**UNIVERSITY OF BOTSWANA**



**FACULTY OF SCIENCE**

**DEPARTMENT OF ENVIRONMENTAL SCIENCE**

**AN INTEGRATED WASTE MANAGEMENT APPROACH AS AN ALTERNATIVE DOMESTIC SOLID WASTE MANAGEMENT STRATEGY FOR THE GROWING AFRICAN URBAN ENVIRONMENTS: A CASE STUDY OF GABORONE, BOTSWANA**

**A Dissertation Submitted in Partial fulfillment of the Requirements for the MSc Degree in Environmental Science**

**BY**

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Dedications

I dedicate this work to my late father Rev Felix Mupara and my mother Rev Winnet Mupara, who have provided the necessary foundation to my education, and family members for their support and inspiration throughout my studies.

Approval

This Dissertation has been examined and is approved as meeting the expected standards for the partial fulfilment of the requirements for the MSc Degree in Environmental Science.

Internal Examiner…………………………………….          Date………………………

External Examiner……………………………………          Date………………………

Dean, School of Graduate Studies……………………          Date………………………

## Statement of Originality

The work contained in this dissertation was completed by author at the University of Botswana between August, 2012 and May 2016. It is original work except where due reference is made. It has not been and will not be submitted for the award of any degrees or diplomas to any other institution of higher learning.

Author's Signature………………………………………….. Date…………………………..

ABSTRACT

Domestic Solid waste management in Gaborone, as in most of African cities has become a daunting task for urban practioners to tackle. Rapid urbanisation without the matched increase in service provision has exerted pressure on the existing Gaborone City Council's waste management system. Improving the system by increasing the number of waste trucks or the frequency of waste collection in residential areas does not however appear to solve the emerging problems.

Therefore the main aim of this study was to investigate whether an integrated domestic solid waste management system can be adopted to solve the various problems associated with poor domestic solid waste management systems in Gaborone. The specific objectives of the study were to:

- investigate the existing Domestic Solid Waste Management system;

- identify factors that determine Domestic Solid Waste Management practices;

- identify the main stakeholders in Domestic Solid Waste Management; and

- assess the feasibility of adopting the Integrated Domestic Solid Waste Management Strategy in Gaborone.

Case studies from several successful integrated domestic solid waste management projects in other countries, reports from books, field observations, and responses to questionnaires and interview schedules were used while statistics, tables, charts, diagrams and graphs constituted the analytical basis for data presentation and interpretation.

The hypothesis of the study was that domestic solid waste management practices in Gaborone are determined by socio-economic, policy and perceptual factors. Field observations and statistical tests were employed to identify the major determinants of waste management practices and how these could help in providing viable solutions to the problem. The study findings showed that socio-economic factors like, educational level, gender coupled with location of residential area determine waste management practices like, recycling, reuse and waste reduction.

The study recommended, among other things, that an Integrated Domestic Solid Waste Management System be implemented in Gaborone and Botswana as a whole. It further

recommended the formulation of waste management policies that are education and awareness- centered and the implementation of these policies. These policies should have the practice of 3Rs (recycle, reuse and reduce) as a priority. It is strongly recommended that all stakeholders be involved in decision- making where domestic solid waste management is concerned. A more participatory approach is thus needed instead of the existing top-down-approach. Other stakeholders like NGOs, residents and Recycling Organisations should participate in helping the city council to conduct education and awareness campaign programmes for the residents on the requirements of the by laws pertaining to sustainable domestic waste management practices.

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**List of Abbreviations**

| | |
|---|---|
| DWMPC | Department of Waste Management and Pollution Control |
| EPA | Environmental Protection Agency |
| GIM | Ghana Innovative Market |
| GHG | Greenhouse gases |
| GoB | Government of Botswana |
| ISWMS | Integrated Solid Waste Management System |
| MSW | Municipal Solid Waste |
| SADC | Southern Africa Development Committee |
| USEPA | United States Environmental Protection Agency |
| ISWMS | Integrated Solid Waste Management System |
| IDSWMS | Integrated Domestic Solid Waste Management System |
| HDPE | High Density Polyethene |

<center>**Chapter 1**</center>

**INTRODUCTION TO THE STUDY**

**1.0 Overview**

This Chapter presents the background, statement of the research problem, aims, research objectives and research questions, and the overall significance of the study. It also outlines the relevant characteristics of the study area in terms of its history, physical attributes, population and economy.

**1.1 Background to the Study**

The problem of urban domestic solid waste management does not only affect Botswana. It is a global concern that is now at the forefront of environmental issues (Saungweme, 2012, UNEP, 2007). Different countries have now come up with various and more effective ways of dealing with urban domestic solid waste management. Countries like Japan, United States of America, India and Lesotho have now introduced the Integrated Domestic Solid Waste Management Strategy and the aesthetic beauty of their cities have since been restored (Nakamura, 2007 and GTZ, 2010). On the other hand, Botswana is still fighting an almost lost battle because the existing system has failed to curb the growing urban domestic solid waste management problems.

Previous studies on Botswana have pointed out that there is a serious and growing problem in the increase of domestic solid waste generated, indiscriminate dumping of waste, littering and open burning of waste (Maphorisa, 2000; Gwebu, 2002; Gwebu, 2003; Tabane, 2006; Kwailane, 2012). In Botswana this increase, in domestic solid waste generation, has been matched by low efforts to reduce waste at source, and this has put pressure on the existing waste collection system. Hardoy et al (2001) have pointed out that the common domestic solid waste problem in African cities is either inadequate waste collection or non-collection at all. Sometimes such waste in Gaborone, like any other African city, is left uncollected and often ends up littering highways, roadsides, streets, bushes and open spaces.

Growing public consciousness about solid waste issues has increased over the years (Dev, 2007). As evidence mounts about the environmental and public health impacts associated with open burning of waste, illegal dumping of waste, leaching landfills and improperly designed incinerators, relevant authorities have been forced to come up with new ways to manage waste sustainably. The relative scarcity of disposal facilities, along with increasing environmental controls, has forced waste disposal costs to go up. Strategies to address urban domestic solid waste management are often the first line of action for those seeking to reverse the trends of deteriorating urban environmental conditions. However, in Botswana most city councils are failing to address the domestic solid waste problem due to:

- lack of trained personnel;
- lack of legislation enforcement for waste management;
- lack of facilities for waste management;
- lack of public awareness on the effects of poor waste management on the environment;
- lack of public awareness on the benefits of the 3Rs of waste management;
- lack of finance for the growing waste management budget;
- rapid urbanization ; and
- ever increasing domestic solid waste being generated by residents.

Because of the above problems there is need for adopting an Integrated Domestic Solid Waste Management System (IDSWMS) as an alternative strategy for improving the existing domestic solid waste management system in Botswana. Pourimede (2010) defines an Integrated Solid Waste Management System as a comprehensive solid waste model that combines elements of waste prevention, recycling, composting and disposal with active stakeholder participation that ensures efficient and sustainable waste management. An effective ISWM system considers how to prevent, recycle, and manage solid waste in ways that most effectively protect human health and the environment.

## 1.3 Statement of the Research Problem

The research problem focuses on investigating the failure, by the city of Gaborone, to manage their domestic solid waste more sustainably, in spite of available institutional legislation and open source global best practices. Botswana established Guidelines for the Disposal of Waste

by Landfilling in 1997, a Waste Management Act and Waste Management Strategy in 1998 and several other waste-related bye-laws, with the aim of solving its waste management problems. The main aim of the Waste Management Act is to make provisions for planning, facilitation and implementation of advanced systems for regulating the management of waste in order to prevent harm to human, animal and plant life and to minimize the pollution of the environment (Government of Botswana 1998b). The Waste Management Strategy provides the framework for solid waste management. Its main objectives are to:

- protect the environment (water, air, soil and biodiversity);

- protect natural resources (land, raw materials and energy); and

- protect human health.

The Strategy's key principles, as shown in Figure 1-1, are to reduce waste generation through the implementation of the 3Rs (reduce, re-use and recycle) and involving all relevant stakeholders in waste management.
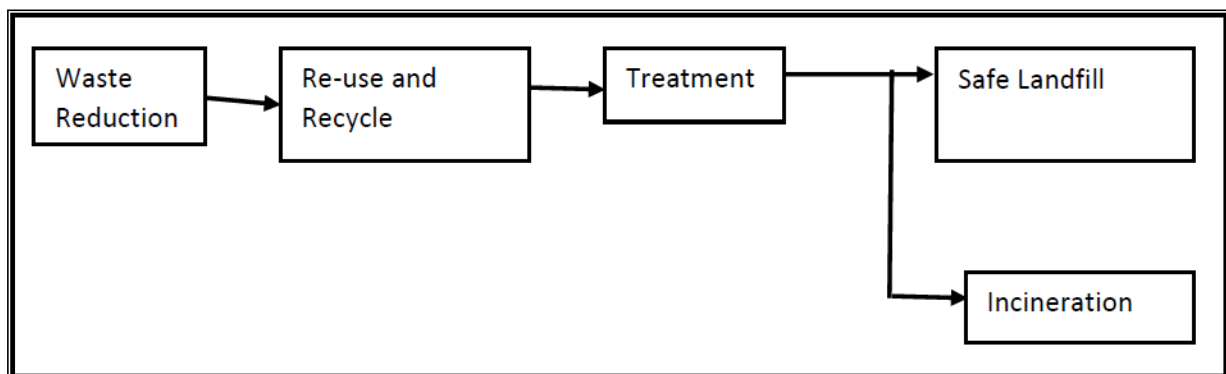


Figure 1-1: The Botswana Waste Management Strategy

**Source:** Government of Botswana (1998a)

Even with all existing statutes in place, the city of Gaborone still struggles with its urban domestic solid waste handling because it has failed to reduce waste generation at source resulting in all its waste ending up in the Gamodubu landfill.

Experiences from other countries show that innovative, cost effective and participatory methods of domestic solid waste management are feasible. Cases in point include less

developed countries such as Lesotho (GTZ.2010) and India (GTZ, 2010), and the relatively more developed nations like Brazil (GTZ, 2010), USA (Nakamura, 2007) and Japan (Nakamura, 2007), where the benefits of such methods cannot go unnoticed. In Gaborone, there has been an increase in the waste management expenditure. It is estimated that almost 70% of the Gaborone City Council budget services domestic solid waste (GCC, 2014). Most of this money is being spent on waste collection, transport and disposal. Waste disposal cost rose from P36/tonne in 2010 to P136/tonne in 2013 (GCC, 2014). The waste management budget has been increasing by approximately a million pula every year, from P16 million in 2010 to P20 million in 2014 (GCC, 2014) yet the problems appear to be worsening.

There is evidence of increasing volumes of domestic solid waste generated by the urban residents each year, as shown in Figure 1-2, whereas there is little effort to reduce the waste at source.
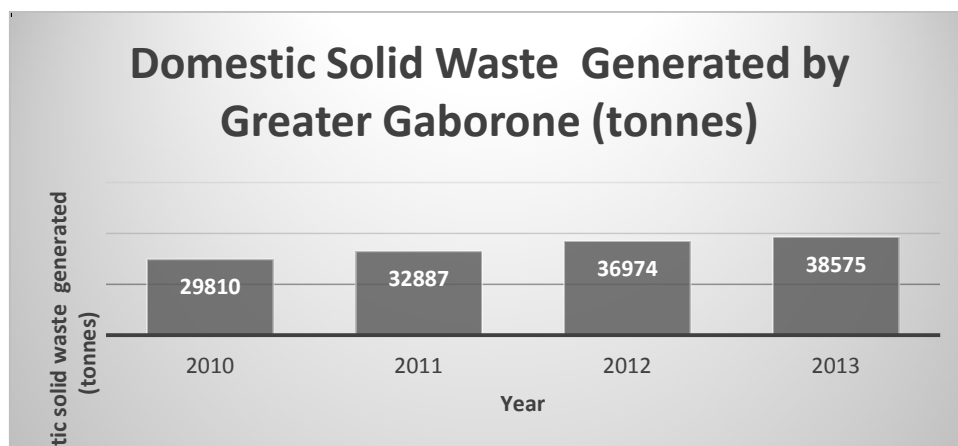


Figure 1-2: Domestic solid waste generated by Gaborone residents from 2010 to 2013.

**Source:** Gaborone City Council (2014)

There has been an insufficient waste collection service in Gaborone. Collection of waste once a week has been in place since 2010 (GCC, 2014). However, frequency has not increased even though population and volumes of waste generated are on the increase. GCC also do not collect rubble and garden waste, residents have to find private companies to dispose of this waste. In instances where residents cannot afford to use private companies they either dispose waste illegally or burn it.

Finally, the rising cost of managing waste and the limited financial resources available to manage it makes it difficult for the GCC to introduce more expensive and technologically intensive strategies to the existing domestic solid waste management system.

The research problem of this study is to therefore investigate, firstly the current practices by households in handling their domestic solid waste. Secondly, it will probe the level of appreciation and acceptability of sustainable domestic solid waste management alternatives by households and policy makers when compared to their current waste management practices. Lastly, it will investigate the feasibility of introducing an alternative domestic solid waste management system that is both human- centered and cost effective.

## 1.4 Scope of the study

This study will be limited to urban domestic solid waste in Gaborone. This is waste/garbage produced by households, thus other types of waste like liquid, industrial and hazardous clinical waste will not be considered. This will ensure that the project is manageable, given the time and resource constraints faced by the researcher. The study will be limited to dealing with waste generation, prevention, collection, transportation and disposal. The study will also look at the feasibility of establishing and implementing an integrated domestic solid waste management system.

## 1.5 Main Aim of the Study

The purpose of the study is to analyse the existing domestic solid waste management system in Gaborone, assess its strengths and limitations and suggest opportunities for adopting and implementing a sustainable integrated domestic solid waste management strategy that is economically viable, socially inclusive and ecologically sensitive.

**1.6 Research Objectives**

The study has the following objectives, namely to:

1.      Investigate the existing Domestic Solid Waste Management System;

2.      Identify factors that determine domestic solid waste management practices;

3.      Identify the main stakeholders involved in domestic solid waste management; and

4.      Assess the feasibility of adopting the Integrated Domestic Solid Waste Management Strategy in

        Gaborone.


**1.7 Key Research Questions**

The study seeks to answer the following questions:

1.      What are the existing Domestic Solid Waste Management systems?

2.      To what extent are the residents practicing the 3Rs?

3.      How do domestic solid waste management determinants affect the actual practice in solid waste management?

4.      Who are the major stakeholders and what roles do they play in domestic solid waste management?

5.      How can the Integrated Domestic Solid Waste Management Strategy be adopted and implemented in Gaborone?


**1.8 Research Hypothesis**

Domestic solid waste management practices in Gaborone are determined by socio-economic, policy and perceptual factors.

**1.9 Justification of the Study**

The study is pertinent and timely to Gaborone in particular and Botswana as a whole for the following reasons. The Department of Waste Management and Pollution Control (DWMPC) under the "thinking 2016" theme has a vision of making Botswana to become a world-class leader in ensuring a clean and safe environment for sustainable development. This vision appears too far- fetched considering that it's only one year before 2016 and the situation on the ground might not be solved by the existing system within the few remaining months. Botswana cities and towns are still far from being regarded as clean. The extent of the problem, shows that there is need to come up with new and sustainable ways of managing domestic solid waste in urban Botswana.

Decision making in waste management has always been the duty of the City Councils and the Department of Waste Management and Pollution Control (DWMPC) .This study will seek to give all stakeholders, especially the residents, the power to make informed decisions on domestic solid waste management and come up with a system that is community- specific and household-friendly. It will recommend to all stakeholders a cost effective and participatory domestic solid waste management system. Experiences from other countries show that innovative, cost effective and participatory methods of domestic solid waste management are feasible in solving urban domestic waste management problems.

Unlike previous studies which focused on the design of waste management technologies like siting and construction of sanitary landfills, waste collection systems (Johannessen and Boyer 1999; Maphorisa, 2000), this study will focus on the 3Rs that could help reduce the amount of domestic solid waste that ends up at the landfill, therefore reducing the cost of handling.

The study will also apply statistical tools to determine the strength of socio-economic and demographic factors in the practice of urban domestic solid waste management. In countries, where the IDSWM strategy has been adopted, education was the most effective tool used to change the residents' attitude towards waste management. A change in attitude ensured behaviour change in waste management thereby reducing the negative impacts of poor waste management on the environment.

**1.10 Significance of the Study**

Domestic solid waste management has become a major development challenge in developing countries' cities and towns in recent times (Saungweme, 2012). This deserves not only the attention of the City Councils or Municipalities and other waste management institutions but also of residents in finding lasting solutions to the problem. This is mainly because vital human and environmental resources could be lost through poor domestic solid waste management practices. The study therefore intends to explore appropriate strategies and recommendations in managing domestic solid waste in a sustainable manner in Gaborone and Botswana as a whole.

Despite the immensity of the domestic solid waste management problem, no research on the possibility of adopting and implementing an Integrated Domestic Solid Waste Management Strategy as a solution been carried out in Gaborone or Botswana. This study will serve as a reference point for the Gaborone City Council, Department of Waste Management and Pollution Control and other stakeholders as far as domestic solid waste management is concerned. In this case it will give them an in-depth understanding of domestic solid waste management problems and how the Integrated Domestic Solid Waste Management Strategy can be used to tackle these problems. Additionally, the study will contribute to the existing body of knowledge on the problems of domestic solid waste management and will also stimulate further research on the importance of the Integrated Domestic Solid Waste Management Strategy for other cities in Botswana.

**1.11 Choice of the study area**

This section outlines the relevant characteristics of the study area in terms of its relative location, history, physical attributes, population and socio-economic and demographic data.

**1.11.1 Location and Physical Background**

Gaborone is located in the southern part of Botswana. As shown in figure 1.3, the latitude and longitude of Gaborone are 24°39′29″S and 25°54′44″E.
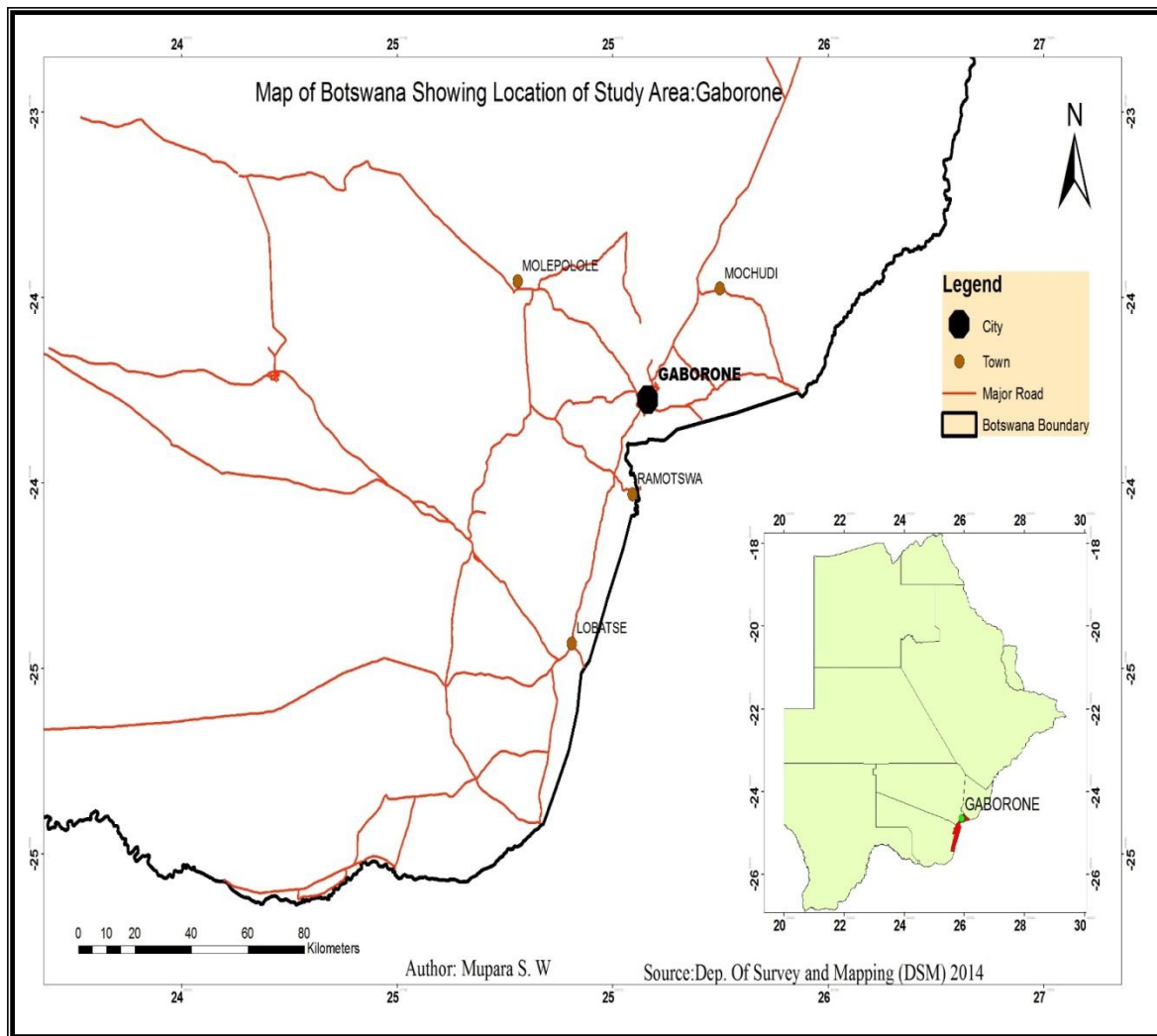
Figure 1-3: Relative location of Gaborone

**Source:** Department of Surveys and Mapping (2014)

The city lies at an elevation of 1,010 metres above the sea level. The city is located between the Kgale and Oodi hills and it is 15 kilometers from the Zeerust South African Boarder. It is surrounded by numerous urban villages that include Ramotswa to the southeast, Mogoditshane to the northwest and Mochudi to the east. Its residential suburbs include Broadhurst, Old Naledi, Phakalane, Gaborone North and Mokolodi (Gaborone City Council, 2009). As shown in Figure 1-4 below, Phakalane, Block 5 and Old Naledi were chosen as the study sites.
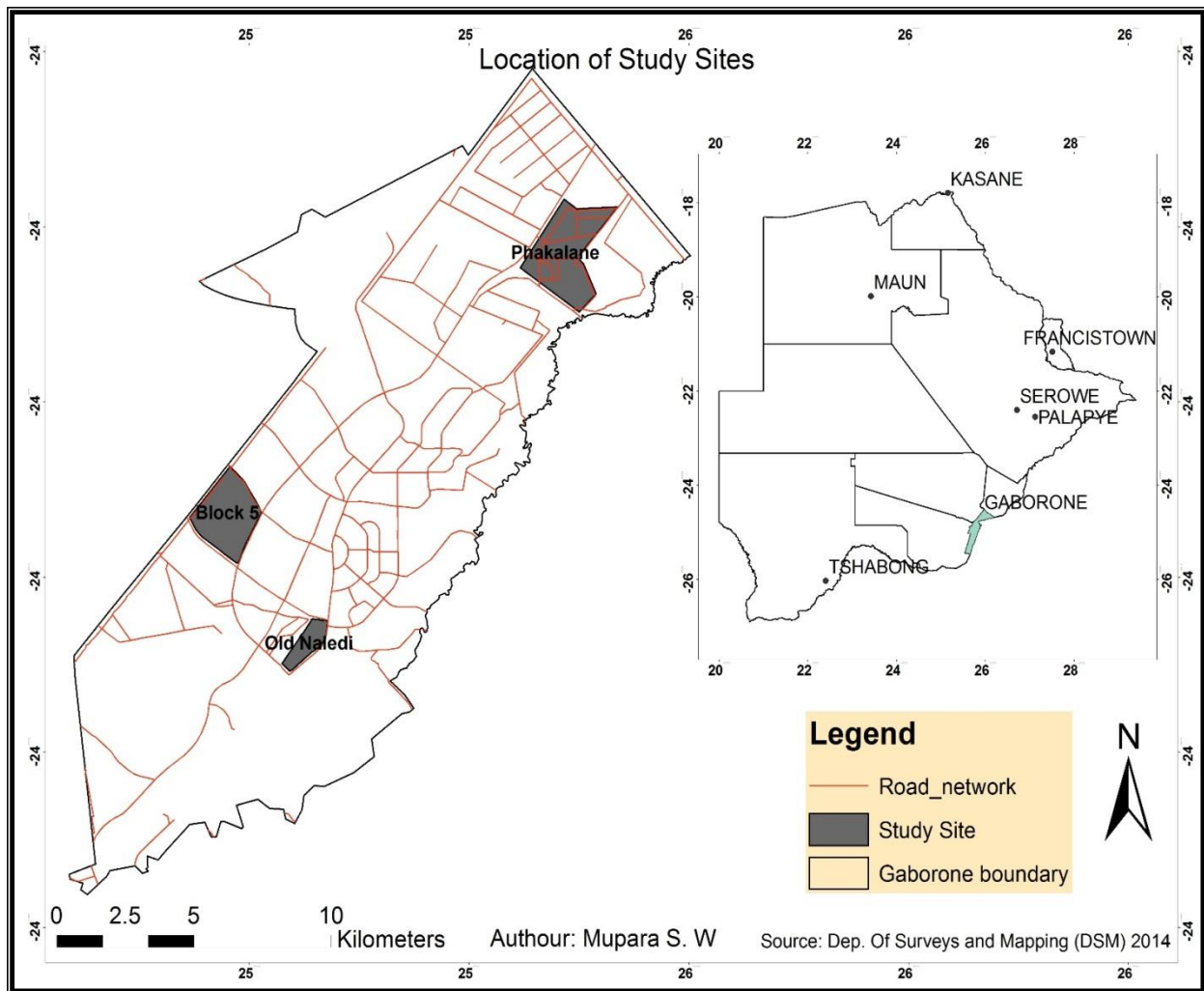
Figure 1-4: Location of Study Sites

**Source:** Department of Surveys and Mapping (2014)

The city has a hot semi-arid climate. Most of the year it is sunny. In summer, days are hot and nights are cool. During winter, days are warm but nights are very cold. Like the rest of the country, the City experiences hot wet summers between September and April and cold and dry winters from May up to August (Bhalotra, 1987, Pule-Meulenberg et al., 2005). The mean annual temperature is 22°C. Rainfall is scanty and erratic. The city's mean annual rainfall is around 500mm.

### 1.11.2 Population Growth and Waste Generation

From a population of less than 1,000 in the early 1960, Gaborone recorded a *de facto* population of 17,718 in 1971. By 1981 the population had increased to 59,657, representing

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an annual growth rate of 23%. By 1991, the Census showed a rapid intercensal increase in population. The population had doubled and it was 133,468. The 2001 and 2011 population censuses recorded population figures of 186,007 and 231,626 respectively (Central Statistics Office 1964- 2011).
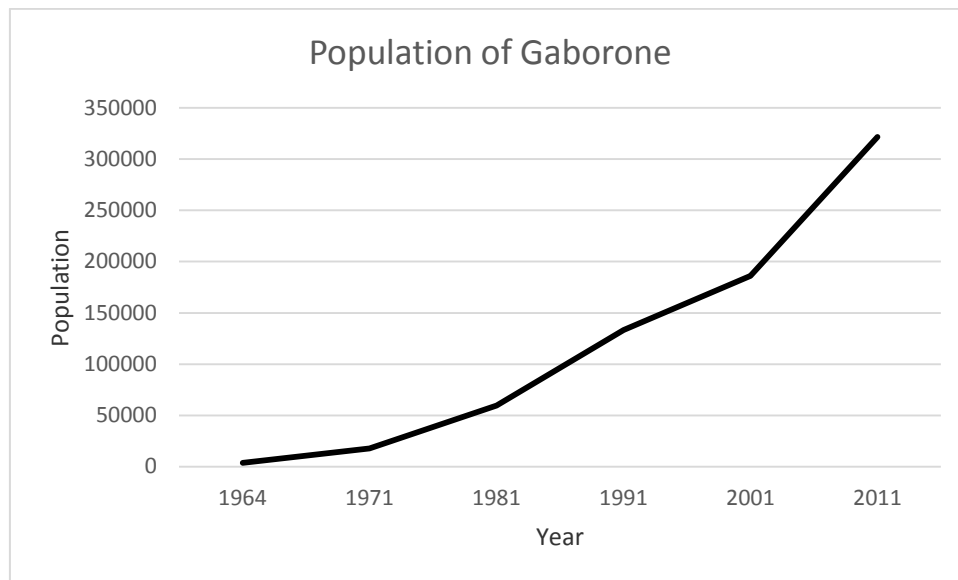


Figure 1-5: Population growth for Gaborone City from 1964 up to 2011

**Source:** CSO (1964-2011)

Currently, the population growth rate of Gaborone is 3.4 % per year and it is the highest in the country. This is most likely because the city has more developed infrastructure making it more livable. Also many people migrate to the city in search of better job opportunities, better paying jobs, and better healthcare and education services. The poor state of domestic solid waste management in Gaborone can be attibuted to several factors. Firstly, there has been rapid population growth, as shown in Figure 1.4, caused by rural-urban migration that has been matched by deterioration in service provision. Population growth without a comensurate improvement in service provision has put immense pressure on available waste management resources and services.

Secondly, socio-economic factors affect the quantities and types of waste generated and how waste is managed at the household level. As the standards of living of people improve, they tend to generate more waste. An increase in incomes is directly proportional to the increase in

waste generation. Thus solid waste generation has emerged as a visible and tangible symbol of a materialistic and consumptive society. Yelda (2005) ascribes the increase in waste generation to the adoption of the western "throw away culture" in African cities. With the increase of disposable income, the consumption of non-durable commodities at the household level has continued to expand and domestic solid waste generation has equally increased.

Conduits that feed into the domestic solid waste stream in Gaborone include residential homes and residential premises forming part of universities, colleges, schools and other government institution establishments. University of Botswana residential halls, Old Naledi, Phakalane and Gaborone West Block 5 are all examples of sources of domestic solid waste in Gaborone. Upon generation, domestic solid waste is stored at source in different types of receptacles. Waste is collected by the Gaborone City Council and transported straight to Gamodubu landfill for disposal.

<center>**Chapter 2**</center>

**LITERATURE REVIEW**

**2.0 Overview**

The purpose of this Chapter is to explore and critically discuss the various studies that have been conducted on urban domestic solid waste management, mostly in Developing Countries. Such studies provide concepts, approaches and findings on the topic under study. These should inform the current investigation on Gaborone. Finally, the literature review will highlight the knowledge gaps inherent in those studies and suggest how the present research intends to shed academic light on those areas that still require to be better understood.

The Chapter is divided into sub-sections. The first section will define the key concepts that are encountered in solid waste management research. The second section will examine the various elements found in different domestic solid waste management streams in different countries. The third section will examine the former and contemporary methods of managing domestic solid waste sustainably. This will be followed by a discussion on challenges and determinants of domestic solid waste management and the impacts of poorly managed waste on the health of humans, animals and surrounding environments. This will be followed by a discussion on best practices of solid waste management citing examples of countries where IDSWM has been implemented. Finally, the knowledge gaps that are apparent from these studies and how this research intends to deal with them will be elaborated.

**2.1 Definition of Terms**

The Government of Botswana (GoB, 1998) defines domestic solid waste or household waste as waste that emanates from any building used wholly for the purpose of living accommodation; a residential home and premises forming part of a university or school or such other educational establishments. Khitoliya (2004) defines domestic solid waste as waste emanating from household preparations, cooking and serving of food and waste paper, plastic, cloth and rags. Domestic solid waste consists of organic and inorganic constituents which may or may not be biodegradable. For purposes of this study, domestic solid waste

will be defined as any solid or semi-solid unwanted or unusable items, substances, remains, or by-products of any anthropogenic activities, discarded from residential areas.

Domestic solid waste can be classified as biodegradable and non-biodegradable. Bio-degradable waste is waste that can be degraded or decomposed by natural biochemical processes and include paper, wood, fruits and others. Non-biodegradable waste cannot be degraded by natural biochemical processes and it includes plastics, bottles, old machines, cans, styrofoam containers and others. Domestic solid waste can also be classified by its constituent material, for example:

*Glass:* all glass waste produced at households e.g. water glasses, juice bottles, test tubes, wind screens, broken windows, light bulbs, medicine bottles and certain food containers.

*Paper:* White photocopying and printing paper, newspapers, coloured paper, lined paper and old books and magazines.

*Cardboard:* This includes all packaging boxes.

*Plastic:* This includes plastic carrier bags from the retailing shops, and also juice and water plastic bottles.

*Rubble:* Waste generated from construction. It includes brick and concrete.

*Furniture:* This includes broken and old furniture from households (tables, chairs, cabinets).

*Food waste:* these include bio-degradable waste that is generated from food preparation and consumption.

There are different types of waste found in the domestic solid waste stream. These include:

*Food waste:* It includes animal, vegetable and plant residue emanating from handling, preparation, cooking and eating of foods. Most food waste is bio-degradable and decomposes rapidly in warm temperature and often leaves a foul odour.

*Garden or agriculture waste:* Includes waste from raising animals as well as crop and tree harvesting, tree trimmings and dead flowers and leaves.

*Ashes:* Dev (2007) and Puopiel (2010) both define ashes as waste resulting from the combustion processes in households. It emanates from the burning of wood, coal, garden

waste and domestic waste. In most African cities, where waste is not collected regularly, residents often burn it to reduce its volume.

*Rubbish:* These are materials that are non-biodegradable and they include paper, plastics, cans, bottles, glass, metals and ceramics (Dev, 2007). Puopiel (2010) defines rubbish as, "combustible materials like paper, cardboard, plastic, textiles, rubber, leather, wood, furniture and glass."

*Electronic waste:* As shown in Plate 2-1, E-waste is a collective terminology for the entire stream of electronic wastes such as used televisions, radios, refrigerators, telephones, air conditioners, computers, computer accessories and mobile phones.
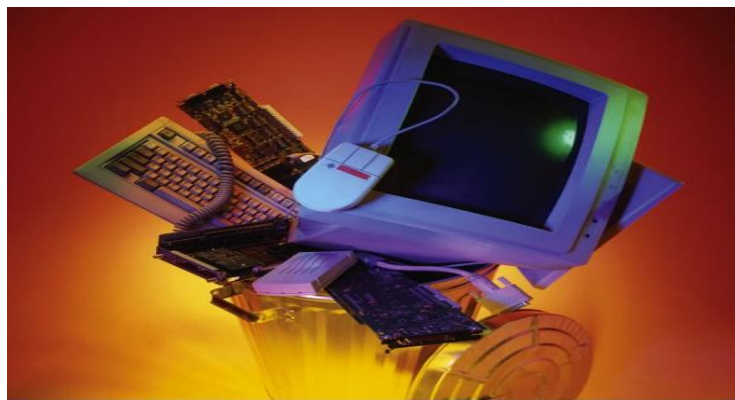


Plate 2-1: Electronic Waste

**Source:** http://en.wikipedia.org

*Demolition and construction waste:* Waste generated from demolition, renovations and construction of new buildings.

## 2.2 Domestic Solid Waste Management

Kumah (2007) defines solid waste management as being constituted by those activities that include the collection, source separation, storage, transportation, transfer, processing, treatment and its disposal. Tchobanoglous et al (1993) define proper solid waste management as:

> the discipline associated with control of generation, storage, transfer, transport, processing and disposal of waste in a manner that is in accordance with the best principles of public health, economics, engineering, conservation, aesthetics, and other environmental consideration.

From the above definitions, domestic solid waste management can then be regarded, generically, as those activities that include the generation, source reduction, collection, source separation, storage, transportation, transfer, processing, treatment and disposal of domestic solid waste generated in residential areas. Sustainable domestic solid waste management should seek to safeguard the health of human, animals and the environment and it should involve all stakeholders.

## 2.3 Elements of Waste Management Systems and Strategies

The primary functional elements of any waste management system are waste generation, onsite handling and processing, collection, sorting and processing, transfer and disposal (Khitoliya, 2004 and USEPA, 2010). Waste generation involves activities in which materials are identified as no longer being of value and are then thrown away or gathered together for disposal (Khitoliya, 2004). Geographical location, season of the year, socio-economic characteristics of the populace, extent of salvaging and recycling, public attitude and legislation are the key factors that affect waste generation trends and the waste profile.

After the waste has been generated it is handled, stored and processed on site. Onsite handling, storage and processing involves all those activities associated with waste handling until the waste is placed in storage containers for collection. Separating different types of waste components is an important step in the handling of waste. Different types of storage containers are used in different localities. The most common ones include black polythene refuse plastic bags, metal and plastic containers and large community skips. In some instances, composting and incineration are practiced at the point of generation. According to Khotoliya (2004), onsite storage of waste depends on the type of containers being used, public health issues, aesthetics and the collection method to be used. In Gaborone, household wastes are stored in metal receptacles, High Density Polyethylene refuse storage receptacles, metal refuse storage skips, black polythene refuse plastic bags and cardboard boxes. Waste handling also includes the movement of loaded containers to the point of collection.

When waste has been stored in different receptacles, on the day of collection it is either collected by municipal vehicles or private companies. Waste collection includes not only the

gathering of domestic solid waste and recyclables, but also the transportation of these materials to the location where the vehicles will be emptied. The location maybe a material processing facility, a transfer station or a landfill or dumpsite.

After recyclable materials have been collected they are transported to curb-side collection points, drop-off and or buy-back centres (Nakamura, 2007; Khotoliya, 2004; and Harro Von Blottnitz, 2009). Processing centres vary from country to country depending on the means and facilities that are used for the recovery of waste materials. The USA, Japan and Brazil use curb-side and buy back centres while in Lesotho they use drop-off and buy back centres. In Gaborone private drop-off centres like Northside Primary School and Somareleng Tikologo near Southring Mall are used. At these stations, the materials are further separated and processed and sent to recycling centres or companies.

All waste that could not be recovered for recycling is then be transferred and transported to disposal sites. Waste is then either landfilled or incinerated with or without energy recovery.

## 2.4 Evolution of Solid Waste Management Strategies

In the 1950s, in African cities, waste was mainly composed of ash from fires, wood, organic and vegetable waste (Saungweme, 2012). Domestic solid waste was disposed of in the ground where it would act as compost and help improve soil quality. As city populations grew, the space for disposal decreased and societies had to begin developing the necessary waste disposal systems. The most common methods used were either to burn personal waste, bury it or leave it to pile up. The piling up of waste in cities caused stench, harbored rats and other pests, led to the contamination of water supplies and perpetuated human diseases. Saungweme, (2012) notes that these systems of domestic solid waste management were limited to waste storage, collection and disposal. The earlier methods focused on waste disposal and not on preventive methods to reduce the amount of waste generated, alienated stakeholders in decision-making for the planning and management of waste.

The earlier methods also focused on the technology to solve solid waste problems. Heavy expensive machines were used to collect, haul, transport and dispose of waste. This engineering approach worked in developed countries, however in developing countries it was unaffordable because governments could not meet the associated costs of acquiring, operating and maintaining the machinery (Saungweme, 2012). As a result, urban residents resorted to dumping waste in open spaces, road sides, unauthorized dumping sites, water bodies, drains and gutters and open burning.

Open burning has been and is still being practiced in several urban centres in Africa among those who want to reduce the volume of waste to be collected and transferred to dumpsites and those who wish to extend the life of their dumpsite or landfills (Tsiboe and Marbell, 2004). Garbage was burnt because of the ease, convenience and cheapness of the method. Open burning has, nonetheless, many negative effects on both human health and the environment. It releases dioxins, particulate matter, polycyclic aromatic compounds, volatile organic compounds, carbon monoxide, hexachlorobenzene and ash into the atmosphere. All of these chemicals pose serious risks to human health and the environment.

In response to the Rio Declaration and recommendations of Agenda 21, the international community came up with a waste management hierarchy which would be adopted by countries to curb waste management problems. The internationally accepted waste management hierarchy shown in Plate 2-2 laid a base for the contemporary methods of handling waste that include source reduction, recycling, reuse, composting, incineration and use of sanitary landfills with energy recovery (Kwailane 2012).



Plate 2-2: Solid waste management hierarchy.

**Source:** http://www.sustainabilityed.org

The main aims of the internationally accepted solid waste management hierarchy, shown in Plate 2.2 are to:

- Divert waste from the landfill;

- Save money through avoided disposal costs;

- Promote re-use , recycling and reduction; and

- Create and sustain a recycling culture.

There are three basic strategies of waste management, namely; waste prevention, re-use and recycling. Waste prevention, also called "source reduction", seeks to prevent waste from being generated. Waste prevention strategies include using less packaging and designing products to last longer. Waste prevention helps reduce handling, treatment, and disposal costs.

Re-use implies using a product more than once, either for the same purpose or for others. Re-use does not require the reprocessing of materials and therefore has lower energy requirements. Re-use strategies include donating products to charity, reusing packaging such as boxes and bags, and using empty jars for the storage of other commodities.

Recycling involves collecting, reprocessing, and/or recovering certain waste materials (e.g., glass, metal, plastics and paper) to make new materials or products. Some recycled organic materials are rich in nutrients and can be used to improve soils. Recycling could generate many environmental and economic benefits. For example, it usually creates employment and income, supplies valuable raw materials to industry, produces soil-enhancing compost, and reduces greenhouse gas emissions and the number of landfills and combustion facilities.
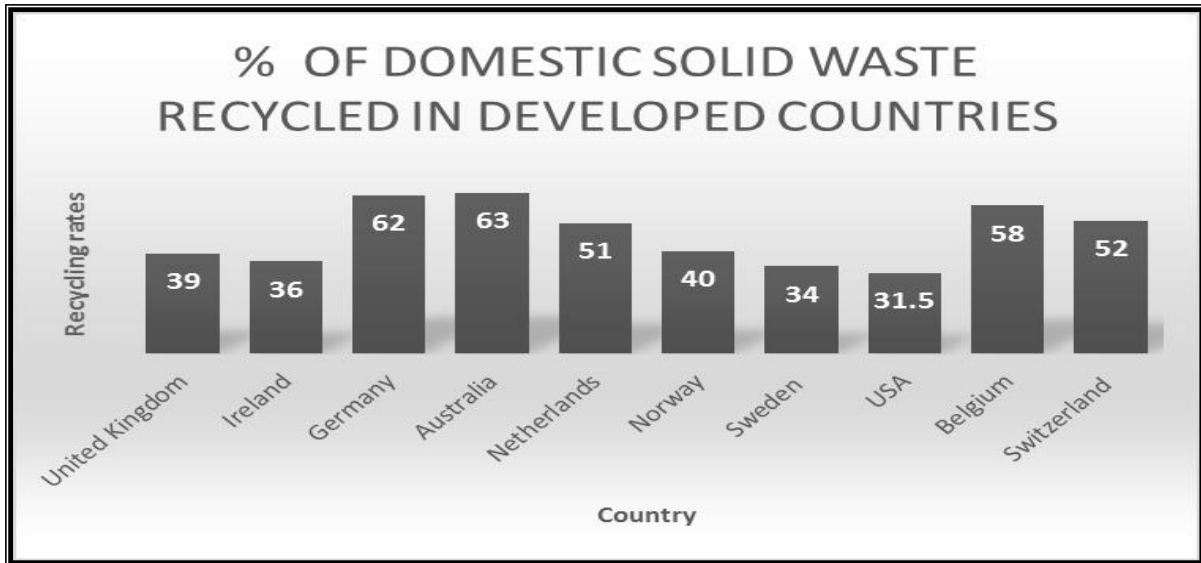
Figure 2-1: Municipal Solid waste recycling statistics in developed countries in 2010.

**Source:**http://www.eea.eu/newsreleases/highest-recycling-rates-in-australia.     Accessed   15 November 2013

Figure 2-1 shows results of a survey conducted by the European Environmental Agency (EEA) on household recycling in 27 European Union member states in 2010. EEA reported that 5 of the 27 countries managed to reach the 50% recycling rate of domestic solid waste. Figure 2-2 implies relatively few developing countries have successfully encouraged a culture of recycling by providing infrastructure, incentives and by public awareness campaigns.
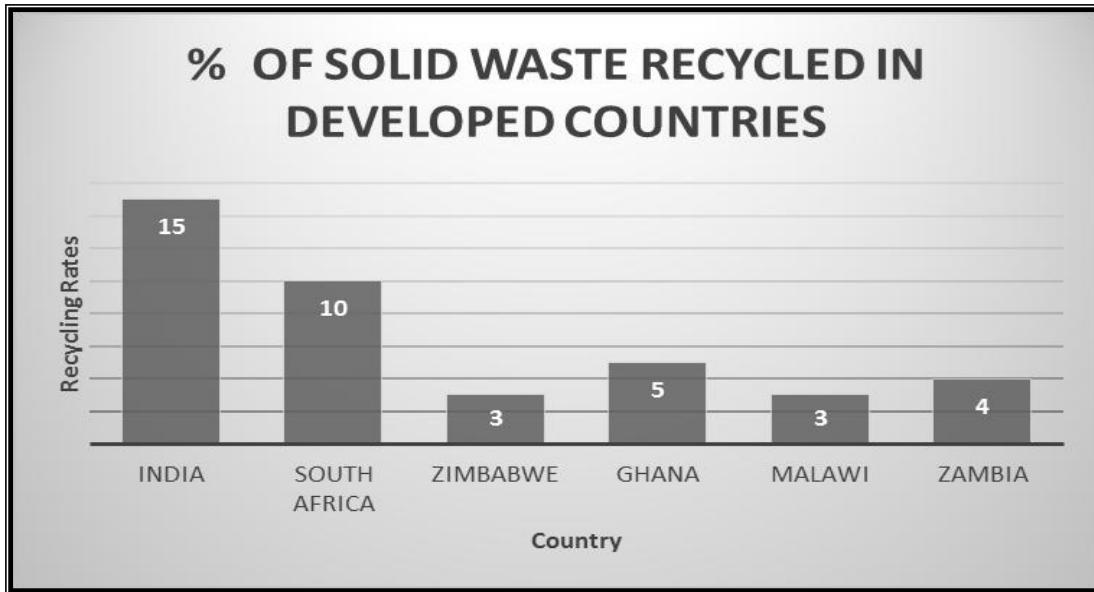
Figure 2-2: Waste recycling statistics in developing countries in 2010

**Source:** Council for Scientific and Industrial Research website accessed 10 December 2013

A comparison of recycling efforts between Figure 2-1 and Figure 2-2 shows that developing countries are lagging behind, consequently wasting huge volumes of resources by sending them either to dumpsites or landfills. Plate 2-3 shows some of the various advantages of the recycling process. These include reduction in; global warming, acid deposits, air pollution, water pollution, solid waste disposal, energy demand, mineral demand, habitat loss and protection of both flora and fauna species.
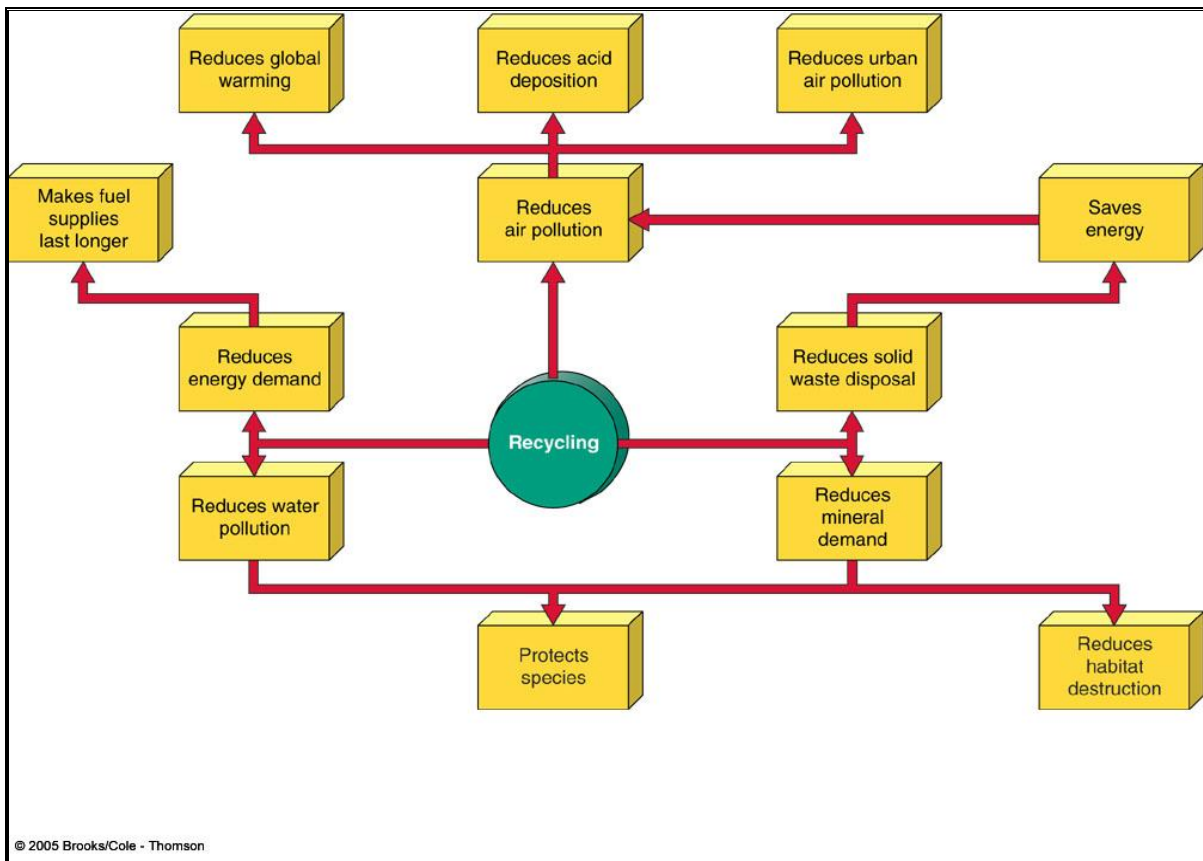
Plate 2-3*:* Benefits of Recycling

**Source:** www.greenvolved.org:

Composting is the controlled aerobic decomposition of organic matter by the action of microorganisms and small invertebrates. Composted material can be used as organic fertilizer. Composting is an old practice, adopted by numerous households in African cities in their gardens or backyards as a strategy of reducing waste. Composting is done using bio-degradable waste. Zerbock (2003), comments that composting, a low-technology approach of reducing waste, is ideal for developing countries since over 50% of their solid waste is made up of organic material. However, most organic waste in Africa ends up in the municipal bins.

Disposal activities are used to manage waste that cannot be prevented or recycled. Waste treatment techniques seek to transform the waste into a form that is more manageable, reduce the volume or reduce the toxicity of the waste thus making the waste easier to dispose of. Treatment methods are selected based on available financial resources, the composition, quantity and form of the waste material. Some waste treatment methods being used today include subjecting the waste to extremely high temperatures, dumping it on land or land

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filling and use of biological processes to treat the waste. It should be noted that treatment and disposal options are chosen as a last resort.

## 2.5 Determinants and Challenges of Domestic Solid Waste Management in Developing Countries

The generation rates and quantities of domestic solid waste in many cities in developing countries have increased at an alarming rate over the years. The generation rates, source separation, re-use, recycling and disposal of domestic solid waste are, however, functions of several factors. These factors include income, household size, education level and awareness, religion, culture and attitude towards the environment.

Income is directly proportional to waste generation quantities. The amount of waste generated by a country is proportional to the living standards of its residents (Medina, 1997; Haider, 2010; Afroz et al, 2010; Nilanthi, 2007). Studies in Colombo- Sri Lanka, Accra-Ghana, Dhaka-Bangladesh, Kampala- Uganda and Bhakkar- Pakistan have shown that residents in high income areas generate more waste than those in low income areas (Medina, 1997; Haider, 2010; Afroz 2010; Tsiboe and Marbell, 2004). Heider (2010) observed that as income increases the demand for commodity products also increases.

Heider (2010) observed that in Pakistan the size of household affects the quantities of waste generated. Large families generate more waste since more individuals are included in the generation of waste for the household unit. In Pakistan, Heider (2010) observed that a 1 % increase in household size brings a 0.81 % increase in waste generated.

Education and awareness play a vital role in waste management as observed by Heider (2010) and Afroz et al (2010). Education and awareness are responsible for shaping the residents' attitude towards their environment (Chanda, 1997). A study by Afroz et al, (2010) shows that 75 % of Bangladesh urban residents who separate domestic solid waste at source are well aware of the importance of keeping their environment clean. These residents get information about source segregation from television, radios and newspapers. On the other hand, residents who are not well informed about waste management tend to litter a lot and dump waste

illegally. This suggests that municipal authorities ought to find ways to reach out to residents who do not have access to mass media such as TVs, radios and newspapers. A study by Babayemi and Dauda (2011) in Abeokuta- Nigeria showed that awareness of waste management regulations and policies was highest among residents with tertiary education and lower among those who had primary education. Most urban residents in Nigeria who did not practice the 3Rs were not educated on the practice. Policy formulation should therefore focus on raising awareness, promoting knowledge and motivating households with regard to environmental and waste management practices.

Gender and cultural beliefs also play an important role in urban waste management. Women are responsible for waste handling at the household level because they are responsible for cleaning the domestic premises since they spend most of their time at home. Men are less concerned about waste management at home because they spend most of their time outside the home. Men only appear in waste management systems if they are employed by the city councils (Tsiboe and Marbell, 2004).

Domestic solid waste management in developing countries remains an issue of growing concern, especially where city councils are either unable or unwilling to provide waste management services to their residents. Domestic solid waste management has been and is still a challenging task for most developing countries due to lack of trained personnel, weak legislation for waste management, inadequate facilities for waste management and rapid urbanisation.

Most governments in Africa are overburdened by severe debts such that they cannot afford to provide necessary services such as clean water or electricity to their residents. Under such circumstances, allocation of finances to services like waste management is not a priority. Several solid waste management budgets are financed partly from waste collection fees (GCC, 2014; Tsiboe and Marbell, 2004). However, a lack of effective legislation to enforce the payment of waste collection fees from residents leave the affected municipalities with no money to service debts, cover operation and management costs and to replace assets. As Tsiboe and Marbell (2004) have noted, in most African cities where a waste collection fee has been introduced like in Accra, Ghana, only high income areas are well serviced because

residents regularly pay for waste collection. On the other hand the low-income areas either rarely or do not receive waste collection services at all because residents fail or cannot afford to pay.

Waste management is a relatively engineering intensive discipline that requires personnel with relevant technical expertise in its day-to-day operations. Ogawa (2006) asserts that developing countries lack human resources that have relevant technical expertise to manage solid waste. The same view is shared by UNEP (2007), that developing countries lack the adequate numbers of human resources who have appropriate qualifications to solve solid waste problems in their countries. Kwailane (2012) and Maphorisa (2000), all observed that Botswana suffers from the same predicament. Most personnel employed in the urban waste management stream lack the necessary technical know-how to handle waste and this leads to poor waste management practices.

In developing countries, there has been a tendency to standardise waste collection fleets, with the obvious objective to reduce the costs of maintenance and supervision. The result has been that whole areas have been left out, because some of the streets are too narrow, unpaved, or too sloping to be used by the huge waste collection trucks. Such areas often happen to be low-income neighbourhoods, located either at the urban fringe or in densely-populated old city centres (Saungweme, 2012). Leaving these areas subserviced, subsequently affects environmental and public health conditions in the whole city. Gwebu (2002) noted that Old Naledi in Gaborone suffered from a similar problem where roads were too narrow for refuse trucks to do door-to-door waste collection. As a result, Gaborone City Council provided communal skips where residents could deliver their refuse for the city council to collect. It was observed that the system was not coping because waste was being generated faster than the rate at which skips were being emptied. This would leave skips overflowing with waste rotting, posing a risk to the local residents and the environment.

Developing countries also face several institutional challenges which all contribute to poor waste management. These include lack of policy frameworks, lack of legislation to enforce laws, poor governance, corruption and unnecessary political interference. In most countries,

high profile cabinet ministers or politicians have been awarded contracts to clear waste, but they tend to collect the service fee without collecting the waste (Saungweme, 2012). Many countries have waste management policies in place but they lack implementation capacity and legislation to arrest and charge law breakers (Saungweme, 2012). In some instances the policy framework focuses more on waste disposal methods instead of raising community awareness, promoting knowledge and motivating households with regard to sustainable waste management practices.

Even with proper policies and Acts in place, Botswana still struggles with waste management problems. The noble principles of the Waste Management Act of 1998 are never put into practice. Residents are not aware of the Act and the authorities responsible are not involving waste generators in waste management. Services like education and awareness are never extended to residents (Kwailane, 2012). According to Chanda (1997) sustainable environmental management requires appropriately attuned human perceptions and attitudes and both perceptions and attitudes can be changed through education and awareness.

Tsiboe and Marbell (2004), noted that in Ghana culture plays a vital role in waste management. Culturally the girl-child or the females are involved in taking care of the household, including cleaning both the house and its immediate surroundings. Women basically spend the whole day at home and their activities like cooking, washing and sweeping apparently produce more waste than men who spend most of the day away from home. This leaves the responsibility of domestic solid waste management solely to females because the men make it clear that because they do not produce waste, they should not be bothered (Kwawe 1995).According to Navez-Bouchaire (1993), the management of household waste is tied to cultural perceptions and social practices, hence the need to involve man in solid waste management at household level, through cultural change.

The typical domestic solid waste stream normally contains general waste, refuse, hazardous waste like detergents, food waste, paint and empty medicine containers, construction and demolition debris. Improperly managed solid waste poses a risk both to human health and the environment. Uncontrolled dumping and improper waste handling causes a variety of

problems, including contaminating water, attracting insects and rodents, increasing disease transmission, damaging ecosystems, injuring people and property, discouraging tourism and business and increasing flooding due to blocked drainage canals or gullies. For example in the Philippines, more than 200 people died and hundreds were injured when the Payatas Dumpsite collapsed in 2000. In addition, inappropriately managed waste may result in safety hazards from fires or explosions. Improper waste management also increases greenhouse gas (GHG) emissions, which contribute to climate change (Saungweme, 2012). Planning for and implementing a comprehensive program for waste collection, transport, and disposal, along with activities to prevent or recycle it, could eliminate these problems.

## 2.6 Best Practices of Domestic Solid Waste Management

Efforts have been made by Local Authorities and Municipalities to handle solid waste in developing countries, but available evidence shows that they have failed to solve the solid waste problems they are facing (Tsiboe and Marbell, 2004). Developing countries channel more than 30% of their budgets to waste management yet more than 50% of domestic solid waste remains uncollected (UNEP, 2009). UNEP (2009) has suggested that the only way to solve domestic solid waste management problems is to adopt an Integrated Solid Waste Management Strategy for communities.

Tanskanen (2000) defines an Integrated Solid Waste Management System (ISWMS) as a selection and application of suitable techniques, technologies, and management programmes to achieve waste management objectives and goals. Pourideme (2010) defines an Integrated Solid Waste Management System (ISWMS) as a comprehensive solid waste management model that combines elements of waste prevention, recycling, composting and disposal with active stakeholders' participation which ensures efficient and sustainable waste management. Klundert (1999) defines an Integrated Solid Waste Management System (ISWMS) as a strategy that uses a range of inter-related collection and treatment options, at different habitat scales (household, neighbourhood, and city). It involves all stakeholders, be they governmental or non-governmental, formal or informal institutions, profit- or non-profit oriented organisations and takes into account interactions between the existing waste management system and other urban sub-systems. From the three foregoing definitions any ISWMS should acknowledge that residents have a right to waste management, they should

participate in the waste management decision-making process and it should seek to protect the health of the residents and the environment. Any Integrated Solid Waste Management system should be socially acceptable, economically viable and environmentally sustainable. According to Bartone (2000), a well employed IDSWMS should have the following benefits: lower operating costs, better cost management and cost recovery, fewer health hazards, less environmental pollution, conservation of natural resources, better coordination and performance, and improved public participation.

The IDSWM system has been pilot- tested in a few locations including Tokyo- Japan, Pune- India, Cairo- Egypt and Maseru- Lesotho where it has been well received by local authorities and residents. It has been shown that with an appropriate segregation and recycling system in place, significant quantities of waste can be diverted from landfills and converted into a valuable resource. The benefits of ISWM System include, reduction in collection and disposal fees, resource conservation, creation of business opportunities and economic growth, cleaner and safe communities, income generation and saving cities from drowning in waste (Klundert, 1999).


Since its implementation in Japan focus has been on educating residents on source segregation. Waste management studies have been incorporated into the education system. Waste management education starts from as early as the kindergarten stage. To date Japan recycles more than 60 percent of its domestic solid waste (Daimon, 2011). The Government has encouraged the growth of private waste management companies. These companies own recycling centres, landfills, incineration and hydration facilities. Notably, the following Companies earned more than US$ 80 million each in 2005: Daiei Kankyo US$ 174 million, Miyana Inc US$ 111million, Takeei Pvt Ltd US$ 86 million and Term Cooperation US$ 128million (Nakamura, 2007). Clearly these revenues are enough to encourage any individual to join the waste management business.


India produces an estimated 115,000 Metric Tonnes of solid waste every day and domestic solid waste accounts for over 50 percent of the overall generation (Chikarmane and Narayan 2009). Domestic solid waste management accounts for more than 70% on the metropolitan budgets. As the waste management budgets expanded and problems grew, the Pune Municipality decided to employ an ISWMS to curb the problem. One notable NGO operating

in Pune is the Solid Waste Collection and Handling (SWaCH) enterprise. The cooperative provides door-to door waste picking services. To date, the cooperative operates in 127 residential areas in Pune, services more than 200 000 households and has employed 1500 waste recyclers (GTZ, 2010). Statistics show that in 2010 of the 8 million tonnes of waste paper that India required, half of it came from waste pickers and of the 6.8 metric tonnes of plastic that it required, 3.6 metric tonnes came from plastic recovered by waste pickers (Chikarmane, 2012).

In Maseru- Lesotho, an IDSWMS was introduced in 2008 with the aims of fighting poverty through job creation, raising the residents' awareness on waste management issues and to clean up the city. During the first 3 years of its operation from 2008-2011, 104 direct jobs were created, the aesthetic aspect of the city was enhanced through improved waste management services and business opportunities were created for local entrepreneurs in the waste recycling business (GTZ 2010).

## 2.7 Knowledge Gaps

There are a number of important studies that have been undertaken on the waste management systems in Botswana such as Phatswe (2001), Gwebu (2003), Gwebu (2002) and Kwailane (2012). There is a general consensus that city councils in Botswana, unlike other African cities, collect more than 60 percent of their domestic solid waste. Kwailane (2012) notes that in Lobatse, generally, solid waste services are rendered in a satisfactory manner regardless of the socio-economic situation of a given area. Effective waste collection on its own does not amount to sustainable waste management as long as the 3Rs of waste are not practiced. Kwailane (2012) notes that only 30.6 percent of urban residents agree that they are involved in the planning and decision–making in waste management. This shows that public participation and education and awareness among residents is still comparatively very low in Botswana. Hence the need to introduce an ISWMS which will include residents in decision-making as they are the major stakeholders in waste management. Previous studies in other developing countries have shown that factors like income, household size, education and awareness, gender and cultural beliefs affect the waste management stream. This study will enquire if similar factors hold true for Gaborone.

## 2.8 Conceptual Framework

The linkages between population, development and the environment have been expressed through the Ehrlich and Holdren Model (1971).

I=PAT

The equation was put forward in an attempt to describe the role of multiple factors in determining environmental degradation. It describes the multiplicative contribution of population, affluence and technology to environmental impact.

For the purpose of this study (I) will represent the impact of poor waste management practices on the environment. (P) Represents population growth, whilst (A) refers to the average consumption of each person in the population and (T) refers to processes employed by the population to obtain resources and transform them into consumable goods and wastes.

For example, from the studies that have been reviewed above, waste generation increases with the increase in population and affluence. When the population growth is not matched by an increase in provision of waste management services (T), the population will exert pressure on the existing waste management system. The system will eventually fail to cope and residents will begin to illegally dispose of their waste. These actions will have severe negative impacts on the environment like pollution that harm both humans and animal life. At that stage, interventions would be sought to improve the situation. Residents would be educated on the impacts of poor waste management practices. Education would be used as a tool to change attitudes. Strategies like IDSWM systems would also be employed to help existing systems to solve the domestic solid waste problems.
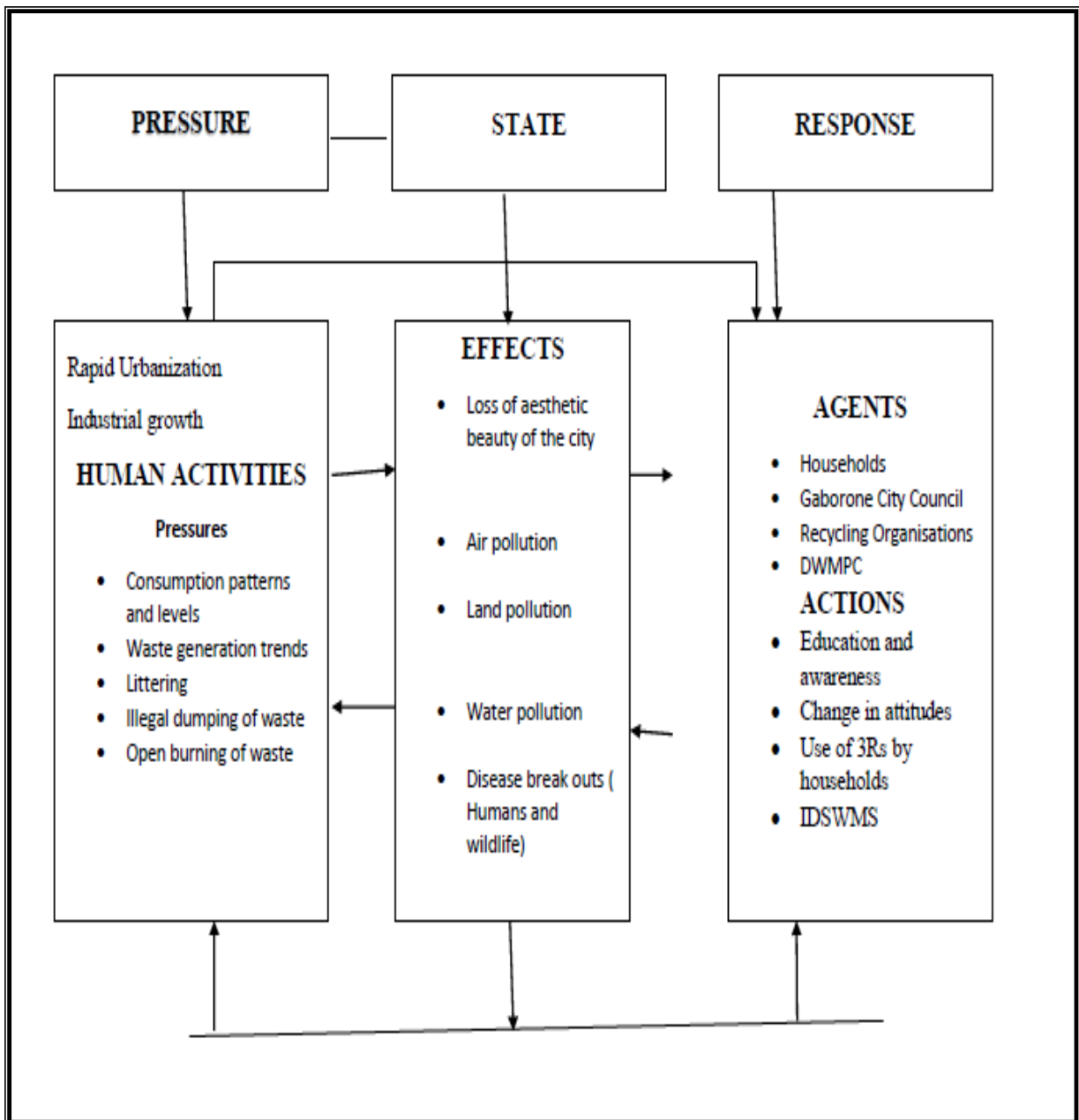
Figure 2-3: The Pressure-State-Response Framework.

**Source:** Adapted from, Towards Environmental Pressure Indicators for the EU- First Edition (1998)

Figure 2-3 depicts the Pressure-State-Response Framework. The drivers for the model are both economic and social. As population grows, there will also be a growing need to satisfy its needs. Thus industries respond by expanding to meet those needs. However, the growing population and expansion of the industrial sector will cause more resources to be exploited and an increase in waste generation.

When population grows without a matched growth in service provision there is a tendency to exert pressure on the available services and the environment. The Municipalities are failing to cope with waste being generated because of pressure on limited financial and skilled human resources available to manage the domestic solid waste being generated.

As a result, residents resort to the illegal dumping of waste. The waste ends up rotting on the roadsides or streets. Illegal dumpsites get created in open spaces either within the residential area or at their outskirts. These illegal dumpsites create breeding grounds for insects, rats and diseases. Residents also resort to open burning of waste. The city continues to lose its attractiveness because of waste lying everywhere. As more waste is generated at a faster rate than it can be compacted, most landfills are reduced to mere dumpsite. The impacts of poor or inadequate waste management systems include air pollution, ground and surface water pollution, foul odours and disease outbreaks. There tends be a corresponding increase in number of residents who suffer from diseases like malaria, cholera and various respiratory diseases.

In response to these threats, different nations tend to focus on different factors to reduce their overall impact on their environments. More affluent countries could contribute most by reducing their level of consumption whilst many developing countries could contribute most by reducing their population, making their technologies more efficient and coming up with systems that reduce the waste they generate. Various stakeholders in waste management could come up with actions to solve the waste management problems. In Gaborone stakeholders like households, City Council, Recycling Organisations could employ waste reduction systems. The most effective way could be to introduce an Integrated Domestic Solid Waste Management system that focuses on the 3Rs (re-use, reduce and recycle). Using the 3Rs would not only reduce the environmental impact of waste generation, but it could also help in creating employment for the waste recyclers and provide raw materials for the growing industries. The use of the 3Rs can only be effective if awareness is raised on the impacts of unsustainable waste management (Kwailane, 2012 and Chanda, 1997). DWMPC and GCC need to come up with polies and City Council with policies that focus on education and awareness creation. The last two studies emphasize the important and recurring theme on

the role of cognitive factors in domestic solid waste management. Establishing this relationship is the major thrust of this research. As shown in Figure 2.4, certain elements of this conceptualization derive from the Pressure-State-Response Framework format above but the behavioural ones are unique constructs.
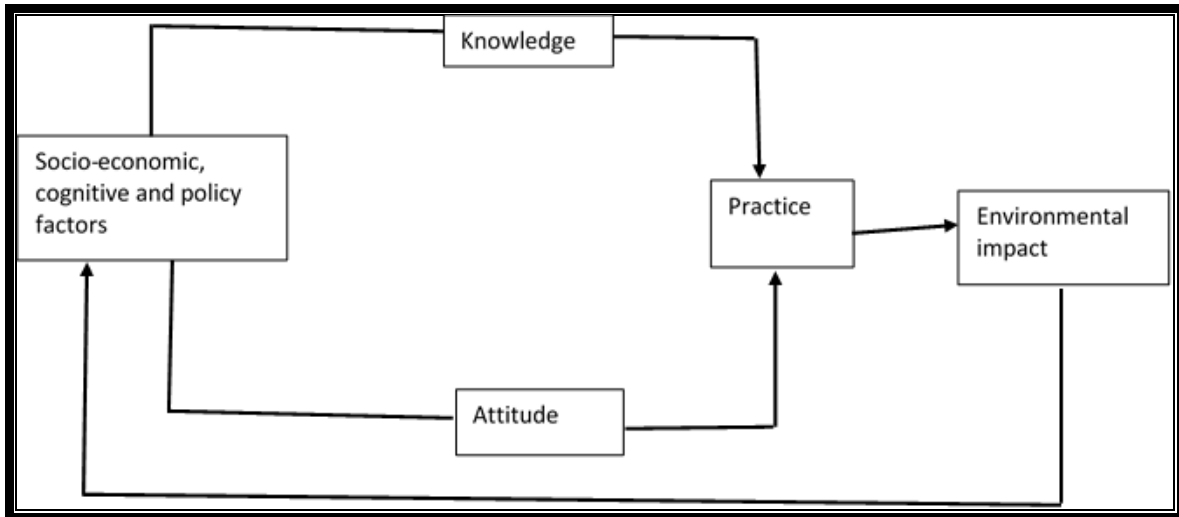


Figure 2-4: The role of socioeconomic, policy and cognitive factors on environmental management

 **Source:** Author (2014)

The main point is that domestic solid waste management is determined by socio-economic, policy and cognitive factors as shown in Figure 2-4. Studies by Afroz et al (2010), Haider, (2010), Nilingiye et al (2010), Babayemi and Dauda (2011) and Nilanthi et al (2007) show that the amount of knowledge residents have determines their attitudes towards the environment. In turn attitudes affect the various practices employed by residents in both waste generation and handling. Both sustainable and poor waste management practices will have different significant impacts on the environment. Acceptance or rejection of the proposed alternative strategy is therefore dependent on the significance that is attached to these factors by the stakeholders, particularly the households.

# Chapter 3

## RESEARCH METHODOLOGY

### 3.0 Introduction

The research design for this study can be termed a hybrid research design (Mouton, 2001) because it made use of primary data and relevant existing data and information. It combined both numerical and textual data and information. Various methods were used to collect pertinent data and information. These included a social survey, key informant interviews, field observations and the consultation of diverse secondary data sources. This use of triangulation is encouraged because combining different methods in a single study enhances the accuracy of conclusions provided that all the methods employed produce valid and consistent research results (Bryman, 2004).

Both quantitative and qualitative methods of data collection were used. The advantage of collecting quantitative data is that it facilitates a variety of statistical analyses to be performed (Babbie, 2004). However quantitative data has a potential loss of richness in meaning (Babbie 2004; Kitchin and Tate, 2000). Quantitative data was used to obtain facts and analyse relationships between sets of variables and thereby facilitating a generalised conclusion. Quantitative methods were used to collect data on socio-demographics and socio-economic characteristics of selected residents and their waste generation trends.

Qualitative methods were used to gather information on people's attitudes and feelings about the current waste management system in Gaborone. Qualitative data is non-numerical data. It is data that deals with words and typically verbal description of an issue or information needed. It is guided by fewer universal rules and standardised procedures than statistical data. In this study, qualitative data consisted of open-ended responses to interview schedules and case studies. A qualitative research approach is important for the understanding of individuals' perceptions on matters under investigation by providing their subjective insights of the world. It could however be prone to bias where the opinion of individual measurement scale varies per individual.

## 3.1 Selection of study sites

Old Naledi, Block 5 and Phakalane are the three selected study sites that are representative of the socio-income groups of Gaborone. Old Naledi a low income residential area; Block 5 a middle income area and Phakalane a high socio-economic site. The three residential areas were selected so that the researcher could make a comparison of the impacts of socio-economic and demographic data on waste generation trends, stakeholder views, service provision and the feasibility of introducing an integrated solid waste management strategy.

The socio-demographic attributes of the three residential areas are shown in Table 3-1.

Table 3-1: Main Characteristics of the 3 residential areas selected

| Characteristics | Residential Area | | |
|---|---|---|---|
| | Old Naledi | Block 5 | Phakalane |
| Population | 19,075 | 7,231 | 7,028 |
| No of residential plots | 1736 | 1049 | 2103 |
| Economic Level | Low | Medium | High |
| Access to utilities | Yes | Yes | Yes |
| Type of Building | Low cost | Medium cost | High cost |

**Source:** The Department of Town and Regional Planning (2013)

## 3.2 Social Survey Sampling Procedures

According to Seale (2004), sampling is performed to statistically represent a population. For the social survey, a multi-stage sampling procedure was adopted. Firstly, residential areas in Gaborone were stratified into three distinct socio-economic groups namely; high-income, medium-income and low income. From each stratum residential areas for this study were then randomly selected.

From each residential area the sample size of the number of plots was determined using Yamane (1967) simple statistical formula.

$$n = \frac{N}{1+N(e)^2}$$

Where n = targeted number of plots

      N = total number of plots

      e = margin of error

The advantage of using the formula is that it provides 95% confidence limits for the sample size for a stipulated margin of error, which is 10% in this case. On the basis of the formula, 95 plots were chosen from Old Naledi, 91 from Block 5, and 95 from Phakalane. However, because of time a 50 percent sampling fraction was used to select the actual number of household units from each residential stratum. Consequently, the number of units selected were 48, 45 and 48, respectively.

Most plots in Gaborone consist of more than one household unit making them multi-residential. In Phakalane and Block 5, a plot mainly consists of a main house and a cottage, however in Old Naledi, it usually consists of the main house and several other out buildings that are occupied by different households. For the purpose of this study, the main household was targeted as the unit of analysis. Targeting the main house in a multi-residential set up is one of the limitations to this study as other households in the same plot might possess different demographic characteristics that determine practice in waste management.

From each plot, the household head was targeted. In the absence of the household head, any individual above the age of twenty-one provided answers. Where there was no potential respondent at a targeted household, the targeted plot was replaced by the next one.

## 3.3 Data Collection Tools

### 3.3.1 Questionnaire

A questionnaire was designed and used to collect the primary data for the social survey. See Appendix A.

A questionnaire can be defined as a collection of questions (Barrie, 2005). When a researcher is using a questionnaire, there are ethical considerations to be taken into account, i.e. the respondent must be willing to answer the questions presented to him or her. The advantages of using it are that it is, firstly, a cheaper method of collecting data and information because a larger population can be covered with less effort since this method requires distribution and collection. This is not as labour intensive as conducting the in-depth interviews (Babbie, 2005). Secondly, it is free from bias since respondents have to write down answers to structured and predetermined questions. However, this method is open to ambiguous replies and omissions of other questions. Also, people might not respond to all questions and even if they complete their answers, they may not be able to do so as anticipated by the researcher, therefore it could be the slowest of all methods used by the researcher.

A structured and open- ended questionnaire instrument was used to conduct the interviews on the selected respondents to facilitate the compilation of quantitative statistics and qualitative information. Questionnaires were administered by the researcher and research assistants. The questionnaire close- ended questions provided a greater uniformity of responses that were easily processed, and limited the respondent to give the most appropriate answers. The element of omission was counted by going through the questionnaire to see if all questions have been attempted before collection. The open –ended questions provided the data required to capture the perception aspects that underlay this research.

### 3.3.2   Key Informant Interviews

Key informant interviewing is a form of systematic talking and listening to some people who have experience and knowledge on the topic of a selected study (Kerry, 2004). The draw backs of using this method are that it uses predetermined questions and high standard recording techniques, making it an expensive method of data collection. This method requires an interviewer who stays focused to the key open-ended questions and does not deviate. However, it gives in-depth information and is a flexible method as the interviewer can restructure questions (Kothari 2010) to suit each situation. It can be adjusted to also suit the language needs of the respondent.

Key informant interviews were conducted with representatives from the:

- Department of Waste Management and Pollution Control. Information collected was on waste management services, existing waste management policies, bye-laws and Acts.

- Gaborone City Council. Information collected was on demographic trends, which includes population's growth trends, population composition and housing and the existing waste management systems.

- Recycling organisations. Information collected was on the market of recyclables.

All the key informant interviews were conducted face- to- face by the researcher. An interview guide with both closed and open ended questions was used.

### 3.3.3 Field Observations

An observation guideline was designed to monitor the various effects of waste management on both human and physical environments. Site visits, aimed at observing and documenting environmental impacts and their nature, were then conducted. Where appropriate, photographs were taken to confirm a few environmental impacts.

### 3.3.4 Secondary Data Sources

A desk study was conducted on what has already been done on this topic in both the developing and developed world. Using this technique, the researcher sought to obtain or source existing relevant information with the aim of deriving maximum benefits from existing information and data on previous studies conducted. Case studies were compiled using information already available in literature in Botswana and other countries. Sources included the internet, University of Botswana library, Non-Governmental Organisations (NGOs), Community Based Organisations (CBOs), Gaborone City Council and Department of Waste Management and Pollution Control and Ministry of Environment Wildlife and Tourism. This provided the necessary background information and data from the findings of previous studies that have been carried out by other scholars on the same topic. This is a faster way of getting information and is a cheaper method as some of the documents with the relevant information are freely available. The secondary data sources helped the researcher in understanding the key concepts and challenges in solid waste management especially in

developing countries. This helped the researcher to identify gaps and pointed to areas to pursue for the contributory purpose of this study.

## 3.4 Data Processing and Data Analysis

Data processing and analysis involved the summarizing and interpretation of the data and information collected. After data collection, questionnaires administered during the social survey and key informant interviews were examined and checked for completeness, accuracy and consistency to minimize computational and analytical errors. Table 3-2 show the variable definition format followed when conducting the preliminary summary of the data before entry into the SPSS software.

Table 3-2: Listing of variables

| Variable name | Numeric code | Label | Value | Scale |
|---|---|---|---|---|
| Education | 1 | EDUCTN | Years in School | Interval |
| Income | 2 | INCOME | Monthly | Interval |
| Length of urban stay | 3 | Urbanization | Years | Interval |
| Quantity of waste | 4 | Qwaste | Cubic meters | Interval |
| Sex | 5 | Gender | Male=0,Female=1 | Nominal |
| Locality | 6 | Site | Old-Naledi=1, Block5=2, Phakalane=3 | Nominal |
| Practice | 7 | Disposal strategy | Measured on a semantic difference or likert scale. Values will be converted to interval scale through SPSS transformation function | Nominal |
| Attitude | 8 | Attitude | | Nominal |
| Knowledge | 9 | Knowledge | | Nominal |
| Household size | 10 | Size | Number | Interval |

**Source:** Author (2014)

The responses in the questionnaires were pre-coded. Each listed response fitted into one and only one of the categories. Both the quantitative and qualitative responses were then captured in the Statistical Package for Social Science (SPSS) database that the researcher created for the study for the ease analysis of the quantitative data. Cross tabulations were used to relate a variety of socio-demographic to residential variables.

Figure 3.2 illustrates an important component of the study that attempts to determine the linkage between cognitive factors and how they are linked with behavioural ones in an integrated domestic solid waste management strategy. The guiding operational format for this waste management perception study derives from sexual and reproductive health conceptual framework on the inter-relationship involving Knowledge, Attitude and Practice, commonly referred to as the KAP triad. Figure 3-1: The Relationship between Knowledge, Attitude and Practice in Domestic Solid Waste Management
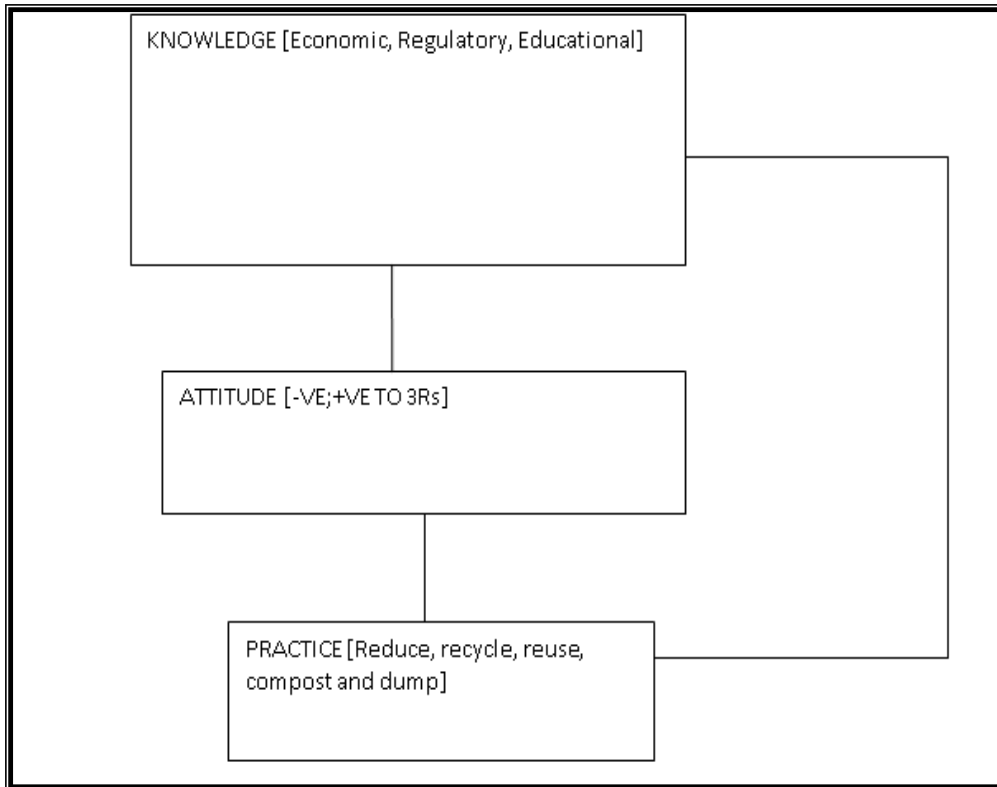
Figure 3-1: KAP Relationship

**Source:** Derived from Gwebu (2013)

Several techniques exist for calibrating perception and cognition variables. Among the simplest and most relevant for this study is magnitude estimation. Magnitude estimation has been utilized by psychophysicists to measure and analyse perceived aircraft noise levels by respondents. In several experiments, responses of several individuals, assumed to represent a homogenous group, were averaged and then plotted against the decibel values of the stimuli, producing a smooth curve of the form:

$$R = KS^n$$

where; R is the response value in arbitrary units,

S is the stimulus value in decibels,

n is an empirical but non-arbitrary exponent, and

K is an empirical constant dependent on units

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The assumption is that the objective decibel sound scale is best captured by the response value in arbitrary units.

Briefly, then, magnitude estimation involves subjective individual rating of the sound variable on a scale calibrated from zero to a specified maximum. Its advantage is that this rating scale can be generated for the measurement of other stimuli apart from sound. Its main drawback is that it considers only unit variables.

An alternative if more complete answer to this challenge is provided through the computation of single variables from a set of responses to a range of perceptual questions under a predetermined component. Taken individually, the semantic differential responses could be to a: binary yes/no question item; a five point likert scale item or to a magnitude estimation query. The mean response from each individual permits a simple conversion to a component response $Cs_{ij} = \sum s_{ij}/k$,

where; $Cs_{ij}$ is the derived score,

 $s_{ij}$ is the elicited response

k is the number of responses from the respondent.

Each mean response therefore permitted the conversion of the original responses from either a nominal or ordinal scale to an interval scale that were amenable to more robust and powerful statistical procedures and tests. Such procedures for example, facilitated assessing the level of covariance between; household attitude to sustainable waste management and its knowledge about waste management in terms of knowledge, practice, and attitude.

Content analysis, defined as any technique for making inferences by objectively and systematically identifying specified characteristics of messages from texts and/or responses to open ended questions, was also used. Qualitative data was content analysed and collated into themes to reflect the research questions which this study intended to investigate. It was chosen as the best method for analysing the lengthy key informant interview responses by compressing them into few descriptive words.

## 3.5 Reliability and Validity

Reliability and validity are the most important hallmarks of any meaningful research study. Nueman (2012) defines reliability as the consistency or regularity of a research method, meaning that if a that research method is used several times to measure the same variables, it should produce the consistent results. Validity is used in to indicate the extent to which observed results reflects the actual study variables in real life. In this study, reliability and validity were ensured by the use of several methods to measure similar or related variables. For example, triangulation methods involving key informant interviews, social survey and observation, were used. The use of different methods ensured consistency of results and overcame the shortcomings of relying on only one method.

## 3.6 Ethical issues

The study focused on domestic solid waste management systems in Old Naledi, Phakalane and Block 5 and involved obtaining information from a wide range of respondents. Prior to conducting the field work, a permit was sought from the Gaborone City Council. Before any household interview was undertaken, an "informed consent" from each respondents was obtained. The respondents were informed about the overall aims and objectives of the study and the implications of their participation in it. The researcher made it clear to them that they were to participate on their free will. The respondents were assured of confidentiality and that the research findings were to be used solely for academic purposes. To safeguard the privacy of the participants, personal identifying details were not included in the questionnaires. Furthermore, personal interactions with participants in the exercise were not shared with any third party outside the research team. Those who agreed to participate were also informed that they could withdraw from the exercise at any stage if they wish to do so. Finally, all respondents were treated with utmost respect. The researcher took into consideration the need to protect vulnerable groups like minors and or the disabled. They were protected by observing the necessary exclusion criteria. This was done by replacing them with the next available respondent who could answer the questions reliably.

# Chapter 4

REPORT ON FINDINGS

## 4.0 Introduction

This section of the study presents the study findings on the background characteristics of the study area residents. The intention is to compare and contrast the various attributes of the three socio-economic residential areas, selected for this study, in order to eventually analyse the knowledge, attitude and practices of the residents on domestic solid waste management.

## 4.1 Background Characteristics of the Study Area

### 4.1.1 Locality and household size

Table 4-1 shows the relationship between locality and household size. About 23 % of the households within Old Naledi have 0-3 household members, compared with 58 % for Phakalane and 35.6 % for Block 5. For the household size of 4-6, Old Naledi has the least percentage at 20.8 % compared with 39.6 % for Phakalane and 62.2 % for Block 5. The contrast becomes very pronounced for the household size of above 7 members where over 56.3 % of the households in Old Naledi record that number compared with only 2 % in the case of Phakalane and Block 5.

Table 4-1: Locality and Household Size

| Household Size | | | 0-3 | 4-6 | 7-8 | over 8 | Total |
|---|---|---|---|---|---|---|---|
| **Location of House** | Old Naledi | Count | 11 | 10 | 9 | 18 | 48 |
| | | % within Location of House | 22.90 | 20.80 | 18.80 | 37.50 | 100.00 |
| | | % within Household Size | 20.00 | 17.50 | 81.80 | 100.00 | 34.00 |
| | Phakalane | Count | 28 | 19 | 1 | 0 | 48 |
| | | % within Location of House | 58.30 | 39.60 | 2.10 | 0.00 | 100.00 |
| | | % within Household Size | 50.90 | 33.30 | 9.10 | 0.00 | 34.00 |
| | Block 5 | Count | 16 | 28 | 1 | 0 | 45 |
| | | % within Location of House | 35.60 | 62.20 | 2.20 | 0.00 | 100.00 |
| | | % within Household Size | 29.10 | 49.10 | 9.10 | 0.00 | 31.90 |
| **Total** | | Count | 55 | 57 | 11 | 18 | 141 |
| | | % within Location of House | 39.00 | 40.40 | 7.80 | 12.80 | 100.00 |
| | | % within Household Size | 100.00 | 100.00 | 100.00 | 100.00 | 100.00 |

**Source:** Author's Fieldwork (2014)

These figures clearly show that there are significant variations in household size by locality, with the area of the lowest socio-economic class of Old Naledi having the highest household size. The implication is that the latter location is likely to experience comparatively more challenges with its domestic solid waste management.

**4.1. 2 Locality and Highest Educational Level Attained**

Table 4-2 shows a relationship between locality and highest educational level attained. Highest educational levels are evident in Phakalane, followed by Block 5 and lastly Old Naledi. 8.3 % of respondents in Old Naledi have not received formal education at all compared to zero % in Phakalane and 2.2 % in Block 5. The percentage of respondents with primary education in Old Naledi is relatively high at 6.3 % compared to none in both Phakalane and Block 5. This shows that the respondents in the last two residential suburbs have all attained more than primary education. About 64 % of Old Naledi respondents have only attained secondary school education compared to 4.2 % in Phakalane and 42.3 %in Block 5.

In Old Naledi only 20.8 % of the respondents have received post-secondary education, this is very low compared to 95.9 % in Phakalane and 55.6 % in Block 5. These contrasts in educational attainment show substantial differences by residential locality, where Phakalane, a high income residential area, recorded the highest educational attainment followed by Block 5 and lastly Old Naledi. Educational attainment is expected to play a significant role in waste management practices, with awareness of waste management information being highest among residents with tertiary education and lower among those with primary and secondary education.

Table 4-2: Locality and Highest Level of Education Attained

| | | | None | Primary Level | Junior Secondary | Senior Secondary | Advanced Level | Vocational | Tertiary/ Degree | Total |
|---|---|---|---|---|---|---|---|---|---|---|
| **Education level** | | | | | | | | | | |
| Location of House | Old Naledi | Count | 4 | 3 | 12 | 14 | 5 | 6 | 4 | 48 |
| | | % within Location of House | 8.30 | 6.20 | 25.00 | 29.20 | 10.40 | 12.50 | 8.30 | 100.00 |
| | | % within Education level | 80.00 | 100.00 | 57.10 | 66.70 | 50.00 | 37.50 | 6.20 | 34.00 |
| | Phakalane | Count | 0 | 0 | 2 | 0 | 0 | 2 | 44 | 48 |
| | | % within Location of House | 0.00 | 0.00 | 4.20 | 0.00 | 0.00 | 4.20 | 91.70 | 100.00 |
| | | % within Education level | 0.00 | 0.00 | 9.50 | 0.00 | 0.00 | 12.50 | 67.70 | 34.00 |
| | Block 5 | Count | 1 | 0 | 7 | 7 | 5 | 8 | 17 | 45 |
| | | % within Location of House | 2.20 | 0.00 | 15.60 | 15.60 | 11.10 | 17.80 | 37.80 | 100.00 |
| | | % within Education level | 20.00 | 0.00 | 33.30 | 33.30 | 50.00 | 50.00 | 26.20 | 31.90 |
| Total | | Count | 5 | 3 | 21 | 21 | 10 | 16 | 65 | 141 |
| | | % within Location of House | 3.50 | 2.10 | 14.90 | 14.90 | 7.10 | 11.30 | 46.10 | 100.00 |
| | | % within Education level | 100.00 | 100.00 | 100.00 | 100.00 | 100.00 | 100.00 | 100.00 | 100.00 |

**Source:** Author's field work (2014)

### 4.1.3 Locality and tenure

Table 4-3 shows a relationship between locality and type of tenure. Different types of tenure found in Gaborone include owning, renting and saying in pool houses. 46 % of Phakalane, residents own the houses they are staying in while only 25 % in Old Naledi and 15.6 % in Block 5 own their houses of residence. These contrasts in tenure status show substantial differences by residential locality, where Phakalane, a high income residential area, recorded the highest percentage of residents who own houses. This is because Phakalane residents are relatively wealthier and can afford to buy houses. Block 5 recorded the highest percentage of respondents who rent the houses they are staying in at 82.2 %, followed by Old Naledi at 75 % and lastly Phakalane at 52.1 %. The above tenurial patterns could suggest that rental tenancy, in the absence of situational and aesthetic environmental pride, could promote dereliction and neglect for sustainable domestic solid waste management practices.

Table 4-3: Locality and Tenure

| Tenure | | | own | rent | Other | Total |
|---|---|---|---|---|---|---|
| Location of House | Old Naledi | Count | 12 | 36 | 0 | 48 |
| | | % within Location of House | 25.00 | 75.00 | 0.00 | 100.00 |
| | | % within Tenure | 29.30 | 36.70 | 0.00 | 34.00 |
| | Phakalane | Count | 22 | 25 | 1 | 48 |
| | | % within Location of House | 45.80 | 52.10 | 2.10 | 100.00 |
| | | % within Tenure | 53.70 | 25.50 | 50.00 | 34.00 |
| | Block 5 | Count | 7 | 37 | 1 | 45 |
| | | % within Location of House | 15.60 | 82.20 | 2.20 | 100.00 |
| | | % within Tenure | 17.10 | 37.80 | 50.00 | 31.90 |
| Total | | Count | 41 | 98 | 2 | 141 |
| | | % within Location of House | 29.10 | 69.50 | 1.40 | 100.00 |
| | | % within Tenure | 100.00 | 100.00 | 100.00 | 100.00 |

**Source:** Author's Fieldwork, (2014)

The remainder of respondents in Block 5 and Phakalane who do not either own or rent houses stay in pool houses. A pool house is a house given to a new employee, especially expatriates. They stay in the house temporarily until they are settled and can look for their own accommodation. Most companies who provide pool houses are big companies who can afford the high rentals in both Block 5 and Phakalane. Under such      conditions, it is incumbent

upon the company to ensure that the premises are kept clean at all times. From the foregoing observations, it would seem plausible to assume that the residential premises of Phakalane and Block 5 are more likely to be cleaner than those at Old Naledi.

### 4.1.4 Locality and Length of stay

Table 4-4 shows the relationship between location and the number of years that respondents have stayed at their current house. A majority of respondents from all the 3 residential areas has stayed at their current place of residence for only ten years or less. In the category of 0-10 years Phakalane has the highest percentage at 91.7 %, followed by Block 5 at 80 % and lastly Old Naledi with 79.2 %. This could be attributed to either the rate of rapid turnover of tenants or to the recency of occupation by the *bona fide* owners who had been awaiting the completion of the construction their houses.

Table 4-4: Locality and Length of Stay

| Length of Stay | | | | | | |
|---|---|---|---|---|---|---|
| | | | 0-10years | 11-20 years | 20 years+ | Total |
| Location of House | Old Naledi | Count | 38 | 3 | 7 | 48 |
| | | % within Location of House | 79.20 | 6.20 | 14.60 | 100.00 |
| | | % within Length of Stay | 32.20 | 23.10 | 70.00 | 34.00 |
| | Phakalane | Count | 44 | 3 | 1 | 48 |
| | | % within Location of House | 91.70 | 6.20 | 2.10 | 100.00 |
| | | % within Length of Stay | 37.30 | 23.10 | 10.00 | 34.00 |
| | Block 5 | Count | 36 | 7 | 2 | 45 |
| | | % within Location of House | 80.00 | 15.60 | 4.40 | 100.00 |
| | | % within Length of Stay | 30.50 | 53.80% | 20.00 | 31.90 |
| Total | | Count | 118 | 13 | 10 | 141 |
| | | % within Location of House | 83.70 | 9.20 | 7.10 | 100.00 |
| | | % within Length of Stay | 100.00 | 100.00 | 100.00 | 100.00 |

**Source:** Author's Fieldwork, (2014)

The lack of permanency thus shows that residents are constantly moving either within the same suburbs or across residential areas. Movement within the same residential areas is mainly caused by leases that would have expired while movement across residential areas is associated with change in economic status.

In the category 11-20 years, both Old Naledi and Phakalane recorded low percentages of 6.2 % and Block 5 recorded 15.6 %. The 20 years + category shows the percentage of respondents who have stayed at the same house for more than 20 years. In this category Old Naledi has the highest percentage at about 15 %, followed by Block 5 at 4.4 % and lastly Phakalane at 2.2 %. The relative age of the localities is thus clearly reflected. Normally solid domestic waste facilities tend to deteriorate as neighbourhoods become occupied over longer periods of time.

## 4.2 Domestic Solid Waste Management

This section of the study presents findings on location and how residents are managing their domestic solid waste.

### 4.2.1 Locality and Waste Management Sensitization

Waste management sensitization campaigns are tools that are used to transfer waste management knowledge to residents. These campaigns are fostered by different stakeholders, for example government ministries and departments, non-governmental organisations, formal education, journalists, influential individuals and traditional leaders. Waste management awareness can be done through the media, infusing it in the mainstream education, workshops, exhibitions and school based programs like green schools. Education and awareness play a vital role in waste management. They are responsible for shaping residents' attitude towards the environment and this in turn determines practice. During such campaigns, residents are taught sustainable ways of managing their waste, for example, practicing the 3Rs, and their benefits such as pollution reduction. They also teach residents about the impacts of unsustainable ways of managing waste, like burning and dumping waste illegally and how they cause disease outbreaks and pollution.

Table 4-5 shows the relationship between location and waste management sensitization. About 46 % of Old Naledi respondents admitted that there have been exposed to campaigns in their areas unlike only 6.7 % in Block 5 and none at all in Phakalane. A majority of those who indicated that there has been exposed to campaigns in their areas named Gaborone City Council as the stakeholder fostering such campaigns. These figures indicate that there is a

bias in exposure to waste management campaigns with Old Naledi, the lowest income area, being targeted most by Gaborone City Council and other sanitation stakeholders.

Table 4-5: Locality and Waste Management Sensitization.

| | | | Yes | No | Total |
|---|---|---|---|---|---|
| Location of House | Old Naledi | Count | 22 | 26 | 48 |
| | | % within Location of House | 45.80 | 54.20 | 100.00 |
| | | % within campaigns | 88.00 | 22.40 | 34.00 |
| | Phakalane | Count | 0 | 48 | 48 |
| | | % within Location of House | 0.00 | 100.00 | 100.00 |
| | | % within campaigns | 0.00 | 41.40 | 34.00 |
| | Block 5 | Count | 3 | 42 | 45 |
| | | % within Location of House | 6.70 | 93.30 | 100.00 |
| | | % within campaigns | 12.00 | 36.20 | 31.90 |
| Total | | Count | 25 | 116 | 141 |
| | | % within Location of House | 17.70 | 82.30 | 100.00 |
| | | % within campaigns | 100.00 | 100.00 | 100.00 |

**Source:** Author's Fieldwork, (2014)

Old Naledi has large household sizes, is overcrowded and as result tends to generate more waste than what the management system in place can handle. As a result, different waste and sanitation stakeholders tend to target them for various reasons. For example, Gaborone City Council focuses on teaching the 3Rs so as to reduce waste that ends up in the waste stream. Health workers attempt to inculcate skills on the sanitary handling of waste to avoid the spread of waste-related diseases whereas social workers mostly encourage households to recycle domestic solid waste as a means of generating an additional disposable income.

**4.2.2 Locality and satisfaction with domestic solid waste collection service**

Table 4-6 shows the level of satisfaction by residents of the Gaborone City Council (GCC) waste management service provision, by locality. There are variations in satisfaction with waste management service provided by GCC.

Table 4-6: Locality and Satisfaction with solid waste collection

| | | | How satisfied are you with the domestic solid waste management provided by City Council | | | | | Total |
|---|---|---|---|---|---|---|---|---|
| | | | Very satisfied | Satisfied | Neutral | Dissatisfied | Very dissatisfied | |
| Location of House | Old Naledi | Count | 13 | 4 | 3 | 11 | 17 | 48 |
| | | % within Location of House | 27.10 | 8.30 | 6.20 | 22.90 | 35.40 | 100.00 |
| | | % within satisfaction with service | 92.90 | 12.10 | 7.70 | 37.90 | 65.40 | 34.00 |
| | Phakalane | Count | 1 | 20 | 22 | 2 | 3 | 48 |
| | | % within Location of House | 2.10 | 41.70 | 45.80 | 4.20 | 6.20 | 100.00 |
| | | % within satisfaction with service | 7.10 | 60.60 | 56.40 | 6.90 | 11.50 | 34.00 |
| | Block 5 | Count | 0 | 9 | 14 | 16 | 6 | 45 |
| | | % within Location of House | 0.00 | 20.00 | 31.10 | 35.60 | 13.30 | 100.00 |
| | | % within satisfaction with service | 0.00 | 27.30 | 35.90 | 55.20 | 23.10 | 31.90 |
| Total | | Count | 14 | 33 | 39 | 29 | 26 | 141 |
| | | % within Location of House | 9.90 | 23.40 | 27.70 | 20.60 | 18.40 | 100.00 |
| | | % within satisfaction with service | 100.00 | 100.00 | 100.00 | 100.00 | 100.00 | 100.00 |

**Source:** Author's Fieldwork, (2014)

About 27 % of respondents in Old Naledi are very satisfied with the service, unlike 2 percent in Phakalane and zero % in Block 5. Phakalane has the highest percentage of residents who are only satisfied at 41.7 % compared to 8.3 % in Old Naledi and 20 % in Block 5. About 6 % of Old Naledi residents are neutral about service provision whereas 45.8 % in Phakalane and 31.1 % in Block 5 are neutral. About 23 % of respondents in Old Naledi and 36 % in Block 5 are dissatisfied with service provision while only 4 % in Phakalane are dissatisfied. At 35 %, Old Naledi recorded a high percentage of respondents who are very dissatisfied with service provision, compared to 6.2 % in Phakalane and 13.3 % in Block 5.

### 4.2.3 Locality and Type of Storage Receptacle in Use

All domestic solid waste produced is kept within the household premises until its collection by the Gaborone City Council. Table 4-7 shows the relationship between locality and the type of receptacle used. The following have been identified as receptacles used in Gaborone: black polythene plastic bag; metal city council bin; other metal receptacles; and high density polyethylene receptacle.

Table 4-7: Locality and Type of Storage Receptacle in Use

| | | | Type of storage receptacle | | | | |
|---|---|---|---|---|---|---|---|
| | | | Black Polythene plastic bag | Metal City Council Bin | Other metal bins | HDPE (Plastic) bin | Total |
| Location of House | Old Naledi | Count | 19 | 22 | 7 | 0 | 48 |
| | | % within Location of House | 39.60 | 45.80 | 14.60 | 0.00 | 100.00 |
| | | % within Type of receptacle | 32.80 | 48.90 | 28.00 | 0.00 | 34.00 |
| | Phakalane | Count | 9 | 10 | 17 | 12 | 48 |
| | | % within Location of House | 18.80 | 20.80 | 35.40 | 25.00 | 100.00 |
| | | % within Type of receptacle | 15.50 | 22.20 | 68.00 | 92.30 | 34.00 |
| | Block 5 | Count | 30 | 13 | 1 | 1 | 45 |
| | | % within Location of House | 66.70 | 28.90 | 2.20 | 2.20 | 100.00 |
| | | % within Type of receptacle | 51.70 | 28.90 | 4.00 | 7.70 | 31.90 |
| Total | | Count | 58 | 45 | 25 | 13 | 141 |
| | | % within Location of House | 41.10 | 31.90 | 17.70 | 9.20 | 100.00 |
| | | % within Type of receptacle | 100.00 | 100.00 | 100.00 | 100.00 | 100.00 |

**Source:** Author's Fieldwork, (2014)

About 19 % of households in Phakalane use black polythene plastic bags compared with 40 % in Old Naledi and 67 % in Block 5. The black polythene plastic bag is mainly used by household who cannot afford to use the other three types of receptacles. Of the households that use City Council bins, Phakalane and Block 5 have the least percentages at 20.8 and 28.9 % respectively, compared to 45.8 % for Old Naledi.

Of the households that use other metal bins, Phakalane has a high percentage at 35.4 % compared to 14.6 % of Old Naledi and 2.2 % of Block 5. Phakalane households also use the HDPE receptacle which is not very popular in both Block 5 and not used at all in Old Naledi. Though cheap, the black polythene plastic bag can easily tear and spill garbage.  An observation guide revealed that Old Naledi and Block 5 streets and drains are littered. This is mainly caused by torn out receptacles.  The City Council provides metal bins to residents, however this is not done on a regular basis. Thus most households in Phakalane do not use

them; rather they use other metal receptacles and HDPE receptacles which they buy on their own. This shows that for the low income households, in the absence of a bin supplied by city council, they will opt for the cheaper black polythene plastic bags unlike high income who can afford to buy expensive more durable bins.

### 4.2.4 Location and segregation of dry waste

Table 4-8 shows the extent of segregation of dry domestic solid waste by locality. Dry waste segregation is practiced in all the three residential areas, as shown in Table 4-8.

Table 4-8: Location and separation of dry waste.

| | | | Do you separate your dry waste? | | |
|---|---|---|---|---|---|
| | | | Yes | No | Total |
| Location of House | Old Naledi | Count | 10 | 38 | 48 |
| | | % within Location of House | 20.80 | 79.20 | 100.00 |
| | | % within separation of dry waste | 22.70 | 39.20 | 34.00 |
| | Phakalane | Count | 27 | 21 | 48 |
| | | % within Location of House | 56.20 | 43.80 | 100.00 |
| | | % within separation of dry waste | 61.40 | 21.60 | 34.00 |
| | Block 5 | Count | 7 | 38 | 45 |
| | | % within Location of House | 15.60 | 84.40 | 100.00 |
| | | % within separation of dry waste | 15.90 | 39.20 | 31.90 |
| Total | | Count | 44 | 97 | 141 |
| | | % within Location of House | 31.20 | 68.80 | 100.00 |
| | | % within separation of dry waste | 100.00 | 100.00 | 100.00 |

**Source:** Author's Fieldwork, (2014)

### 4.2.5 Locality and food waste segregation

Table 4-9 shows the extent of separation of food waste from the rest of solid domestic waste by locality. In any proper waste recycling society, waste segregation is vital. One has to first separate all food and organic waste from the rest of the waste as it decomposes quickly, and may attract scavenging animals and produce foul odours.

Table 4-9: Location and segregation of food waste

| | | | **Do you separate your food waste from your other garbage** | | |
|---|---|---|---|---|---|
| | | | Yes | No | Total |
| Location of House | Old Naledi | Count | 18 | 30 | 48 |
| | | % within Location of House | 37.50 | 62.50 | 100.00 |
| | | % within separation of food waste | 35.30 | 33.30 | 34.00 |
| | Phakalane | Count | 21 | 27 | 48 |
| | | % within Location of House | 43.80 | 56.20 | 100.00 |
| | | % within separation of food waste | 41.20 | 30.00 | 34.00 |
| | Block 5 | Count | 12 | 33 | 45 |
| | | % within Location of House | 26.70 | 73.30 | 100.00 |
| | | % within separation of food waste | 23.50 | 36.70 | 31.90 |
| Total | | Count | 51 | 90 | 141 |
| | | % within Location of House | 36.20 | 63.80 | 100.00 |
| | | % within separation of food waste | 100.00 | 100.00 | 100.00 |

**Source:** Author's Fieldwork, (2014)

Phakalane has the highest percentage of households who separate waste at source, at 43.8 %, followed by Old Naledi with 37.5 % and lastly Block 5 with 26.7 %. The main reason for separation of waste indicated by respondents was to feed domestic animals. The results show that Phakalane a high income area has more domestic animals than the other two because they can afford to feed and keep the animals. As more households separate food waste the less organic waste ends up in the waste stream and the reverse is true.

**4.2.6 Locality and disposal of garden waste**

Table 4-10 shows the disposal methods of garden waste by locality. The Gaborone City Council does not collect garden waste with the rest of the domestic solid waste that residents generate. Residents have to find means of disposing of their own waste. As a result, both sustainable and unsustainable methods are used, as shown in Table 4-10. The environmentally sustainable methods include using either private collectors, the Gaborone City Council special collection service, burying and composting, while the unsustainable ones include illegal dumping in bushes or open spaces or burning it. When using the Gaborone City Council, residents pay a fee to GCC for the collection of their garden waste.

The highest percentage of those who use private collectors is in Old Naledi at 60.4 %, followed by Block 5 with 60 % and the least is Phakalane with 39.6 %. For Old Naledi, the collectors could be informal engagements whilst for the upper income areas they could be registered companies. Illegal dumping of garden waste is highest in Block 5 at 17.8 %, compared to 6.2 % in Phakalane and Old Naledi. This is mainly due to the fact that Block 5 respondents do not use the Gaborone City Council special collection service, whilst 18 % of Old Naledi use it. In Phakalane households compost their garden waste.

The differences in garden waste management become more pronounced for the households that compost garden waste, wherein 54.2 % of the households in Phakalane compost their waste compared to 4.2 % in Old Naledi and 11.1 % in Block 5. It is possible that the high income areas utilize the compost for their vegetable gardens, flower beds and lawns. Burning and burying of waste is practiced in Block 5 and Old Naledi only. The absence of burning in Phakalane could reflect relative pre-occupation with environmental aesthetics among the residents. 18.8 % of Old Naledi households use GCC special collection service for disposal of garden waste unlike the other two suburbs which do not use GCC. Table 4-10 shows the various methods used by households to manage their garden waste. The most sustainable method, which is composting, is mainly practiced in Phakalane a high income area. Phakalane also has the highest percentage of tertiary education graduates, thus education can be attributed to their sustainable ways of managing garden waste.

Table 4-10: Locality and disposal of garden waste

| | | | Pvt CO | Illegal dump | Composting | Burning | GCC | Dont have | Bury | Total |
|---|---|---|---|---|---|---|---|---|---|---|
| **Method of disposal for garden waste** | | | | | | | | | | |
| Location of House | Old Naledi | Count | 29 | 3 | 2 | 2 | 9 | 1 | 2 | 48 |
| | | % within Location of House | 60.40 | 6.20 | 4.20 | 4.20 | 18.80 | 2.10 | 4.20 | 100.00 |
| | | % within disposal of garden waste | 38.70 | 21.40 | 6.10 | 33.30 | 100.00 | 100.00 | 66.70 | 34.00 |
| | | % of Total | 20.60 | 2.10 | 1.40 | 1.4 | 6.40 | 0.70 | 1.40 | 34.00 |
| | Phakalane | Count | 19 | 3 | 26 | 0 | 0 | 0 | 0 | 48 |
| | | % within Location of House | 39.60 | 6.20 | 54.20 | 0.00 | 0.00 | 0.00 | 0.00 | 100.00 |
| | | % within disposal for garden waste | 25.30 | 21.40 | 78.80 | 0.00 | 0.00 | 0.00 | 0.00 | 34.00 |
| | | % of Total | 13.50 | 2.10 | 18.40 | 0.00 | 0.00 | 0.00 | 0.00 | 34.00 |
| | Block 5 | Count | 27 | 8 | 5 | 4 | 0 | 0 | 1 | 45 |
| | | % within Location of House | 60.00 | 17.80 | 11.10 | 8.90 | 0.00 | 0.00 | 2.20 | 100.00 |
| | | % within disposal for garden waste | 36.00 | 57.10 | 15.20 | 66.70 | 0.00 | 0.00 | 33.30 | 31.90 |
| | | % of Total | 19.10 | 5.70 | 3.50 | 2.80 | 0.00 | 0.00 | 0.70 | 31.90 |
| Total | | Count | 75 | 14 | 33 | 6 | 9 | 1 | 3 | 141 |
| | | % within Location of House | 53.20 | 9.90 | 23.40 | 4.30 | 6.40 | 0.70 | 2.10 | 100.00 |
| | | % within disposal for garden waste | 100.00 | 100.00 | 100.00 | 100.00 | 100.00 | 100.00 | 100.00 | 100.00 |
| | | % of Total | 53.20 | 9.90 | 23.40 | 4.30 | 6.40 | 0.70 | 2.10 | 100.00 |

**Source:** Author's Fieldwork, (2014)

**4.2.7 Location and disposal of construction waste**

Table 4-11 relates locality with the methods of disposing domestic construction waste. Construction waste is generated from various construction activities in residential areas. Similar to garden waste, the Gaborone City Council does not collect construction waste with the rest of the domestic solid waste that residents generate. Residents have to find their own means of disposing of their waste. As a result, both sustainable and unsustainable methods are used, as shown in Table 4-11.

Table 4-11: Locality and disposal of construction waste

| Methods of disposal for construction waste | | | | | | | |
|---|---|---|---|---|---|---|---|
| | | | PVT CO | Dump illegally | Re-use it | Don't have | Total |
| **Location of House** | Old Naledi | Count | 31 | 4 | 10 | 3 | 48 |
| | | % within Location of House | 64.6 | 8.30 | 20.80 | 6.20 | 100.00 |
| | | % within disposal for construction waste | 27.40 | 33.30 | 100.00 | 50.00 | 34.00 |
| | Phakalane | Count | 43 | 4 | 0 | 1 | 48 |
| | | % within Location of House | 89.60 | 8.30 | 0.00 | 2.10 | 100.00 |
| | | % within disposal for construction waste | 38.10 | 33.30 | 0.00 | 16.70 | 34.00 |
| | Block 5 | Count | 39 | 4 | 0 | 2 | 45 |
| | | % within Location of House | 86.70 | 8.90 | 0.00 | 4.40 | 100.00 |
| | | % within disposal for construction waste | 34.50 | 33.30 | 0.00 | 33.30 | 31.90 |
| **Total** | | Count | 113 | 12 | 10 | 6 | 141 |
| | | % within Location of House | 80.10 | 8.50 | 7.10 | 4.30 | 100.00 |
| | | % within disposal for construction waste | 100.00 | 100.00 | 100.00 | 100.00 | 100.00 |

**Source:** Author's Fieldwork, (2014)

As shown in Table 4-11, a majority of respondents in all the three residential areas use legal ways of disposing construction waste. For the households that rely on private companies for the disposal of their construction waste, Phakalane has the highest percentage at 89.6 %, followed by block 5 at 86.5 % and the least Old Naledi with 64.6 %. Even though majority of

the households dump their waste legally, there are some who are dumping theirs illegally. Dumping of waste illegally is, to some extent, practiced in all the three residential areas. Of those that dump waste illegally, Block 5 has the highest percentage at 8.9 % compared to the 8.3 % in both Phakalane and Old Naledi. Illegal dumping of construction waste is mainly due to the fact that households cannot afford or are unwilling to pay neither the private companies nor Gaborone City Council the extra money required to dispose of their waste. Most respondents use private companies like Skip Hire because they are efficient, unlike the City Council that often delay in collecting the waste, even after a resident has paid for the service.

### 4.2.8 Locality and the illegal dumping of waste

Table 4-12 shows the illegal status of dumping waste by locality. Although household waste is collected by the GCC, other methods like dumping waste illegally, burying and burning are also used. This is due to insufficient waste collection services provided by the Gaborone City Council accompanied by the absence of collection services for garden and construction waste in the residential areas.

Table 4-12: Locality and illegal dumping of waste

| | | | Dumping waste illegally | | |
|---|---|---|---|---|---|
| | | | No | Yes | Total |
| Location of House | Old Naledi | Count | 41 | 7 | 48 |
| | | % within Location of House | 85.40 | 14.60 | 100.00 |
| | | % within Dump waste illegally | 32.30 | 50.00 | 34.00 |
| | Phakalane | Count | 45 | 3 | 48 |
| | | % within Location of House | 93.80 | 6.20 | 100.00 |
| | | % within Dump waste illegally | 35.40 | 21.40 | 34.00 |
| | Block 5 | Count | 41 | 4 | 45 |
| | | % within Location of House | 91.10 | 8.90 | 100.00 |
| | | % within Dump waste illegally | 32.30 | 28.60 | 31.90 |
| Total | | Count | 127 | 14 | 141 |
| | | % within Location of House | 90.10 | 9.90 | 100.00 |
| | | % within Dump waste illegally | 100.00 | 100.00 | 100.00 |

**Source:** Author's Fieldwork, (2014)

In all the three residential areas, some respondents indicated that they dump waste illegally, as shown in Table 4-12. Old Naledi has the highest percentage of residents who dump waste illegally with a high of 14.6 %, followed by Block 5 with 8.9 % and the least is Phakalane with 6.2 %. Most of this waste is dumped in open spaces and roadsides. The higher the

percentage of households who dump waste illegally the dirtier an area becomes. An observation guide indicated that Old Naledi was the dirtiest suburb with litter found in drains, street and open spaces compared to the other two areas which were generally clean.

### 4.2.9 Educational level and recycling

Waste recycling is one of the most important waste reduction methods. Waste recycling involves segregation of waste and sending it to different recycling drop off centres. Recyclers are either paid or not paid for their recyclables. The amount of knowledge one has and/or the value to be obtained from waste determines whether they recycle or not and the frequency of recycling. Table 4-13 shows the relationship between education and waste recycling.

Table 4-13: Educational Level and recycling

| **Do you send your waste for recycling?** | | | | | |
|---|---|---|---|---|---|
| | | | Yes | No | |
| Education level | None | Count | 0 | 5 | 5 |
| | | % within Education level | 0.00 | 100.00 | 100.00 |
| | | % within Do you send your waste for recycling | 0.00 | 5.70 | 3.50 |
| | | % of Total | 0.00 | 3.50 | 3.50 |
| | Primary Level | Count | 1 | 2 | 3 |
| | | % within Education level | 33.30 | 66.70 | 100.00 |
| | | % within Do you send your waste for recycling | 1.90 | 2.30 | 2.10 |
| | | % of Total | 0.70 | 1.40 | 2.10 |
| | Junior Secondary | Count | 4 | 17 | 21 |
| | | % within Education level | 19.00 | 81.00 | 100.00 |
| | | % within Do you send your waste for recycling | 7.50 | 19.30 | 14.90 |
| | | % of Total | 2.80 | 12.10 | 14.90 |
| | Senior Secondary | Count | 5 | 16 | 21 |
| | | % within Education level | 23.80 | 76.20 | 100.00 |
| | | % within Do you send your waste for recycling | 9.40 | 18.20 | 14.90 |
| | | % of Total | 3.50 | 11.30 | 14.90 |
| | Advanced Level | Count | 0 | 10 | 10 |
| | | % within Education level | 0.00 | 100.00 | 100.00 |
| | | % within Do you send your waste for recycling | 0.00 | 11.40 | 7.10 |
| | | % of Total | 0.00 | 7.10 | 7.10 |
| | Vocational | Count | 6 | 10 | 16 |
| | | % within Education level | 37.50 | 62.50 | 100.00 |
| | | % within Do you send your waste for recycling | 11.30 | 11.40 | 11.30 |
| | | % of Total | 4.30 | 7.10 | 11.30 |
| | Tertiary/ Degree | Count | 37 | 28 | 65 |
| | | % within Education level | 56.90 | 43.10 | 100.00 |
| | | % within Do you send your waste for recycling | 69.80 | 31.80 | 46.10 |
| | | % of Total | 26.20 | 19.90 | 46.10 |
| Total | | Count | 53 | 88 | 141 |
| | | % within Education level | 37.60 | 62.40 | 100.00 |
| | | % within Do you send your waste for recycling | 100.00 | 100.00 | 100.00 |
| | | % of Total | 37.60 | 62.40 | 100.00 |

**Source:** Author's Fieldwork, (2014)

Table 4-13 shows that educational level has some relationship with practice in waste management, in particular recycling. The percentage of recyclers increases as educational level goes up. None of the respondents with no educational level at all recycles their waste whereas educated respondents recycle. About 19 % of Junior Secondary School respondents,

23% of Senior Secondary School respondents, 37.5% of Vocational education respondents, and 54% of tertiary education respondents recycle.

## 4.3 Household conformity with the sustainable domestic solid waste management strategy

This section of the study examines the extent to which the households subscribe to and engage in the sustainable management of domestic solid waste as stipulated under the acronym 3Rs.

### 4.3.1  Locality and Recycling

Recycling levels in Developing Countries are low compared to their Developed counter parts. Most developed nations recycle more than 50% of the domestic waste they generate, unlike developing countries who only recycle about 15% (Council for Scientific and Industrial Research website accessed 10 December 2013). The low percentage is true for Gaborone where, only 37.6% of respondents participate in recycling activities as shown in Table 4-14.

Table 4-14: Location of house and recycling

| Do you send your waste for recycling? | | | | | |
|---|---|---|---|---|---|
| | | | Yes | No | Total |
| Location of House | Old Naledi | Count | 15 | 33 | 48 |
| | | % within Location of House | 31.20 | 68.80 | 100.00 |
| | | % within recycling | 28.30 | 37.50 | 34.00 |
| | Phakalane | Count | 33 | 15 | 48 |
| | | % within Location of House | 68.80 | 31.20 | 100.00 |
| | | % within recycling | 62.30 | 17.00 | 34.00 |
| | Block 5 | Count | 5 | 40 | 45 |
| | | % within Location of House | 11.10 | 88.90 | 100.00 |
| | | % within recycling | 9.40 | 45.50 | 31.90 |
| Total | | Count | 53 | 88 | 141 |
| | | % within Location of House | 37.60 | 62.40 | 100.00 |
| | | % within  recycling | 100.00 | 100.00 | 100.00 |

**Source:** Author's Fieldwork, (2014)

Recycling is mainly practiced in Phakalane with 68.8 % of the households compared to 31.2 % in Old Naledi and 11.1 % in Block 5. This could be due to the relative amounts of waste associated with consumed products such as bottles and beer cans and those products that are

packaged in plastics, paper or cardboard. Materials recycled in Block 5 and Old Naledi are limited to glass, mainly beer bottles that the residents pick from their yards or beer parlors and exchange them for money at KBL. Unlike in Phakalane plastic, paper, batteries, glass, cans, tyres and cardboard are all recycled.

### 4.3.2 Locality and Waste Reduction

This section examines the location of residence in relation to the practice of domestic solid waste reduction. Waste reduction seeks to prevent waste from being generated at the source, in this instance at the household level. This can be done by using less packaging, designing and using products that last longer. Three sensitive indicators selected to investigate waste reduction are; use of refillable containers in place of bottled water, the use of products that last longer and feeding of leftovers to domestic pets.

Table 4-15 shows the location of residence in relation to the use of refillable water bottles. Using refillable water bottles is intended to discourage residents from buying bottled water. This could reduce the amount of plastic water bottles that end up in the waste stream.

Table 4-15: Locality and the use of refillable water bottles

| | | **I use a refillable water bottle instead of buying bottled water** | | | | |
|---|---|---|---|---|---|---|
| | | | Always | Some times | Not at all | Total |
| Location of House | Old Naledi | Count | 13 | 23 | 12 | 48 |
| | | % within Location of House | 27.10 | 47.90 | 25.00 | 100.0 |
| | | % within I use a refillable water container | 39.40 | 25.30 | 70.60 | 34.00 |
| | Phakalane | Count | 12 | 33 | 3 | 48 |
| | | % within Location of House | 25.00 | 68.80 | 6.20 | 100.0 |
| | | % within I use a refillable water container | 36.40 | 36.30 | 17.60 | 34.00 |
| | Block 5 | Count | 8 | 35 | 2 | 45 |
| | | % within Location of House | 17.80 | 77.80 | 4.40 | 100.0 |
| | | % within I use a refillable water container | 24.20 | 38.50 | 11.80 | 31.90 |
| Total | | Count | 33 | 91 | 17 | 141 |
| | | % within Location of House | 23.40 | 64.50 | 12.10 | 100.0 |
| | | % within I use a refillable water container | 100.00 | 100.0 | 100.0 | 100.0 |

**Source:** Authors Fieldwork (2014)

In all the three residential areas, some respondents indicated that they "always" use refillable water bottles. Old Naledi has the highest percentage of residents who "always" use refillable water bottles with a relatively high percentage of 27.1 %, compared to Phakalane with 25% and Block 5 with 17.8 %. A low income residential area Old Naledi has the highest percentage probably because most of the residents can hardly afford to buy bottled water, thus they reuse their old bottles. This is followed by Phakalane a high income residential area probably because of their higher sensitivity to environmental aesthetics. This behavioural pattern could reflect their higher levels of education that encourages them to use refillable water bottles to avoid generating domestic solid waste. Block 5, a medium income area, reflects the least sensitivity to refillable water bottle reuse probably because of the intermediate level of both education and income compared to the other two residential areas.

Block 5 has the highest percentage of residents who "sometimes" use refillable water bottles with a high of 78 %, followed by Phakalane with 68 % and the least is Old Naledi with 48 %. The high percentages in this category compliment the low percentages in the "always" category. In the "sometimes" category respondents sometimes use refillable water bottles and other times buy bottled water.

At 25 % Old Naledi has the highest percentage of respondents who do not use refillable water bottles at all compared to 6% in Phakalane and 4 percent in Block 5. This could be because the respondents in Old Naledi cannot afford to buy the refillable water bottles, whereas those in Phakalane and Block 5 can afford. The study shows a high percentage of respondents who "sometimes" use refillable water bottles, compared to those who use it always. The implication is that more plastic water bottles end up in the waste stream and puts pressure on the existing waste management service.

Table 4-16 shows the location of residence in relation to the preferred use of products that last longer such as washable napkins instead of disposable diapers for babies. All babies born in all the three residential areas use napkins. However the type of napkin they use depends on their different demographic characteristics such as income.

Old Naledi has the highest percentage of residents who "always" use washable napkins with a high of 21%, compared 6 percent in Phakalane and 0% in Block 5. A low income residential area Old Naledi has the highest percentage probably because most of the residents cannot

afford to buy disposable diapers, thus they buy washable napkins. This is followed by Phakalane a high income residential area probably because of their sensitivity to the environment which comes with their higher level of education, thus they use washable napkins to minimize generating domestic solid waste. Block 5 a medium income area has no respondents who use washable napkins probably because of the relative availability of disposable income compared to Old Naledi.

Table 4-16: Locality and use of washable napkins for babies.

| | | | Always | Sometimes | Not at all | Total |
|---|---|---|---|---|---|---|
| **I use washable napkins instead of disposable diapers** | | | | | | |
| Location of House | Old Naledi | Count | 10 | 22 | 16 | 48 |
| | | % within Location of House | 20.80 | 45.80 | 33.30 | 100.00 |
| | | % within I use washable napkins instead of diapers | 76.90 | 35.50 | 24.20 | 34.00 |
| | Phakalane | Count | 3 | 22 | 23 | 48 |
| | | % within Location of House | 6.20 | 45.80 | 47.90 | 100.00 |
| | | % within I use washable napkins instead of diapers | 23.10 | 35.50 | 34.80 | 34.00 |
| | Block 5 | Count | 0 | 18 | 27 | 45 |
| | | % within Location of House | 0.00 | 40.00 | 60.00 | 100.00 |
| | | % within I use washable napkins instead of diapers | 0.00 | 29.00 | 40.90 | 31.90 |
| Total | | Count | 13 | 62 | 66 | 141 |
| | | % within Location of House | 9.20 | 44.00 | 46.80 | 100.00 |
| | | % within I use washable napkins instead of diapers | 100.00 | 100.00 | 100.00 | 100.00 |

**Source:** Authors Fieldwork (2014)

Block 5 has the lowest percentage of residents who "sometimes" use washable napkins at 40 %, compared to 46 % for both Phakalane and Old Naledi. In the "sometimes" category respondents sometimes use both washable napkins and disposable diapers. At 60 % Block 5 has the highest percentage of respondents who do not use washable napkins at all compared to 48 % in Phakalane and 33 % in Old Naledi. This could be because the respondents in Old Naledi cannot afford to buy the diapers and Block 5 can afford.

The results from the study show a high percentage of respondents who "do not use washable napkins at all" with a total of 47%, compared to those who "always" use them with 9 %. The implication is that more disposable diapers end up in the waste stream and puts pressure on the existing waste management service.

Table 4-17 shows the location of residence in relation to feeding their domestic animals with food left overs. Feeding of animals with food leftovers reduces the amount of organic waste that will end up in the waste stream.

Table 4-17: Locality and feeding animals with food leftovers.

| | | | I give food scraps to animals | | | |
|---|---|---|---|---|---|---|
| | | | Always | Sometimes | Not at all | Total |
| **Location of House** | Old Naledi | Count | 4 | 5 | 39 | 48 |
| | | % within Location of House | 8.30 | 10.40 | 81.20 | 100.00 |
| | | % within I give food scraps to animals | 20.00 | 27.80 | 37.90 | 34.00 |
| | Phakalane | Count | 16 | 11 | 21 | 48 |
| | | % within Location of House | 33.30 | 22.90 | 43.80 | 100.00 |
| | | % within I give food scraps to animals | 80.00 | 61.10 | 20.40 | 34.00 |
| | Block 5 | Count | 0 | 2 | 43 | 45 |
| | | % within Location of House | 0.00 | 4.40 | 95.60 | 100.00 |
| | | % within I give food scraps to animals | 0.00 | 11.10 | 41.70 | 31.90 |
| **Total** | | Count | 20 | 18 | 103 | 141 |
| | | % within Location of House | 14.20 | 12.80 | 73.00 | 100.00 |
| | | % within I give food scraps to animals | 100.00 | 100.00 | 100.00 | 100.00 |

**Source:** Author's Fieldwork (2014)

Phakalane has the highest percentage of residents who "always" feed their animals with food left overs at 33 %, compared to Old Naledi with 8 % and Block 5 none at all. At 23 % Phakalane has the highest percentage of respondents who "sometimes" feed their animals with food leftovers compared to 10 percent in Old Naledi and 4.4 % in Block 5. At 96 % Block 5 has the highest percentage of respondents who do not feed animals with food left

overs, followed by Old Naledi at 81 %, and Phakalane has the least with 44 %. A high income residential area Phakalane has the highest percentage of respondents who either "always" or "sometimes" feed animals with food left overs probably because most of the residents own animals like dogs and chickens. Dogs are mainly kept for security reasons and as pets. Their big yards allow them to keep animals unlike the other two residential areas. Also their high income allows them to be able to take care of animals unlike low income like Old Naledi who struggle to feed their own families let alone animals. The implication of a lack of food waste reduction at the source especially by Old Naledi and Block 5 respondents is that more food waste is ending up in the waste stream.

**4.3.3 Locality and Waste Re-use**

This section shows the location of residence in relation to the practice of domestic solid waste re-use. The two selected sensitive indicators for the study are: the re-use of plastic containers and jars, and lunch boxes.Table 4-18 shows the location of residence in relation to the re-use of containers and jars. Containers like paint buckets, cooking oil 25 litre containers, mayonnaise and ice-cream containers are often washed and used to store water and other food stuffs.  Re-using of waste reduces the amount of waste that end up in the waste stream.

Table 4-18: Locality and the re-use containers and bottle jars

| | | | Always | Sometimes | Not at all | Total |
|---|---|---|---|---|---|---|
| **Wash plastic containers and jars for re-use** | | | | | | |
| Location of House | Old Naledi | Count | 16 | 29 | 3 | 48 |
| | | % within Location of House | 33.30 | 60.40 | 6.20 | 100.00 |
| | | % within Wash plastic containers and jars for re-use | 29.60 | 36.20 | 42.90 | 34.00 |
| | Phakalane | Count | 23 | 24 | 1 | 48 |
| | | % within Location of House | 47.90 | 50.00 | 2.10 | 100.00 |
| | | % within Wash plastic containers and jars for re-use | 42.60 | 30.00 | 14.30 | 34.00 |
| | Block 5 | Count | 15 | 27 | 3 | 45 |
| | | % within Location of House | 33.30 | 60.00 | 6.70 | 100.00 |
| | | % within Wash plastic containers and jars for re-use | 27.80 | 33.80 | 42.90 | 31.90 |
| Total | | Count | 54 | 80 | 7 | 141 |
| | | % within Location of House | 38.30 | 56.70 | 5.00 | 100.00 |
| | | % within Wash plastic containers and jars for re-use | 100.00 | 100.00 | 100.00 | 100.00 |

**Source:** Author's Fieldwork (2014).

Phakalane has the highest percentage of residents who "always" re use containers at 48 %, compared to Old Naledi and Block 5 with 33 %. This is because Phakalane a high income area respondents tend to buy commodities in bulk and end up with a lot of containers to re-use. Over half of the households in the study area do sometimes re-use plastic bottles and jars. Apart from storing food stuffs the containers can also be used for landscaping like planting trees and flowers.

Phakalane has the least percentage of respondents who do not re-use containers and jars at 2 % compared to 6 % of Old Naledi and 7 % of Block 5. These contrasts are because in Phakalane most respondents either "always" or "sometimes" re-use their containers. The respondents who do not re-use containers, either do so because cheap alternative containers are always available or some containers are difficult to clean for re-use. This means all their containers and jars still end up in the waste stream.

School and work -going residents always carry food to eat during the day when they are away from home. This food is carried in various containers. These include the reusable plastic food containers, and disposable kaylites, foil paper and paper food wrappers. When residents use the reusable containers, it reduces the amount of waste that ends up in the waste stream.

Table 4-19 shows the location of residence in relation to the use of reusable food lunchboxes instead of disposable containers like kaylite, foil paper and food wrappers. Phakalane a high income residential area has the highest percentage of respondents who "always" use reusable lunchboxes with 77 %, unlike 46 % for Old Naledi and 42 % for Block 5. This could be either residents in Phakalane are sensitive to the environment and avoid waste generation or they can afford to buy the food to carry in the lunchboxes. This is followed by Old Naledi a low income, mainly because respondents carry food in lunchboxes because they cannot afford to buy the food that is sold in either shops or fast food facilities.

Phakalane has the lowest percentage of respondents who "sometimes" use reusable lunchboxes with 31 % compared to 54 % for Old Naledi and 38 % for Block 5. The low percentage for Phakalane in the "sometimes" category is a reflection of the high percentage of its respondents who "always" use reusable lunch boxes. Whereas for Block 5 and Old Naledi the high percentages is a reflection of the low percentages of the respondents who "always' use reusable lunchboxes. This category shows the percentage of respondents who are not consistent in re-using products, thus most of the times they use disposable food containers, the containers end up in the waste stream.

Table 4-19: Locality and the use of reusable lunch boxes.

| **I use food lunch box instead of disposable boxes, foil or kaylite** | | | | | | |
|---|---|---|---|---|---|---|
| | | | Always | Sometimes | Not at all | Total |
| **Location of House** | Old Naledi | Count | 22 | 26 | 0 | 48 |
| | | % within Location of House | 45.80 | 54.20 | 0.00 | 100.00 |
| | | % within I use food lunch box instead of disposable boxes, foil or kaylite | 30.10 | 44.80 | 0.00 | 34.00 |
| | Phakalane | Count | 32 | 15 | 1 | 48 |
| | | % within Location of House | 66.70 | 31.20 | 2.10 | 100.00 |
| | | % within I use food lunch box instead of disposable boxes, foil or kaylite | 43.80 | 25.90 | 10.00 | 34.00 |
| | Block 5 | Count | 19 | 17 | 9 | 45 |
| | | % within Location of House | 42.20 | 37.80 | 20.00 | 100.00 |
| | | % within I use food lunch box instead of disposable boxes, foil or kaylite | 26.00 | 29.30 | 90.00 | 31.90 |
| **Total** | | Count | 73 | 58 | 10 | 141 |
| | | % within Location of House | 51.80 | 41.10 | 7.10 | 100.00 |
| | | % within I use food lunch box instead of disposable boxes, foil or kaylite | 100.00 | 100.00 | 100.00 | 100.00 |

**Source:** Author's Fieldwork (2014)

For the "not at all" category Block 5 has the highest percentage with  20 % compare to  2 % of Phakalane and none in Old Naledi. This shows that Block 5 has the highest percentage of respondents who do not use reusable lunchboxes at all, they use disposable food containers. The implication is that all the disposable containers they use end up in the waste stream.

## 4.4 Correlation Matrix for the KAP Conceptualization.

Table 4-20 shows a correlation matrix of Knowledge, Attitude and Practice. Previous studies by Afroz et al (2010), Haider, (2010), Nilingiye et al (2010), Babayemi and Dauda (2011) and Nilanthi et al (2007), Golledge, (1999) and Downs and Stea (1973) have shown that knowledge changes attitude which will in turn influence practice. In the same instance, these

three variables are going to be tested to examine if the former holds true for domestic solid waste management in Gaborone.

Table 4-20: Correlation Matrix for the KAP Conceptualization

|  |  | Knowledge | ATTITUDE | PRACTICE |
|---|---|---|---|---|
| Knowledge |  | 1.0 | - | - |
| ATTITUDE |  | 0.540** | 1.0 | - |
| PRACTICE |  | 0.617** | 0.183* | 1.0 |

n = 141

** significant at the 0.01 α level (2-tailed)
* significant at the 0.05 α level (2-tailed)

### 4.4.1 Knowledge and Practice

Table 4.20 shows that there is a positive, strong and statistically significant relationship between knowledge of 3Rs to sustainable waste management practice. The findings show that as knowledge of 3Rs increases so does sustainable waste management practice. This shows that as residents get more knowledgeable about 3Rs they tend to practice the integrated methods of solid domestic waste management. This implies that waste is diverted from the landfills. Increasing recycling, reduction and reuse efforts are probably because residents realize the importance of a sustainable waste management system in the form of reduction of pollution, reduction in solid waste disposal, reduction in water pollution and creation of jobs for the local people for economic and environmental reasons.

### 4.4.2 Attitude and Practice.

There is a positive, weak but statistically significant relationship between attitude towards the 3Rs and practice. The positive relationship means as the positive attitude towards 3Rs increases so does sustainable domestic waste management practice. This weak relationship

shows that positive levels of attitude towards the 3Rs is not necessarily matched by high levels of sustainable waste management practices. This shows that even though people have a positive attitude towards the 3Rs, they don't always put equal effort in practicing them. The findings show that attitude change does not always result in behavior change. This could probably be caused by various barriers to practicing the 3Rs. The implications being that most waste could end up in the garbage receptacles. This will increase pollution rates, put pressure on Gaborone City Council as the service provider put pressure on government financial resources. This suggest that there is need to intensify education and awareness efforts.

### 4.4.3 Knowledge and attitude

There is a positive, strong and statistically significant relationship between knowledge about the 3Rs and attitude towards sustainable solid domestic waste management. The strong positive relationship means as knowledge of the 3Rs is increases, attitude about sustainable solid domestic waste management also increases. Attitude is one of the factors responsible for behaviour change.  Such a strong relationship between attitude and knowledge is vital behaviour change in domestic solid waste management.

The research hypothesis states that domestic solid waste management practices in Gaborone are determined by socio-economic, policy and perceptual factors. This study has shown that the practice of solid domestic waste recycling is influenced by educational level. The more educated people tend to recycle solid domestic waste compared to than those with no education. More respondents in Phakalane segregate their waste compared to those in Old Naledi and Block 5. Old Naledi has the highest number of respondent who always re-use water bottles compared to Block 5 and Phakalane. This shows that in all the three residential areas waste management is influenced by socio-economic factors that include education.

# Chapter 5

DISCUSSION OF RESULTS

## 5.0 Overview

This section provides a discussion of the result findings presented in Chapter 4.

## 5.1 Domestic Solid Waste Management Approaches

### 5.1.1 Solid waste handling

The Gaborone City Council employs a uniform approach to domestic solid waste management for the entire city in spite of some important distinguishing peculiarities in the demographic attributes that characterize its different residential areas. A face- to -face interview with Mr. Makati from Gaborone City Council revealed that the GCC collects, transports and disposes all domestic solid waste generated from the three different residential areas by landfilling (GCC Office, Gaborone, 2014). Their reliance on similar domestic solid waste management methods across communities makes the domestic solid waste management process unsustainable, as noted in literature review in Chapter 2. Saungweme, (2012) stated that unique socio-economic factors like educational level, age, income, type of waste generated and waste profiles require that domestic solid waste management approaches be customized to local conditions to ensure the sustainability and effectiveness of the waste management methods.

### 5.1.2 Solid waste Collection

The study shows that there are no major differences in the way domestic solid waste is collected in all the three different residential areas. Waste is collected once a week by the Gaborone City Council through the door-to-door method of collection. A face- to- face interview with Mr. Makati from GCC affirmed this (GCC Office, Gaborone, 2014). Studies by Saungweme (2012), GTZ (2010) and Tsiboe and Marbell, (2004) show that, like in Gaborone, domestic solid waste in Harare: Zimbabwe, Maseru: Lesotho and Accra: Ghana is collected once a week. However the routines in Accra and Harare as noted by Saungweme (2012) and Tsiboe and Marbell (2004) respectively, are not uniform, as some areas, especially low income ones, do not have a waste collection service at all , yet in Gaborone both respondents and City Council officials from the Health Department confirmed that collection is consistent. This goes to show that Gaborone City Council has been

comparatively more successful in providing a consistent waste collection service to its city dwellers.

### 5.1.3 Satisfaction with solid waste collection services

With regard to satisfaction with the waste collection service provided by the Gaborone City Council, only 43% of the respondents stated that they are either satisfied or very satisfied, the remaining 57% were not. Upon further probing, the respondents highlighted that a once-a-week waste collection service is not sufficient, considering that the amount of waste being generated continues to be on the increase. An interview with Mr. Makati, from GCC, revealed that domestic waste generated in Gaborone increased from 29 810 in 2010 up to 38 575 tones in 2013 (GCC Office, Gaborone, 2014). Such an increase in waste generation should be matched with an increase in the frequency of waste collection. However, this has not been the case so far for Gaborone. Since 2010 waste has been collected only once a week. As a result, through field observations, areas like Old Naledi, with majority of households comprising of more than 6 people, there are high incidences of littering on roadsides, in gullies and open spaces. This provides empirical evidence that the waste collection service that is in place is not sufficient to cater for all the waste being generated.


### 5.1.4 Knowledge about waste caretaking stakeholders

For any waste management system to be successful, all the stakeholders should play a participatory role. When asked to identify stakeholders in their respective residential areas apart from identifying GCC as the main stakeholder like everyone else, respondents in Old Naledi also identified Ipelegeng workers while those in Phakalane identified private companies like Skip Hire and Leaf Environment. Old Naledi, a low income area, relies on Ipelegeng workers who are hired and paid by government, while Phakalane, a high income area, uses private companies because the residents can afford to pay the fees required for any waste management service rendered. This therefore clearly confirms that income determines the way in which domestic solid waste is managed at household level. Respondents in all the three residential areas did not mention relying on either the Department of Waste Management and Pollution Control (DWMPC) nor environmental NGOs, yet these are the nation's important waste management organizations. This suggests that these latter stakeholders might not be in touch with the municipal residents.

For any integrated domestic solid waste management to be a success, there is need to involve all stakeholders from both the private, public sector and the residents, (Tanskanen, 2000, Pourideme, 2010 and Klundert (1999). As stated in Chapter 2, studies conducted in Japan, USA and Maseru- Lesotho, revealed that there is need to involve private organisations in order to achieve effective waste management. A face -to -face interview with Mr. Makati from GCC revealed that currently all the domestic solid waste generated in Gaborone is managed by the GCC (GCC Office, Gaborone and 2014).

Littering around residential areas has been on the rise and residents indicated that this is not indiscriminate littering, rather it is the inadequacy of the existing waste collection services. These problems can be solved by involving private companies like Skip Hire, Clean Cities, Daisy Loo and Cleaning Wizards in waste management. Such have been effective in Japan, USA and Lesotho where they are involved in domestic solid waste management (Nakamura, 2007, GTZ, 2010). GCC like most municipalities in Africa is cash- strapped thus they fail to provide sustainable domestic solid waste management to their residents. Scholars like Saungweme (2012) and Tsiboe and Marbell (2004) and Nakamura (2007) suggested that private companies are best placed to manage waste because they have both the financial and skilled human resources to manage waste. During face-to-face interviews with personnel from GCC and DWMPC, they also agreed that private companies are best suited to manage domestic solid waste as they have financial resources to do so.

As noted by Kwailane (2012), in a study in Lobatse- Botswana and Tsiboe and Marbell (2004) in a study in Accra- Ghana, waste management in African cities takes a top-down-approach. Residents and other stakeholders like recycling companies are not involved in the planning and implementation of the waste management plans in Gaborone as revealed during the survey. Residents are viewed only as waste generators who are recipients of the waste management service provided by GCC. During the household survey, most residents did not know other activities performed by GCC besides collecting waste and they also failed to identify DWMPC as a stakeholder. Face- to- face interviews with recycling organisations confirmed that they are alienated from the waste management system, by relevant government bodies. Recycling companies complained about the complicated tendering

process that hinders them from getting tenders to set up recycling centres in residential areas or recover recyclables from the Gamodubu Landfill.

### 5.1.5 Type of receptacle used

Four different receptacles were identified as the major storage containers for storing all the waste generated on the different residential sites. These are either black polythene plastic bags, City Council Metal bins, the 200 litre metal bin and the HDPE plastic bin. All the receptacles are used in all the three residential areas except for the HDPE which is not used in Old Naledi. As noted by Medina, (1997), Nilanthi, (2007) and Saungweme, (2012), waste management is influenced by socio-economic factors thus the type of receptacle used varies from area to area. Phakalane a high income area has the highest percentage of respondents who use the HDPE and other metal receptacles which residents buy on their own. On the other hand, Old Naledi a low income area, has the highest percentage of respondents who use the City Council Metal bin which is supplied by the GCC for free. A study by Saungweme (2012) revealed that 61% of Mbare residents, a low income residential area, use either mealie- meal bags, sacks, plastic bags or cardboard boxes and only 1 percent use metal bins. In the absence of the metal bin supplied by the GCC, Old Naledi and Block 5, low income and medium income areas respectively, resort to using a cheaper receptacle, the black polythene plastic bag while residents in Phakalane a high income area will buy more expensive receptacles. This goes to show how disparities in income determine the type of receptacle residents use in solid domestic waste management. The durability of the receptacle is related to the effective retention of waste and prevention from its scattering by scavenging animals.

### 5.1.6 Domestic solid waste management strategy used

The diverse approaches to domestic solid waste management used in the three residential areas have a lot of characteristics noted in Chapter 2. The approaches include both the earlier and contemporary domestic solid waste management practices. The earlier domestic solid waste practices of managing waste included burying, burning, dumping waste on land, roadside, drains and gutters as asserted by Saungweme (2012). These methods are used in all the three residential areas despite their different socio-economic characteristics. Elements of contemporary methods noted in Chapter 2 like reduction, recycling, and re-use by Kwailane

(2012) are practiced in all the three residential areas but with differences in degree of practice. For example, recycling and composting is practiced in all the three residential areas, but most of the respondents who practice this are found in Phakalane. Residents in Phakalane, a high income residential area, have extensive yards that allow them to use the compost for landscaping. Also recycling is highest in Phakalane because majority of residents are apparently and comparatively more environmentally- sensitive.

**5.1.7 Elements of a sustainable domestic solid waste management systems**

As noted in Chapter 2, a domestic solid waste management system can involve either a) generation, source segregation, storage, transport, transfer and processing centres, disposal by landfill or incineration both with or without energy recovery (Nakamura, 2007), or b) generation, source separation, composting, transport, transfer to points/drop-off points, disposal by landfill or incineration both with energy recovery, (Harro Von Blottnitz, 2009) or c) generation, separation at source, collection by recycling companies and municipalities and disposal by landfill (Chikarmane, 2012).The study findings from all the three residential areas show that their domestic solid waste management systems have certain elements that are common with various case studies found in literature .

Domestic solid waste management in all the three residential areas involves, waste generation, re-use, reduction, recycling, storage, burying, composting, illegal dumping, collection and disposal by landfilling with no energy recovery. Of these elements found in the three residential areas, their emphasis varies with each residential area. Recycling for example is mostly practiced in the high income area of Phakalane, followed by Old Naledi a low income area and it is least in Block 5, a medium income locality. Thus the domestic solid waste management practices in the three residential areas appears to be inclined to the earlier approaches of managing domestic solid waste though with some elements of contemporary approach to managing domestic solid waste. Earlier methods of managing waste were limited in scope to generation, storage, collection and disposal while contemporary methods place more emphasis on source reduction, sanitary landfills, composting, recycling and incineration (Saungweme, 2012).

## 5.1.8 Domestic solid waste streams

The Gaborone City waste management system, like that in most African cities, as noted by Gwebu (2002), has two waste streams: the legal and the illegal. The legal one being where waste generated is stored in different receptacles awaiting collection by the Gaborone City Council and transported to Gamodubu landfill for disposal. The illegal waste stream, otherwise known as illicit dumping, is caused by either the inadequacy of the waste collection system in place or by the absence of waste collection (Saungweme, 2012 and Tsiboe and Marbell, 2004). Evidence of the illegal waste steam is the presence of waste being dumped illegally in open spaces, roadside, by the railway line, and in storm drains as shown in Plate 5.1.It has also been confirmed by residents who actually practice it. Waste is also either being buried or incinerated mostly at the back of the residential premises. Residents in all the three residential areas cited delays in waste collection and the absence of garden and construction waste collection service as the main reasons for resorting to illegal ways of dumping their waste.

Plate 5-1: Illegal waste disposal. From top to Bottom. Top: Waste dumped by the roadside, middle: waste burning and bottom: waste dumped in a storm drain

**Source:** Author's fieldwork (2014)

### 5.1.9 Domestic solid waste disposal

The domestic solid waste produced in the three residential areas is eventually disposed of at

Gamodubu Landfill. This Landfill is one of the few sanitary landfills in Botswana, as stated

by Kwailane (2012) and GCC (2014). As noted in Chapter 2, landfills are one of the commonest ways of disposing of all domestic solid waste that could not be recovered (Saungweme, 2012). As noted in Chapter 2, sanitary landfills are different from traditional landfills and dumpsites because their construction methods prevent the seepage of leachates into underground water. Gamodubu landfill meets the required international standards of a sanitary landfill, making Gaborone one of the few African cities to have adopted a sustainable method of disposing of their waste by landfilling. Agenda 21 of the Rio Declaration recommends that the use of landfills should be coupled with energy recovery. Most African cities have not adopted such expensive technologies, as noted by Ogawa (2006), Kwailane (2012) and Maphorisa (2001), because they lack the technological know-how, skilled labour and financial resources to do so. Botswana has ratified to the international hierarchy of managing waste yet Gaborone has not adopted the recovering of energy from the Gamodubu Landfill due to its lack of financial resources, skilled labour and technical know-how to implement this practice.

## 5.2 Factors influencing domestic solid waste management practices

### 5.2.1 Gender and culture

Tsiboe and Marbell (2004) and Babayemi and Dauda (2011) have acknowledged that gender and culture play a significant role on who manages waste at the household level. Studies in Accra-Ghana and in certain Nigerian cities (Tsiboe and Marbell, 2004, Babayemi and Dauda, 2011) show that more women than men are involved in waste management at the household level. This is mainly because women who don't have formal jobs spend most of their time at home and are involved in cleaning duties. Findings from the study confirm that the majority of respondents who are directly involved in managing waste, at the household level, are women.

### 5.2.2 Education and awareness of respondents

Education and awareness are vital in waste management as observed by Heider (2010) and Afroz et al (2010) because they shape residents' attitude towards waste management, which will in turn determines practice. As noted in Chapter Two, in a study by Afroz et al, (2010) 75% of Bangladesh urban residents who separated their domestic solid waste at source were well aware of the importance of keeping their environment clean.

The study revealed that 61 percent of respondents who separate food waste from the rest of the garbage have tertiary education compared to 31 percent with secondary education and 2 percent with primary education. Also 81 percent of those who recycle have tertiary education compared to the 17 percent with secondary education and 2 percent with primary education. This provides ample evidence that the more educated residents are the more they are environmentally sensitive. This points to the significance of providing formal education to communities.

### 5.2.3 Income level and quantity of waste generated

Factors, including income and household size, combine to contribute to an increase in waste being generated by residents as noted by Medina, (1997) and Haider, (2010) from their studies in urban Sri Lanka and Accra- Ghana. The same can also be said for Gaborone whereas the standards living of residents improve and population increases so is the quantity of waste that they generate. Mr. Makati, from GCC, confirmed that domestic solid waste generated in Gaborone increased from 29 810 in 2010 up to 38 575 tonnes in 2013I (GCC Office: Gaborone, 2014). This is evidence that domestic solid waste being generated by Gaborone residents is increasing in response to increasing consumption patterns by increasing household numbers.

### 5.2.4 Knowledge, Attitude and Practice

Various literature sources have confirmed that cognitive variables influence spatial behaviour (Garling and Golledge, (1993), Golledge (1999) and Downs and Stea (1973). The study findings show that practice is greatly influence by knowledge thus residents should be educated about the 3Rs to ensure behavior that impacts on waste management change. For Gaborone to adopt and implement an Integrated Domestic Solid Waste Management, policies formulated should put emphasis on educating residents on the 3Rs in order to ensure behaviour change. Policies should have clear objectives and action plans that would influence residents to change their behaviour through education. This can be done by making formal education more accessible, raising awareness through waste management door-to-door campaigns, TV and Radios, social media and in the print media. As noted by Golledge, (1999) a positive attitude results in behaviour change. The study findings show that attitude towards the 3Rs is also influenced by knowledge on the 3Rs. A majority of respondents who

had a positive attitude towards the 3Rs often practice sustainable waste management principles. Residents' attitude should be changed by educating them as this will result in behaviour change.

## 5.3 Extent of household 3R practices

Chapter 2 has suggested that the adoption of an integrated domestic solid waste management strategy (IDSWMS) is a more practical solution to solving the ever mounting domestic solid waste problems that Gaborone is facing. The strategy proposed in Chapter 2 was derived from various literature sources, including Saungweme (2012), Tanskanen (2000) and Puopiel (2010). This strategy puts much emphasis on the practice of 3Rs to reduce the amount of waste that ends up in the waste stream and eventually in the landfill. The key principles of Botswana's Waste Management Strategy are to manage waste more sustainably through the implementation of the 3Rs. The strategy emphasizes the 3Rs, as prescribed activities under the management of domestic solid waste, but does not propose steps in which this should be done at household level (Government of Botswana 1998a). The lack of practical actions, which can be taught to the residents by responsible bodies like DWMPC and GCC, remains a drawback in the fight to the management of waste being generated.

### 5.3.1 Waste reduction

The survey respondents claim that they employ measures like composting organic waste, use shopping bags instead of buying plastic bags, donate old clothes, use refillable water bottles, use washable napkins instead disposable diapers for babies, feed animals with food leftovers and use washable cloth dish towels instead of paper napkins.

Waste reduction, as noted by Khotoliya (2004) in Chapter 2, are measures taken by residents to avoid generating any waste. Such measures reduce the amount of waste that ends up in landfills. As noted by Saungweme (2012) in a study in Mbare-Harare, the practice of the 3Rs remains very low amongst residents, even though they are aware of the concept. The study findings show that most residents are aware of the concept of waste reduction but they don't always practise it. When asked a series of question on their waste- reduction practices, a majority of residents indicated that they sometimes or never reduce waste at all while only a

minority answered they always practice it. The responses showed that there is need for awareness campaigns on the benefits of reducing waste to ensure consistency in practice.

**5.3.2 Waste recycling**

The study findings show that residents are familiar with recycling and that it is practiced in all the three residential areas but the degree to which they practise it differs by locality. As noted by Saungweme (2012) and Kruger and Haferburg (2014), residents are aware of the recycling concept yet only a few send their waste for recycling. The study findings show that only 38% of respondents actually participate in recycling efforts. This shows that there are vast discrepancies between knowing about recycling and actually practising it. As noted in Chapter 2, studies in India (Chikarmane and Narayan 2009), Maseru (GTZ, 2010), Japan and USA (Nakamura, 2007) revealed that recycling is vital in waste management. Not only does it reduce the amount of waste that ends up in the landfill, it also creates jobs, stimulates the growth of entrepreneurs, saves the environment from exploitation of resources, reduces pollution and provides raw materials for the growing industries.

Developed counties like Japan and Germany who recycle over 60% of their waste are realizing benefits like reduction in number of landfills, increase in the number of waste management companies and restoration of the aesthetics of the cities. On the other hand, most Developing Countries still recycle less than 15% of their domestic solid waste. This shows that recycling rates are still very low and this is revealed in the findings of this study where a majority of the respondents do not recycle at all. Interviews with personnel from recycling organisations such as Recycle-It, Simply Recycle, Collect-A-Can, Lebs Recycling and Somareleng Tikologo revealed that most of the waste they recover does not come from households but from shopping malls. The study findings showed that in all the three residential areas, there are no comprehensive waste recycling programmes. This was confirmed by Mr. Makati from GCC who confirmed that there are no recycling facilities like drop-off centres that residents may readily use (GCC office, Gaborone, 2014).

The study also revealed that respondents mainly recycle in order to either earn income or because they are environmentally sensitive.  As noted by Medina (2000) recycling in low

income communities provides a source of income and it is practiced in several cities in India, Zimbabwe, South Africa and Egypt. The study finding revealed that respondents in Old Naledi, a low income residential area, and Block 5, a medium income area, get paid for their recyclables, while those in Phakalane, a high income area, are not paid for recycling. The recycling by residents of Phakalane for no financial gain was confirmed in face- to- face interviews with personnel from Collect-A-Can and Somareleng Tigoloko affirming that residents from high income areas drop off their recyclables (glass and cans) and they don't get paid to do so yet those from low and medium income are paid to do so.

Education and awareness have been recommended as a vital tool to encourage residents to participate in recycling efforts Heider (2010). In countries like Japan and USA, where recycling education and awareness campaigns have been introduced, recycling rates have risen up to 60 percent. A study by Afroz et al (2010), shows that 75% of Bangladesh urban residents who separate waste at source are well aware of the importance of keeping the environment clean. The study findings show that recycling participation is highest amongst residents with tertiary education with 80 % compared to 17 % with secondary education and 2 % with primary education.

This study found out that the majority of recyclers live in Phakalane, a high income area. This shows disparities with other studies done on recycling in cities in developing countries, by Chikarmane (2012) and Medina (1997), where a majority of recyclers were from the low income ranks of the city. Most parents in Phakalane send their children to Northside Primary School which has incorporated waste management into their school curriculum.  Plate 5.2, shows a recycling drop -off centre has been set-up at the school premises.

Plate 5-2: Segregation receptacles at Northside School Recycling drop -off centre

**Source:** Author's fieldwork, (2014)

An interview with the school Headmaster revealed that every last Friday of the month is dedicated to environmental issues in order to continue raising environmental awareness amongst the students and teachers. Students and parents from Northside School have taken a participatory role in the recycling process wherein all recyclables are dropped off at the school's recycling drop -off centre. There is need to set up such structures in Government and other Private schools so as to inculcate the culture of recycling in residents from a young age.

### 5.3.3 Waste re-use

As noted in Chapter 2, re-use implies using a product more than once, either for the same purpose or for others. Re-use strategies include reusing packaging such as boxes, glasses, plastic containers and bags and empty containers for the storage of other commodities. Respondents said that they take measures like washing plastic containers and jars for re-use,

re-use plastic bags, use lunchboxes and buy goods in containers that can be re-used. When asked if they wash containers for re-use the majority answered that they sometimes do. This revealed that residents are not consistent in reusing product and need to be made aware of the benefits of waste re-use.  This can be made possible by having policies with practical action plans to encourage the re-use of waste.

# Chapter 6

## CONCLUSION AND RECOMMENDATIONS

### 6.0 Overview

Based on the research objectives of the study, this Chapter presents the summary of findings and related recommendations.

### 6.1 Summary of findings in relation to the objectives of the study

The first objective of the study was to investigate the existing domestic solid waste management system in Gaborone. The study findings show that waste management system in Gaborone is consistent with generation, limited 3Rs practice, collection, transfer and disposal to landfill with no energy recovery. Waste management practice should encourage consistent 3Rs promotion and encompass other components like incineration and landfilling disposal with energy recovery. As noted in this study, and by various scholars on this topic, municipalities in Botswana collect more than 60 percent of the waste generated. This is higher than most municipalities in other African cities showing that Botswana is hard pressed to implement a sustainable waste management strategy.

The second objective was to identify factors that determine domestic solid waste management practices. The study findings show that variables like the socio economic status of the residential area, type of tenure, length of stay, size of household and education level all influence household behaviour in waste management. The study findings show that respondents with high educational levels tend to segregate their waste and recycle compared to those who have attained Primary and Secondary school as their highest level of education. Various literature sources show that cognitive variable influence spatial behaviour (Afroz et al (2010), Haider, (2010), Nilingiye et al (2010), Babayemi and Dauda (2011) Nilanthi et al (2007), Golledge, (1999) Downs and Stea (1973)). The study findings show that the amount of knowledge of the 3Rs respondents have determines their attitudes towards the 3Rs. In turn they influence the various practices employed by respondents in waste management at the household level. Household surveys revealed that most residents are knowledgeable about the 3Rs and most of them have a positive attitude towards waste management, yet practice of the

3Rs is comparatively still very low. Thus residents should be encouraged to practice sustainable waste management through educating them about the benefits of practicing the 3Rs and offering positive incentives to those who practice. Waste management studies should be introduced in schools so as to inculcate the 3Rs practicing culture among future generations.

The third objective was to identify the active stakeholders in domestic solid waste management. The respondents identified GCC, Ipelegeng workers and private waste management companies like Skip hire as the stakeholders involved in active domestic solid waste management. Other stakeholders included recycling organisations such as Collect-A-Can, Recycle-It-Botswana, Lebs Recycling, Somareleng Tigoloko and Simply Recycle. Waste management in Gaborone takes a top-down-approach in which responsible bodies such as GCC and DWMPC make decisions on waste management without involving residents. The social survey revealed that residents are more than willing to participate in managing their waste so as to keep their environments clean. Residents should not be alienated from participating in waste management efforts. Instead of viewing them as only waste generators, they should be seen as vital stakeholders and should be involved in decision making on waste management issues. As they are the people on the ground, they should be actively involved in coming up with domestic solid waste plans that best suit their areas.

## 6.2 Recommendations

This section will suggest recommendations on what needs to be done in order to adopt and implement an integrated domestic solid waste management (IDSWMS). The main aim of the IDSWMS should be to reduce the amount of solid waste being generated, and this can be done by implementing the following:

- ❖ Raising awareness of waste management through public education campaigns. These can be done through various tools like road shows, distribution of information pamphlets, radio and televisions programmes, social networks, magazines, newspapers and door-to-door visits. For these to be effective, different tools should be used so at to reach specific target groups. Social media (Facebook, What's App and Twitter) should also be incorporated as a majority of respondents in all the three

residential areas indicated that it as their preferred source of additional information about waste management. Waste management studies should be introduced into the school curriculum so as to "catch them young" and influence their waste management attitudes.

❖ Promote separation of waste at source, i.e. household level.  This can be made possible by providing residents with segregation receptacles. Waste can be separated into three main groups namely, biodegradable waste, recyclables and garbage.

❖ Promote waste reduction and re-use as they are vital for attaining a sustainable waste management strategy. They will save money for the residents and, at the same time, reduce the amount of waste that ends up in the waste stream.

❖ Promote recycling. Public awareness campaigns on recycling should be promoted. Residents should be aware of the benefits of recycling and given incentives or get paid for their recyclables. Government should also encourage the growth of recycling businesses. Various drop off points should also be put in all the residential areas to encourage recycling. Schools also should be used as drop off centres to encourage students to be involved in recycling.

❖ Encourage backyard composting. With an effective three way segregation system, all organic waste can be composted, reducing the amount of waste that will end up in the landfill, at the same time reducing foul odours associated with rotting biodegradable waste.

❖ Regular collection of waste. With a proper waste segregation system in place, regular collection of non-biodegradable waste will be possible in all the residential areas. GCC can continue to collect garbage, and, just like in Maseru-Lesotho, recycling companies should collect all the recyclables.

❖ More involvement of the private sector. Private waste management companies like Skip Hire and Leaf Environment, who are well equipped to manage waste, should be contracted to collect garbage. At the same time recycling companies should be licensed to collect recyclables from households and drop off centres.

❖ Develop a long term integrated domestic solid waste management plan. The DWMPC, GCC and all relevant stakeholders should develop a long term integrated

domestic solid waste management plan for Gaborone. This could be implemented in three or five year phases.

❖ Bring recycling companies on board as they will encourage residents to recycle. Prices of recyclables should also be favourable to encourage recycling as many respondents said they don't recycle because the price of recyclables is too low. Less stringent regulations should be put in place to encourage recovering of waste from landfills. In the long run there is need to establish a waste transfer centre where waste can be sorted into garbage and recyclables before it reaches the landfill.

❖ Adopt an Integrated Domestic Solid Waste Management Strategy (IDSWMS) in Gaborone. The findings from the study clearly show that there is a need for the adoption of an integrated domestic solid waste management in order to solve the waste management problems that Gaborone residents are facing. These problems include littering, insufficient waste collection service and a lack of waste reduction at household level. For IDSWMS to be successful all stakeholders should participate in waste management decision-making process, residents should be educated on sustainable waste management practices and relevant stakeholders should provide necessary resources to encourage 3Rs practice. This can be done by providing segregation receptacles, recycling drop-off centers and encourage the growth of waste management businesses.

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**Appendix  A: Semi-structured interview guide for Greater Gaborone domestic solid waste management household survey.**


**UNIVERSITY OF BOTSWANA, FACULTY OF SCIENCE, DEPARTMENT OF ENVIRONMENTAL SCIENCE**

**TOPIC:** *AN INTEGRATED WASTE MANAGEMENT APPROACH AS AN ALTERNATIVE DOMESTIC SOLID WASTE MANAGEMENT STRATEGY FOR THE GROWING AFRICAN URBAN ENVIRONMENTS: A CASE STUDY OF GABORONE, BOTSWANA*

Household survey semi-structured questionnaire

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*This research is only for academic purposes and information obtained and answers given will be treated in strict confidence.*

*Thank you.*

**Location of house:**
...................................................................................................................

**House Number and Street:**
...............................................................................................................

**Interview Date:**
.........................................................................................................................

**Questionnaire Number:**
...................................................................................................................

**SECTION A**

1.Location of the house (Tick)

| | |
|---|---|
| OLD Naledi | |
| Phakalane | |
| Block 5 | |

2.What is your age? (***Tick appropriate***)

| **Age** | 21-29 | 30-39 | 40-46 | +50 |
|---|---|---|---|---|

3.Do you own or rent your residence?

| Own | Rent | Don't know | Other |
|---|---|---|---|

4.How many years have you lived at your present residence? .......

5.What is your highest educational level? (***Tick appropriate***)

| **Level** | **Tick** |
|---|---|
| None | |
| Primary Level | |
| Junior Secondary | |
| Senior Secondary | |
| Advanced level | |
| Vocational /College Training | |
| Tertiary/Degree | |

6.How many are you in your household? (***Tick appropriate***)

| **Number of People** | **Tick** |
|---|---|
| 1-3 people | |
| 4-6 people | |
| 7-8 people | |
| Over 8 people | |

**SECTION B**

**Domestic solid waste management**

7.What is your source of information for waste management?

| Source | Tick |
|---|---|
| Television | |
| Radio | |
| Friend and relatives | |
| Magazines | |
| School | |
| Newspapers | |
| Other | |

8.How do you dispose of your waste? (***Tick appropriate***)

| Waste | Method of disposal |
|---|---|
| Collected by City Council | |
| Dump illegally in open spaces | |
| Collected by recycling companies | |
| Rubbish pit | |
| Burn | |
| Bury | |
| Other | |

9. How often do you get waste collection service in a week? (*Tick appropriate*)

| **Frequency** | Once | Twice | 3Times | 4 Times | 5 Times | 6Times | Everyday | None |
|---|---|---|---|---|---|---|---|---|
| **Tick** | | | | | | | | |

10. Do you separate your food waste from your other garbage**? Yes/No**

11. If no what is the main reason?

| **Main Reason** | **Tick** |
|---|---|
| I don't have time | |
| I don't know how ant what to do | |
| Its dirty | |
| **Other** | |

12. **If yes what are the reasons?**

| **Reason** | **Tick** |
|---|---|
| To make compost | |
| To feed the domestic animals | |
| Avoid scavenging | |
| To take it to recyclers | |
| Other | |

13. Do you separate your dry waste into different types e.g (glass, plastic, Metal)  YES/NO

14. If No, what are your reasons?

| **Reason** | **Tick** |
|---|---|
| I do not have time | |
| Its tedious | |
| Its dirty | |
| Other | |

15.If yes, why do you separate your waste? (*Tick appropriate*)

| **Reason** | **Tick** |
|---|---|
| To avoid scavenging by pest | |
| For collection by voluntary recycling companies | |
| For selling to recycling companies | |
| To send to waste recycling drop off points | |
| Other | |

16.What type of storage bin do you use? (*Tick appropriate*)

| **Type of bin** | **Tick** |
|---|---|

| | |
|---|---|
| Black polythene plastic bags | |
| Metal City council bin | |
| Other metal bins | |
| HDPE (plastic) bins | |
| Other | |

17.If you indicated that you dump waste illegally, where do you dump it (***Tick appropriate***)

| Where | Tick |
|---|---|
| Open spaces | |
| Roadside | |
| Bushes | |
| Illegal dumpsites | |
| Drains | |
| Other | |

Main Reason why you dump it illegally?

| Main Reason | Tick |
|---|---|
| Inability to pay waste collection fees | |
| Delays in collection by City Council | |
| Absence of waste collection services in the area | |
| Other ( Specify) | |

18.How do you dispose of your garden waste? (***Tick appropriate***)

| Method | Tick |
|---|---|
| Private collectors | |
| Illegal dumping in open spaces | |
| Composting | |
| Burning | |
| Other (specify) | |

19.How do you dispose of your construction waste? (***Tick appropriate***)

| Method | Tick |
|---|---|
| Private companies collectors | |
| Illegal dumping in open spaces | |
| Other (specify) | |

20.Who are the major stakeholders and what role do they play in domestic solid waste management in your area.

| Name of Stakeholder | Current activities | What could they do in your opinion which they are not doing at present? |
|---|---|---|
| | | |

|  |  |  |
| --- | --- | --- |
|  |  |  |
|  |  |  |

## SECTION C

**The 3Rs (Reduce, Recycle and Re-use)**

**REDUCTION- Avoiding generating waste/Use less quantities/Use more durable goods.**

**KNOWLEDGE**

|  | True | False | I don't Know |
| --- | --- | --- | --- |
| 21.Making a compost with garden waste and food leftovers is a waste reduction technique. |  |  |  |
| 22.Donating old clothes is a waste reduction technique. |  |  |  |
| 23.Waste reduction reduces the amount of waste that ends up in the landfill. |  |  |  |
| 24.Throwing away all the waste I produce is a waste reduction technique. |  |  |  |
| 25.Using my own shopping bag helps reduces plastic bags that will end up in the landfill |  |  |  |

**Attitude**

| Statement | Strongly agree | Agree | Neutral | Disagree | Strongly disagree |
| --- | --- | --- | --- | --- | --- |
| 26.Waste reduction helps to conserve the environment. |  |  |  |  |  |
| 27.Waste reduction is an important aspect of waste management and I want to do my part to help. |  |  |  |  |  |
| 28.Waste reduction is one way I can make a difference. |  |  |  |  |  |

| | | | | | |
|---|---|---|---|---|---|
| 29.I pay City Council for waste management so I don't bother with waste reduction. | | | | | |
| 30.I am well informed about waste reduction. | | | | | |

## PRACTICE

| Activity | No at all | Sometimes | Always |
|---|---|---|---|
| 31.Use a refillable container for water in place of bottled water | | | |
| 32.Take your own bag or basket to the grocery and market to break the plastic bag habit. | | | |
| 33.Use products that last longer e.g. use washable napkins instead of disposable diapers. | | | |
| 34.Compost vegetable scraps and garden waste | | | |
| 35.Give your food scraps to animals. | | | |

## RECYCLING

## KNOWLEDGE

| | True | False | I don't Know |
|---|---|---|---|
| 36.Waste recycling is a source of income | | | |
| 37.Somareleng Togoloko, Collect-A-Can and Recycle it Botswana all recovers different materials for recycling. | | | |
| 38. Segregation of waste is vita in the recycling process. | | | |
| 39.Waste recycling easies pressure on service providers | | | |
| 40.Waste recycling is vital in this generation, so as to preserve resources for future generations. | | | |

## ATTITUDE

To what extent do you agree with the following statements?

| Statement | Strongly agree | Agree | Neutral | Disagree | Strongly disagree |
|---|---|---|---|---|---|
| 41.Recycling helps to conserve the environment. | | | | | |
| 42.Recycling reduces the amount of waste that ends up in the landfill. | | | | | |
| 43.Low revenue from recycling discourages recycling. | | | | | |
| 44.Residents need to be more educated on the subject of recycling. | | | | | |
| 45.As a resident I am satisfied with the quality of information I receive/have about recycling. | | | | | |

## PRACTICE

46.Do you send your waste for recycling?

| Yes | No |
|---|---|

47.If you answered yes, which type? *(Tick appropriate)*

| Waste type | Tick |
|---|---|
| Food | |
| Paper and cardboard | |
| Plastic | |
| Rubber | |
| Metals | |
| Glass | |
| Textiles | |
| Ashes | |
| Other | |

48.Why do you recycle? Rate the answers from 1-4

| Reason | Tick |
|---|---|
| I recycle to help conserve natural resources | |
| I recycle to help support charity | |
| I recycle to earn money | |
| I recycle because it seems like the right thing to do | |

49. In what state do recycling organisations collect your recyclables?

| Segregated | |
| --- | --- |
| Not segregated | |

50. How often do you recycle?

- o Always
- o Sometimes

51. Where do the recycling organizations collect your recyclables from? (*Tick appropriate*)

| Place | Tick |
| --- | --- |
| At my house | |
| Recycling drop off points | |
| Recycling Depots | |
| Other | |

52. Does the organization pay for the recyclables? (*Tick appropriate*)

| Yes | No |
| --- | --- |

**53.** Are you happy with the gazetted prices for your recyclables? (*Tick appropriate*)

| Yes | No |
| --- | --- |

54. If you do not participate in recycling what are your reasons? Rank the answers from 1-8

| Reason | Tick | Reason | Tick |
| --- | --- | --- | --- |
| Don't know how to do it. | | Lack of market for recyclables. | |
| The price for recyclables is too low. | | Lack of space. | |
| Can't see the importance. | | Can't afford separating bins. | |
| Its time consuming | | I pay for waste management fee to the City Council | |
| Other | | Other | |

55. What would motivate you participate in recycling efforts? Rank the answers from 1-4.

| Main reason | Tick |
| --- | --- |
| Market for recyclables | |
| If I get paid for it | |
| Availability of separating containers | |
| If everyone is doing it. | |
| Other | |

56. In your opinion what factors limit people's participation in waste segregation for recycling?

| Factor | Tick |
| --- | --- |
| Lack education and awareness | |
| I simply forget to recycle | |
| Recycling cost me too much money | |
| There is no facility/pick-up service available | |
| Absence of market for segregated recyclables | |
| Low prices for recyclables | |

| | | |
|---|---|---|
| Lack of storage for segregated waste | | |
| The segregation process is tedious and dirty | | |
| Other | | |

**RE-USE. Using a product more than once**

**KNOWLEDGE**

| | True | False | Don't Know |
|---|---|---|---|
| 57.Re-using a product saves me money | | | |
| 58.Re-using products reduces the need to produce more new products. | | | |
| 59.Using shopping plastic bags as a refuse bins is a waste re-use technique | | | |
| 60. Making use of my own shopping bag every time I do shopping is a re-use technique | | | |
| 61.Using Juice/ Drink or paint buckets containers to store water is a re-use technique. | | | |

ATTITUDE

To what extent do you agree with the following statements?

| Statement | Strongly agree | Agree | Neutral | Disagree | Strongly disagree | Don't Know |
|---|---|---|---|---|---|---|
| 62. An important reason to reuse products is to save my money. | | | | | | |
| 63. Waste re-use helps to conserve the environment. | | | | | | |
| 64. Re-using products reduces the amount of waste that ends up in the landfill. | | | | | | |
| 65. Re-use is an important aspect of waste management and I should do my part to help. | | | | | | |
| 66. Easy items to re-use are ok but items that have to be cleaned are too much trouble to bother. | | | | | | |

**PRACTICE**

67. How often do you practice any of the following below? Tick appropriate.

| Activity | Not at all | Sometimes | Always |
|---|---|---|---|
| Wash plastic containers and jars and reuse | | | |
| Buy things in plastic or glass containers that can be reused | | | |
| Use reusable containers for food instead of disposable boxes, plastic wrap, foil, or sandwich bags. | | | |
| Re-use plastic bags | | | |
| Use products that last longer (Washable baby napkins than pampers) | | | |
| Use dish towels instead of paper towels | | | |

68. What factors limit the re-use of products?

| Reason | Tick |
|---|---|
| Cleaning of products for re-use is tedious | |
| Cleaning of products for re-use is time consuming | |
| New cheap products are readily available | |
| I forget | |
| Other | |

## SECTION D

## Participating in Waste Management

69. How satisfied are you with the domestic solid waste management service provided by GCC?

| Very satisfied | Satisfied | Neutral | Dissatisfied | Very dissatisfied |
|---|---|---|---|---|
| | | | | |

70. Has there been any waste management campaigns in your area? *(Tick appropriate)*

| Yes | No |
|---|---|

71. If yes who was fostering the campaign?

| Fostering organization. | Tick |
|---|---|
| Government | |
| Private waste management organisations | |
| City Council | |
| DWMPC | |
| Political parties | |
| NGOs | |
| Others | |

72. What would motivate you to participate in waste management efforts? *(Tick appropriate)*

| Main reason | Tick |
|---|---|
| It is the right thing to do | |
| To maintain a clean environment | |
| To easy pressure on service providers | |
| To protect the environment | |
| Others | |

73. What would discourage you from participating in waste management efforts?

| Reason | tick |
|---|---|
| Lack of financial incentive | |
| Because it's the duty of City Council | |
| Don't have time | |

| Other | |
|-------|--|

74. What is your preferred source of additional information on waste management?

| Source | Tick | Source | Tick |
|--------|------|--------|------|
| Newspapers | | TV | |
| Social Media (facebook, whats app, twitter, etc.) | | Radio | |
| Magazines | | Billboards | |
| Fliers | | Other | |

75. Have noticed any of the following environmental problems in your area? (*Tick appropriate*)

| Environmental Problem | Always | Sometimes | No at all |
|-----------------------|--------|-----------|-----------|
| Uncollected rubbish hips | | | |
| Dirty streets | | | |
| Waste dumped in alleys | | | |
| Rodents, flies and mosquitoes | | | |
| Scavengers on illegal waste disposal sites | | | |
| Children play around illegal waste disposal sites | | | |
| Dogs and other pets scavenge for food in bins and illegal waste hips | | | |
| Illegal burning of waste | | | |

76. How do think the situation can be improved? (*Tick appropriate*)

| How | Tick |
|-----|------|
| Education and awareness | |
| Encourage public participation | |
| Other | |

77. In your opinion what can stakeholders do to improve domestic solid waste management in your area? (*Tick appropriate*)

| How | Tick |
|-----|------|
| Provide segregation bins to encourage sorting of waste | |
| Educate residents on waste management | |
| Provision of waste sorting centres | |
| Government, NGOs and Private Sector to encourage growth of recycling businesses | |
| Other | |

THANK YOU FOR FILLING THIS Questionnaire!!!!!!!!!!!!!!!!!!!!!!!!!!

**Appendix B: Semi-structured key-informant interview guide for Greater Gaborone domestic solid waste management service provider interviews.**

**UNIVERSITY OF BOTSWANA, FACULTY OF SCIENCE, DEPARTMENT OF ENVIRONMENTAL SCIENCE**

**TOPIC:** *AN INTEGRATED WASTE MANAGEMENT APPROACH AS AN ALTERNATIVE DOMESTIC SOLID WASTE MANAGEMENT STRATEGY FOR THE GROWING AFRICAN URBAN ENVIRONMENTS: A CASE STUDY OF GABORONE, BOTSWANA*

Service provider interview guide.

---

*This research is only for academic purposes and information obtained and answers given will be treated in strict confidence.*

*Thank you.*

**Position of respondent:**
...................................................................................................................

**Interview Date:**
......................................................................................................................

**Questionnaire Number:**
.................................................................................................................

**Area being serviced:**
................................................................................................................

## SECTION A

**Domestic Solid Waste Management**

1. Approximately what is the quantity of domestic solid waste generated in your area in a month in tonnes? .......................................

2. What are the common types of domestic solid waste generated in the area and in what quantities?

| Waste type | Tick | %of the total domestic solid waste |
|---|---|---|
| Food | | |
| Paper and cardboard | | |
| Plastic | | |
| Rubber | | |
| Metals | | |
| Glass | | |
| Textiles | | |
| Ashes | | |
| Other | | |

3. Do you separate solid waste before disposal?....................................................................

4. If no, explain why?

5. What are the possibilities of waste domestic solid waste segregation and recycling in Botswana?

6. What are the limitations to waste segregation and recycling?

## SECTION B

**Integrated Solid Waste Management**

7. What is the council's policy on integrated solid waste management system?

8. What facilities are in place to achieve ISWM?

9. In your opinion are the efforts of achieving an ISWMS succeeding? If yes, who does the separation and how is it done?

| YES | |
|---|---|
| NO | |

10. What are the limitations to achieve an integrated solid waste management system?

11. In the absence of policy, what intervention at the council level are you implementing?

12. What is the policy position on the collection and disposal of garden and rubble?

13. What is your annual budget for domestic solid waste management in Pula?

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

14. How do you finance the budget?

| Source of Finance | Percentage |
|---|---|
| Government grant | |
| Own revenue collection | |
| Donations | |
| Other: | |

15. Do beneficiaries of your waste management services pay collection fees?

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

16. What problems are you facing regarding financing your waste management budget if any?

## SECTION E

## Role of education and Public participation

17. Do you carry out campaigns to raise awareness on waste management?

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

18. If yes, please outline the type of campaigns and methodologies used?

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

19. What impacts has the campaigns had so far?

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

20. In your own opinion, are residents well educated on waste management, especially the 3Rs?

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

## SECTION F

**Policy and legislative Framework**

21. Which policies and laws are in place to foster an integrated domestic solid waste management system?

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

22. What do you see as the gaps and weaknesses in policies and laws?

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

23. What needs to be done to address these gaps in policies and laws?

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

**SECTION G**
**Stakeholders**

24. Who are the major stakeholders and what role do they play in domestic solid waste management in your area.

| Name of Stakeholder | **Current activities** | **What could they do in your opinion which they are not doing at present?** |
|---|---|---|
| | | |
| | | |
| | | |

**SECTION H**

**Challenges in domestic solid waste management.**

25. What are the key challenges you are currently facing in domestic solid waste management in your area?

26. What do you think are some of the solutions to these challenges?

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


**THANK YOU**

**Appendix C: Semi-structured key-informant interview guide for Greater Gaborone domestic solid waste management for Department of Waste Management and Pollution Control officials.**

**UNIVERSITY OF BOTSWANA, FACULTY OF SCIENCE, DEPARTMENT OF ENVIRONMENTAL SCIENCE**

**TOPIC:** AN INTEGRATED WASTE MANAGEMENT APPROACH AS AN ALTERNATIVE DOMESTIC SOLID WASTE MANAGEMENT STRATEGY FOR THE GROWING AFRICAN URBAN ENVIRONMENTS: A CASE STUDY OF GABORONE, BOTSWANA

Department of Waste Management and Pollution Control officials interview guide.

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*This research is only for academic purposes and information obtained and answers given will be treated in strict confidence.*

*Thank you.*

**Position of respondent:**
...................................................................................................

**Interview Date:**
......................................................................................................

**Questionnaire Number:**
................................................................................................

**Location:**
.................................................................................................................
.

**SECTION A**

**Waste Management**

1) How would you describe the domestic solid waste situation in this city?

2) In your opinion who is best equipped to manage waste in the city?

3) How would you rate the effectiveness of the current waste management systems in the city?

|  | Tick |
|---|---|
| Excellent |  |
| Very good |  |
| Good |  |
| Poor |  |
| Very poor |  |

4) Please suggest sustainable ways of managing domestic solid waste in the city.

**SECTION B**

**Integrated Domestic Solid Waste Management System.**

5) Are there any effort made to reduce waste generated by households at a national level?

6) What are the challenges you face in trying to educate residents on waste?

7) What is the role of local authorities or other institutions in the implementation of an ISWMS?

8) What are your feelings on recycling/re use of waste?

9) Do you think there is potential to generate income from waste recycling for residents and entrepreneurs?

10) Do you know any companies/organisations involved in recycling of domestic solid waste?

| Yes |  |
|---|---|
| NO |  |

11) If yes, list them and the waste they recycle.

| Company/ Organisation | Waste they recycle |
|---|---|
|  |  |
|  |  |
|  |  |
|  |  |
|  |  |

12) What can the government/council, NGOs, CBOs and other institution do to help increase the amount of waste recycled?

13) In your opinion is the government doing much in promoting markets for recycled materials?

14) Do you offer any incentives to encourage waste management by residents?

**SECTION C**

**Role of education and Public participation**

15) Do you carry out campaigns to raise awareness on waste management?

16) If yes, please outline the type of campaigns and methodologies used?

17) How often do you carry out these campaigns?

18) What impacts has the campaigns had so far?

**SECTION D**

**Policy and legislative Framework**

19) What policies and laws are in place to foster ISWMS?

20) What do you see as the gaps and weaknesses in policies and laws governing integrated domestic solid waste management?

21) What needs to be done to address these gaps in policies and laws?

22) In the absence of policy what are the systems in place to implement ISWMS?

23) What is the role played by the private sector in an ISWMS?

**SECTION E**

**24) Stakeholders**

| Name of Stakeholder | **Interest** (*What do you think they want in Gaborone?*) | **Interest** (*What do you think they want in Gaborone?*) | **Current support** (*What are they currently doing in Gaborone?*) | **What could they do in your opinion which they are not doing at present?** |
|---|---|---|---|---|
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |

**SECTION F**

**Challenges in domestic solid waste management.**

25) What are the key challenges the nation is currently facing in domestic solid waste management?

26) What do you think are some of the solutions to these challenges?

27) In your opinion own opinion what is the way forward if ISWMS is to be a success in Botswana?

**THANK YOU**

**Appendix D: Semi-structured key-informant interview guide for Greater Gaborone domestic solid waste management for recycling organisations.**

**UNIVERSITY OF BOTSWANA, FACULTY OF SCIENCE, DEPARTMENT OF ENVIRONMENTAL SCIENCE**

**TOPIC:** *AN INTEGRATED WASTE MANAGEMENT APPROACH AS AN ALTERNATIVE DOMESTIC SOLID WASTE MANAGEMENT STRATEGY FOR THE GROWING AFRICAN URBAN ENVIRONMENTS: A CASE STUDY OF GABORONE, BOTSWANA* Recycling Companies interview guide.

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*This research is only for academic purposes and information obtained and answers given will be treated in strict confidence.*

*Thank you.*

**Position of respondent:** ......................................................................................................

**Interview Date:** ....................................................................................................................

**Questionnaire Number:** ......................................................................................................

**Company Name:** …………………………………………………………………………….

1. What type of recyclables do you deal with?

2. Where do you get your recyclables?

3. Do you offer incentives to waste pickers or generators for recyclables?

4. Which systems do you use in collecting your recyclables?

5. What is the state of segregation when you collect the recyclables?

6. What do you use the recyclables?

7. Do you buy the recyclables or you get them for free?

8. In your opinion is the recycling industry viable?

9. What the main challenges you face in the industry?

10. What can be done to improve the situation?

11. In your opinion, is the government doing much in promoting recycling entrepreneurship?

12. What is your opinion on segregation of domestic solid waste at source?

13. Are you involved in any education and awareness campaigns in educating residents on the 3Rs of waste management?

14. Are you willing to work with the government and local authorities in the effort to encourage recycling of waste by residents?

**Appendix E: Observation Guide for domestic solid waste management study**

**UNIVERSITY OF BOTSWANA, FACULTY OF SCIENCE, DEPARTMENT OF ENVIRONMENTAL SCIENCE**

**TOPIC:** *AN INTEGRATED WASTE MANAGEMENT APPROACH AS AN ALTERNATIVE DOMESTIC SOLID WASTE MANAGEMENT STRATEGY FOR THE GROWING AFRICAN URBAN ENVIRONMENTS: A CASE STUDY OF GABORONE, BOTSWANA*

**Observation Guide**

**Date:**
..............................................................................................................................

**Location:**
..............................................................................................................................
.

Photographs will be used to capture some of the observations and where people's photographs are taken consent will be sought first and the use of the photograph in the dissertation will be acknowledged.

| Observations | Yes | No | Comments |
|---|---|---|---|
| Is waste lest on the streets and vacant land? | | | |
| What are the main components of waste dumped in the open? | | | |
| Is there waste dumped in alleys and drains? | | | |
| Is there waste dumped in water bodies? | | | |
| How far are the waste heaps from homes? | | | |
| Are there communal waste collection areas? | | | |
| Are there waste scavengers on illegal waste heaps? | | | |
| Do children play around the illegal waste disposal sites? | | | |
| Do dogs and other pests scavenge for food in bins and illegal waste heaps? | | | |
| Do people burn waste? | | | |

**Appendix F: Informed Consent Form for the Residents, Key Informants.**

PROJECT TITLE*:* **AN INTEGRATED WASTE MANAGEMENT APPROACH AS AN ALTERNATIVE DOMESTIC SOLID WASTE MANAGEMENT STRATEGY FOR THE GROWING AFRICAN URBAN ENVIRONMENTS: A CASE STUDY OF GABORONE, BOTSWANA**

Principal Investigator SHAMISO MUPARA, [*MSc.*]

Phone number(s): 74541364

**What you should know about this research study:**

- We give you this informed consent document so that you may read about the purpose, risks, and benefits of this research study.
- You have the right to refuse to take part, or agree to take part now and change your mind later.
- Please review this consent form carefully.  Ask any questions before you make a decision.
- Your participation is voluntary.

**PURPOSE**

You are being asked to participate in a research study of domestic solid waste management. The purpose of the study is to contribute to the sustainable ways of managing waste**.** You were selected as a possible participant in this study because you are a resident in Gaborone. Before you sign this form, please ask any questions on any aspect of this study that is unclear to you.  You may take as much time as necessary to think it over.

**PROCEDURES AND DURATION**

If you decide to participate, you will be invited to

**RISKS AND DISCOMFORTS**

None

**BENEFITS AND/OR COMPENSATION**

None

## CONFIDENTIALITY

The data from this investigation will be used for academic use only. None of these will be used for commercial use.

## VOLUNTARY PARTICIPATION

Participation in this study is voluntary.  If you decide not to participate in this study, your decision will not affect your future relations with the University of Botswana, its personnel, and associated institutions.  If you decide to participate, you are free to withdraw your consent and to discontinue participation at any time without penalty.  Any refusal to observe and meet appointments agreed upon with the central investigator will be considered as implicit withdrawal and therefore will terminate the subject's participation in the investigation without his/her prior request. In this event the subject will be paid what if owed to him/her or forfeit a proportionate amount of relative payment mentioned earlier in this document.  In the event of incapacity to fulfill the duties agreed upon the subject's participation to this investigation will be terminate without his/her consent and no compensation will be offered under these circumstances.

## AUTHORIZATION

You are making a decision whether or not to participate in this study.  Your signature indicates that you have read and understood the information provided above, have had all your questions answered, and have decided to participate.

_____          _____

Name of Research Participant (please print)                            Date

_____          _____

Signature of Staff Obtaining Consent                            Date

(Optional)

## YOU WILL BE GIVEN A COPY OF THIS CONSENT FORM TO KEEP.

If you have any questions concerning this study or consent form beyond those answered by the investigator, including questions about the research, your rights as a research participant; or if you feel that you have been treated unfairly and would like to talk to someone other than

a member of the research team, please feel free to contact the Office of Research and Development, University of Botswana, Phone: Ms Dimpho Njadingwe on 355-2900, E-mail: research@mopipi.ub.bw, Telefax: [0267] 395-7573.