014; Palthe, 2014; Stewart, 2015; Bergeron *et al.,* 2017).

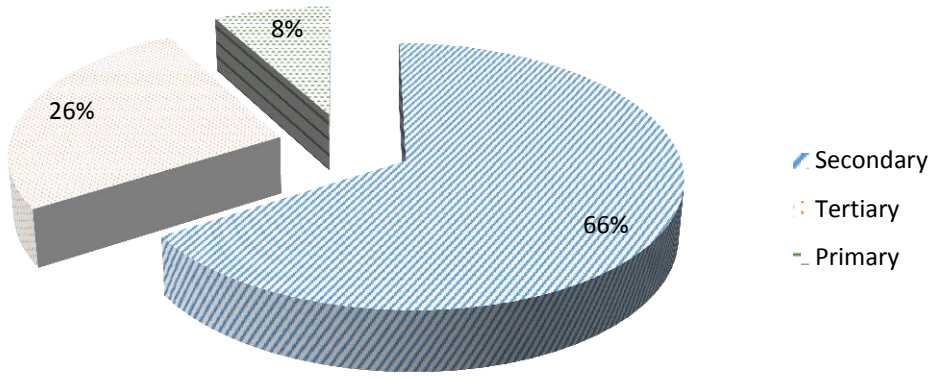


Figure 4.4: Proportion of respondents and their educational level (*n* = 400)

4.3 STATUS OF PLASTIC BAG POLLUTION IN THE CBD OF BULAWAYO

The researcher observed high, medium and low activity areas in the study area to determine the prevalence of PB pollution in the study area.

4.3.1 Prevalence and Spread

Public members were asked if there was prevalence of PB in the CBD. The findings reveal prevalence of PBW in the CBD of Bulawayo as indicated by the majority, 68 % (*n* = 271) of respondents (Figure 4.5). The researcher observed that there was prevalence of PBs especially in high activity areas like bus termini and fresh produce markets.

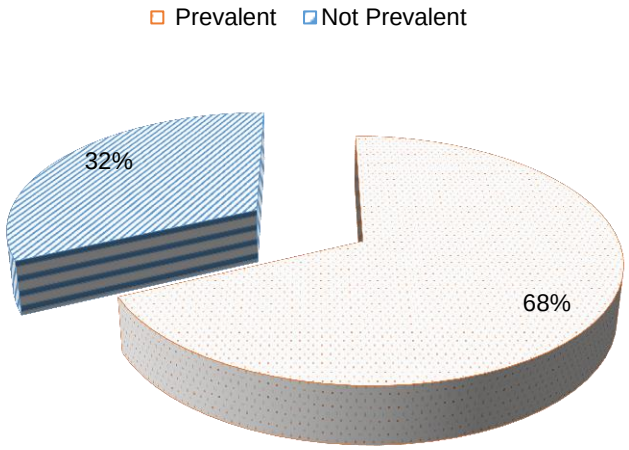


Figure 4.5: Prevalence of plastic bag waste in the CBD by respondents (*n* = 400)

Respondents were further asked to indicate areas where PBW is widespread. They indicated high activity areas such markets, commuter omnibus termini, drainage systems and alleys. Observations corroborated what respondents said in Figure 4.5. These places can guide the local authority in positioning bins.

A B

Figure 4.6: Observed concentration of plastic bag waste in the CBD: green market area (A) and low activity area (B) in the Bulawayo CBD

Figure 4.6 A and 4.6 B indicate that more PBW is highly concentrated around fresh produce market. Therefore, BCC should provide more waste bins in high activity areas. On the other hand, the areas far away from markets (Figure 4.6 B) were not heavily polluted because of low human traffic. Adverts on municipal property (Figure 4.6 B) should be paid for. This can be one way for the municipality to generate revenue. Good looking bins can attract more advertisements and generate revenue which can go to waste management. The beauty of advertising on bins is that the BCC can undercut competition with lower rates in high people traffic environments.

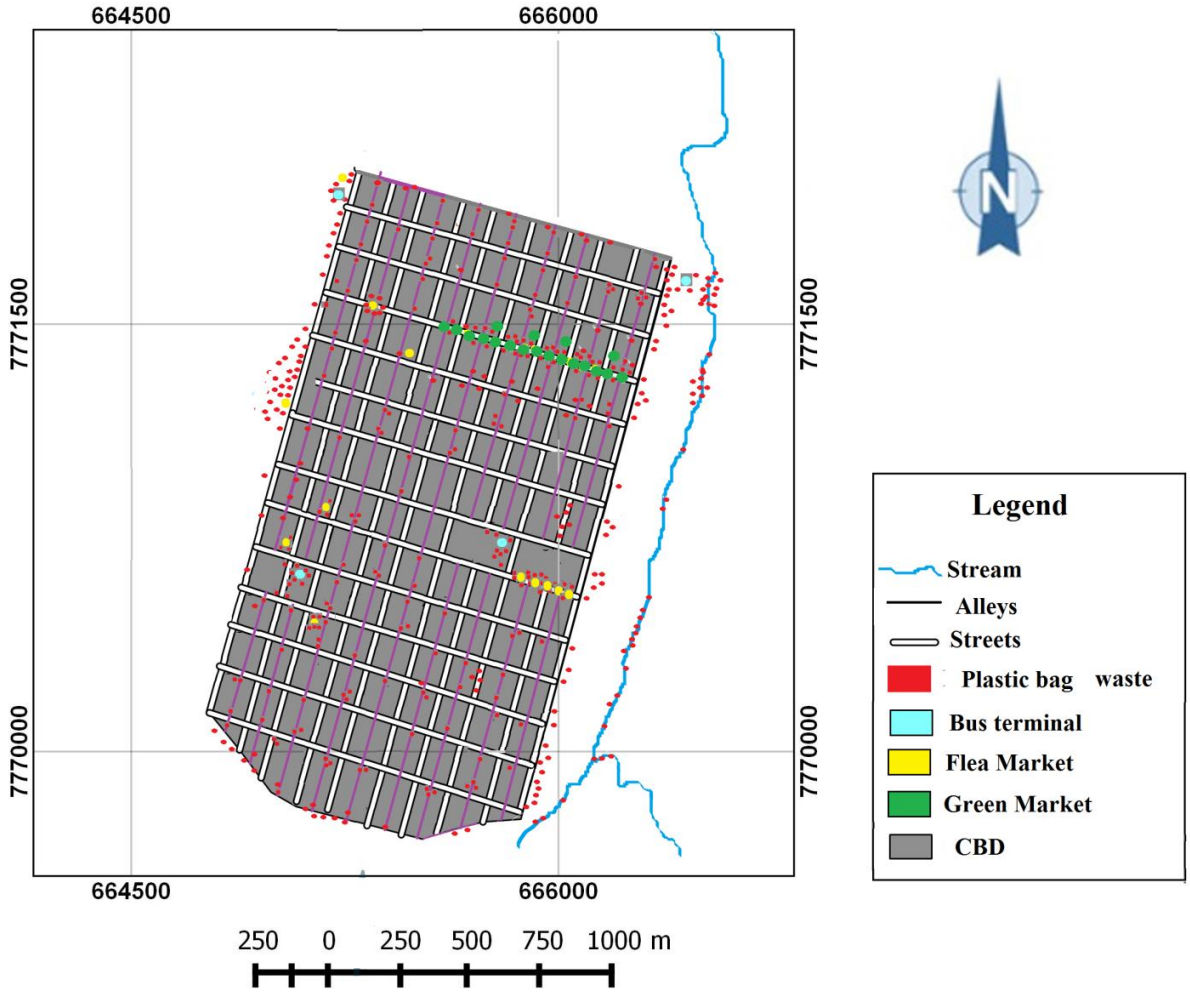


Figure 4.7: Spread of plastic bag litter in the CBD

Adane and Muleta (2011); Jerie and Tevera (2014); and Mahamba (2015) respectively found out that in Jimma City (Ethiopia), Gweru and Harare (Zimbabwe), PBs and other solid waste was most prevalent in places such roadsides, drains, green markets and bus termini. Wachira (2013) observed that 44.2 % of the respondents indicated that plastic waste was prevalent around waste dumping sites, 20.8 % of the respondents indicated that plastic waste was prevalent in market places and 19.2 % indicated that waste was prevalent in open places in town while 15.8 % indicated that waste was

commonly found along the road. These findings suggest that PBs litter is common in high activity areas (public places) like bus termini and market places. The findings suggest the need for the provision of adequate waste bins in these areas to reduce PB pollution.

Figure 4.8 shows that the extent of PB litter is directly proportional to human traffic. The proportion of PB litter was highest in high activity areas and minimum in low activity areas. More waste bins should be provided in high to medium activity areas to reduce the prevalence of PB litter in the CBD.

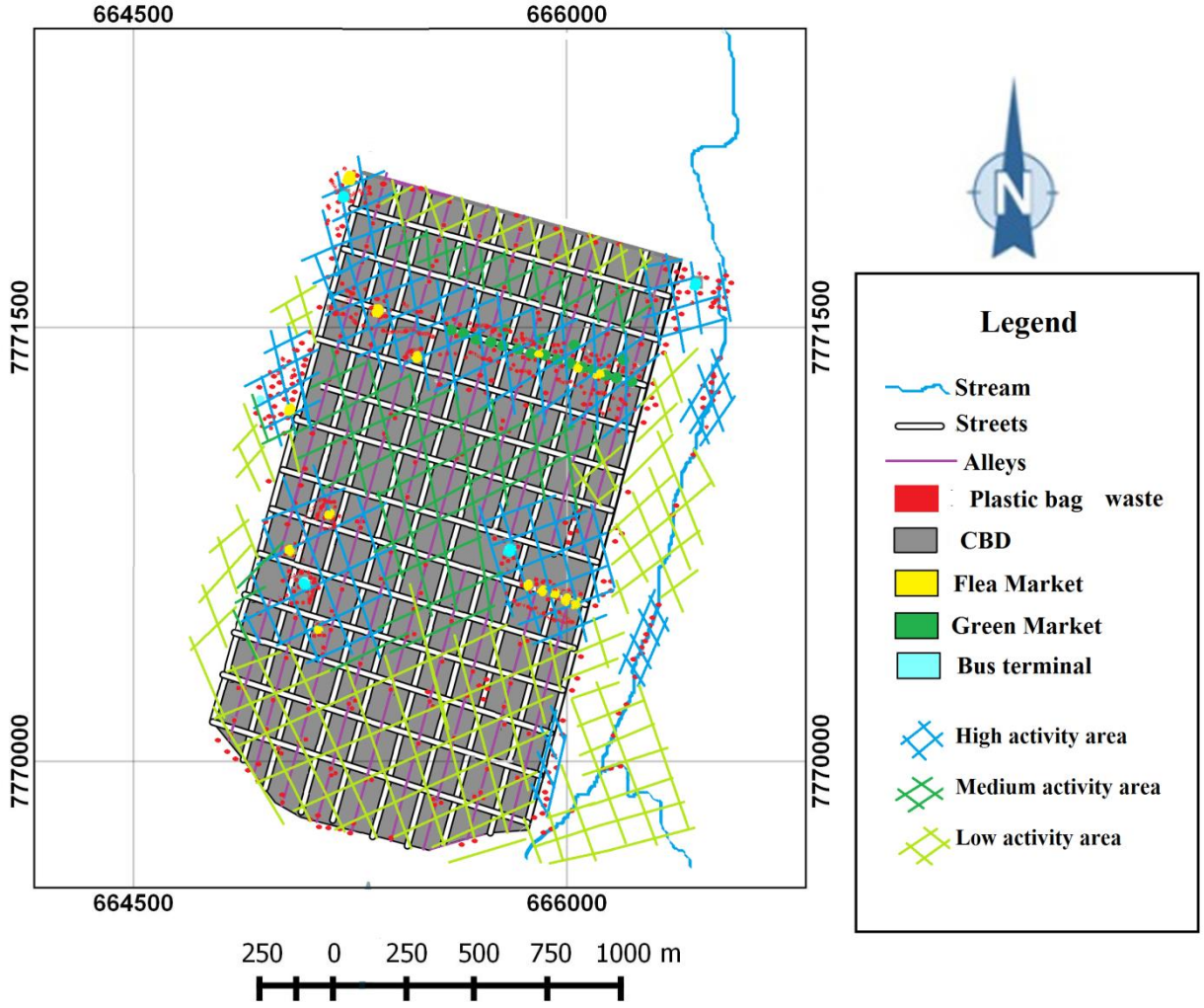


Figure 4.8: Plastic bag pollution and activity levels

Environmental Management Agency and BCC cited markets and commuter omnibus termini as major places where PBW was most common. Wesley Schultz and colleagues (2013) argued that about 15 % of littering acts stemmed from factors such as limited or distance to, waste bins. The high volume of waste in high activity areas coupled to limited bins promote littering; people will perceive it to be a normal and an accepted behaviour. Thus, heavily polluted areas tend to push people to be comfortable about littering whereas a clean environment promotes anti-littering behaviour. Personal

attributes must be also given attention of any behavioural change strategies intended at minimising littering.

Bins require to be positioned in strategic sites particularly in high activity areas, and in places where consumers litter the most. Areas with high retail activities such as bus termini and fresh produce markets are the obvious choices (Jerie and Tavera, 2014; Mahamba, 2015). In locating the bins, consideration around distance to the bin from source of waste is critical as suggested by Schultz *et al*. (2013). Furthermore, the bins must be adequate, visible and within reach (Glad, 2018; Keramitsoglou and Tsagarakis, 2018). Data about the spread of PBW in the CBD help to determine the most suitable locations for positioning extra bins.

4.3.2 Diurnal Trends

Public members were asked to indicate the time of the day when PBW was most prevalent. The majority of respondents indicated that PBs were prevalent in the evening (65 %, *n* = 261) and afternoon (22 %, *n* = 88) and less common in the morning (13 %, *n* = 52) as shown in Figure 4.9. The results were corroborated by field observations that revealed high PB pollution particularly in the evening.

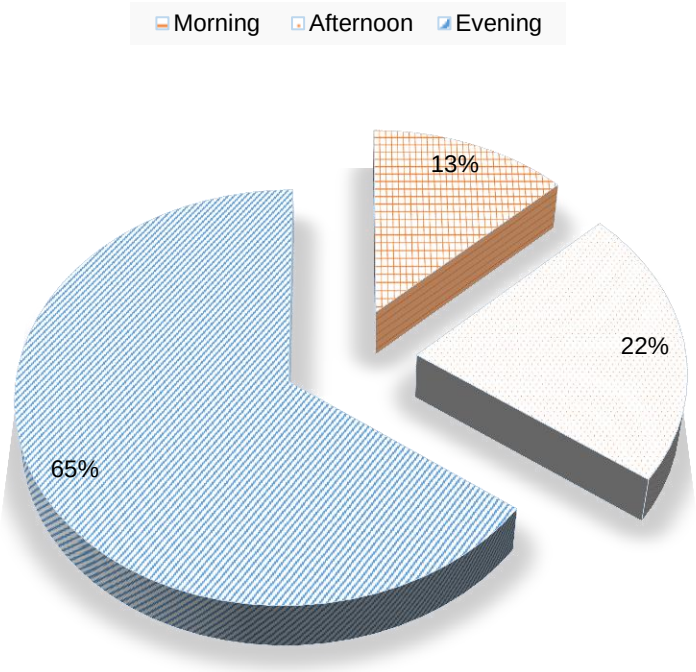


Figure 4.9: Time of the day when plastic bag is prevalent according to respondents (*n* = 400)

The trend can be explained by:

i. continuous accumulation of PB waste from morning to evening;
ii. wind's ability to carry PBs all over the CBD without human and vehicle traffic impediments; and
iii. Inconsistence collection of waste.

Bulawayo City Council street cleaners indicated that street cleaning was done daily in the morning (a normal practice). Morning is preferred to avoid human activity interference and to prepare waste for collection. Marais and Armitage (2004) found out that street sweeping conducted two to three times daily in the CBD of Cape Town, South Africa removed approximately 99 % of litter load from the streets. On the

contrary, sweeping selected streets in Springs, South Africa, indicated that once a day sweeping removes about 83 % of litter (Armitage *et al,* 1998). This implies that, where the sweeping frequency is less the litter removal efficiency is likely to drop. Considering that the CBD of Bulawayo is smaller than that of Cape Town, street sweeping can be done two times a day especially in high activity areas.

Bulawayo City Council revealed that the low revenue inflows compromised daily refuse collection. The frequency of waste collectin varied from three times to six times a week. Guerrero *et al.* (2013) found out that municipalities in developed and developing countries collect waste from the commercial areas with frequencies that vary from 14 times a week (for example Amasya Municipality in Turkey) to one time a week (for example Lilongwe Municipality in Malawi). The trend promotes the existence of PB litter in storm waterways and this in turn manifests the following negative environmental impacts:

i. plastic litter is aesthetically unappealing;
ii. birds are at risk of being choked and entangled by PBs in search for food; and
iii. the local authority is likely to incur significant costs in clean-up operations.

Bulawayo City Council indicated that the waste management budget caters for street cleaning, collection and disposal services (Table 4.1). Sources of revenue in the CBD include some of the following: stall owners at fresh produce markets, taxi ranks, from flea markets and advertisement on council's property.

Table 4.1: Total expenditure for waste service

Waste service	USD/ month
Collection and transportation	260,000
Sweeping	80,000
Final disposal	70,000
Total expenditure revenue for waste service	410,000

The total budget for waste service is USD 720,000/month, USD 260,000 is spent on solid waste collection and transportation per month, USD 80 000 on sweeping and USD 70 000 on final disposal. Waste management expenditure is more than USD 310,000 of what is allocated. However, the CBD does not have adequate waste collection vehicles, waste bins in high activity areas like fresh produce market. Bulawayo City Council should have a different costing model that incorporates Materials Recovery Facility, wastes bins and waste collection and management vehicles such as landfill compactors, waste collection vehicles and front end loaders.

Interviews with EMA and BCC officials revealed that PBW is associated with detrimental effects in the study area such as:

- land pollution;
- block drainage systems; and
- reduced aesthetic quality of the environment.

Bulawayo CBD is a well-known tourism destination and happens to be one of the important centres of the history of Zimbabwe with Natural History Museum, Bulawayo Railway Museum and Bulawayo National Gallery of Zimbabwe. Proper PBWM is a vital in upholding the tourism industry in Bulawayo. Visitors usually seek to visit a pristine environment that is free from litter. Therefore, PB pollution in the CBD of Bulawayo may scare away tourists.

The researcher observed that plastic bag waste was part of material that obstructed drainage systems (Figure 4.10 A) and loss of aesthetic value in the CBD (Figure 4.9 B). Observations also revealed that in some areas of the CBD, there was lack of grid covers over the catchpit entrances to prevent clogging of drains (Figure 4.11). High PB litter volumes and high amount of rainfall, unreliable maintenance programmes often cause drainage obstruction and risk of floods (Gambrah, 2013; Danielsson, 2017; Behuria, 2019). In 2015, PB and other plastic packaging waste accumulated and clogged drains during a heavy downpour in Ghana Accra. This scenario resulted in flooding in which at least 150 people lost their lives and infrastructure was damaged (Blue Tube, 2015; Plastic Pollution Coalition, 2015). However, this measure also relies on regular street sweeping and waste collection efficiency.

A (drainage system at bus termini) B (fresh produce market area)

Figure 4.10: Observed detrimental effects of plastic bag waste to the environment: clogging of drainage system (A) and loss of aesthetic value (B) in the Bulawayo CBD

Figure 4.11: A catchpit entrance without a screen cover in the Bulawayo CBD

4.3.3 Perceived Polluting Reasons

Public members were asked about the causes of PB pollution in the CBD. The majority of respondents, 41 % (*n* =163) cited inadequate waste bins followed by uncollected waste, 28 % (*n* = 113), limited law enforcement, 21 % (*n* = 83) and throw-away culture 10 % (*n* = 41) (Figure 4.12). Inadequate waste bins promote PB pollution, odours and overfilled bins. Plastic bag litter act as breeding grounds for bacteria and insects and are a public eyesore. The high percentage of uncollected waste can be attributed to vehicle breakdown and fuel shortages that interrupt normal service delivery. In a similar study in Gweru, Zimbabwe, Jerie and Tavenga (2014) found out that there was in market areas such as Kudzanai there was inadequacy in waste collection and few disposal bins. This reflects that the challenges in BCC are common in other cities of Zimbabwe where local authorities struggle to provide efficient service delivery due to factors such as inadequate waste bins and limited removal fleet.

Limited law enforcement can be attributed to limited community policing and engagement techniques. Effective law enforcement involves officers who show a genuine intent of forming an environment for dialogue and alliance with the community (Bratton, 2015; Madebwe, 2015). Throw-away is regarded as the least cause of environmental pollution by respondents. This can be attributed to the high level of environmental awareness. Citizens tend to make self-sacrifices when they are well-informed about the benefits that will be attained because of their pro-environmental behaviour (Sinclair, 2017; United Sates of America Department of Justice, 2019). The presence of overfilled bins and waste around them is an indication that members of the public see the need to dispose waste in waste bins although there are full. The problem is inadequate waste bins installed in high activity areas.

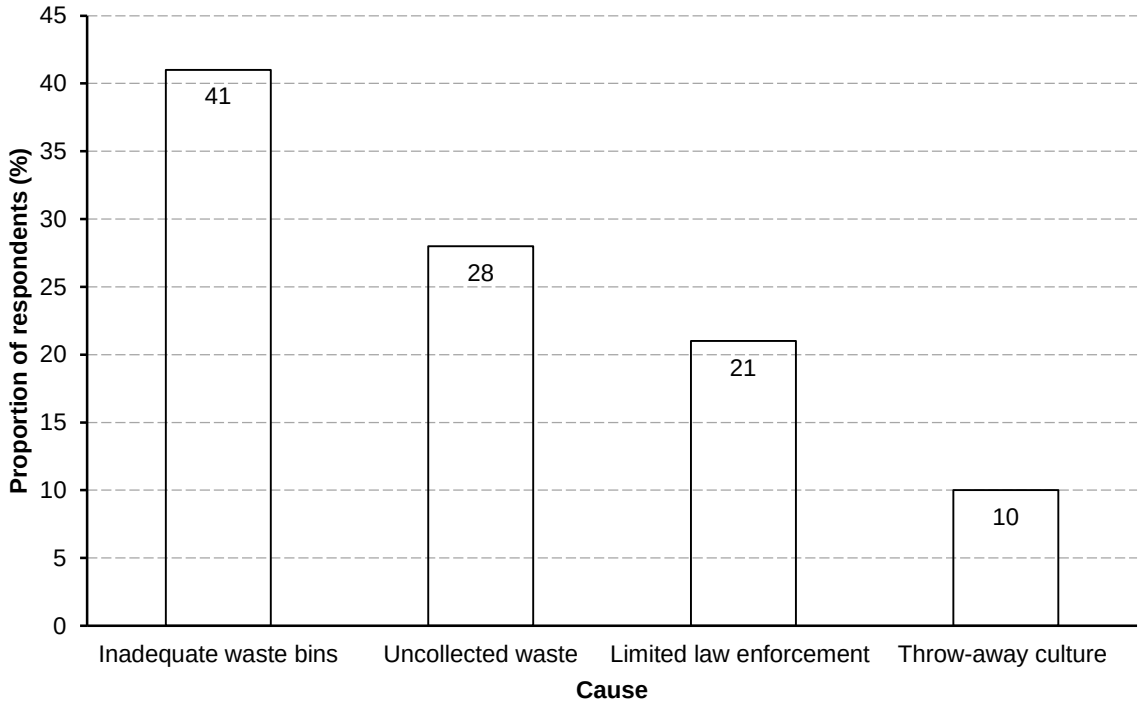


Figure 4.12: Causes of PB pollution according to respondents (*n* =400)

4.3.4 Potential Solutions

Public members were asked to suggest possible solutions to improve PBWM. The majority of respondents, 51 % (*n* = 204) proposed the construction of a recycling facility, 38 % (*n* = 152) suggested the provision of waste bins and 11 % (*n* = 44) recommended the provision of PB alternatives (Figure 4.13). Several studies have underscored the advantages of promoting plastic waste recycling as a viable strategy to sustainable PBWM (Peprah *et al.,* 2015; Mativenga *et al.* 2017; Van Eygen *et al.,* 2017). Potential solutions suggested by respondents like the establishment of a recycling facility are environmental sound. This reflects that most citizens in Bulawayo are environmental conscious and see the need for institutional capacity building. The local community should be taken as the primary focus of attention in MSWM since they are the immediate victims of the adverse effects of uncollected PBW.

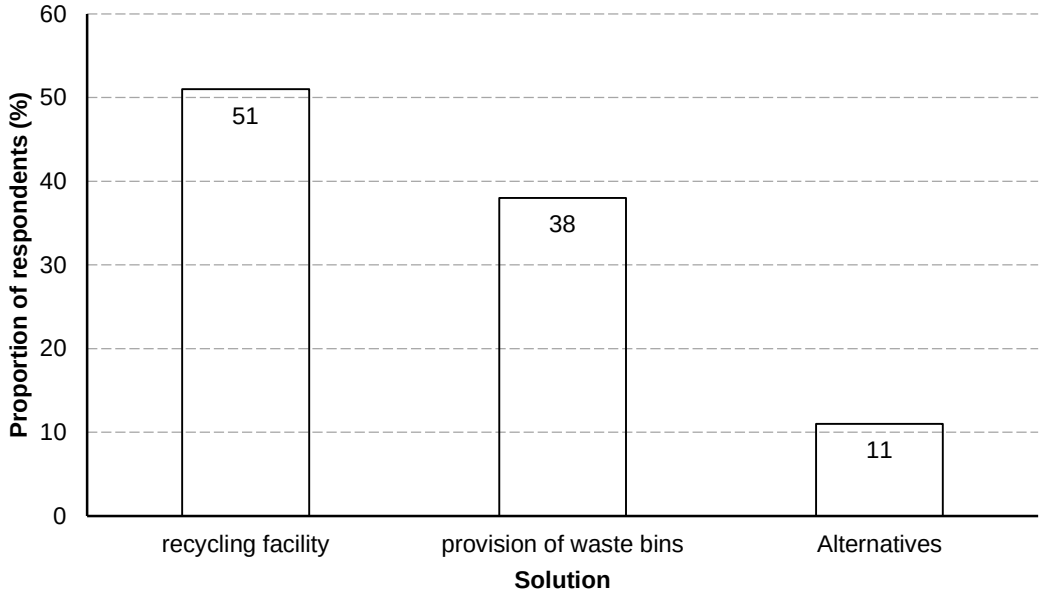


Figure 4.13: Potential Solutions by respondents (*n* = 400)

Bulawayo City Council and EMA officials were asked to outline measures to address PB pollution. They recommended the following:

i. stronger enforcement strategies and continual monitoring of their relevance;
ii. use of PB substitutes such as cloth bags;
iii. support to waste pickers through:
    - formalisation and formation of cooperatives;
    - providing space for sorting;
    - provision of trolleys; and
    - provision of incentives such as bonuses.

Giving waste pickers bonus/capital requires more thought as most of them are not organised and do not have business skills (Dias, 2016; Kumar, 2017; da Silver, 2018). Local universities and colleges such as NUST and Poly Technic College of Bulawayo should establish programmes that educate and train informal waste pickers about business management and ensure that waste pickers do appropriate business most preferably as a consortium.

Cotton bags are preferred because they are eco-friendly, durable and save more money (Mugisha and Diiro, 2015; Thomas, 2015; Ari and Yılmaz, 2017; Kish, 2018). The Ministry of Small and Medium Enterprises and Cooperative Development should encourage business to engage cotton manufacturing industry.

4.4 PUBLIC AND PRIVATE PARTIES PARTICIPATION

The researcher sought to determine the level of private and public participation in PBWM in the CBD of Bulawayo. Issues identified included support for commitment actions (private clean up campaigns, recycling initiatives, educational awareness and provision of PBWM equipment and infrastructure) and public participation.

4.4.1 Level of Awareness and Disposal practices

Participants (public) were asked if they were aware of the 3Rs in waste management. The majority of the respondents 66 % (*n* = 264) were aware of the 3Rs in waste management while 34 % (*n* = 136) were unaware (Figure 4.14).

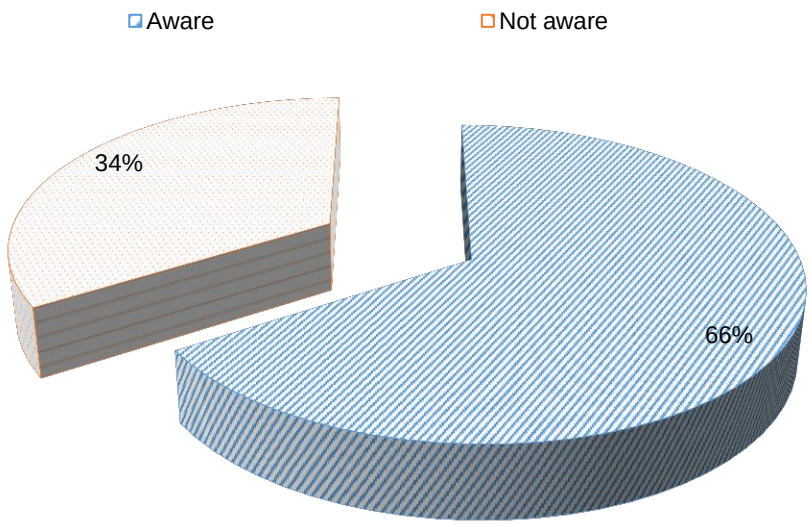


Figure 4.14: Awareness of the 3Rs in waste management by respondents (*n* = 400)

The high level of awareness is not surprising considering the previous responses to PB ban and type of plastics banned. The results suggest that people are taught about the 3Rs in waste management through awareness and educational campaigns. The environmental consciousness can be attributed to the Zimbabwe school curriculum that includes environmental education in primary, secondary and tertiary levels. A well-informed society on environmental sustainability is essential for effective environmental management (Kish, 2018; Behuria, 2019). The results can be confirming the views of BCC and EMA that they conduct education and awareness programmes on waste management issues. Ascertaining of the level of reach of the awareness campaigns could have been confirmed with follow-up questions to the public around sources of

information. As indicated in the knowledge about the PB banning, high level of awareness does not necessarily translate to implementation of 3Rs in PBWM but there are other extenuating factors involved such as shortage of waste bins.

4.4.1 Reasons for using PBs

Respondents (public) were asked to state the reasons for using PBs .The majority of the respondents cited that they are provided for free, 42 % (n = 168), low price , 36 % (*n* = 144), lack of PB substitutes,12 % (*n* = 48) and reusability, 10 % (*n* = 40) (Figure 4.15).

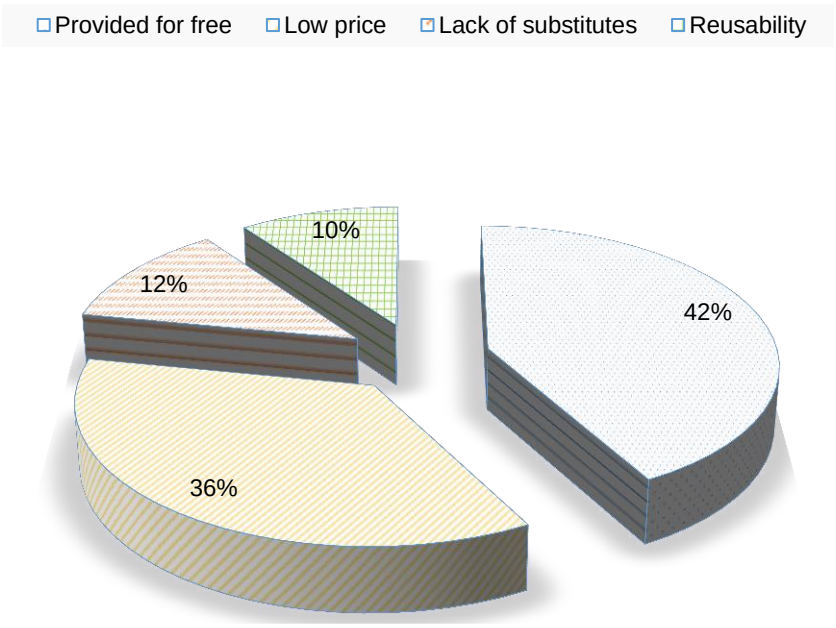


Figure 4.15: Reasons for using PBs by respondents (*n* = 400)

In their study in Nigeria, O'brien and Thondhlana (2019) found out that consumers preferred using PBs because of the following factors:

i. convenience (51 %);
ii. reusability (42 %);
iii. easily available (40 %);
iv. cheap (20 %); and
v. lightweight (12 %).

Plastic convenience to respondents meant that PBs are quicker to open, pack and more durable than paper bags. They are considered reusable because they do not easily tear like paper bags. They are easily available because some retail outlets offer them for free. Plastic bags are seen as cheap when compared to paper and cloth bag. They are said to be lightweight because they are easy to carry. European Bioplastics, (2017); Saidan *et al*. (2017); Plastic Bag Source (2018); and Iheukwumere *et al*. (2019) stressed that although PBs are preferred by consumers because they are inexpensive, more durable than paper bags, are easy to carry and are a flexible way of packaging goods however, there is a downside on waste they generate. They obstruct water channels and are a blight on the landscape. The order of responses (hierarchy of reasons for using PB) between the study area and that of O'brien and Thondhlana is different. The majority of the respondents who cited provided for free, 42 % (n = 168), low price, 36 % (n = 144) in the study area is a sign of hyperinflationary environment in Zimbabwe that force people to go for affodable products (Makate *et al.,* 2019).

Wachira (2013) reported the similar reasons for the high consumption of PBs in Ongata Rongai Township in Kenya. The majority of the respondents, 41.7 % preferred PBs because they were easily available in retail outlets, 28.3 % cited affordability, 15 % cited lack of alternatives and 15 % said were easy to carry. Chitotombe (2014) indicated that increased use of PBs in South Africa was attributed to low-priced PBs stretching from

R0.30 to R0.50. The results suggest that measures around promoting PB alternatives and increasing PB levy should be considered.

Of 232 female respondents interviewed (to state the reasons for using PBs), the majority cited provided for free, 46 % (*n* = 107) (Table 4.2). Similarly, of 168 male respondents interviewed, the majority cited provided for free, 37 % (*n* = 62). The majority of the respondents in all age groups cited provided for free, 41-50, 51 % (*n* = 33), 31-40, 44 % (*n* = 69), 21-30, 39 % (*n* = 41), 51 and above, 34 % (*n* =11) and 20 and below, 32 % (*n* = 14). The majority of the respondents in all educational levels cited provided for free, secondary level, 43 % (*n* = 114), primary level 40 % (*n* = 13), and tertiary level, 39 % (*n* = 41). The high proportion of respondents in both genders, all age groups and educational levels who cited provided for free is a sign of hyperinflationary environment in Zimbabwe that force people to go for affordable products (Makate *et al.,* 2019). High prices affect the demand for consumer goods (Brady, 2020; World Bank, 2020).

Table 4.2: Reasons for using PBs by age, gender and level of education

Responses	Gender		Sample
	Female	Male	
	%	%	%
Provided for free	46	37	42
Low price	35	37	36
Lack of BP substitutes	10	15	12
Reusability	9	11	10
Total	100	100	100

Responses	Age					
	20 and below	21-30	31-40	41-50	51-and above	Sample
	%	%	%	%	%	%
Provided for free	32	39	44	51	34	42
Low price	27	37.5	37	41	28	36
Lack of BP substitutes	23	12.5	10	5	19	12
Reusability	18	11	8	3	19	10
Total	100	100	100	100	100	100

Responses	Educational levels			
	Primary	Secondary	Tertiary	Sample
	%	%	%	%
Provided for free	40	43	39	42
Low price	25	37	37. 5	36
Lack of BP substitutes	19	11	12. 5	12
Reusability	16	9	11	10
Total	100	100	100	100

4.4.2 Plastic bag management practices

Public members were asked to indicate their PB management practices (Figure 4.16). The majority of respondents, 64 % (*n* = 256) indicated that they reused PBs and 36 % (*n* = 144) threw away PBs after use. It is worth noting that promoting re-use of PBs reduces PB consumption among consumers.

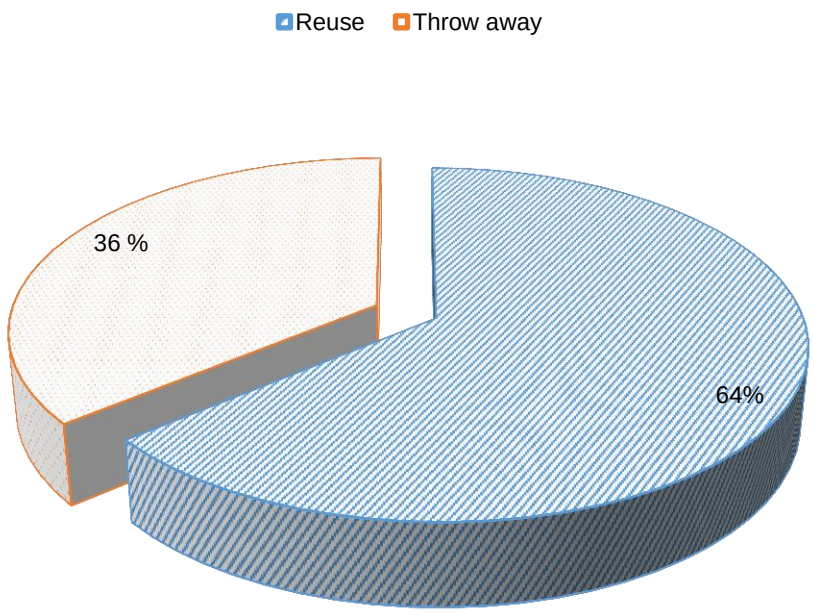


Figure 4.16: Plastic bag management practices by respondents (*n* = 400)

Sixty-four percent of the respondents who reuse PBs imply that the majority of people practise the 3Rs in waste management. However factors such as limited and overfilled bins leave them with no option but to dispose waste around bins. Capacity building is a key in meeting waste storage problem. Capacity building concept requires municipalities to strengthen the ability to build structures, systems and skills in order to

achieve effective and sustainable MSWM system. Thus, there is a pressing need for capacity building on technology solutions (waste bins) to deal with PBW.

People usually respond well to social incentives such as positive criticism and praise for practising the 3Rs in waste management. Social incentives are often cheap, making them a practical tool in behaviour change in PBWM. In a similar study, in the Peri-urban households of Kampala City, Masaka Municipality and Iganga in Uganda 36 % of the respondents replaced polythene bags with other packaging substitutes. About 20 % respondents stopped accepting the single use PBs from retail outlets with 95 % indicating willingness to pay for PB substitutes. The results indicate that citizens are becoming environmentally conscious and see the need to practise sound environmental management practices. Appreciating and praising the efforts or role of citizens can motivate them to be actively involved in PBWM.

Interviews with EMA and BCC officials and direct observations indicated that a small group of consumers still practised throw-away culture and this posed a great risk to the environment (loss of aesthetic value and clogged drainage systems). Environmental Management Agency and BCC ought to increase awareness about proper waste disposal and implications of littering. The impact of PBW is also an immense problem in Africa for example; Somalia, Kenya and Ethiopia because of throwaway culture perpetuated by limited waste management infrastructure (Masai, 2015; Alhindawi, 2017; The East African, 2017).

Of 232 female respondents interviewed, the majority, 74 % (*n* = 171) indicated that they reused PBs and 26 % (*n* = 61) threw away PBs after use (Table 4.3). In contrast, of 168 male respondents interviewed, 51 % (*n* = 85) reused PBs and 49 % (*n* = 83) threw away PBs after use. The findings reflect that females are more actively involved in PBWM reuse than males. In a similar study in Ethiopia, Shen and Saijo (2008) found out that 85 % of the women were more active in SWM. One may advance reasons such as

affordability and propensity for economic savings for the observed differences. Despite the reason for these observations, one can justifiably say females are more sensitive and cooperative towards environmental sustainability initatives.

Table 4.3: PBWM practices by gender, age and educational level (n = 400)

Responses	Gender					
	Female		Male			Sample
	%		%			%
Reuse	74		51			64
Throw-away	26		49			36
Total	100		100			100
Responses	Age					
	20 and below	21-30	31-40	41-50	51-and above	Sample
	%	%	%	%	%	%
Reuse	48	56	62	86	81	64
Throw-away	52	44	38	14	19	36
Total	100	100	100	100	100	100
Responses	Educational levels					
	Primary		Secondary		Tertiary	Sample
	%		%		%	%
Reuse	53		61		74	64
Throw-away	47		39		26	36
Total	100		100		100	100

Eighty-six percent (*n* = 55) of the respondents aged 41-50 reused PBs and 14 % (*n* = 9) threw away PBs after use. Eighty–one percent (*n* = 26) of the respondents aged 51 and above reused PBs and 14 % (*n* = 9) threw away PBs after use. Forty-eight percent (*n* = 21) of the respondents aged 20 and below reused PBs and fifty-two percent (*n* = 23) threw away PBs after use. Sixty-two percent (*n* = 96) of the respondents aged 31-40 reused PBs and 38 % (*n* = 60) threw away PBs after use. The findings reflect that the older generation (41-50 and 51 and above age groups) is more environmental conscious than the younger generation (20 and below, 21-30 and 31-40 groups) in the

study area. Thus, there is a relationship between age and PBWM pactises in the study area. Shen and Saijo (2008) in their study in Shanghai Japan, found out that the older generation was more concerned about the environment as compared to the younger generation.

Seventy-four percent (*n* = 77) of the respondents who attained tertiary level reused PBs and twenty-six percent (*n* = 27) threw away PBs after use. Sixty-one percent (*n* = 162) of the respondents who attained secondary reused PBs and thirty-nine percent (*n* = 102) threw away plastic bag after use. Fifty-three percent (*n* = 17) of the respondents who attained primary level reused PBs and forty-seven percent (*n* = 15) threw away PBs after use. The findings reveal that respondents who attained secondary and tertiary education have high level of environmental awareness. In a study in Tshwane South Africa, Kamara (2006) found out that about 75 % of the respondents with secondary and tertiary education participated in SWM and about 67 % of the respondents with primary education participated in SWM. This calls for continued efforts of reaching out to less educated people with environmental awareness programmes.

4.4.3 Alternatives for plastic bag

Public members were asked to suggest substitutes for banned PBs. Packaging substitutes suggested included biodegradable and degradable PBs (42 %; *n* = 168), cotton bags (33 %; *n* = 132), paper bags (16 %; *n* = 64) and grass woven bags (9 %; *n* = 36) (Figure 4.17). Respondents indicated that PB substitutes were not readily available and were expensive as compared to banned PBs. However, observations revealed that it was cheap to use the cloth bag 20 times after buying it for USD 5 while expensive to use 20 single use PBs each costing USD 2 totaling to USD 40. Thus, Environmental Management Agency and BCC should articulate a clear value proposition to the public for utilising cotton bags. National Geographic (2020) argued that cotton bags can be reused 131 times to match the environmental footprint of a conventional PB used once

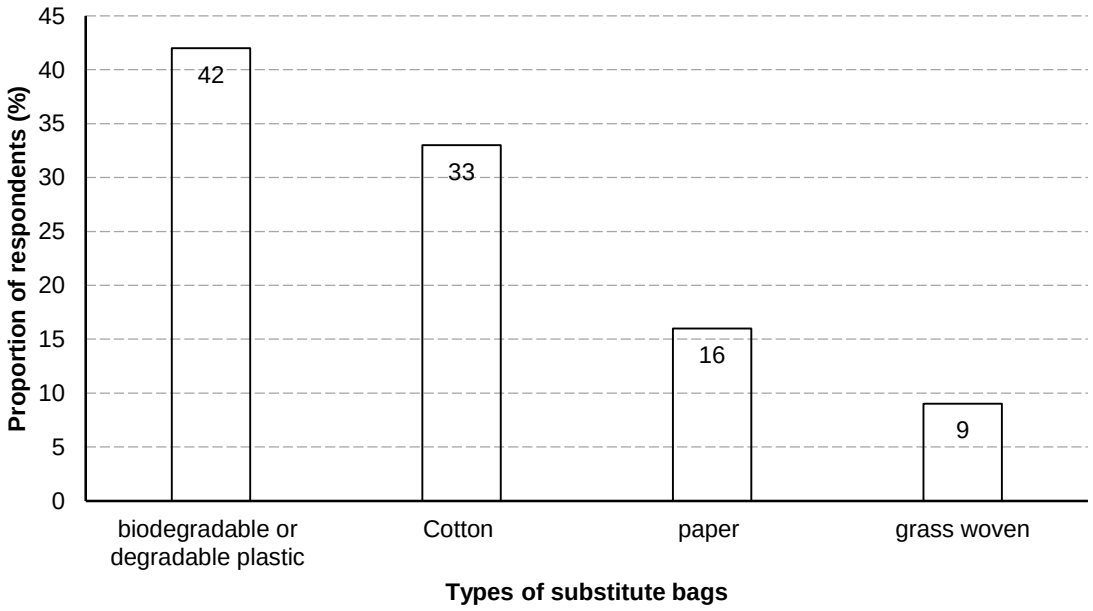


Figure 4.17: Proportion of respondents (%) and the types of substitute packaging bags they suggested (*n* = 400)

According to respondents, biodegradable or degradable PBs were preferred because they are environmental friendly (reduce carbon emission) and are suitable for recycling. Cotton bags were preferred because they are eco-friendly, durable and save more money. Paper bags were less preferred by consumers as they are not waterproof, more expensive than PBs and are considerably heavier while grass woven bags were considered to be expensive and not water resistant. From the above reasons, convenience theme for customers runs across the selection of different alternatives. Similar results were reported by Sharma and Kanwar (2007) from a study in India where people preferred PBs because of ease of use. Water proofing is a desirable feature for the consumers. Therefore, any alternative should have some level of water proofing.

4.4.4 Perceptions regarding plastic bag litter

Public members were asked how they felt when they observed PB litter in the CBD (Figure 4.18). The findings revealed that the majority of the participants 97 % (*n* = 388) were worried by PB litter in the environment while a small percentage 3 % (*n* = 12) was not worried at all.

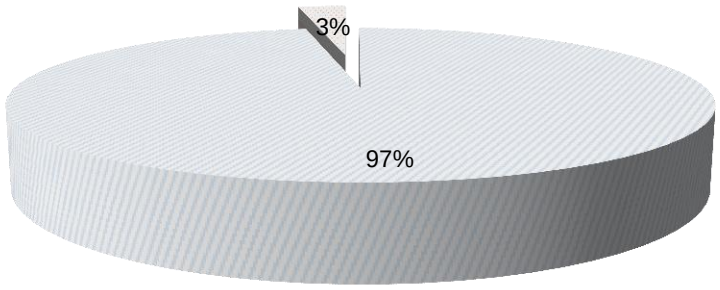


Figure 4.18: Proportion of respondents (%) and their PB perceptions regarding PB litter (*n* = 400)

The high proportion of respondents that felt disturbed by litter indicates that most people are aware of the detrimental effects of PBs into the environment hence they are troubled when they see PB pollution. This indicates an environmental mindful society. In a similar study in Anambra State, Nigeria, Iheukwumere *et al.* (2020) found out that the majority of respondents (85 %) were disturbed when they observed PB litter in the environment. Litter is a noticeable mark in the environment that societies should not take pride in (Peprah *et al.,* 2015; Mativenga *et al.,* 2017).

4.4.5 Willingness to pay for waste service delivery

Public members were asked if they are willing to pay for waste service delivery to improve PBWM. The majority of the respondents 66 % (*n* = 264) were willing to pay for waste service delivery, 31 % (*n* = 124) were not willing to pay for improved service delivery while 3 % (*n* = 12) were not sure (Figure 4.19. The high proportion of people who are willing to pay for improved PBW reflects an environmental conscious society that see the need for institutional capacity building. There is willingness by members of the public to be part of solution to successful PBWM.

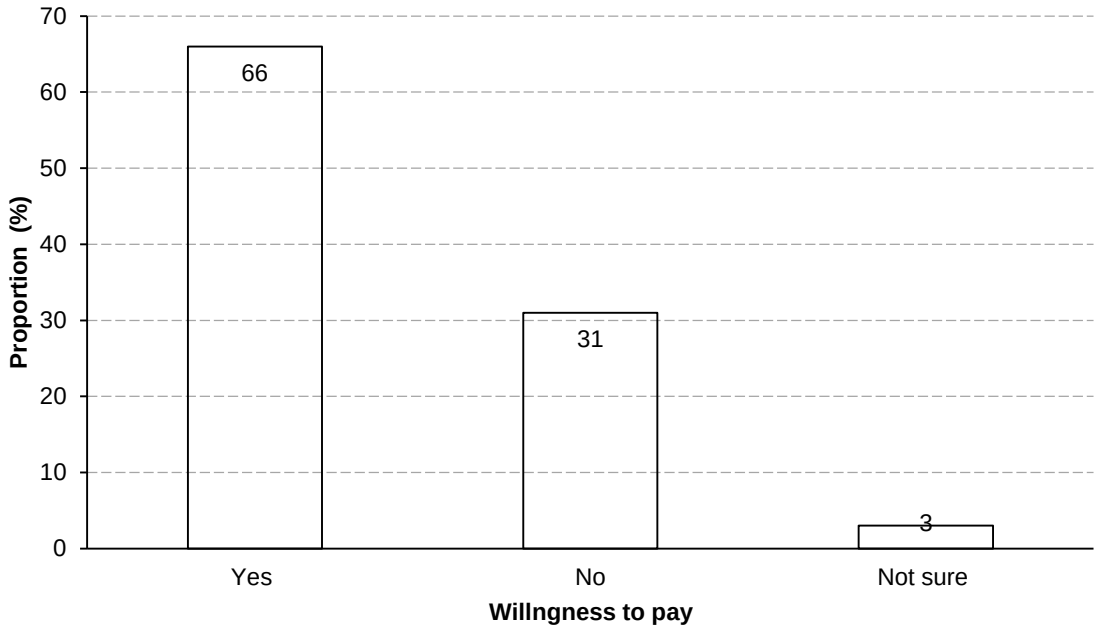


Figure 4.19: Proportion of respondents (%) and their willingness to pay for service delivery (*n* = 400)

Respondents who were willing to pay for service delivey were further asked to indicate the reason for their response (Figure 4.20). The majority of the respondents indicated the need for a safe and clean environment. This implies that they are aware of the negative effects of PB pollution on the environment. The remaining respondents

indicated that they could not afford, 8 % (suggestive of Zimbabwe's unstable economy) and 3 % did not have a reason.

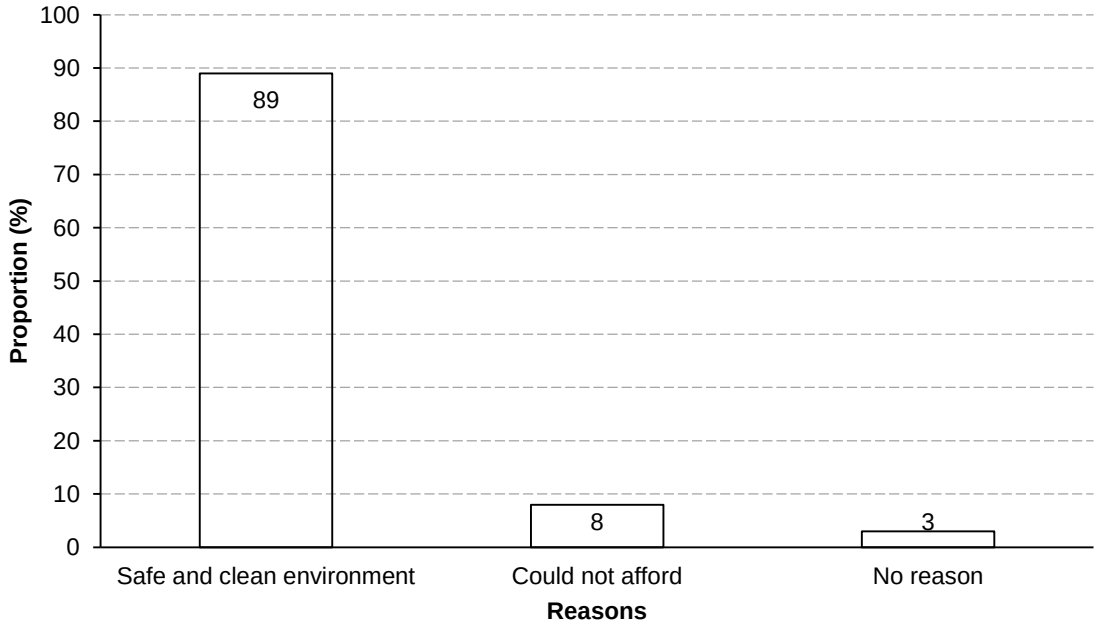


Figure 4.20: Proportion of respondents (%) and factors influencing willingness to pay for waste management services (*n* = 264).

4.4.6 Plastic bag waste pickers/recyclers

The researcher observed waste pickers searching for recyclable material such as plastics within and around the CBD. Interviews and observations with waste pickers indicated that waste pickers face a several obstacles in their operations as outlined in Figure 4.21. Waste pickers revealed that there was lack of support and incentives such as user friendly trolleys from the local authority and the government to effectively carry out their operations.

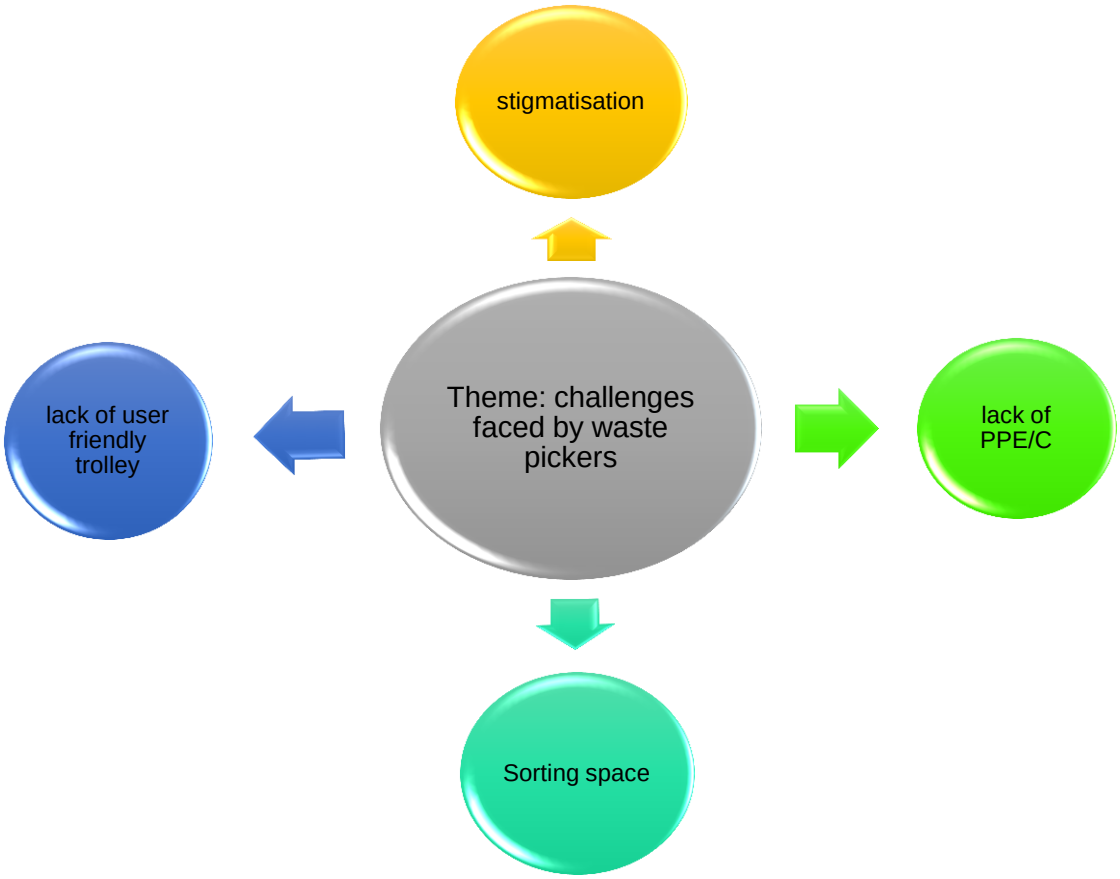


Figure 4.21: Challenges faced by waste pickers

In a similar study, Kuria and Mausysa (2010) established that Nairobi solid waste pickers lacked support from the municipal council to effectively carry out their operations. Peres (2016) also indicated that there was lack of support structures in place for informal street waste pickers in Cape Town in South Africa.

Bulawayo City Council and EMA officials outlined formalisation and formation of cooperatives and provide support through provision of equipment and infrastructure, to improve the working conditions of waste pickers. However, the process of formalising and integrating waste pickers requires government and local authorities to have a

deeper understanding of the obstacles faced by waste pickers and the complexities of PB waste collection (Scheinberg *et al.,* 2015). Problems that occur after formalisation include corruption, mistrust, conflicts amongst waste pickers and lack of transparency in the formalisation processes (Wang and Geng, 2012). The fact that waste pickers are not formalised, it means that they cannot pay tax to the government. Therefore, they should not often expect funding from government without injecting into the economy as it promotes draining of government resources and creation of a dependency syndrome. Investors often consider the value for their money when injecting money into a business. Profits should be realised (Scheinberg *et al.,* 2015). The formalisation of informal waste pickers means that tax revenue can be generated. However, the risk of resistance to paying tax once formalised is real. Rais (2018) argued that informal waste pickers have developed an independent culture and therefore find it challenging to work in formalised way/ adhere to legislation.

Examples of inclusive MSWM systems have been noted Johannesburg and Kwazulu Natal. The City of Johannesburg established programs meant to incorporate waste pickers through skills training, formalisation and formation of cooperatives (Baker, 2016). In Kwazulu Natal, the Department of Environmental Affairs handed trolleys to Mooi River Waste Pickers Association for easy transportation of collected waste (Baker, 2016). Similarly, Unconventional Waste and Recycling provide safe and revamped trolleys to waste pickers that also serve as mobile billboards and provide training and mentorship to waste pickers (Unconventional Media, 2019). The issue of incentives and support is fundamental and requires a deeper thought from the local authority and private parties. Various waste picker co-operatives have disintegrated in time because of insufficient trust between members, proving that transparency and confidence-building are very important in the organising process.

Formalisation of waste pickers by BCC can bring the following benefits:

i. reduced cost of a city's SWM system;
ii. extends the lifespan of landfill; and
iii. Reduced amount of plastic waste to be collected transported and disposed at the landfill (Dias, 2016; Joshi and Ahmed, 2016).

Partnership with informal waste pickers often yields the following benefits:

i. help to improve the organization's public image;
ii. Allow the company to achieve its corporate social responsibility (CSR) plan; and
iii. Provide companies involved in PB waste recycling with raw materials (Joshi and Ahmed, 2016).

Waste pickers stated that some members of the public never appreciated them and labelled them as thieves, dirty, poor and uneducated. This is in line with Dias (2016) and Infrastructure News (2016) who argued that waste collectors have a low social status and the public looks down upon them. This undermines sustainable waste management concept. Involvement of all members of the public in the plastic waste management helps to achieve an effective PBWM system. Their involvement motivates them to address the problem at hand (Practical Action, 2014; Thompson 2014).

In similar studies Oyake-Ombis (2012); Ramos (2013); Dias (2016); Joshi and Ahmed (2016); Colombijn (2017); and CSIR News (2018) found out that CBOs and waste pickers face challenges in their operations that include lack of proper machines and equipment to enhance efficiency, inadequate working capital for the business and in adequate space for sorting out waste as well as for storage.

Waste pickers indicated that they encountered financial problems to carry out their operations. The waste pickers must have the business acumen of identifying what

waste is required and for what value so that they focus on what gives them higher returns and come up with strategies to increase their earnings from market without subsidy (Dias, 2016). The local authorities can adopt inclusive MSWM systems through registration and training waste pickers on business management skills.

Incorporating waste pickers in a plastic waste management system is essential in achieving an effective PBWM. This is in line with Institutional theory and capacity building concept that underline the need to capacitate and involve stakeholders in waste management to solve problems and formulate solutions (Karunasena *et al.,* 2010; Stewart, 2015; Bergeron *et al.,* 2017).

4.4.7 Private Organisations

Environmental Management Agency and BCC revealed that some private organisations are actively involved in PBWM. Keep Bulawayo Clean provides bins to BCC to help manage solid waste. However, financial issues have hindered them to provide colour coded bins. It is the goal of Keep Bulawayo Clean to provide colour coded bins at each point to promote recycling. Other organisations and institutions actively involved in clean up campaigns include Rainbow Hotel, Newsday, Schweppes, Sky Metro, Alpha Media Holdings, Herrentials Group of Colleges, Edgars and Econet Wireless. Organisations like Unconventional Waste and Recycling (Pty) Ltd (South Africa) and Proplast (Senegal) that involves waste pickers in the collection of plastic waste are good examples of capacity building projects that empower waste pickers. Unconventional Waste and Recycling provides safe and revamped trolleys to waste pickers, provide training and mentorship to waste pickers while Proplast employs over 100 waste pickers (atkisson.com, 2016; Unconventional Media, 2019).

4.5 TECHNICAL AND INFRASTRUCTURAL APPROACHES

The researcher sought to determine the current technical and infrastructural approaches for PBWM in the CBD of Bulawayo. Inadequate waste bins, lack of colour coded bins, shortage of waste transportation vehicles, unlined landfill, limited recycling and incineration facilities were identified issues.

4.5.1 Refuse Storage Facilities

BCC and EMA officials were asked if there were adequate waste bins in the CBD of Bulawayo. A BCC and EMA official indicated that there was a shortage of PBW collection and storage facilities including absence of colour coded bins in the study area because of financial constraints. In similar studies, lack of appropriate storage facilities has been identified as a limiting factor in sustainable waste management in developing countries such as Kenya and Nigeria (Mbulugwe, 2002; Nyayiemi, 2012; Oyake-Ombis, 2012; Owusu-Sekyere *et al*., 2013; McAllister, 2015; Sinthumule and Mkumbuzi, 2019).

Colour-coded bins assist to sort high quality recyclable materials and lessen the time and effort involved in the identification of appropriate collection bin (Glad, 2018; Keramitsoglou and Tsagarakis, 2018). This has been successfully implemented in developed nations such as Germany, Canada and New Zealand (European Commission, 2014; Keramitsoglou and Tsagaraki, 2018).

The researcher observed that the yellow and green bins that were common in the 1990s and are still used in the study area (Figure 4.22). Most of them are no longer in good condition. Keramitsoglou and Tsagarakis (2018) noted that people do not always approve the condition, colour and design of recycling bins, for example in Sheffield (United Kingdom), people criticised the blue colour of public bins as they considered it as environmental offensive. Poor condition of bins can promote fatigue and frustration to the public thus leading to littering.

Observations revealed that there was shortage of ordinary waste bins at fresh produce markets. Most of the ordinary waste bins with over-spilled waste had heaps of waste around them (Figure 4.23 A). The researcher observed that overfilling of waste bins in high activity areas such as bus termini led to widespread littering and contributed to the obstruction of drainage channels nearby. Obstruction of drainage channels can contribute to flooding. The study area encounters high flooding frequency and intensity in summer. Al-Houri and Al-Omari (2012) observed that PBs along the roads and in the drainage ditches were among the major contributing factors to the rising up of the water level in the tunnels in 2012 in Amman, Jordan.

Figure 4.22: Old waste bin

A B

Figure 4.23: Open metal waste bin (A) and an overfilled plastic bin (B) in the Bulawayo CBD

Figure 4.23 (A and B) shows contrast between the size of a bin in a low activity area and a high activity area in the CBD. The local authority has to reconsider that high activity areas require large bins to accommodate plastic bag waste. If bins are overfilled with solid waste, consumers are left without an option but to indiscriminately dispose waste. Keramitsoglou and Tsagarakis (2018) argue that the size and design of waste storage containers are important aspects in waste management and should make it easy for waste collectors to lift and offload waste (ergonomic principles) into waste trucks.

The overfilled bin (Figure 4.23 B) may be suggestive of a shortage of waste bins and/or low collection frequency. The implication of this is that, with shortage of waste bins in high activity areas, consumers and informal traders will resort to littering. In turn littering manifests wastage of resources, a blight landscape and obstruction of drainage systems. The waste receptacle areas are likely to be used as urinals. Waste heaps around the full bins demonstrates positiveness of the people since they recognise that

waste has its designated place but the facilities are not accommodating. However, people can behave indifferently when they are consistently denied the opportunity to do good which leads to dissonance (Antwerpen and Ferreira, 2016; Conserve Energy Future, 2020).

4.5.2 Vehicle and Equipment

Bulawayo City Council official identified resource constraints in executing waste management services. He noted that, "*Bulawayo City Council is striving hard to ensure collection and transportation services under limited budget*". The local authority highlighted that fuel shortages interrupted waste service delivery. The local authority is hiring local community private truck owners to assist with waste collection since their service fleet is strained. The community members transfer refuse to a Council refuse compactor stationed within the designated temporary transfer point. Table 4.4 shows composition of refuse collection and management fleet during the time of study In Bulawayo. The findings reveal that there is shortage of refuse collection and management fleet.

Table 4.4: Composition of refuse collection and management fleet

Type of fleet	Operational	Required
Collection vehicles	18	25
Bulldozer	1	2
Front end loader	1	2
Landfill compactors	1	5

The number of fully operational collection vehicles 18/25 translates to 72 % fleet capacity. This implies that there is limited strain on collection vehicles. However, there are other factors like fuel shortage and vehicle breakdown that contributes to inefficiency. The number of bulldozers and front end loader 1/2 translates to 50 % fleet capacity while the number of fully operational landfill compactors 1/5 translates to 20 %.

This implies that the BCC is in short of landfill compactors and bulldozers. Strain on resources lead to high vehicle breakdown rates.

In many African countries, local authorities struggle to purchase modern waste management vehicles and spare parts (WaterAid, 2011; Bello, 2016; Mafume *et al.,* 2016). In a similar study, Jerie and Tevera (2014) found out that Gweru City Council had high vehicle breakdown mainly due to inadequate maintenance of vehicles. Effective plastic waste delivery requires a strong fleet which should be frequently serviced (WaterAid, 2011; Bello, 2016; Mafume, 2016; Mgimba and Sanga, 2016). The consequence of limited and vehicle breakdowns is that a lot of PBW will go uncollected, bins will fill up and consumers will resort to open dumping.

There is need for institutional capacity building in developing countries more vulnerable to limited budgets and poor collection and disposal services (Bello *et al.,* 2016; Mafume *et al.,* 2016). Capacity building concept has been cited in several studies as a catalyst for service delivery improvement in municipalities (Nitivattananon and Kulpradit, 2004; Suttibak and Nitivattananon, 2005; van Baalen *et al.*, 2015

4.5.3 Plastic bag disposal practices

4.5.3.1 LANDFILLING

Bulawayo City Council and EMA officials revealed that most of the PBW generated in the CBD of Bulawayo is dumped off at Richmond Landfill. Kubare *et al*. (2010); and Yazdani *et al.* (2015) indicated that landfilling is the most cost effective waste disposal method in less economically developed countries. BCC revealed that they do not have incineration facilities for PBW. In Zimbabwe, incineration is mainly practised in health care. According to Teta and Hikwa (2017) soft plastic waste constituted 33% of all waste streams at Richmond landfill site. Steensgaard *et al*. (2017); Van Eygen (2017); Vince and Hardesty (2017); and Kwesiga (2018) stated that plastics are made of toxic

chemicals and when they decompose in landfills, they leak pollutants into the soil polluting underground water.

Environmental Management Agency indicated that Richmond landfill had three leachate ponds that are not membrane lined, except for a base layer of compacted clay, meant to minimise underground water contamination. According to Kubare *et al*. (2010); Mojalagbe *et al*. (2016); and Teta and Hikwa (2017), landfills should have a membrane lining and leachate ponds to minimise underground water pollution. Kubare *et al*., (2010); and Teta and Hikwa (2017) observed that there was contamination of groundwater at Richmond landfill because some of the leachates seeped through the compacted clay layer.

Bulawayo is dependent on underground water to supplement dam water supplies (Teta and Hikwa, 2017). The contamination of groundwater could pose a public health risk in Bulawayo. The current cells at the disposal site are almost full, thus it is a challenge for the local authority to install membrane lining. Bulawayo City Council revealed that it is considering developing the remaining half of the landfill and to construct waste diversion facilities such as materials recovery (recycling facility) and waste to energy facility (incinerator). Such plans reflect the environmental consciousness of the local authority and demonstrate the will to protect underground water from pollution.

In similar studies, Agamuthu, (2012); Oduro-Appiah *et al*. (2013); Pienaar and Howard (2014); Idowu *et al*. (2019); and Ngaza (2019) found out that developing countries faced problems linked to poor leachate collection systems and absence of gas collection systems. Therefore, there is need for a paradigm shift towards (capacity building) engineered sanitary landfills to curb the problem of PBW pollution.

Bulawayo City Council and EMA revealed that waste compaction and application of daily cover was done to minimise the spread of PBs into the surrounding environment

since they are easily blown. Idowu *et al*. (2019); and Ngaza (2019) underline that soil compaction should be done at least four times a week so as to reduce odours, deter pets, limit water pollution and enable an area upon which waste transportation fleet operate. The researcher observed that there was excess pile of soil waiting to be applied and compacted as daily cover (Figure 4.24). It is important for resources (soil) to be used sustainably as suggested by the capacity building approach. Capacity building is undermined when resources are not utilised sustainably (Karunasena *et al.,* 2010; McAllister, 2015; van Baalen *et al*., 2015). Bulawayo City Council official revealed that compaction and covering is done three to four times a week. This is because there is one functional landfill compactor out of the five required. This makes it difficult to apply daily cover.

Figure 4.24: Heaps of soil used as daily cover

4.5.3.2 RECYCLING

BCC revealed that the local authority does not have materials recovery facility (MRF) because of financial constraints. This situation is worrying since BCC highlighted that

the cells at the disposal site were almost full. This poses a challenge in realising effective PBWM. This is not perculiar to Bulawayo because most local authorities in developing countries lack sustainable management technologies such as recycling facilities due to high cost involved in the collection and transportation of recyclables (Marshall and Farahbakhsh, 2013; Mmereki *et al*., 2016; Moloney and Doolan, 2016). Recycling facilities promote sustainable waste management as they reduce the amount of recyclable material, greenhouse gas emissions and help to mitigate global warming and climate change (Van Eygen *et al.,* 2017; Hovarth *et al.,* 2018). Recycling is a necessary component of a circular economy and 3Rs in waste management (Kobza and Schuster, 2016; Whicher *et al.,* 2017). Environmental Management Agency and BCC officials also identified the following obstacles to plastic recycling:

i. lack of separation at source;
ii. dedicated collection system for the plastic waste bags only; and
iii. lack of recycling facilities.

According to Bello and Kabbashi (2016) a major issue of waste management in Africa is the formation of enough capacity not only limited to financial terms but also in technical and infrastructural improvement. Fam and Ismail Kar (2016) argue that although many developed countries are embracing technologies like recycling facilities, most developing countries still lag behind, because of financial resources. Institutional theory and capacity building concept require organisations to invest in environmental friendly infrastructure such as recycling facilities to enable smooth and effective waste management (Kurunasena *et al.,* 2010).

According to EMA, less than 11 % of plastic waste is recycled in Zimbabwe. This is disturbing considering that recycling reduces the amount of waste and greenhouse gas emissions, helps extend lifespan of a landfill by reducing waste, contributes to Gross Domestic Product (GDP) and provides job opportunities. Approximately 80 % people are employed in the informal sector (Makate *et al.,* 2019). Similarly, Babayemi *et al*.

(2018) found out that PBW recycling was a challenge in Nigeria as less than 12 % of plastic waste was recycled and approximately 80 % of plastic waste landfilled. The low percentage of recycled plastics in Nigeria was attributed to high operating and investment costs (Babayemi and Dauda, 2009; Aderogba, 2014). Although BCC does not have any recycling facilities, BCC and EMA officials recommended the need for proper separation at source and introduction of a plastic waste management collection system for separated waste. They emphasised that separating waste ensures that plastic bag waste is not contaminated. Contaminated PBW devalues and burdens recycling companies with cleaning before processing phase.

4.5.4 Level of Satisfaction with plastic bag Waste Management services

The respondents (members of the public) were asked to say their opinions regarding the level of satisfaction on PBWM services provided by BCC (Figure 4.25). Of the 400 respondents interviewed, 54% (n = 216) indicated that PBWM service provided by BCC was fair, 16 % (*n* = 64) revealed that it was poor, 13 % (n = 52) said it was good, 11 % (44) rated it as very good and 6 % (*n* = 24) viewed it as excellent.

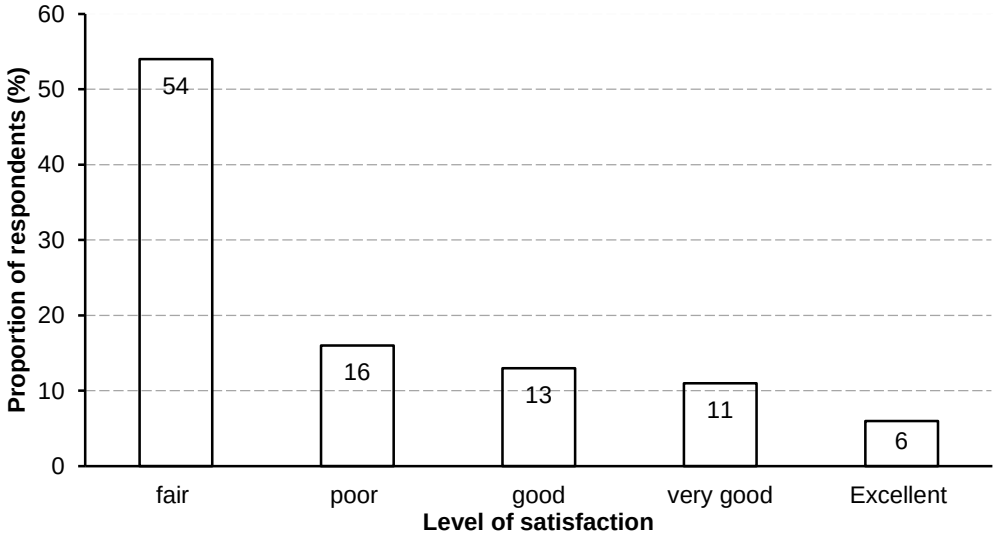


Figure 4.25: Level of satisfaction on PBWM services (*n* = 400)

The results are, cautiously, encouraging because fair is not the best response. The fair score is not encouraged as it is below good and requires improvement to at least good, with excellent being the most preferred. There is need for continual improvement. In a similar study in Lindi Municipal Council in Kenya, 46 % of respondents indicated that that the solid waste management service was poor whereas 33 % of the respondents were of the opinion that waste service delivery was fair. The remaining respondents (21 %) indicated that that service delivery was good.

4.6 LEGAL AND POLICY FRAMEWORK APPROACHES

The research sought to determine legal and policy approaches for PBWM in the CBD of Bulawayo. Issues identified included law enforcement, public resistance and monitoring systems.

4.6.1 Plastic bag legislation

Bulawayo City Council official revealed that PBWM in Zimbabwe is governed by Environmental Management Act (Chapter 20:27), Public Health Act, (Chapter 15:09), Urban Councils Act (Chapter 29:15) as well as Bulawayo Municipal by-laws. These pieces of legislation help to regulate the collection, disposal and treatment of PBW so as to promote a clean environment as emphasised by the institutional theory's regulative pillar (Tolbert, 1996; Palthe, 2014).

Data collected from EMA revealed that the Environmental Management Act Chapter 20:27 and Statutory Instrument 98 of 2010 Environmental Management (Plastic Packaging and Plastic Bottles), guide PBWM in Zimbabwe. Statutory Instrument 98 of 2010 prohibits the manufacture of plastic packaging with a wall thickness of less than thirty micrometers (30 µm) unless they are:

- For plastic bread packaging and clingy film used as plastic barrier packaging of a wall thickness of between 20 and 30 µm; or

- biodegradable plastic packaging.

Other statutory instruments that guide PBWM in Zimbabwe include the following:

- Environmental Management (Hazardous Waste Management) Regulations, 2007;
- Environmental Management (Effluent and Solid Waste Disposal) Regulations, 2007; and
- Environmental Management (Hazardous Substances, Pesticides and Other Toxic Substances) Regulations, 2007.

According to BCC official, Municipal by-laws governing PBWM include Anti-Litter By-Laws 1981, Statutory Instrument 872/8, Public Health By-Laws, 1966 Statutory Instrument 803/66 and Bulawayo (Refuse Removal By-Laws, 1979 Statutory Instrument 525/79. Environmental Management Agency and Bulawayo City Council revealed that the legislation enforcement and implementation system involved the following parties:

i. Ministry of Environment and Tourism (MET): the mission of this ministry is to promote best practices in environmental management, promote stakeholder participation in environmental management. It is in charge of environmental legislation, national policies and supervision;
ii. EMA: a statutory body responsible for ensuring sustainable management of resources and protection of the environment. It is responsible for environmental compliance inspections and environmental prosecutions, dissemination of environmental information, education and training;
iii. Ministry of Health and Child Care (MoHCC): responsible for health care waste in areas outside city council jurisdiction.

iv. BCC Health Services Department (Cleansing Section): a department responsible for the collection, street sweeping, disposal and waste education; and
v. Private sector – involved in collection of waste and recycling activities.

Environmental Management Agency official revealed that legislation enforcement is led by the Environmental Management Agency, state agents, local authority and Zimbabwe Republic Police. The enforcement method involves education, inspections and penalties for non-compliance. Despite the harsh macro-economic environment, EMA is still committed in environmental monitoring. In 2016, 35 orders were issued by the Agency to non-compliant authorities. Twenty-five of the municipalities complied and the cleared illegal solid waste dumps were 597 (EMA, 2016).

The researcher observed some vendors at fresh produce market providing single-use PBs to customers after buying goods from them. It is often assumed that if legislation is strictly enforced, all will be well. Madebwe (2015) argued that law enforcers tend to be captured by individuals or private organisations. Therefore, legislation is likely to be compromised by competing political interests. The EMA suspended two of its Mashonaland Central province officers for corruption (allegedly soliciting a bribe from mining companies) (NewsDay, 2019). The Zimbabwe Anti-corruption Commission arrested a top BCC official (in the department of Housing and Community services) and thirteen police officers in Bulawayo for corruption and malpractices (Sunday News, 2020). However, Sinclair (2017) and United States Department of Justice (2019) underline that law enforcers should develop new enforcement alternatives of least resistance which can help in improving PB legislation implementation. Agencies are required to develop strong connections and continually improve social networks (Braga *et al.,* 2015).

4.6.2 Enforcement and Monitoring System

The researcher observed consumer resistance to PB ban as PBs were still provided in small retail outlets, bus termini and green markets. Environmental Management Agency and BCC indicated that PB law enforcement was a challenge because of limited enforcement officers, resources and resistance from consumers.

Resistance by some consumers could be attributed to lack of enforcement and the affordability of banned PBs (Chitotombe, 2014). Danielsson (2017); Chasse (2018); and Behuria (2019) identified lack of legislation enforcement, public consultation before the law is put in place and affordability of PBs as the main factors contributing to ineffective PBWM legislation. In DRC and Uganda, lack of legislation enforcement, and affordability of PBs have contributed to ineffective PB ban legislation (Loukoula, 2016; Business Insider, 2017; Chasse, 2018). Plastic bag policies should be based on tested approaches, communicated and understood by members of the public to ensure transparency. A mechanism for stakeholder involvement should be established before law enactment (Braga *et al.,* 2015; Sinclair, 2017). Sound legal frameworks contribute to effective law enforcement.

Resistance behavior of some consumers calls for EMA, BCC and the police to do routine monitoring to educate users and illegal traders about the negative impacts of PBs. Thus, law alone is proving not to be good enough, the government and law makers need to move away from conformance and compliance to conscious decision making based on understanding people behavioural trends and their value in keeping the environment clean. The New York Police Department embraces a comprehensive community policing strategy built on improved communication and collaboration between the local police officers and the community. In 2017, New York City saw its lowest violent crime numbers in decades (United States Department of Justice, 2019).

4.6.3 Public Awareness

The ban on the use of plastic packaging with a wall thickness of less than 30 µm in Zimbabwe has brought about varied reactions. The respondents (public) were asked to indicate whether they were aware of the plastic ban legislation (Figure 4.26). Most of the respondents 69 % (*n* = 276) indicated that they were aware of PB ban legislation while the remaining respondents 31 % (*n* = 124) indicated that they were unaware of PB legislation. Statutory Instrument 98 of 2010 prohibits the manufacture of plastic packaging with a wall thickness of less than thirty micrometers (30 µm) unless they are for plastic bread packaging and clingy film used as plastic barrier packaging of a wall thickness of between 20 and 30 µm; or biodegradable plastic packaging. Statutory Instrument 98 of 2010 prohibits the manufacture of plastic packaging with a wall thickness of less than thirty micrometers (30 µm) unless they are plastic bread packaging and clingy film used as plastic barrier packaging of a wall thickness of between 20 and 30 µm; or biodegradable plastic packaging.

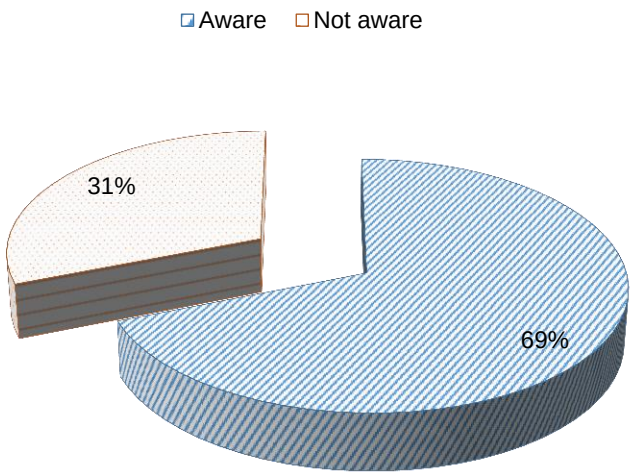


Figure 4.26: Public awareness of the banning of PBs by respondents (*n* = 400)

The high number of respondents who are aware of the PB legislation does not necessarily transform to implementation of PB legislation (Dikgang and Visser, 2012; McAllister, 2015). Bharadwaj (2016) found out that although 90 % of the participants were well-aware of detrimental effects of PBs, only 14 % of the participants were observed using reusable bags in Nepal. Bharadwaj (2016) further revealed that the high number of respondents who were not using reusable bags was attributed to enforcement problems, weak cooperation from retail associations and civic society and changing priorities of local authorities.

To determine the level of legislative awareness, respondents were asked if they could identify banned PB. The majority of respondents 67 % (*n* = 268) indicated that they could identify banned PB while the remaining 33 % (*n* = 132) said they could not (Figure 4.27). The results indicate greater consumer awareness on banned PB. The results can be confirming the views of BCC and EMA that they conduct education and awareness programmes on waste management issues. The findings are similar to observations by Mugisha and Diiro (2015) that 68 % of respondents in urban areas of Uganda were able to identify banned PB. People may identify banned PBs, but resist and fail to implement legislation (Dikgang and Visser, 2012; Ari and Yılmaz, 2017; Behuria, 2019). The findings are promising nevertheless; there is need for regulatory authorities to cultivate a new mindset of embracing and implementing the 3Rs of waste management and a circular economy.

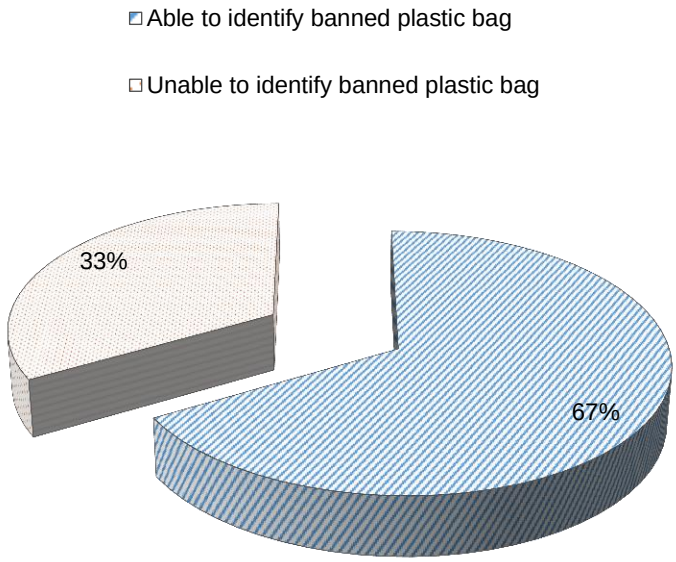


Figure 4.27: Ability to identify banned PB types by respondents (*n* = 400)

Respondents (public) were asked if they supported thin PB ban legislation. Most of the interviewed respondents 64 % (*n* = 256) were in favour of PB ban (Figure 4.28). The remaining respondents 36 % (*n* = 144) had a negative attitude towards thin PB ban legislation. The majority of respondents (64 %) indicate that many people are well-aware of the detrimental effects of PBs. So as to gain the trust of the public and support of the new legislation, law enforcers should on a regular basis share policies, information, investigative results and other important information about legislation (Sinclair, 2017). By taking into consideration people's reactions to any changes in legislation develops opportunities for the public to input their views and commit to environmental management. This is in line with the institutional theory that underlines the need to actively involve stakeholders to achieve sustainable development.

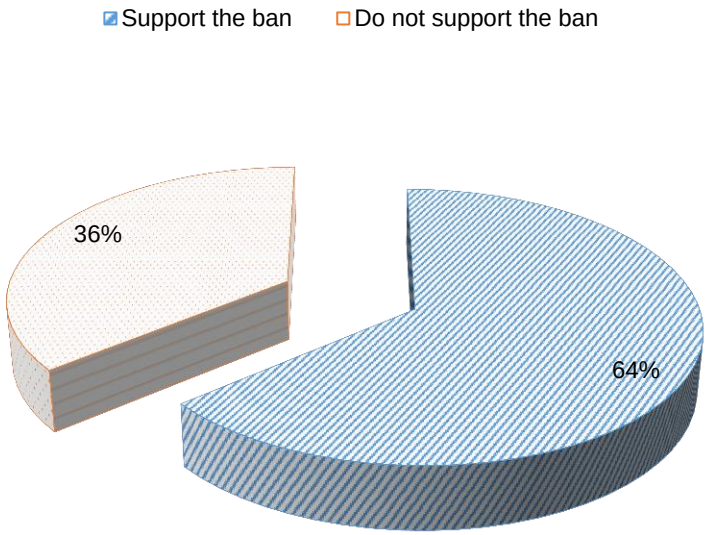


Figure 4.28: Public perception about PB ban by respondents (*n* = 400)

These findings are similar to observations by Mugisha in Uganda, where the majority of respondents 77 % of urban residents were in favour of PB ban because of the negative environmental impacts associated with them. If the majority of people are in favour of the ban in the study area, then law enforcement becomes less relevant. This is further supported by the presence overfilled bins in the study area indicating shortage of waste bins. People seem to be environmentally conscious citizens who need enabling environment to hold each other accountable. The approach of a button stick wielding municipal officer is a thing of the past. One cannot compel someone to do social good using law but there should be demonstration of effort to enable citizens learn from the service providers. In that way, people can hold each other accountable. Law enforcement and penalties just arouse resistance from citizens. Lekala (2019) argues that good local governance is people-orientated and should not be adopted for fear by

citizenry.

Jackson and Matten (2012) and Andrew and Jennings, (2015) argue that legislation must be interpreted, conflicts resolved, and surveillance measures put in place to achieve intended objectives. Thus, key to effective legislation hinges on educating the public and attaining environmental buy-in.

Direct observations revealed that banned PBs were still provided in markets (Figure 4.29) and that there was no strict enforcement. PB legislation is ineffective if there is no strict enforcement (Dikgang *et al.,* 2012; Chitotombe, 2014; Chasse, 2018). Such acts make it a challenge to implement an effective PBWM system. In contrast, Rwanda Environmental Management Agency applies measures such as strict checks at country borders and in market areas, information campaigns and fines or imprisonment up to one year (Danielson, 2017). There is need for EMA and BCC to educate and enforce PB ban to reduce the high consumption of PBs.

Figure 4.29: Consumer carrying a single-use PB in Bulawayo CBD

4.7 PLASTIC BAG WASTE MANAGEMENT MODEL

The research established private and public partnerships, technical and infrastructural, and legal and policy framework as key enablers for effective PBWM (Figure 4.30). The research developed a sustainable PBWM model within the confines of integrated sustainable SWM (Figure 4.31).

The proposed model calls for the establishment of a waste management fund. Potential sources of funds include collection of revenue in the CBD from stall owners at fresh produce markets, taxi ranks and flea markets, advertisement on council's property, and developing a data base of reliable funding organisations. The waste management fund will help in purchasing sound environmental waste management technology such as

colour coded waste bins (that promote source separation of waste), finance research and development of PB substitutes like cotton bags, and training of waste pickers.

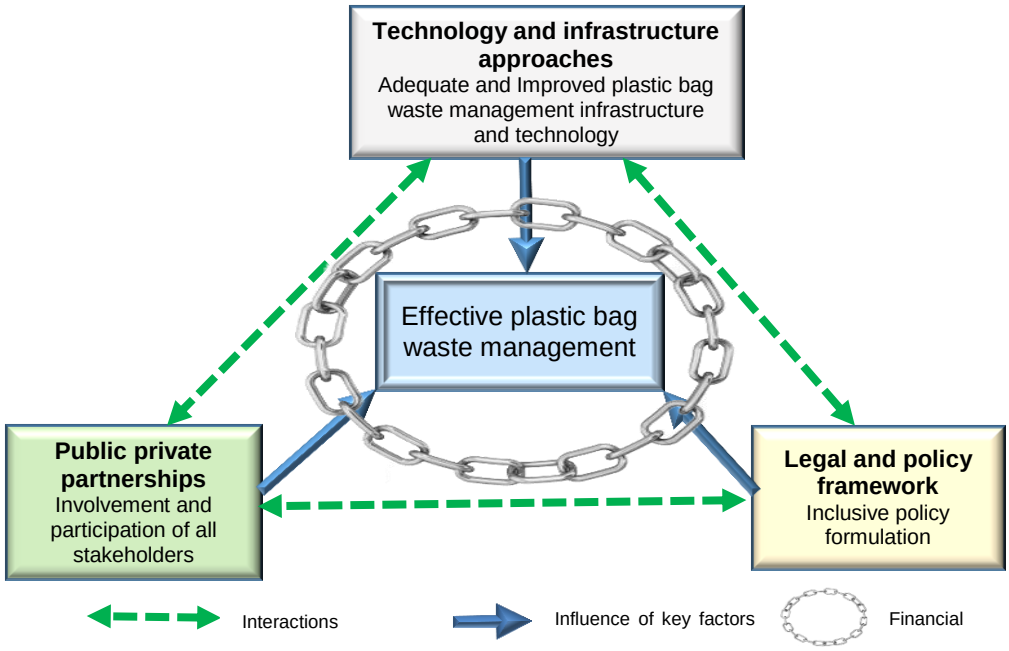


Figure 4.30: Key enablers for effective plastic bag waste management

Plastic bag waste management framework involves the three aspects namely (1) technical and infrastructural issues; (2) legal and policy and (3) public private partnerships (Table 4.5). The framework addresses technical and infrastructural issues that include storage facilities, vehicles and PBW disposal/management. Legal and policy issues that include enforcement and monitoring system are addressed. Identified private and public participation issues that include throw-away culture and the challenges faced by waste pickers included lack of registration, proper protective business management, proper machines and equipment, waste and proper and adequate transport and adequate space for sorting are addressed .

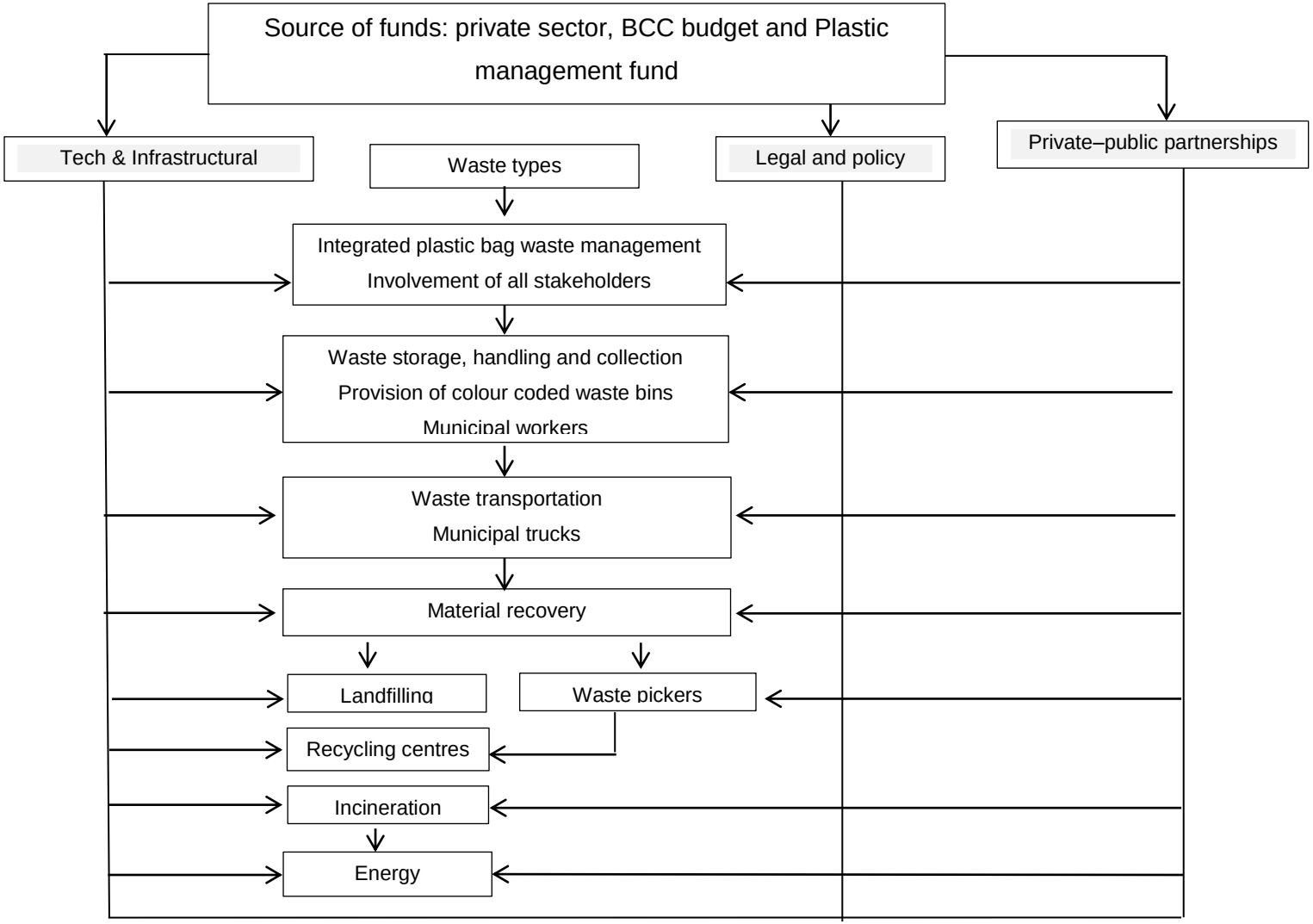


Figure 4.31: Conceptual Model of BCC PBWM

Table 4.5: Plastic bag waste management framework

Aspect	Issue	Approach	Responsible stakeholder	Sourcing of resources
Public private partnerships	Support for commitment actions	• Training (business skills, recycling and local bylaws requirements and registering waste pickers) and provision of user friendly trolleys and PCC/E. • develop a business case of value proposition relevant to those who can benefit and target them for fund raising. • Innovation/ manufacture of environmental friendly alternatives, e.g. cloth handbags and biodegradable packaging material. • Invest in PBWM projects like providing colour coded waste bins.	BCC EMA BCC EMA Private parties BCC Universities and private parties BCC Private parties	• establishment of a multi-stakeholder waste management fund; • BCC should Increase budget specifically for waste management; • fines issued for manufacturing, possessing, and/or selling banned PBs should be channelled to the waste management fund; and; • Development of a data base of reliable funding organisations.
	private public participation	• Conduct educational campaigns about environmental duty of care and extended responsibility. • The public should bring their own bags when shopping and making it a habit. • Actively partake in clean-up campaigns.	BCC EMA Public Private parties	

Aspect	Issue	Approach	Responsible stakeholder	Sourcing of resources
Technical and infrastructural issues	Storage facilities	• Provision of 3 colour coded waste bins in high activity areas to encourage waste separation at source; and • Develop waste collection and drop off storage centres for PBs destined for recycling.	BCC Private Organisations BCC	• establishment of a multi-stakeholder waste management fund; • BCC officials should collect revenue in the CBD from stall owners at fresh produce markets, taxi ranks, flea markets and advertisement on council's property. • fines issued formanufacturing, possessing, and/or selling banned PBs should be channelled to the waste management fund; and • establishment of a
	Vehicles	• Servicing of vehicles; • Employing experienced and qualified drivers; and • Purchasing of vehicles.	BCC	
	Plastic bag waste disposal/management	• Construction of recycling facilities (best in this scenario)	BCC	
Legal and policy	Plastic bag legislation	• Adoption of The Patton and Sawicki Six-Step Rationalist Model in formulation of legislation; • Policies that promote financing of research and development of PB substitutes like cotton bags; • More BCC and EMA inspectors should be deployed in high activity areas; • Sensitization of legislation on	BCC Zimbabwe Government BCC EMA BCC	

Aspect	Issue	Approach	Responsible stakeholder	Sourcing of resources
		TV and radio programs; and • Integrate waste pickers in PBWM.		multi-stakeholder waste management fund; • BCC should Increase budget specifically for waste management; • fines issued formanufacturing, possessing, and/or selling banned PBs should be channelled to the waste management fund; and • Development of a data base of reliable funding organisations.
	Enforcement and monitoring system	• Conduct more foot patrols; • Develop strong connections and continually improve social networks into communities where there are no bonds; • Law enforcers should on a regular basis share policies, information, investigative results and other important information about legislation; and. • Develop posters for anti-littering and illegal dumping.	BCC EMA ZRP BCC EMA BCC EMA	

4.8 CHAPTER SUMMARY

Data presentation indicated that effective PBWM system is embedded on technical and infrastructural approaches, legal and policy framework approaches and level of private and public participation.The research developed a sustainable PWM model within the confines of ISWM Generally, PBWM system in the CBD of Bulawayo is considered fair (Table 4.6). The fair score is not encouraged as it is below good and requires improvement to at least good, with excellent being the most preferred. Therefore the next chapter outlines conclusion and recommendations to promote an effective PBWM system in the study area.

Table 4.6: Summary rating of approaches to waste management

Approach	Ranking			
	Excellent	Good	Fair	Poor
Technical and infrastructure			X	
Legal and policy			X	
Public and private participation			X	

5 CONCLUSIONS AND RECOMMENDATIONS

This chapter provides the conclusions and recommendations to improve the PBWM system in the CBD of Bulawayo. Regarding infrastructure and policy approaches, shortage of resources manifested in different ways was considered as the main issue hindering sustainable PBWM in the CBD of Bulawayo.

5.1.1 Status of Plastic Bag Pollution

The extent of PB pollution is directly proportional to human traffic with areas around flea markets, green markets, alleys, commuter omnibus termini and drainage systems. There is high concentration of PBW in the evening in Bulawayo CBD. The public yearns for waste receptacles such as colour coded bins. Colour coded bins promote waste separation at source.

5.1.2 Public and Private Parties Participation

There is willingness by all stakeholders to be part of solution to successful PBWM. However, this willingness is not translated to action due to incoherence in the framework, value chain and proposition. There is no clarity on who does what in the value chain and who gains what value in participating in the process.

5.1.3 Technical and infrastructural approaches

The current technical and infrastructure approach employed by the BCC is inadequate to effectively manage PBW in the CBD. The inadequacy is exacerbated shortage of:

- general waste bins;
- colour coded bins;
- waste collection vehicles;
- budget; and
- fuel.

5.1.4 Legal and policy framework approaches

Legislation enforcement is a challenge because of limited enforcement officers, resources and resistance from consumers. Banned PBs were still provided in markets.

5.2 RECOMMENDATIONS

The research established technical and infrastructural, legal and policy framework and private and public partnerships as key enablers for effective PBWM (Figure 5.1). The research proposed the following recommendations to enhance PBWM in the CBD of Bulawayo.

5.2.1 Status of Plastic Bag Pollution

Bulawayo City Council and EMA should articulate a clear value proposition to the public for utilising cotton bags. Water proofing is a desirable feature for the consumers. Therefore, any alternative should have some level of water proofing. People who are willing to pay for waste service delivery in the study area imply that BCC can engage the public to help boost the waste management budget.

5.2.2 Public and Private Parties Participation

The waste pickers must have the business acumen of identifying what waste is required and for what value so that they focus on what gives them higher returns and come up with strategies to increase their earnings from market without subsidy. This can help waste pickers to be independent thereby reducing the number of SWM initiatives to be funded by the local authority.

Bulawayo City Council should encourage the public to bring their own reusable bags when shopping and actively partake in clean-up campaigns. Private business should engage in the manufacturing of environmental friendly bags such as cotton bags. Cotton bags enable companies to maximise brand awareness. Adoption of reusable

bags help to reduce pressure on existing bins and PBW generated in the CBD of Bulawayo.

5.2.3 Technical and Infrastructural Approaches

Currently, the local authority does not have any recycling or incineration facility to manage plastic waste. Bulawayo City Council should lead the development of a recycling business case demonstrating value and potential source of funds. There are limited industries that recycle waste in Bulawayo for example, National Waste Company. The establishment of the recycling project is likely to provide job opportunities for many people, help reduce environmental pollution and increase the lifespan of the landfill (the current cells at the disposal site are almost full).

Bulawayo City Council should work together with the Ministry of Small and Medium Enterprises and Cooperative Development to encourage business to engage into the recycling industry. The establishment of private recycling or reprocessing companies will help the city in many ways that include revenue generation for the country through tax payments, employment of people and reduction in environmental pollution. The national government should come up with incentive schemes for funding local government based on a sustainability score that includes handling of waste material.

One of the problems faced by waste pickers is lack of business skills. Bulawayo City Council should engage local universities and colleges such as NUST and Poly Technic College of Bulawayo should establish programmes that train waste pickers about business management and stimulate new industries around reprocessing of plastic and ensure that waste pickers do appropriate business most preferably as a consortium.

The local authority should provide more waste bins in high activity areas like bus termini and fresh produce markets. The local authority has to have motivational signs and stickers that encourage good waste disposal behaviour. Advertising on bins should be

charged for extra revenue.

Adverts on municipal property should be paid for. This can be one way for the municipality to generate revenue. Good looking bins can attract more advertisements and generate revenue which can go to waste management. The beauty of advertising on bins is that the BCC can undercut competition with lower rates in high people traffic environments

5.2.4 Legal and policy framework approaches

Bulawayo City Council, EMA, State Agency and ZRP need to move away from conformance and compliance to conscious decision making based on understanding people behavioural trends and their value in keeping the environment clean. Legislation must be interpreted, conflicts resolved, and surveillance measures put in place to attaining environmental buy-in and intended objectives. In that way, people can hold each other accountable.

Bulawayo City Council and EMA should educate the public to adopt cotton bags as they cheaper in the long run. Cotton bags can be reused 131 times to match the environmental footprint of a conventional PB used once.

The local authority should work with the Ministry of Higher Education, Science and Technology Development to uphold environmental science in primary, secondary and tertiary levels curriculum as educating the young helps them to develop environmental awareness and individual's behaviour. Bulawayo City Council should call for local universities and colleges to equip learners with innovative technologies and approaches towards waste management.

6 FUTURE RESEARCH

The researcher will do further studies on the following apects:

i. Plastics and the circular economy – the research reflects the importance of the circular economy in PBWM but not in sufficient detail. Is the circular economy feasible at all in Bulawayo and Africa? Do we have alternative non-fuel renewable raw materials? Can we develop plastic recycling facilities? Can BCC manage the investment costs when adopting and implementing the circular model? These are some of the questions that need to be investigated in further research;

ii. Impacts of PBs on Agriculture (livestock) – the researcher intends to investigate the impacts of PBs on livestock in the urban-rural fringe of Bulawayo; and

iii. Seasonal variation with respect to PB concentration – the researcher intends to investigate seasonal variations of PBW in the CBD of Bulawayo.

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APPENDICES

APPENDIX 1: ARTICLES

Published article

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Review Article

Overview of Legal and Policy Framework Approaches for Plastic Bag Waste Management in African Countries

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Plastic bag waste is a major challenge in several African countries. As a way of reducing the detrimental effects posed by plastic bags, governments have adopted various approaches for plastic bag waste management that include levies, bans and or the combination of the two. Despite the adoption of anti-plastic bag policies in several African countries, there has been limited investigation regarding their effectiveness. Thus, the present paper reviews the effectiveness of legal and policy framework approaches for plastic bag waste management in African countries. This systematic review covers legal and policy framework approaches for plastic bag waste management in African countries since 2004 with a view to find their effectiveness. Data sources included peer-reviewed journal articles, websites, books, reports, and dissertations. The databases from which literature was retrieved included Elsevier, Taylor, Springer, institutional repository, and Google Scholar. The current paper argues that poorly enforced plastic bag legislation, resistance from stakeholders, and limited effective substitutes are major factors hindering effective plastic bag waste management in Africa. A six-step model developed by Patton and Sawicki assisted in evaluating plastic bag policies in varied African nations. The study concluded that the key to effective legislation is hinged on consistent enforcement and educating the public to attain environmental buy-in. African countries should adopt and implement the Patton and Sawicki six-step rationalist model to achieve effective plastic bag legislation. African governments should enlighten consumers about other alternatives that are more specific to African countries, especially bags made of raffia and leaves. The findings are limited in that there may be other relevant articles (beyond published articles) about policy and legal approaches for plastic bag waste management, which are not available in the public domain. Therefore, data reviewed may not be exhaustible.

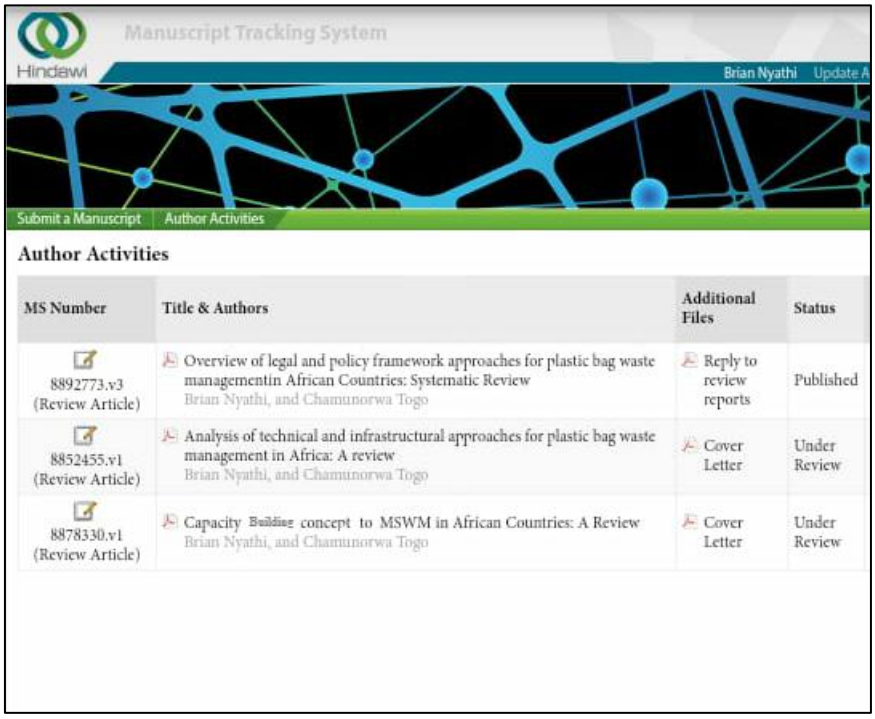
1. Introduction

Plastic bag waste is linked to environmental and socio-economic problems [1, 2]. They are responsible for the clogging of water drains. Blocked water reticulation systems cause water bursts that lead to excessive loss of water [3–5]. This has economic repercussions as local authorities have to repair or acquire new water pipelines. Furthermore, plastic bag waste has been linked to the spread of disease; they create standing water for mosquitoes [5–7]. The light nature of plastic bags makes them windblown, causing loss of aesthetic value in the environment [8–10].

Plastic bag pollution causes negative environmental effects in several African countries for example, Botswana, Uganda, Kenya, and Zimbabwe [11–14]. They negatively affect the aesthetic quality of the environment, block water channels, and are responsible for the deaths of some animals. Animals and livestock often mistake plastic bags for food and often die after ingesting discarded plastic bags. In Gondar city, Ethiopia, plastic bags were found in stomachs of cows in abattoirs [15]. Plastic bag waste in landfills leaches into water sources causing soil pollution. Plastic bag waste promotes breeding ground for mosquitoes that cause malaria [10]. Based on literature review, plastic bag pollution has detrimental effects on the environment.

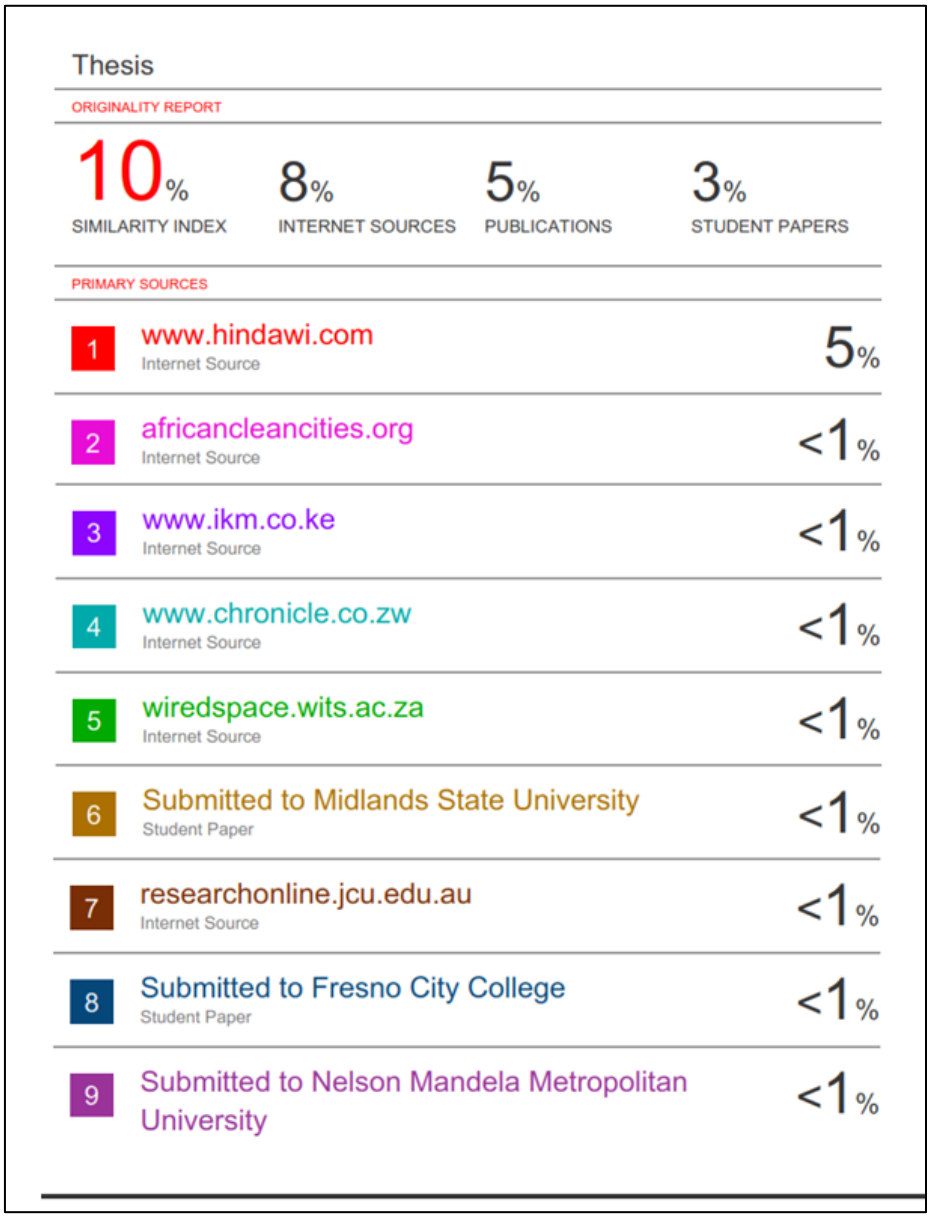
In 2015, plastic bags and other plastic packaging waste accumulated and clogged drains during a heavy downpour in Ghana Accra. This scenario resulted in flooding in which at least 150 people lost their lives and infrastructure was damaged [16]. Improperly disposed plastic bag waste

Submitted for publication



APPENDIX 2: TURNITIN REPORT

All sources used have a similarity index less than 1 % except for Hindawi Publishing Corporation (5 %). This is because the researcher published one article (part of the thesis) (Appendix 1) with Journal of Waste Management under Hindawi Publishing Corporation, hence the similarity index of 10 %.



Thesis

ORIGINALITY REPORT

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APPENDIX 3: INTERVIEW GUIDE FOR EMA AND BCC

Research Topic: Examination of Plastic Bag Waste Management Practices In the Central Business District Of Bulawayo, Zimbabwe.

Interview with EMA and BCC

My name is Brian Nyathi. I am doing research under the supervision of Dr. CA Togo in the Department of Environmental Science, studying towards Doctor of Philosophy in Environmental Management at the University of South Africa. I am kindly asking you to assist in gathering information by completing the attached questionnaire. Information gathered will only be for academic purposes and will be treated with a high sense of confidentiality. Your co-operation will be greatly appreciated.

1. Is there any prevalence of plastic bag waste in the CBD?
2. If yes, please indicate areas where plastic bag waste is widespread?
3. What time of the day is plastic bag waste most widespread?
4. What cause plastic bag pollution in the CBD?
5. Please indicate the negative environmental impact(s) associated with plastic bag waste?
6. What remedial measures /actions should be taken to address the negative impacts identified above?
7. What is the private and public's attitudes towards plastic bag waste management?
8. How is the public complying with legislation on plastic bag waste management?
9. Briefly outline legislation guiding plastic waste management?
10. Are waste bins in the CBD: -

a. adequate

b. colour coded

c. repaired and replaced as and when required?

11. Is the municipal landfill:

    a) properly engineered (availability of leachate management, gas control);

    b) accessible:

    c) away from water sources:

    d) properly fenced:

    e) compacted and there is application of daily cover?

12. Are there any other plastic waste disposal methods practiced in Bulawayo besides landfilling?

13. If Yes, do you think these plastic waste disposal methods are effective?

14. What obstacles are encountered in plastic recycling?

15. Do you think the local authority has:

    a. adequate vehicles for waste collection and transportation services?

    b. sufficient human resources to manage plastic waste?

16. Evaluate the waste management system in the CBD? (good, fair, not good, excellent) handling plastic bag waste?

17. How can these problems be solved?

18. What penalty provisions are given for non-compliance against waste management legislation?

19. What environmental management initiatives are done by Environmental Management Agency to counter the problem of plastic bag waste pollution?

20. Do you think legal and policy framework approaches for plastic bag waste management are:

    a) environmental effective

b) cost effectiveness

c) political acceptable;

d) provide incentives for developing and adopting new environmentally cleaner and economically more efficient technologies?

(give a reason for each answer)

21. What problems does EMA encounter in enforcing plastic bag waste management legislation?

THANK YOU

APPENDIX 4: INTERVIEW WITH MEMBERS OF THE PUBLIC, BCC STREET SWEEPERS AND WASTE PICKERS

Research Topic**:** Examination of Plastic Bag Waste Management Practices In the Central Business District Of Bulawayo, Zimbabwe.

My name is Brian Nyathi. I am doing research under the supervision of Dr. CA Togo in the Department of Environmental Science, studying towards Doctor of Philosophy in Environmental Management at the University of South Africa. I am kindly asking you to assist in gathering information by completing the attached questionnaire. Information gathered will only be for academic purposes and will be treated with a high sense of confidentiality. Your co-operation will be greatly appreciated.

A. General Information

1. What is your age?
2. What is your highest level of education?
3. What is your marital status?

B. Plastic bag Waste Management Practices

1. Is there any prevalence of plastic bag waste in the CBD?
2. If yes, please indicate areas where plastic bag waste is widespread?
3. What time of the day is plastic bag waste most widespread?
4. What cause plastic bag pollution in the CBD?
5. Please indicate the negative environmental impact(s) associated with plastic bag waste?
6. What remedial measures /actions should be taken to address the negative impacts identified above?

7. What is the private and public's attitudes towards plastic bag waste management?
8. Are you aware of the 3Rs in waste management?
9. Do you practice the 3Rs in waste management?
10. State the main reason for using plastic bags?
11. What plastic bag waste management practices do your practice?
12. Are you willing to pay for waste service delivery to improve plastic bag waste management. If yes what is/are the reasons
13. Suggest any substitutes for thin plastic bags?
14. What are the problems faced by waste pickers?
15. Are waste bins in the CBD: -
    a. adequate;
    b. colour coded; and
    c. repaired and replaced as and when required?
16. What type of waste collection vehicles are used by the local authority in transporting solid waste?
17. What are the plastic bag waste disposal methods practised in Bulawayo?
18. Do you think BCC has sufficient manpower and human resources for plastic bag waste management?
19. Evaluate the waste management system in the CBD? (good, fair, not good, excellent)
20. What technical and infrastructural problems does the local authority encounter in handling plastic bag waste?
21. How can these problems be solved?
22. How is the public complying with legislation on plastic bag waste management?
23. Are you aware of the plastic bag ban legislation?
24. Are you able to identify banned plastic bag?
25. Do you support plastic bag ban?

26. Do you feel disturbed when you see prevalent of plastic bag litter

THANK YOU

APPENDIX 5: OBSERVATION CHECKLIST

Research Topic: Examination of Plastic Bag Waste Management Practices In the Central Business District Of Bulawayo, Zimbabwe

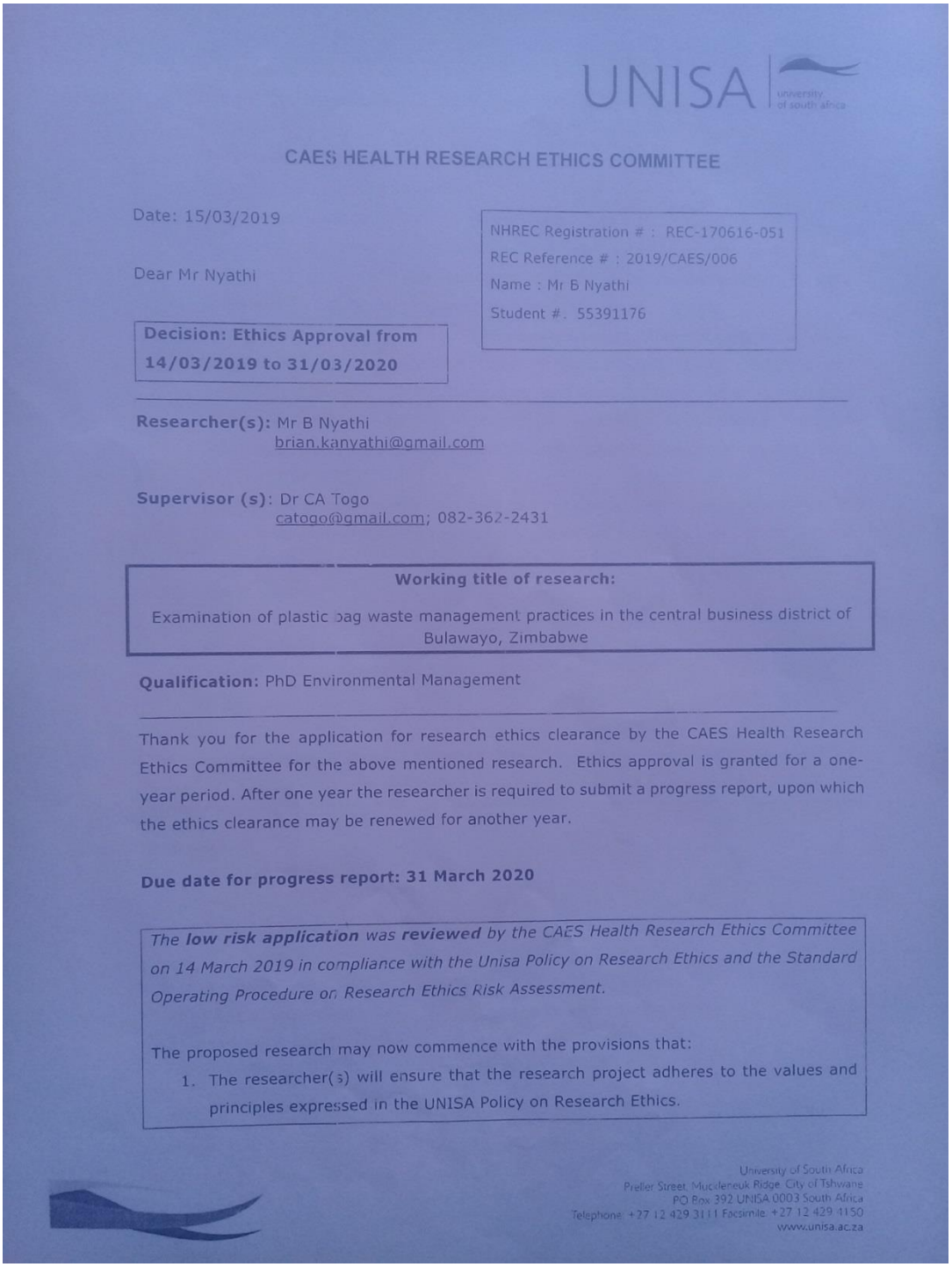
Researcher's name: ……

Observation date: ……

Type of disposal facilities	*Description 1*	*Description 2*	*Description 3*	
Frequency of collection	Twice a week	Once a week	Once in two weeks	irregular
Type State of vehicles	*Description 1*	*Description 2*	*Description 3*	
Availability of recycling facilities	Yes		No	
Prevalence of plastic bag waste	Yes		No	
Are drainage channels free from plastic bag waste?	Yes		No	
Time of the day plastic bag waste most widespread	Morning	Afternoon	Evening	
Presence of municipal posters warning residents about plastic bag littering	Yes		No	
Activities of waste pickers or recyclers	*Description 1*	*Description 2*	*Description 3*	

THANK YOU

APPENDIX 6: ETHICAL APPROVAL FROM UNISA



UNISA university of south africa

CAES HEALTH RESEARCH ETHICS COMMITTEE

Date: 15/03/2019

NHREC Registration # : REC-170616-051
REC Reference # : 2019/CAES/006
Name : Mr B Nyathi
Student #. 55391176

Dear Mr Nyathi

Decision: Ethics Approval from 14/03/2019 to 31/03/2020

Researcher(s): Mr B Nyathi
brian.kanyathi@gmail.com

Supervisor (s): Dr CA Togo
catogo@gmail.com; 082-362-2431

Working title of research:

Examination of plastic bag waste management practices in the central business district of Bulawayo, Zimbabwe

Qualification: PhD Environmental Management

Thank you for the application for research ethics clearance by the CAES Health Research Ethics Committee for the above mentioned research. Ethics approval is granted for a one-year period. After one year the researcher is required to submit a progress report, upon which the ethics clearance may be renewed for another year.

Due date for progress report: 31 March 2020

*The **low risk application** was **reviewed** by the CAES Health Research Ethics Committee on 14 March 2019 in compliance with the Unisa Policy on Research Ethics and the Standard Operating Procedure on Research Ethics Risk Assessment.*

The proposed research may now commence with the provisions that:

1. The researcher(s) will ensure that the research project adheres to the values and principles expressed in the UNISA Policy on Research Ethics.

University of South Africa
Preller Street, Muckleneuk Ridge, City of Tshwane
PO Box 392 UNISA 0003 South Africa
Telephone: +27 12 429 3111 Facsimile: +27 12 429 4150
www.unisa.ac.za

2. Any adverse circumstance arising in the undertaking of the research project that is relevant to the ethicality of the study should be communicated in writing to the Committee.
3. The researcher(s) will conduct the study according to the methods and procedures set out in the approved application.
4. Any changes that can affect the study-related risks for the research participants, particularly in terms of assurances made with regards to the protection of participants' privacy and the confidentiality of the data, should be reported to the Committee in writing, accompanied by a progress report.
5. The researcher will ensure that the research project adheres to any applicable national legislation, professional codes of conduct, institutional guidelines and scientific standards relevant to the specific field of study. Adherence to the following South African legislation is important, if applicable: Protection of Personal Information Act, no 4 of 2013; Children's act no 38 of 2005 and the National Health Act, no 61 of 2003.
6. Only de-identified research data may be used for secondary research purposes in future on condition that the research objectives are similar to those of the original research. Secondary use of identifiable human research data require additional ethics clearance.
7. No field work activities may continue after the expiry date. Submission of a completed research ethics progress report will constitute an application for renewal of Ethics Research Committee approval.

Note:
*The reference number **2019/CAES/006** should be clearly indicated on all forms of communication with the intended research participants, as well as with the Committee.*

Yours sincerely,

Prof EL Kempen
Chair of CAES Health REC
E-mail: kempeel@unisa.ac.za
Tel: (011) 471-2241

Prof MJ Linington
Executive Dean : CAES
E-mail: lininmj@unisa.ac.za
Tel: (011) 471-3806

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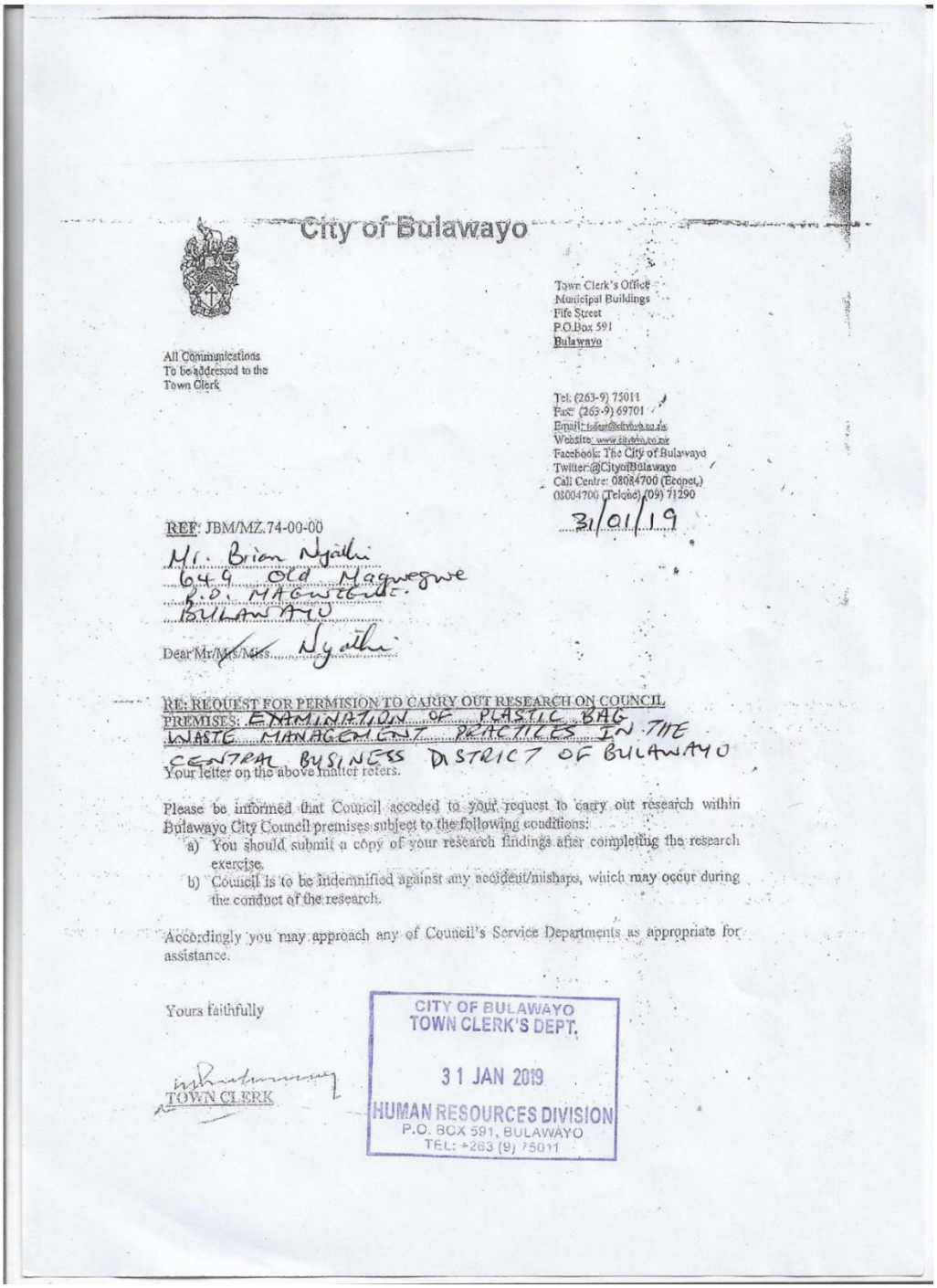
APPENDIX 7: PERMISSION LETTER FROM BCC



City of Bulawayo

Town Clerk's Office
Municipal Buildings
Fife Street
P.O.Box 591
Bulawayo

All Communications
To be addressed to the
Town Clerk

Tel: (263-9) 75011
Fax: (263-9) 69701
Email: tclerk@citybyo.co.zw
Website: www.citybyo.co.zw
Facebook: The City of Bulawayo
Twitter:@CityofBulawayo
Call Centre: 08084700 (Econet,)
08004700 (Telone) (09) 71290

31/01/19

REF: JBM/MZ.74-00-00

Mr. Brian Ngathi
649 Old Magwegwe
P.O. MAGWEGWE.
BULAWAYO

Dear Mr/Ms/Mrs. Ngathi

RE: REQUEST FOR PERMISION TO CARRY OUT RESEARCH ON COUNCIL PREMISES: EXAMINATION OF PLASTIC BAG WASTE MANAGEMENT PRACTICES IN THE CENTRAL BUSINESS DISTRICT OF BULAWAYO

Your letter on the above matter refers.

Please be informed that Council acceded to your request to carry out research within Bulawayo City Council premises subject to the following conditions:

a) You should submit a copy of your research findings after completing the research exercise.
b) Council is to be indemnified against any accident/mishaps, which may occur during the conduct of the research.

Accordingly you may approach any of Council's Service Departments as appropriate for assistance.

Yours faithfully

TOWN CLERK

CITY OF BULAWAYO
TOWN CLERK'S DEPT.
31 JAN 2019
HUMAN RESOURCES DIVISION
P.O. BOX 591, BULAWAYO
TEL: +263 (9) 75011

APPENDIX 8: PARTICIPANT INFORMATION SHEET

Ethics clearance reference number: 2019/CAES/006

28/12/2018

Title: Examination of Plastic bag waste management practices in the Central Business District of Bulawayo, Zimbabwe

Dear Prospective Participant

Your permission is herewith requested to allow Brian Nyathi, a student in the Department of Department of Environmental Science towards Doctor of Philosophy in Environmental Management at the University of South Africa, to conduct academic research in the Central Business District of Bulawayo and in your organisation. The study will involve field observations, recording devices, interviews and document review.

The researcher will also interview the following participants, Amenities Manager, the Senior Health Environmental Officer, the Cleansing Supervisor, the City Chemist and five municipality waste collectors. The suggested participants to be interviewed are key informants in plastic bag waste management.

Purpose of the Study

The purpose of this study is to explore and understand the root causes of plastic bag pollution in the CBD of Bulawayo through audio taping, photographs, direct observations, face to face interviews and document reviews. Research information will help policy makers, researchers as well society to understand the problems brought about by the plastic bag litter and the possible solutions which can be used as a measure to contain the problem. The study will be useful to all environmental safety and health ministries in formulating policy relevant to plastic bag waste management. The research aim will be fulfilled through the following specific objectives, which are to:

- determine the status of plastic bag waste in the CBD;
- examine the level of private and public participation in plastic bag waste management in the CBD of Bulawayo;
- assess the effectiveness of current technical and infrastructural approaches for plastic bag waste management in the CBD of Bulawayo;
- analyse the current legal and policy framework approaches for plastic waste management in the CBD of Bulawayo; and
- develop a sustainable plastic waste management model within the confines of integrated sustainable solid waste management for Bulawayo.

Why Am I Being Invited To Participate?

You have been chosen to participate in this study based on the fact that you are one of the key stakeholders in plastic bag waste management.

What Is the Nature Of participants Involvement In this study?

The study involves audio taping, photographs, direct observations and semi-structured interviews. Some of the questions to be asked will include the following:

- How often are bins emptied?
- What is the number of existing and required waste bins?
- Do you have colour coded bins in the CBD?
- Do you repair and replace bins as and when required?
- Is there any policy to standardise the vehicles and equipment used by the Department?
- Evaluate the waste management system in the CBD?
- What technical and infrastructural problems do you encounter in handling plastic bag waste?
- How can these problems be solved?

The research will be conducted in the morning and afternoon sessions because in the evening, there is a risk of being attached by criminals. The interview is expected not to take more than 15 minutes of time per participant. However, some interviews may take lower than that.

Can I Withdraw From This Study Even After Having Agreed To Participate?

Participating in this study is voluntary and you are under no obligation to consent to participation. If you do decide to take part, you will be given this information sheet to keep and be asked to sign a written consent form. You are free to withdraw at any time and without giving a reason. However, it will not be possible to withdraw once the questionnaire has been submitted. This will depend on the nature of the questionnaire. For example, a questionnaire clearly indicating the identity of the participant, but the researcher would have agreed to anonymise personal data.

What are the potential benefits of taking part in this study?

This study will provide information about the technical infrastructure approaches for plastic bag waste management, the legal and policy framework approaches, roles of private and public participation in plastic bag waste management in the CBD of Bulawayo. Research information will help policy makers, researchers as well society to understand the problems brought about by the plastic bag litter and the possible solutions which can be used as a measure to contain the problem. The study will be useful to all environmental safety and health ministries in formulating policy relevant to plastic bag waste management.

Are there any negative consequences for me if i participate in the research project?

The risks that participants can be exposed to include the following:

- psychological distress and discomfort and
- an invasion of participants (Privacy and anonymity).

In order to minimise these risks, the researcher, will implement the ethical principles of research that stress the need to do good and do no harm. Thus, the researcher will first seek informed consent from research participants, protect their anonymity and confidentiality and avoid using deceptive practices as well as give participants the right to withdraw from the research.

Informed consent: The researcher will provide detailed information about the research project so that participants understand that they are taking part in research and what the research requires of them. For example, purpose of the research, methods used, the possible outcomes

of the research as well as inconveniences that the participants may be exposed to. Participants should be volunteers taking part without having been deceived to take part in research.

Protecting anonymity and confidentiality: A risk is likely to occur if data is not treated confidentially. Information collected from respondents will be kept confidential in a password protected computer and in a locked cabinet. Also, there will be no personalisation of responses in interviews. This will be explained before the commencement of interviews. The data from semi-structured interviews, audio and text transcript of the interviews will be filed and kept under a protected computer password which is accessible to until the research is completed. Policy makers, academicians, interested parties will have access to this research, provided their interest is for personal and academic exercises otherwise permission will be needed by University of South Africa for any other purposes. Respondents will have access to this research to verify if what they said corresponds with the research results.

Avoiding deceptive practices: The researcher will strive for honesty in this study. Participants should understand that they are taking part in research and what the research requires of them. The researcher will provide detailed information about the purpose of the research, expected duration and procedures.

Will the information that i convey to the researcher and my identity be kept confidential?
The participants' name will not be recorded anywhere and that no one, apart from the researcher and identified members of the research team, will know about your involvement in this research. Your answers will be given a code number and you will be referred to in this way in the data, any publications, or other research reporting methods such as conference proceedings.

The confidentiality agreements will be submitted to the Research Ethics Review Committee for consideration. Your answers may be reviewed by people responsible for making sure that research is done properly, including the supervisor and members of the Research Ethics Review Committee. The records that identify you will be available only to people working on the study, unless you give permission for other people to see the records.

The Participant's anonymous data will be used for other purposes, such as a research report, journal articles and/or conference proceedings. Report of the study will be submitted for publication, but individual participants will not be identifiable in the report.

How will the researcher(s) protect the security of data?

Hard copies of your answers will be stored by the researcher for a period of five years in a locked filing cabinet at the researcher's home for future research or academic purposes. Electronic information will be stored on a password protected computer. Future use of the stored data will be subject to further Research Ethics Review and approval if applicable. Hard copies will be shredded and electronic copies will be permanently deleted from the hard drive of the computer through the use of a relevant software programme.

Will i receive payment or any incentives for participating in this study?

There will be no any payment or reward offered financial. However, any costs incurred by the participant will be explained and justified in adherence with the principle of fair procedures (justice).

Has the study received ethics approval?

This study received written approval from the Research Ethics Review Committee of the College of Agriculture and Environmental Sciences, Unisa. A copy of the approval letter can be obtained from the researcher if you so wish.

How will i be informed of the findings/results of the research?

If you would like to be informed of the final research findings, please contact Brian Nyathi on 0027 716392796/ +263 77894275 or email, brian.kanyathi@gmail.com. The findings are accessible for 6 months. Mobile phone numbers are acceptable. Should you require any further information or want to contact the researcher about any aspect of this study, please contact the above mentioned details.

Should you have concerns about the way in which the research has been conducted, you may contact Dr. Togo on +27 82 3622 431, or email catogo@gmail.com. You can also contact the

chairperson of the Ethics Research Committee, Prof EL Kempen on 011-471-2241 or kempeel@unisa.ac.za. Alternatively, you can report any serious unethical behaviour at the University's Toll Free Hotline 0800 86 96 93.

Thank you for taking time to read this information sheet and for participating in this study.

Thank you.

B. Nyathi

APPENDIX 9: CONSENT TO PARTICIPATE IN THIS STUDY

I, _____ (participant name), confirm that the person asking my consent to take part in this research has told me about the nature, procedure, potential benefits and anticipated inconvenience of participation.

I have read (or had explained to me) and understood the study as explained in the information sheet.

I have had sufficient opportunity to ask questions and am prepared to participate in the study.

I understand that my participation is voluntary and that I am free to withdraw at any time without penalty.

I am aware that the findings of this study will be processed into a research report, journal publications and/or conference proceedings, but that my participation will be kept confidential unless otherwise specified.

I agree to the recording of the interview

I have received a signed copy of the informed consent agreement.

Participant Name & Surname…….(please print)

Participant Signature…….. .Date……

Researcher's Name & Surname…… (Please print)

Researcher's signature…….... Date……